

TECHNICAL MANUAL

# **CLEANING AND CORROSION CONTROL**

## **VOLUME II AIRCRAFT**

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**HOW TO USE THIS MANUAL**

1. This manual is one of a set. A complete set of manuals to perform aircraft cleaning and corrosion control functions consists of Volume I (Corrosion Theory), Volume II (this volume), and Volume IV (Consumable Materials and Equipment for Aircraft and Avionics).
2. The following major changes have been made in this revision. These changes should be reviewed for incorporation into local work documents, if applicable.

Addition of Melamine Wash Pads for hard to clean soils	Chapter 2, Paragraph 2-7.9.2	Page 2-7
Addition of Suggested List of Wash Rack Items	Chapter 2, Table 2-2	Page 2-12
Addition of all-purpose grease, MIL-PRF-32014	Chapter 2, Table 2-5	Page 2-30
Addition of Special Cleaning section for desert operations and sand environments	Chapter 2, Section II	Page 2-33
Extended authorization of use for Radial Bristle Disc to include magnesium and titanium	Chapter 4, Paragraph 4-9.2.1	Page 4-11
Addition of Hi-Tak Tape for sealing removable floor boards	Chapter 7, Paragraphs 7-4.4, 7-7.8, 7-9.4	Pages 7-6, 7-19, 7-26
(Navy Only) Addition of Class N (non-chrome corrosion inhibited) primer materials	Appendix A, Paragraphs A-10.2 - A-10.4	Pages A-22 - A-25
(Navy Only) Removal of Self-Priming Topcoat, TT-P-2756, as an authorized paint	Appendix A, Paragraph A-10.5.1.2	Page A-26
(Army Only) Addition of Plastic Media Blast Section	Appendix B, Section VII	Page B-29

3. Specification and document references have been updated throughout the manual.
4. Cleaning and Corrosion Control questions may be directed to NAVAIR North Island, Code 4.3.4.6, 619-545-9759.

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**LIST OF TECHNICAL PUBLICATIONS DEFICIENCY REPORTS INCORPORATED**

<b>Report Control Number (RCN)</b>	<b>Location</b>	<b>Report Control Number (RCN)</b>	<b>Location</b>
NADEP NORIS 65888 2008 0837	Pg HMWS-5	Army Aviation Support Division PRC #94A0982	Pg B-19, B-22, B-23
HMM-764 09402 2009 0001	Pg 3-6	Army Aviation Support Division PRC #05P01585	Pg B-33
VFA-122 09355 2007 0030	Pg A-9	Army Aviation Support Division PRC #05P01586	Pg B-5
Army Aviation Support Division PRC #05P02079	Pg B-29	Army Aviation Support Division PRC #98P01497	Pg B-33
Army Aviation Support Division PRC #08P01030	Pg A-31	Army Aviation Support Division PRC #01P01500	Pg 2-1

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**WARNINGS APPLICABLE TO HAZARDOUS MATERIALS**

1. Warnings and cautions for hazardous materials listed are designed to apprise 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 the Navy Hazardous Material Control Program NAVSUPPINST 5100.27, Navy Safety and Occupational Health (SOH) Program Manuals, OPNAVINST 5100.23 (Ashore) and OPNAVINST 5100.19 (Afloat), and the DoD Hazard Communication (HAZCOM) program, DoDI 6050.05. For each hazardous material used within the Navy, a Material Safety Data Sheet (MSDS) must be provided and available for review by users. Consult your local safety and health staff concerning any questions regarding hazardous materials, MSDS, personal protective equipment requirements, appropriate handling and emergency procedures and disposal guidance.

2. Under the heading HAZARDOUS MATERIALS WARNINGS, complete warnings, including related icon(s) and a numeric identifier, are provided for hazardous materials used in this manual. The numeric identifiers have been assigned to the hazardous material in alphabetical order by material nomenclature. Each hazardous material is assigned only one numerical identifier. Repeat use of a specific hazardous material references the numeric identifier assigned at its initial appearance. The approved icons and their application are shown below.

3. In the text of the manual, the caption WARNING is not used for hazardous material warnings. Hazards are cited with appropriate icon(s), the nomenclature of the hazardous material and the numeric identifier that relates to the complete warning. Users of hazardous materials shall refer to the complete warnings, as necessary.

**4. EXPLANATION OF HAZARDOUS MATERIALS ICONS.****Chemical**

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

**Cryogenic**

The symbol of a hand in a block of ice shows that the material is extremely cold and can injure human skin or tissue.

**Explosion**

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

**Eye Protection**

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

**Fire**

The symbol of a fire shows that the material may ignite or overheat and cause burns.




**Poison**

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

**Vapor**




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

**HAZARDOUS MATERIALS WARNINGS**




INDEX	MATERIAL	WARNING
1	Alcohol, Isopropyl TT-I-735 	<p>Isopropyl alcohol, TT-I-735, is toxic, flammable, and a skin and respiratory tract irritant. It may be fatal if swallowed.</p> <p><b>DO NOT</b> use near open flame, sparks or heat. <b>DO NOT</b> use synthetic cloths for wiping with this solvent. <b>DO NOT</b> smoke, eat or drink when using solvent. Avoid breathing vapor. Use only in well ventilated areas. Metal containers containing solvent shall be grounded to prevent sparking and fires. Avoid prolonged breathing of vapor and skin contact, which can cause dermatitis, irritated nose and throat, and dizziness.</p> <p>Protection: Wear butyl 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.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, give water to drink and seek medical attention. Do not induce vomiting. If inhalation occurs, remove from area to fresh air.</p>
2	Cleaning Compound, Aircraft, Exterior MIL-PRF-85570 Type II 	<p>Cleaning compound, MIL-PRF-85570 Type II, is an eye, skin, and respiratory tract irritant.</p> <p>Avoid contact with eyes, skin and clothing. Prolonged contact may cause dermatitis. Avoid breathing vapors. Avoid contact with strong acids or oxidizing agents. Use only in well ventilated areas. Wash hands thoroughly after use. Launder contaminated clothing before re-use. Keep containers closed when not in use. Store in a cool, dry, well ventilated area.</p> <p>Protection: Wear chemical goggles, rubber gloves, faceshield, and protective clothing; half-mask respirator with organic vapor cartridge required in poorly ventilated areas.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If inhalation occurs, remove from area to fresh air.</p>
3	Cleaning Compound, Turbine Engine Gas Path MIL-PRF-85704 Type II/II RTU 	<p>Cleaning compound, MIL-PRF-85704 Type II/II RTU, is toxic, and an eye, skin and respiratory tract irritant.</p> <p>Avoid contact with eyes, skin and clothing. Prolonged contact may cause dermatitis. Avoid breathing vapors. Use only in well ventilated areas. Wash hands thoroughly after use. Launder contaminated clothing before re-use. Keep containers closed when not in use. Store in a cool, dry, well ventilated area.</p> <p>Protection: Wear chemical goggles, rubber gloves, faceshield, and protective clothing; half-mask respirator with organic vapor cartridge required in poorly ventilated areas.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, give water to drink and seek medical attention. Do not induce vomiting. If inhalation occurs, remove from area to fresh air.</p>






## HAZARDOUS MATERIALS WARNINGS (Cont.)

INDEX	MATERIAL	WARNING
4	Compound, Corrosion Preventive MIL-PRF-81309 Type II and Type III 	<p>Corrosion preventive compound, MIL-PRF-81309 Type II and Type III, is toxic, flammable, and a respiratory tract irritant.</p> <p>Avoid contact with skin and eyes. <b>DO NOT</b> use near open flame, sparks, or heat. Vapor accumulations may explode if ignited. Avoid contact with oxidizing agents. Use only in well ventilated areas. Wash hands thoroughly with soap and water after use. Keep container tightly closed when not in use.</p> <p>Protection: Wear chemical goggles and rubber gloves; faceshield and laboratory apron required when working with large quantities; half-mask respirator with acid/organic vapor cartridge and mist prefilter required during spraying operations or in poorly ventilated areas.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, do not induce vomiting, seek medical attention. If inhalation occurs, remove from area to fresh air.</p>
5	Compound, Corrosion Preventive MIL-DTL-85054 	<p>Corrosion preventative compound, MIL-DTL-85054, is toxic, flammable, and a respiratory tract irritant.</p> <p>Avoid contact with eyes and skin. <b>DO NOT</b> use near open flame, sparks, or heat. Use only in well ventilated areas. Wash hands thoroughly with soap and water after use. Keep container tightly closed when not in use.</p> <p>Protection: Wear chemical goggles and rubber gloves.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, do not induce vomiting, seek medical attention. If inhalation occurs, remove from area to fresh air.</p>
6	Compound, Corrosion Preventive MIL-PRF-16173 Grade 1, 2, and 4 	<p>Corrosion preventative compound, MIL-PRF-16173, is toxic, flammable, and a respiratory tract irritant.</p> <p>Avoid contact with eyes and skin. <b>DO NOT</b> use near open flame, sparks, or heat. Use only in well ventilated areas. Wash hands thoroughly with soap and water after use. Keep container tightly closed when not in use. Avoid contact with oxidizing agents.</p> <p>Protection: Wear chemical goggles, laboratory apron, and rubber gloves; faceshield and laboratory apron required when working with large quantities; half-mask respirator with acid/organic vapor cartridge and mist prefilter required during spraying operations or in poorly ventilated areas.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, do not induce vomiting, seek medical attention. If inhalation occurs, remove from area to fresh air.</p>




**HAZARDOUS MATERIALS WARNINGS (Cont.)**

INDEX	MATERIAL	WARNING
7	Conversion Coating For Aluminum Alloys, MIL-DTL-81706 Class 1A or Class 3 	Chemical conversion coating MIL-DTL-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, which 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 laundry before re-use. Avoid humidity, strong acids, alkalis, 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, faceshield, and laboratory apron; dust mask required when mixing MIL-DTL-81706 Class 1A Form V; halfmask respirator with acid/organic vapor cartridge and mist pre-filter is required during spray operations in poorly ventilated areas.
8	Conversion Coating For Magnesium Alloy, AMS-M-3171 	Chemical conversion material, 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; halfmask respirator with organic vapor cartridges and mist pre-filter required in poorly ventilated areas.
9	Detergent, General Purpose (Liquid, Nonionic) MIL-D-16791 Type I 	Cleaning compound, MIL-D-16791, is an eye and skin irritant. Avoid contact with eyes, skin and clothing. Avoid contact with strong oxidizing or reducing agents. Store away from heat sources. Material is corrosive to copper and brass over long storage periods. Protection: Wear chemical goggles and rubber gloves. If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water.

**HAZARDOUS MATERIALS WARNINGS (Cont.)**

INDEX	MATERIAL	WARNING
10	Fluid, Hydraulic MIL-PRF-83282 	<p>Hydraulic fluid, MIL-PRF-83282, is a skin, eye, and respiratory tract irritant. May contain small quantities of tricresyl-phosphate, a toxic substance. There is a slight fire/explosive hazard when fluid is exposed to heat and flames.</p> <p>Use in well ventilated area. Keep container tightly closed when not in use. Keep away from heat sparks, open flames, and oxidizing agents. Avoid contact with clothing, eyes and skin. Wash hands thoroughly with soap and water after use.</p> <p>Protection: Wear chemical goggles, butyl gloves, and faceshield; half-mask respirator with organic vapor cartridge may be required in poorly ventilated areas.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If inhalation occurs, remove from area to fresh air.</p>
11	Naphtha, Aliphatic TT-N-95 Type II 	<p>Aliphatic Naphtha, TT-N-95 Type II, is toxic, flammable, explosive, and a skin, eye and respiratory tract irritant.</p> <p>DO NOT use near open flame, sparks or heat. Vapor accumulation can flash or explode if ignited. DO NOT use synthetic cloths for wiping with this solvent. Avoid contact with strong oxidizing agents. Use only in well ventilated areas. Metal containers containing solvent shall be grounded to prevent sparking and fires. Avoid prolonged breathing of vapor and skin contact, which can cause dermatitis, irritated nose and throat and dizziness. Ingestion will cause gastro-intestinal irritation.</p> <p>Protection: Wear butyl 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.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, give water to drink and seek medical attention. Do not induce vomiting. If inhalation occurs, remove from area to fresh air.</p>
12	Sealing and Coating Compound, Corrosion Inhibitive, MIL-PRF-81733 Class Optional 	<p>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.</p>

**HAZARDOUS MATERIALS WARNINGS (Cont.)**

INDEX	MATERIAL	WARNING
13	Solvent, Degreasing MIL-PRF-680 Type II and Type III 	<p>Degreasing solvent, MIL-PRF-680 Type II and III, is flammable, and a skin and respiratory tract irritant. Type II has a lower flashpoint (140° F) than Type III (200° F).</p> <p><b>DO NOT</b> use near open flame, sparks or heat. <b>DO NOT</b> use synthetic cloths for wiping with this solvent. <b>DO NOT</b> smoke, eat or drink when using solvent. Avoid contact with strong oxidizing agents. Use only in well ventilated areas. Metal containers containing solvent shall be grounded to prevent sparking and fires. Avoid prolonged breathing of vapor and skin contact, which can cause dermatitis, irritated nose and throat and dizziness. Ingestion will cause gastro-intestinal irritation.</p> <p>Protection: Wear butyl 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.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, give water to drink and seek medical attention. Do not induce vomiting. If inhalation occurs, remove from area to fresh air.</p>
14	Thinner, Aircraft Coating, MIL-T-81772 Type I, II or III 	<p>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.</p>
15	Cleaner, Non-Aqueous, Low VOC, HAP-Free, MIL-PRF-32295 Type I and II 	<p>Non-aqueous cleaner, MIL-PRF-32295 Type I and II, is a skin, eye, and respiratory tract irritant. It is flammable if exposed to high heat, sparks, or flames.</p> <p><b>DO NOT</b> use near open flame, sparks or heat. Combustion products may be toxic. Avoid contact with strong oxidizing agents. Use only in well ventilated areas. Metal containers containing cleaner shall be grounded to prevent sparking and fires. Avoid prolonged breathing of vapor and skin contact, which can cause dermatitis, irritated nose and throat and dizziness. Ingestion will cause gastro-intestinal irritation.</p> <p>Protection: Wear chemical impervious gloves (non-latex) and chemical goggles; faceshield and protective clothing required when splashing is possible or expected; respirator with organic vapor cartridge and P- or R-series particulate filter required in poorly ventilated areas.</p> <p>If eye contact occurs, flush immediately with large amounts of water for 15 minutes and seek medical attention. If skin contact occurs, wash with soap and water, remove contaminated clothing and shoes. If ingested, seek medical attention. Do not induce vomiting. If inhalation occurs, remove from area to fresh air. Seek medical attention if breathing is difficult and does not improve.</p>

## CHAPTER 1 INTRODUCTION

This volume was prepared under the technical cognizance of the Materials Engineering Division, NAVAIR North Island, San Diego, California.

**1-1. GENERAL.** Military aviation is recognized for its unique and complex set of challenges, including maritime patrol operation requirements and powerful electromagnetic operating fields. The highly constrained maintenance infrastructure available to deployed units to combat corrosion can limit the effectiveness of prevention and corrosion control. The materials used to construct military aircraft also contribute to corrosion. High strength steels used in landing gear and launch/recovery systems are sensitive to pitting and stress corrosion cracking, which can lead to catastrophic failure. Aluminum alloys susceptible to exfoliation and intergranular corrosion are commonly found on wing skin and other load carrying structures. Even magnesium, one of the most corrosion sensitive metals known, is still used in canopy frames and gear boxes. Added to this is the ever increasing age of military aircraft and the need to comply with stricter environmental regulations. All of these factors combine to make corrosion prevention and control a significant factor in the safe and economic operation of military aircraft.

**1-2. PURPOSE.** The purpose of this manual is to provide information on materials and procedures to prevent, control, and repair corrosion damage to aircraft on land or at sea.

**1-3. SCOPE.** The material in this manual contains basic corrosion prevention and corrective maintenance information to be used at Organizational, Intermediate, and Depot levels.

### **1-4. ARRANGEMENT OF MANUAL.**

1-4.1. A complete set of manuals to perform aircraft cleaning and corrosion control functions consists of Volumes I, II, and IV.

1-4.2. ARRANGEMENT OF VOLUME II. Volume II consists of nine chapters and two appendices, arranged as shown in Table 1-1.

**1-5. RELATED PUBLICATIONS.** Tables 1-2 (Navy) and 1-3 (Army) list technical publications that may be used as supplemental references by personnel involved in cleaning and corrosion control.

**1-6. CONSUMABLES AND EQUIPMENT.** Procurement information for ordering consumables and equipment referenced in this volume may be found in Volume IV (Navy and Army) of this manual.

Table 1-1. Outline of Volume II

CHAPTER	TITLE	BRIEF DESCRIPTION
1	Introduction	This chapter presents the scope and layout of this volume.
2	Cleaning and Lubrication	This chapter outlines accepted procedures, methods, and materials to be used in the maintenance cleaning and lubrication of aircraft.
3	Inspection and Corrosion Prone Areas	This chapter describes inspection techniques for detecting corrosion (Section I) and discusses corrosion prone areas (Section II).
4	Corrosion Removal	This chapter outlines the approved methods for the removal of corrosion damage.
5	Surface Treatment	This chapter describes the application of surface treatments.
6	Treatment of Specific Areas	This chapter describes the recommended procedures for treating and protecting against corrosion in specific areas.
7	Sealants	This chapter covers recommended materials and procedures for the application of sealing compounds to aircraft structures.
8	Preservation	This chapter outlines accepted procedures, methods, and materials to be used in the preservation of aircraft.
9	Emergency Procedures	This chapter outlines emergency procedures to be followed after exposure of aircraft to salt water, water immersion, or fire extinguishing agents.
Appendix A	Supplementary Requirements for Navy Aircraft	This appendix provides information on materials and procedures specific to Navy aviation equipment. It also describes the approved paint systems that are used on Navy aircraft, and gives detailed procedures for the touch up system to be used by Organizational and Intermediate levels of maintenance. Army personnel should refer to TM 55-1500-345-23.
Appendix B	Supplementary Requirements for Army Aircraft	This appendix provides information on materials and procedures specific to Army aviation equipment.

Table 1-2. Related Navy Publications

NUMBER	TITLE
DoDI 6050.05	DoD Hazard Communication (HAZCOM) Program
DoDI 6055.06	DoD Fire and Emergency Services Program
FED-STD-595	Colors Used in Government Procurement (Color Fandeck)
MIL-STD-2161	Paint Schemes and Exterior Markings for U.S. Navy and Marine Corps Aircraft
MIL-STD-7179	Finishes, Coatings, and Sealants for the Protection of Aircraft Weapons Systems
NAVAIR 00-80R-14	NATOPS U.S. Navy Aircraft Firefighting and Rescue Manual
NAVAIR 00-80T-121	Chemical and Biological Defense NATOPS Manual
NAVAIR 01-1A-1	General Manual for Structural Repair, Engineering Handbook Series for Aircraft Repair
NAVAIR 01-1A-16	Non-Destructive Inspection Methods
NAVAIR 01-1A-17	Aviation Hydraulics Manual
NAVAIR 01-1A-21	General Composite Repair
NAVAIR 01-1A-35	Aircraft Fuel Cells and Internal/External Tanks, Organizational, Intermediate, and Depot Maintenance Instructions
NAVAIR 01-1A-520	Anti-icing, Deicing, and Defrosting of Parked Aircraft
NAVAIR 15-01-500	Preservation of Naval Aircraft
NAVAIR 17-1-125	Ground Support Equipment Cleaning and Corrosion Control, Maintenance Instructions, Organizational and Intermediate Levels
NAVAIR 17-5BM-1	Portable Dry Honing Machine (Vacu-Blast), Operation, Service and Overhaul Instructions
NAVAIR 17-5BM-2	Stationary Dry Honing Machine (Model 12542), Operation and Service Instructions with Illustrated Parts Breakdown
NAVAIR 17-5BM-3	Dry Honing Machine (Zero Mfg. Co.), C-150-6 and C-150-7, Maintenance Instructions
NAVAIR 17-600-22-6-1	Pre-operational Checklist for Portable Dry Honing Machine (Zero/Vacu-Blast)
NAVAIR 17-600-22-6-2	Periodic Maintenance Requirements for Portable Dry Honing Machine (Zero/Vacu-Blast)
NAVAIR 17-600-191-6-1	Pre-Operational Checklist, Abrasive Media Glove Box (PRC-4848)
NAVAIR 17-600-191-6-2	Periodic Maintenance Requirements Manual, Abrasive Media Glove Box (PRC-4848)
NAVAIR 19-20D-1	Jet Engine Corrosion Control Cart, Operation and Service Instructions
NAVAIR 19-20D-2	Spray Unit, Corrosion Control, Trailer Mounted, Operation and Intermediate Maintenance
COMNAVAIRFORINST 4790.2	Naval Aviation Maintenance Program (NAMP)
OPNAVINST 5100.23	Navy Occupational Safety and Health (NAVOSH) Program Manual
OPNAVINST 5100.8	Navy Safety and Occupational Safety and Health Program

Table 1-3. Related Army Publications

NUMBER	TITLE
FM 3-5	Chemical, Biological, and Radiological Decontamination
MIL-HDBK-729	Corrosion and Corrosion Prevention - Metals
PAM 738-750	The Army Maintenance Management Systems - Aviation (TAMMS)
TM 55-1500-204-25/1	General Aircraft Maintenance Manual
TM 55-1500-345-23	Painting and Marking of Army Aircraft
TM 743-200-1	Storage and Material Handling



## CHAPTER 2 CLEANING

### SECTION I. CLEANING AND LUBRICATION

**2-1. INTRODUCTION.** Cleaning is the first step in preventing aircraft corrosion and wear. Dirt, salt air deposits, and other contaminants can promote rapid corrosion and wear of aircraft surfaces, and can have an adverse impact on aircraft systems performance. Effective cleaning requires knowledge of the appropriate materials and methods needed to remove these contaminants.

**2-2. REASONS FOR CLEANING.** Aircraft should be cleaned regularly in order to:

- a. Prevent corrosion by removing salt deposits, other corrosive soils, and electrolytes;
- b. Maintain visibility through canopies and windows;
- c. Allow a thorough inspection for corrosion and corrosion damage;
- d. Maintain turbine engine efficiency;
- e. Reduce fire hazards by the removal of accumulations of leaking fluids;
- f. Improve overall appearance;
- g. Ensure aerodynamic efficiency of the aircraft; and
- h. Maintain special paint scheme characteristics.

**2-3. FREQUENCY OF CLEANING.** All aircraft shall be cleaned according to schedules required by the parent service organization. Navy aircraft shall be cleaned in accordance with the schedule in the aircraft specific manual. In the absence of aircraft specific requirements, Navy aircraft shall be cleaned at least every 7 days when aboard ship and at least every 14 days when ashore. Army requirements are given in Appendix B. Under certain conditions, depending on the type of aircraft and usage, the normal wash cycle may not be sufficient. More frequent cleaning may be required for certain types of aircraft when:

- a. Excessive exhaust gases or gun blast soils accumulate within impingement areas;
- b. Paint is peeling, flaking, or softening;

- c. Fluid leakage (coolant, hydraulic fluid, or oil) occurs; or

- d. Exposure to salt spray, salt water, or other corrosive materials occurs.

**2-3.1. DAILY CLEANING.** When deployed within three miles of salt water or when flown below 3000 feet over salt water, daily cleaning or wipe down is required on all exposed, unpainted surfaces, such as landing gear struts and actuating rods of hydraulic cylinders.

#### NOTE

Optimum use of taxi-through rinse facilities is recommended for removal of salt contamination and light soils when operating near sea water. Rinsing does not satisfy aircraft washing requirements, it only removes readily soluble matter from exterior surfaces.

**2-3.2. IMMEDIATE CLEANING.** Affected areas must be cleaned immediately if:

- a. Spilled electrolyte and corrosive deposits are found around battery terminals and battery area;
- b. Aircraft are exposed to corrosive fire extinguishing materials;
- c. Salt deposits, relief tube waste, or other corrosive contaminants are apparent;
- d. Aircraft are exposed to significant amounts of salt water;
- e. Fungus growth is apparent; or
- f. Chemical, biological, or radiological (CBR) contaminants are detected.

**2-3.3.** Procedures for decontamination of aircraft exposed to chemical, biological or radiological (CBR) materials are contained in FM 3-5 (Army) or or NAVAIR 00-80T-121(Navy).

**2-4. WATER QUALITY.** Cleanliness of water can affect aircraft cleaning operations. Chlorides and pH have the most effect on corrosion. Recommended guidelines for

Table 2-1. Water Quality Guidelines

Parameter	Limits
Chlorides	400 mg/l max
pH	6.5-8.5
Total Dissolved Solids (TDS)	500 mg/l max
Total Suspended Solids (TSS)	5 mg/l max
Hardness (CaCO <sub>3</sub> )	75-150 mg/l
Biological Oxygen Demand (BOD)	5 mg/l max
Total Petroleum Hydrocarbon (TPH)	10 mg/l max
Langlier Saturation Index (LSI)	Slightly above zero

the quality of fresh water used for cleaning and rinsing are shown in Table 2-1. The limits for chlorides and pH shown are approximately the same as for potable water. Adequate disinfection should be provided to control the growth of microorganisms in the water.

**CAUTION**

Authorized cleaning agents are listed in this chapter and Volume IV. Do not use unauthorized cleaners. Although commercial cleaners may appear to perform as well or better than approved products, these materials may be corrosive to aircraft alloys.

**2-5. CLEANING COMPOUNDS.** Cleaning compounds work by dissolving soluble soils, emulsifying oily soils, and suspending solid soils. There are several types of cleaning compounds, each of which clean by one or more of these mechanisms. The following paragraphs describe the various authorized cleaning materials for aircraft surfaces. Paragraph 2-9 provides detailed cleaning procedures.

**2-5.1. DILUTION.** MIL-PRF-85570 Types I and II, MIL-PRF-85704 Types I, II and III, and MIL-D-16791 detergent cleaning compounds should be diluted with water as specified prior to use. Other detergent cleaning compounds may also require dilution with water. In general, more concentrated solutions than those recommended do not clean better and are wasteful; **MORE IS NOT ALWAYS BETTER.** In fact, higher concentrations can interfere with effective cleaning and rinsing processes. The solution merely becomes slippery, prevents the washing pad from loosening the soil and makes rinsing more difficult. Do not exceed the recommended dilution.

**CAUTION**

High strength steels (typically 180 ksi and above), some high strength aluminums, and some stainless steels can develop a condition known as hydrogen embrittlement when exposed to some highly alkaline materials, such as unauthorized cleaners. Sudden catastrophic failure may occur as a result of hydrogen embrittlement when the part can no longer sustain the internal and/or applied stresses. See Volume I for additional information.

**NOTE**

Ozone depleting substances (ODS) are solvents such as, but not limited to, 1,1,1 trichloroethane (MIL-T-81533) and trichlorotrifluoroethane (MIL-C-81302). These solvents, as well as products containing them, are still used in some aircraft maintenance processes, including high pressure oxygen systems cleaning and some avionics cleaning. Alternate materials continue to be identified. Wherever possible, specifications are being changed to eliminate their use automatically. Some products that have been reformulated are now flammable. Pay close attention to all CAUTION/WARNING labels on solvents and solvent-based products.

**2-5.2. MODERATELY ALKALINE CLEANERS.** Highly alkaline cleaning compounds (pH greater than 10) are not authorized for Navy or Army aircraft, due to incompatibility with polyimide wiring insulation. Moderately alkaline cleaners (pH between 7.5 and 10), such as MIL-PRF-85570 Types I and II (Exterior Aircraft Cleaning Compound), are recommended. Both types contain detergents and foaming agents, and work in the same way as a detergent solution. Type I is a more effective cleaner for heavy oils and greases, including wire rope lubricant, due to its solvent content, but it should not be used in areas where ventilation is poor. Type IA is a premixed (1:4 dilution) Type I solution available in a 16 oz aerosol can. Type II contains no solvent but is an excellent cleaner for light oils and hydraulic fluids, and can be used in areas of reduced ventilation (such as cockpits, cabins, bilges, and equipment bays). Type II RTU is a premixed (1:4 dilution) Type II solution available in a 32 oz trigger spray bottle and a five gallon can.

### 2-5.3. TURBINE ENGINE GAS PATH CLEANERS.

MIL-PRF-85704 (Cleaning Compound, Turbine Engine Gas Path) is specially formulated for cleaning the compressor section of gas turbine aircraft engines and minimizing engine corrosion during wash cycles. Types I, II, and III are supplied as concentrates and must be mixed with water prior to use. Types II RTU and III RTU are premixed and ready to use upon receipt. Types I, II, and II RTU are intended for use with the engine off-line, with the starter motoring the engine. Type I (solvent emulsion concentrate with hydrocarbon solvents) works by softening oily soils so that they can be emulsified by the detergent. Local air pollution regulations may restrict the amount and methods of application of Type I cleaner: Types II or II RTU (aqueous cleaner without hydrocarbon solvents) may be used as alternates. Types III and III RTU are intended for use with the engine on-line (fired). Because purified water is required to mix the Type III concentrate and may be unavailable, use of Type III RTU is recommended for on-line cleaning.

2-5.4. SPOT CLEANERS. The following three cleaners (to be used without dilution) are approved for specific localized applications in areas of heavy soil.

2-5.4.1. High Gloss Spot Cleaner. MIL-PRF-85570 Type III is recommended for cleaning exhaust track and gun blast areas of high gloss paint systems. This material contains solvents, detergents, and suspended abrasive matter to remove soil by wearing away the surface that holds it. It shall not be used on aircraft painted with tactical paint schemes since it raises the gloss of the surface.

2-5.4.2. Low Gloss Tactical Paint Scheme Spot Cleaner. MIL-PRF-85570 Type IV is recommended for cleaning exhaust track and gun blast deposits, smudges, boot marks, and other embedded soils on low gloss coatings. This material contains solvents, detergents, and suspended rubber particles. When rubbed on a soiled surface, the rubber particles act like tiny erasers, removing soil by mechanically entrapping it in the rubber. The gloss of tactical paint coatings is unchanged. For more information on tactical paint schemes, see Appendix A.

### NOTE

Solvents in MIL-PRF-85570 Type IV cleaner may be considered hazardous air pollutants (HAPs). Consult local regulations before use. MIL-PRF-85570 Type V may be used as an alternate.

### 2-5.4.3. Thixotropic (Viscous) Cleaner.

MIL-PRF-85570 Type V is recommended for cleaning wheel wells and wing butts, and replaces solvent cleaning where water rinsing can be tolerated. This cleaner contains solvents, detergents and some thickening agents. When applied undiluted to an oily or greasy surface, the cleaner clings long enough to emulsify the soil (about 5 to 15 minutes) and can then be rinsed away with fresh water. To perform most effectively, Type V must be applied to a dry surface. Do not prerinse areas of the aircraft that require application of Type V.

2-5.5. DETERGENT SOLUTION. MIL-D-16791 (Detergents, General Purpose Liquid Nonionic) dissolved in water cleans by dissolving soluble salts, emulsifying low viscosity oils, and suspending easily removed dirt and dust. It is not very effective on grease, but is an excellent cleaner for interior lightly soiled areas, plastics, and instrument glass covers.

2-5.6. NON-AQUEOUS CLEANERS. MIL-PRF-32295 (Cleaner, Non-Aqueous, Low VOC, HAP-Free) is an environmentally friendly chemical cleaner that is free of hazardous air pollutants (HAP) and contains a very low level of volatile organic compounds (VOC < 25 g/l). Because these cleaners do not contain water, they can be used in areas where water-based cleaners are not allowed. MIL-PRF-32295 can be used as a substitute for MIL-PRF-680 in most applications. Type I is recommended for removal of light soils (oils, dirt, CPCs). Type II is a more effective cleaner for removal of heavy soils (greases, carbonized oils, aged CPCs).

2-5.7. SOLVENTS. Cleaning solvents dissolve oils and greasy soils so that they can be easily wiped away or absorbed on a cloth. However, solvents differ significantly in cleaning ability, toxicity, evaporation rate, effect on paint, and flammability. MIL-PRF-680 Type II Degreasing Solvent is the most common cleaning solvent used on aircraft, due to its low toxicity, minimal effect on paint, and relative safety. Other solvents, such as alcohols, ketones, and aliphatic naphtha, are specialized materials restricted for use.

## NOTE

The use of solvents for cleaning operations is dependent upon stringent environmental and safety regulations. Determine local requirements regarding limitations and restrictions on materials, quantities, and disposal from your work center supervisor, safety officer, or industrial hygienist.

Degreasing Solvent, MIL-PRF-680, replaces Dry Cleaning and Degreasing Solvent, P-D-680. MIL-PRF-680 has been reformulated to eliminate Hazardous Air Pollutants, however, its high VOC content may prevent use in some locations.

2-5.7.1. Degreasing Solvent (MIL-PRF-680). This solvent is used as a cleaner and degreaser for painted and unpainted metal parts. It is also used to remove oily corrosion preventive compounds. The solvent is available in four types. Although the degreasing effectiveness is approximately the same for each type, the flash points as a measure of flammability differ as follows: Type I, 100°F (38°C) minimum; Type II, 140°F (61°C) minimum; Type III, 200°F (93°C) minimum; Type IV, 140°F (61°C) minimum. A lower flash point indicates greater flammability; however, all types will burn intensely once ignited. Type I is not authorized for use as a general cleaner due to its flammability, but may be used in parts washers that are designed for such solvents. Type II is the most common cleaning solvent used on aircraft, and is intended for use where a solvent with a higher flash point is required. Type III is intended for use in confined atmospheric conditions where a very high flash point is required. Type IV is used where a higher flash point and strong solvency is desired. The dwell time for all types should be held to a minimum (less than 15 minutes) to avoid damage to paint.

2-5.7.2. Isopropyl Alcohol (TT-I-735). This flammable solvent is used as a disinfectant, and for removing fungus and mold from aircraft surfaces. It is a poor degreaser, but is a good solvent for removing fingerprints.

2-5.7.3. Methyl Ethyl Ketone (MEK) (ASTM D 740). This highly flammable solvent is used for cleaning prior to adhesive bonding. Most locations cannot use MEK as a wipe solvent for general cleaning or prior to painting due to restrictions on the use of solvents with vapor pressures greater than 45 millimeters of mercury (mm Hg). As an alternate cleaner, use MIL-PRF-85570 Type II Aircraft Cleaning Compound (diluted 1 part cleaner to 14 parts water), rinse thoroughly with fresh water and

allow surfaces to dry. Surfaces may be also be cleaned by solvent wiping with AMS 3166 (Solvents, Cleaning Prior to Application of Sealing Compounds).

2-5.7.4. Aliphatic Naphtha (TT-N-95). This highly flammable solvent is used for cleaning oils or greasy deposits and other soils from aircraft transparencies such as acrylic canopy materials. Other solvents may cause crazing and other damage to transparencies. It is also effective at removing masking or preservation tape residue. This material may be restricted in many geographic locations for other cleaning operations due to its high vapor pressure.

2-5.7.5. Thinner, Aliphatic Polyurethane Coatings (MIL-T-81772). This highly flammable solvent can be used for prepaint solvent cleaning as an alternative to MEK. MIL-T-81772 may be used at locations requiring a solvent vapor pressure less than or equal to 45 mm Hg.

2-5.8. PARTS WASHER CLEANING SOLUTION. MIL-PRF-29602 (Cleaning Compounds for Parts Washer and Spray Cabinets) is the recommended cleaning agent for use in high pressure cabinet-style parts washers to remove oils and greases from disassembled components. It shall not be used for bearings unless authorized by part specific documentation. Also, due to the high maximum allowable pH (pH 13.5) of MIL-PRF-29602 cleaning compound, aircraft cognizant engineering authority approval is required before cleaning aluminum alloy parts. MIL-PRF-29602 must be diluted with water in accordance with manufacturer's instructions, and the concentration must be tested periodically (every 28 days is recommended).

2-5.9. MILDEW REMOVER. NAVCLEAN is a mildew remover developed by NAVAIR for cleaning mildew, mold, and fungus from aircraft surfaces. The mildew remover kit consists of four components (an oxidizing agent, a detergent, and corrosion inhibitors). The components are mixed with water immediately prior to use. The solution is effective for twenty four hours after mixing. Surfaces cleaned with NAVCLEAN shall be rinsed thoroughly with fresh water after application to remove residue.

## 2-5.10. MISCELLANEOUS CLEANING AGENTS.

2-5.10.1. Plastic polish (P-P-560), which contains mild abrasives, to polish out scratches in certain canopy materials.

2-5.10.2. Optical glass cleaner (A-A-59199) for cleaning lenses.

2-5.10.3. Ammonium hydroxide (O-A-451) to neutralize urine.

2-5.10.4. Sodium bicarbonate (ASTM D928) to neutralize electrolyte spills from sulfuric acid batteries.

2-5.10.5. Monobasic sodium phosphate (ANSI/AWWA B504) or boric acid (A-A-59282) to neutralize electrolyte spills from nickel-cadmium batteries.

**2-6. STEAM CLEANING.** Steam cleaning is defined as super-heated water vapor delivered at relatively high pressure through a nozzle or wand. Steam cleaning can erode paint, craze plastic, debond adhesives, damage electrical insulation, and drive lubricants out of bearings. Due to the potential for damage, it shall not be used on aircraft/missiles at the Organizational/Unit or Intermediate levels of maintenance. In addition, steam cleaning shall not be used on the following items removed from aircraft/missiles: honeycomb bonded structure, sealant, fiberglass composites, acrylic windows, or electrical wiring.

**2-7. CLEANING EQUIPMENT.** Equipment specific to one type of aircraft is not covered in this manual. The following equipment is available for general cleaning. Ordering information for approved equipment can be found in Volume IV, Chapter 3. General operating instructions are found in paragraph 2-8. See specific operating manuals for detailed instructions on automated equipment.

### **CAUTION**

No equipment which produces more than 175 psi nozzle pressure shall be used for aircraft cleaning purposes unless specifically authorized by the parent service organization. This restriction includes portable pressure washers. High-pressure cleaning processes can erode paint, drive lubricants out of bearings, drive water into hidden areas, damage electrical insulation, damage honeycomb bonded structure and composite surfaces, and damage sealant.

### **NOTE**

Use only cleaning materials or equipment authorized by the parent service organization and as described in this manual. Experimentation with unauthorized cleaning materials or equipment may damage aircraft, reduce reliability and increase maintenance costs.

**2-7.1. SMALL PORTABLE FOAM GENERATING CLEANING UNIT.** The cleaning unit is compact, light, and ideal for cleaning hard to reach areas. It consists of a 54 inch applicator wand, 50 feet of hose, and either a 15 gallon stainless steel tank or a 20 gallon carbon steel tank. The tank assembly moves easily on rubber tire wheels (see Figure 2-1). The control system allows the operator to adjust wetness of foam to fit any job. The cleaning unit provides a foam capable of clinging to vertical surfaces to soften and dislodge soils. General operating instructions for the cleaning unit are given in paragraph 2-8.1.

**2-7.2. LARGE PORTABLE FOAM GENERATING CLEANING UNIT.** This cleaning unit is a simplified, pressure operated, foam-dispensing system (see Figure 2-2). It uses available air supply for its power source without using pumps. Air is metered directly from the pressurized solution chamber into the hose to create foam. Units are available with a 45 gallon stainless steel tank or a 50 gallon carbon steel tank. General operating instructions for the cleaning unit are given in paragraph 2-8.2.

**2-7.3. TURBINE ENGINE COMPRESSOR CLEANING EQUIPMENT.** Equipment used for cleaning Navy aircraft turbine engines is contained in Appendix A. Army: refer to specific engine technical manual.

**2-7.4. MISCELLANEOUS LARGE CLEANING EQUIPMENT.** Other equipment such as truck or trailer mounted spray or foam equipment may be available at certain locations.

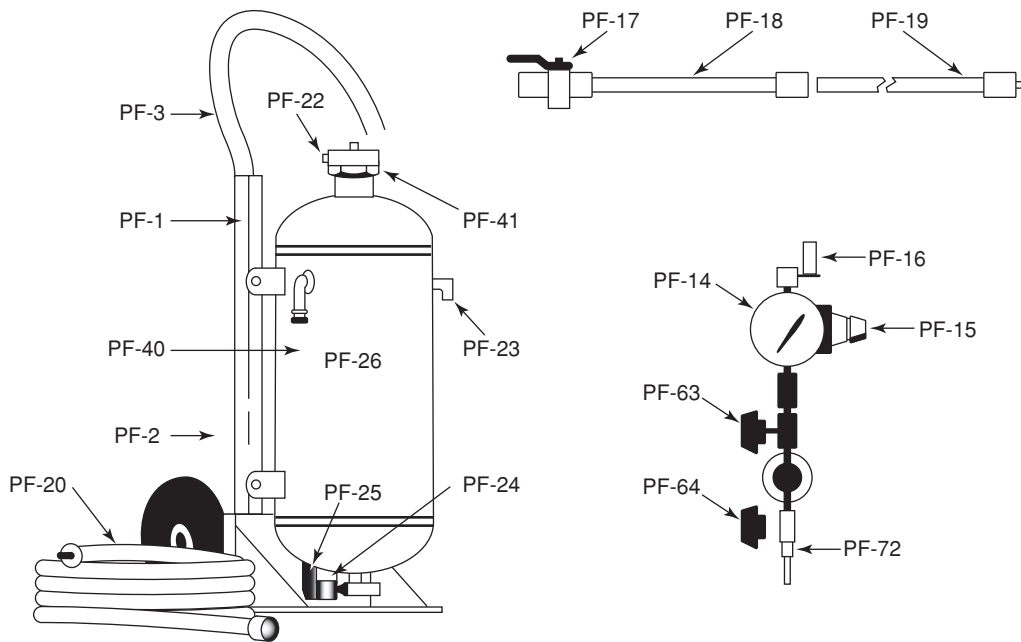
**2-7.5. SPRAY GUN FOR CLEANING COMPOUNDS.** This spray gun (AMS-G-952 Type I) has an extended nozzle/tube and requires approximately 14 cfm of air at 50 psi to siphon cleaning compounds from a container. Do not use with solvents.

**2-7.6. PNEUMATIC VACUUM CLEANER.** The air-operated vacuum cleaner is a small, portable unit for removing debris and water from aircraft (Volume IV, Chapter 3).

**2-7.7. UNIVERSAL WASH UNIT.** The universal wash unit is used for general purpose cleaning. General operating procedures are given in paragraph 2-8.3.

**2-7.8. CABINET-STYLE AQUEOUS PARTS WASHER.** This method of cleaning utilizes an industrial power washer that is comprised of an enclosed cabinet equipped with a system of spray impingement nozzles, cleaning solution heater, fluid pump, skimmer for oil and





Parts Breakdown					
Part No.	Description	Part No.	Description	Part No.	Description
PF-1	Portable Carriage	PF-18	Short Wand	PF-26	Air Bleed Valve
PF-2	Wheel	PF-19	Wand Extension	PF-40	Compound Tank (20 Gal)
PF-3	Curved Handle	PF-20	Application Hose	PF-41	Tank Cap Gasket
PF-14	Pressure Guage	PF-21	Tank Fill Cap	PF-63	Air Metering Valve
PF-15	Air Regulator	PF-22	Safety Valve	PF-64	Compound Metering Valve
PF-16	Air Inlet Valve	PF-23	Check Valve	PF-72	SK Fitting (F)
PF-17	Foam Discharge Valve	PF-24	SK Fitting (M)	PF-73	SS Tubing

Figure 2-1. Small Portable Foam Generating Cleaning Unit (20 Gallons)



Figure 2-2. Large Portable Foam Generating Cleaning Unit (45 Gallons)

its residues, and separate reservoirs for cleaning solution and waste. Cabinet-style parts washers have been implemented to replace the use of 1,1,1-trichloroethane vapor degreasing and to reduce the dependence upon MIL-PRF-680 Type II. They are suitable for degreasing disassembled components. This cleaning process effectively removes soils, oils/greases, corrosion preventive compounds and other contaminants by applying aqueous cleaner at varying combinations of high temperature and pressure. The washers are equipped with oil skimming devices and particulate filtration devices to extend the life of the cleaning solution. Cognizant aircraft engineering authority approval is required prior to using cabinet-style parts washers for cleaning bearings or aluminum alloy parts. General operating instructions are given in paragraph 2-8.4.

2-7.9. MISCELLANEOUS EQUIPMENT. Accessories and consumable materials for manual operations, listed in Volume IV, Chapters 2 and 3, include the following important items:

2-7.9.1. 3M No. 33 Aircraft Cleaning Pads and 3M No. 261 Pad Holders are replacements for the 3M No. 251M Washing Kit for Exterior Aircraft Washing Operations. The wooden handle used with the No. 251M Washing Kit can also be used with the 3M No. 261 Pad Holder; however, use of the A-A-1464 Aluminum Handle is highly recommended because it is more ergonomic and

easily extendable from five to ten feet. The No. 33 pads are primarily used for general aircraft cleaning.

2-7.9.2. 3M "Jet Pad" Melamine Wash Pads are soft foam pads with a urethane foam backing and a polyester attachment layer. These pads have demonstrated cleaning efficiency that is superior to conventional woven polyester cleaning pads. The Jet Pads are compatible with the 3M No. 261 Pad Holder, and are recommended for hard to clean soils; however, they will degrade over time and generate debris during use.

2-7.9.3. Non-Metallic Cleaning and Polishing Pads (A-A-3100) are crimped polyester fiber pads for detergent and solvent cleaning aircraft surfaces. Do not use with paint removers.

2-7.9.4. Brushes, Non-Metallic Bristles (MIL-B-23958, A-A-3080) are used with aircraft detergent cleaners, such as MIL-PRF-85570.

2-7.9.5. Cheesecloth (CCC-C-440) and non-woven cloth (CCC-C-46) are used for cleaning critical areas where an exceptionally clean cloth is required, such as solvent cleaning prior to painting, adhesive bonding, or sealing.

2-7.9.6. Plastic spray bottles are used for applying diluted MIL-PRF-85570 Type I or II or concentrated Type V.

**2-8. EQUIPMENT OPERATING PROCEDURES.** This section contains general operating instructions for the most commonly used large pieces of cleaning equipment.

**2-8.1. SMALL PORTABLE FOAM GENERATING CLEANING UNIT.**

**WARNING**

Do not service the small portable foam generating cleaning unit without releasing pressure.

- a. Release pressure prior to servicing.

**NOTE**

Refer to manufacturer's instructions to mix the proper ratio of solution to be used.

- b. Remove tank fill cap and fill container with appropriate diluted cleaning compound. Allow adequate air space at the top of the tank. Replace filler plug.

- c. Connect air supply to air inlet valve on air regulator.

- d. Open compound metering valve to full open position.

- e. Open air inlet valve and set air pressure regulator to 30-70 psi.

- f. Open foam discharge valve and direct foam at object to be cleaned.

- g. If foam is too wet, close compound metering valve slightly.

- h. If foam is too dry, open compound metering valve slightly and close air metering valve slightly.

- i. Allow foam to remain on the surface for up to one minute, but not long enough to dry, then scrub and rinse.

**CAUTION**

When cleaning task is completed, drain tank and flush with fresh water to prevent a concentrated cleaning solution from being used that could be damaging to aircraft surfaces.

- j. When cleaning task is completed, drain detergent solution from tank and flush with fresh water.

**2-8.2. LARGE PORTABLE FOAM GENERATING CLEANING UNIT.**

**WARNING**

Do not service the large portable foam generating cleaning unit without releasing pressure.

- a. Release pressure prior to servicing.

- b. If tank has been in prior use and is closed, close cleaning compound valve and air valve, then open air dump valve to bleed off retained air pressure.

- c. Remove cover of tank. The cover is retained by several draw bolts.

**NOTE**

Refer to manufacturer's instructions to mix the proper ratio of solution to be used.

- d. Fill with cleaning compound in appropriate dilution, allowing for adequate air space at the top of the tank.

- e. Replace cover, being sure it is firmly locked in place.

- f. Close air and cleaning compound handle valves.

- g. Attach air line to air inlet on side of unit. Fill and check air regulator to ensure proper pressure (30-70 psi).

- h. Open air valve.

- i. Open cleaning compound valve slowly until desired foam consistency is reached.

- j. Apply foam to surface to be cleaned. Generally, thin uniform layers perform best. During initial setting of the unit, air and cleaning compound valves should be adjusted to give the desired foam consistency. Combinations of less air and more cleaning compound make a wet foam. Combinations of more air and less



cleaning compound make a drier foam. Dry foams give greater dwell time and prolong cleaning action, but wet foams clean better.

k. Allow foam to remain for up to one minute, but not long enough to dry, then scrub and rinse.

### **CAUTION**

Insure that tank is drained to prevent a build-up of highly concentrated solution, which may damage aircraft surfaces.

l. When cleaning task is completed, drain detergent solution from tank and flush with fresh water.

### 2-8.3. UNIVERSAL WASH UNIT.

### **WARNING**

Use the universal wash unit in the horizontal position only.

a. Connect the strainer unit to the intake hose.

b. Connect the wand and nozzle spray to the output (discharge) hose or connect the discharge quick disconnect to the aircraft wash manifold quick disconnect.

c. Insert the strainer unit into a container of water or cleaning solution.

d. Press and hold the start or remote start switch; observe the pressure gage. It should immediately indicate an increase in pressure.

e. After the pressure reaches approximately 10 psig, release the start switch. The unit should continue to operate.

f. The unit will deliver approximately 2.5 gallons per minute at 30 psig.

g. Press the stop or remote switch to stop the unit from operating.

### 2-8.4. CABINET-STYLE AQUEOUS PARTS WASHER.

### **WARNING**

The materials used and waste generated from this cleaning process may be hazardous to operating personnel and the environment. Drain any entrapped solution back into the washer. Contact the local industrial hygienist, bioenvironmental engineer, or Environmental Office for guidance regarding personal protective equipment (PPE) and other health and safety precautions.

Parts will be very hot after the cleaning process. Handle with thermally protective and water repellent gloves.

### **CAUTION**

High pressure parts washers shall not be used for cleaning bearings unless specifically authorized. Due to the maximum allowable pH (pH 13.5) that the required cleaning compound, MIL-PRF-29602, can reach, cognizant engineering authority approval is required before cleaning aluminum alloy and IVD aluminum coated parts.

a. Determine the reservoir capacity of the parts washer. Fill the reservoir with a solution of MIL-PRF-29602 cleaning compound, diluted per manufacturer's recommended concentration.

### **NOTE**

Do not use the parts washer until the cleaning solution has stabilized at the required temperature. Agitation of the solution prior to reaching elevated temperatures may result in excessive foaming of the cleaning solution.

b. Allow cleaning solution to stabilize at manufacturer's recommended temperature (usually 140°F to 180°F).

### **CAUTION**

Caution shall be exercised when loading components with areas which can entrap water. Position parts in the cabinet and baskets such that the cavities which can hold or entrap water are face down. It is imperative that suitable fixtures and/or baskets are used to secure components during the cleaning cycle. Failure to do so may result in damage to the components being cleaned by the high pressure impingement spray.

c. Place components to be cleaned into parts washer. Components shall be secured to the turntable, or placed in a basket that is secured to the turntable.

### **CAUTION**

Parts shall not be left unattended in the washing cabinet. Once the cleaning cycle is complete, the inside environment of the cabinet will become very hot and humid. Parts left unattended, or not removed within the required time, may develop corrosion. Follow the recommended manufacturer's instructions for the removal of cleaned parts.

d. Set the wash cycle timer for 3-30 minutes depending upon the type of soil to be removed and the quantity of soil on the parts. For light degreasing, a 3 minute cycle may be sufficient, while heavily soiled and baked on grease may require a full 30 minute cycle. Run the wash cycle, and allow components to cool before handling.

e. If the cleaned part is subjected to an immediate inline process, i.e., fluorescent penetrant inspection, or painting, or in cases where precision cleaning is required, rinse the part with fresh clean water and thoroughly dry.

f. For bare steel parts which have been cleaned/rinsed and will not be processed immediately, wrap in VCI film (MIL-PRF-22019) or apply CPCs (MIL-PRF-81309 Type II, followed by MIL-PRF-16173 Grade 4).

## **2-9. CLEANING PROCEDURES.**

2-9.1. WARNINGS AND CAUTIONS. The following warnings and cautions shall be observed during aircraft cleaning operations:

### 2-9.1.1. Electrical Warnings.

a. Aircraft and/or other equipment shall not be washed, cleaned, or inspected on an outdoor wash rack when an electrical storm is in the immediate area.

b. Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of flammable solvent cleaners.

c. In order to guard against the danger of static electricity, aircraft shall be electrically grounded during all cleaning operations and when moored or parked.

d. Before cleaning electrical and avionic equipment, make sure electrical power is disconnected. Injury or death may otherwise result.

2-9.1.2. Personal Protection. Consult the local safety office for personal protective equipment (PPE) requirements. The following Warnings apply.

a. Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL-PRF-85570 or MIL-PRF-85704. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.

b. Cleaning solutions are slippery. Maintenance stands shall be used where practical. Safety harness and safety lines must be used when standing on upper surfaces of aircraft during cleaning operations.

### 2-9.1.3. Solvent Warnings.

a. Do not use synthetic wiping cloths with flammable solvents, such as aliphatic naphtha (TT-N-95), MEK, or MIL-T-87177 paint thinner. Synthetic cloths can generate

static electricity which can result in sparks and fire. Cotton wiping cloths, such as terry cloth, flannel, or cheesecloth, are acceptable.

b. Solvents shall not be applied with atomizing spray equipment. This is not only hazardous, but violates environmental regulations in most areas.

c. Keep all solvents away from open flames and any live electrical circuit or sources of electrical arcing. Ensure that residual solvent is removed from aircraft, engine bays, and equipment.

d. Use solvents in well-ventilated areas. Wear rubber gloves and chemical or splash proof goggles. Avoid skin contact. Consult the local safety office regarding respiratory protection.

e. Do not mix cleaning compound with any solvent (e.g. MIL-PRF-680). The added solvents will create a fire hazard and a serious disposal problem, and can cause damage to nonmetallic materials.

#### 2-9.1.4. Cleaning Solution Cautions.

a. Steam shall not be used for cleaning aircraft or components.

b. Do not apply MIL-PRF-85570 Types I, III, IV or V, or MIL-PRF-85704 Type I or II cleaning solutions or any unauthorized solvents to electrical wiring or plastic aircraft canopies, as it may cause damage to insulation or crazing of transparent surfaces.

c. Do not use cleaning compounds at higher concentrations than those recommended.

d. Do not allow cleaning solutions to dry on aircraft surfaces. Such practices will cause streaking and can damage aircraft finishes and components.

#### 2-9.1.5. Water Intrusion Cautions.

a. To prevent entrapment of water, solvents, and other cleaning solutions inside of aircraft parts and structural areas, all drain holes and flap valves shall be opened before washing, and checked again after washing, to ensure that proper drainage occurs.

b. Do not wash or rinse aircraft with a solid stream of water. Use a soft spray pattern to avoid damaging fragile surfaces or causing water intrusion.

c. Water must not be directed at pitot tubes, static ports, or vents. These areas shall be adequately protected.

d. Relubricate all fittings and other lube points in areas to which cleaning compounds have been applied, such as wheel wells, flap wells, and flight control wells. Ensure that these areas are adequately drained. Check the specific aircraft manual to determine lubrication requirements.

2-9.1.6. Oxygen System Cautions. Observe warnings and cautions in specific oxygen system manuals.

2-9.1.7. Special Precautions. Use extreme care when cleaning and related treatment is performed around radomes, access doors to integral fuel tank cells, light fixtures, electrical components, and antennas. These areas may be damaged by cleaning and related equipment.

2-9.2. PREPARATION FOR AIRCRAFT CLEANING. A list of recommended wash rack equipment and consumables is provided in Table 2-2.

### WARNING

Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of any flammable solvent.

### CAUTION

Cover acrylic or polycarbonate canopies during shore based washing to prevent accidental scratching or crazing by cleaning compounds.

2-9.2.1. Canopy. Cover canopy with flannel cloth (A-A-50129 Type II). Cover flannel with barrier material (MIL-PRF-131 Class 1), and tape to canopy frame or painted surface near canopy using preservation tape (AMS-T-22085 Type II) or masking tape (AMS-T-21595 Type III). Do not apply tape directly to transparent surface.

Table 2-2. Suggested List of Wash Rack Items

Item Number.	Equipment (see Volume IV, Chapter 3)	Specification/ Part Number
1	Small/Large Portable Foam Generating Cleaning Unit (including attachments/accessories)	-----
2	Water Hose	-----
3	Water Nozzle	M-70 Pistol Grip, Straham Valves, Inc.
4	Aircraft Wash Pads and Holders	3M No. 33 Wash Pads 3M "Jet Pad" Melamine Wash Pads 3M No. 261 Wash Pad Holder A-A-1464 Aluminum Handle
5	Scrub Brushes, Nylon Bristle	MIL-B-23958 Type I
6	Utility Pail, Rubber	L-P-65
7	Ground Covers (canopy, wheel, intake, exhaust)	-----
8	Gloves	MIL-G-87066
9	Apron, Rubber, Full Length	A-A-3104
10	Goggles	A-A-1110
11	Face Shield	ANSI Z87.1
12	Boots	A-A-50371
Item Number.	Consumable Materials (see Volume IV, Chapter 2)	Specification/ Part Number
13	Aircraft Cleaning Detergent	MIL-PRF-85570, Type II and V
14	Water Repellent, Window and Windshield	MIL-W-6882
15	Lubricants (as required by maintenance manuals/cards)	-----
16	Flannel Cloth	A-A-50129 Type II
17	Barrier Material	MIL-PRF-131 Class 1
18	Aircraft Preservation Tape	AMS-T-22085 Type II

2-9.2.2. (N) Pre-Wash Lubrication.

a. To protect against cleaning solution entrapment, inspect all lubrication points that have exposure type lubrication fittings.

b. Prior to lubricating any components or parts, remove all foreign matter from joints, fittings, and bearing surfaces, using non-woven cleaning cloth. Wipe up all spilled or excess oil and grease.

c. Lubricate all fittings which will be exposed to wash solutions, in accordance with maintenance manuals or maintenance cards. If fittings do not accept lubrication, replace and lube prior to wash.

d. See applicable maintenance manual and paragraph 2-13 for lubrication of aircraft components.

2-9.2.3. Protection From Water/Cleaning Compound Intrusion. Take the following steps to prevent water/cleaning compound intrusion during cleaning:

a. Close doors and emergency openings.

b. Refer to aircraft maintenance manuals for locations of drain holes. Check drain holes. Make sure that all drain holes are clear by inserting a probe (such as a pipe cleaner), except where pressurized flapper valves are located.

c. Cover vents, openings, and ports. Refer to aircraft maintenance manuals for locations of vents to be masked. Pitot static ports shall be covered. If covers are not available, barrier material (MIL-PRF-131 Class 1) may be cut into circular pieces and taped in place with preservation tape (AMS-T-22085 Type II). Covers must be removed prior to release of aircraft for flight. Particular care shall be taken to ensure that static vents are not fouled by tape adhesive transfer. In the event of significant adhesive transfer, clean with aliphatic naphtha (TT-N-95) or degreasing solvent (MIL-PRF-680 Type II).

**CAUTION**

Do not use a direct spray of water or cleaning compound on carbon brakes, wheels or wheel hubs.

d. Cover wheels with locally fabricated covers to prevent water/cleaning compound contamination of wheel bearings and carbon brakes. Carbon brakes have temporarily reduced performance when subjected to water, deicers, degreasers, and oil. Brakes should be protected from direct impingement as much as practical during maintenance, aircraft cleaning or operations. Weak or spongy brakes (and in some cases, smoke) may result until the contaminants are burned off (normally one flight). If contamination, corrosion, or loss of lubricant in wheel bearings is suspected, remove wheel bearings and relubricate in accordance with applicable maintenance instructions. If contamination of carbon brakes is suspected, decontaminate in accordance with applicable maintenance instructions.

2-9.3. CLEANING METHODS.**WARNING**

Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL-PRF-85570 or MIL-PRF-85704. Wet weather clothing is not required except during cold weather. Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of flammable solvents.

2-9.3.1. The methods for cleaning aircraft vary depending upon the availability of fresh water. The following methods should be used for cleaning aircraft exterior surfaces. See Table 2-3 for instructions on specific areas and components.

Table 2-3. Cleaning of Specific Areas and Components

Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
<b>NOTE</b>			
Cleaning procedures are listed in this table. Ordering information for approved materials can be found in Volume IV, Chapter 2. Ordering information for approved equipment can be found in Volume IV, Chapter 3.			
<b>ACRYLIC PLASTIC PARTS (EXCEPT CANOPIES)</b>			
NOTE: Refer to specific aircraft manual to determine acrylic plastic parts.			
Light soil and smudges	MIL-D-16791  A-A-50129	1 oz. detergent in 1 gallon water  Cloth, Flannel	Wipe with cloth wet with cleaning solution and follow with a cloth wet with fresh water. Dry with a clean cloth.
<b>ARRESTING GEAR AND WHEEL WELLS</b>			
Dirt, grease, hydraulic fluid	MIL-PRF-85570 Type V  or  MIL-PRF-680 Type II or III and MIL-PRF-85570 Type I or MIL-PRF-85570 Type 1A	Use undiluted  Degreasing Solvent  1 part cleaner in 4 parts water  Use undiluted	Apply MIL-PRF-85570 Type V with spray or brush. Allow a 5-15 minute dwell. Brush, if necessary. Rinse thoroughly with fresh water. Repeat rinsing with brushing to remove cleaner residues.  Alternate procedure: Brush on solvent to loosen stubborn soil. Apply MIL-PRF-85570 Type I or 1A, then brush and rinse.
<b>BATTERY COMPARTMENTS</b>			
NOTE: See paragraph 6-2 for detailed instructions.			
Lead-acid acid battery electrolyte deposits	ASTM D928  MIL-PRF-81309 Type II	Sodium bicarbonate, 6 oz. in 1 gallon water  Corrosion Preventive Compound	<b>WARNING</b> Never use a wire brush to clean a battery.  Remove spilled electrolyte immediately by flushing with fresh water. Neutralize the area by sponging with sodium bicarbonate solution. Apply generously until bubbling stops. Let it stay on 5 minutes, but do not allow to dry. Brush with a fiber brush, then flush with fresh water. Dry with clean wiping cloths. Keep the cell vents open. Preserve compartment with MIL-PRF-81309 Type II. Do not paint or preserve batteries.
Nickel-cadmium battery electrolyte deposits	AWWA B504  MIL-PRF-81309 Type II	Monobasic sodium phosphate 6 oz. in 1 gallon water  Corrosion Preventive Compound	Remove spilled electrolyte immediately by flushing with fresh water. Neutralize the area by sponging generously with sodium phosphate solution. Brush with a fiber brush, then flush with fresh water. Dry with clean wiping cloths. Keep the cell vents open. Preserve compartment with MIL-PRF-81309 Type II. Do not paint or preserve batteries.

Table 2-3. Cleaning of Specific Areas and Components (Cont.)

Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures		
<b>BILGE AREAS</b>					
Algae contamination	MIL-PRF-85570 Type II or MIL-PRF-85570 Type II RTU or MIL-PRF-85570 Type I or MIL-PRF-85570 Type IA or MIL-PRF-85570 Type V	1 part cleaner in 4 parts water  Use undiluted  1 part cleaner in 4 parts water  Use undiluted  Use undiluted	For Type I or II, mix cleaner and water in a pump spray bottle. Spray cleaner on contaminated area and allow to dwell at least 2 minutes. Wipe off with a sponge and dry with a clean cloth.		
	Hydraulic fluid, water, dirt, metallic debris	MIL-PRF-85570 Type II or MIL-PRF-85570 Type I or  MIL-PRF-680 Type II or MIL-PRF-32295 Type I		1 part cleaner in 14 parts water 1 part cleaner 14 parts water  Degreasing Solvent Non-Aqueous Cleaner	Vacuum clean liquids and debris and dry. Wipe area with a sponge dampened in cleaning solution. Rinse by sponging with fresh water. Wipe dry with a clean cloth.  Wipe with cloth dampened with solvent or cleaner. Wipe dry with a clean cloth.
	Mold/Mildew/Fungus	NAVCLEAN		Mix in accordance with manufacturer's instructions	Apply solution to mold/mildew/fungus growth using cotton cheesecloth or a soft bristle brush. Let stand 5-15 minutes. Rinse thoroughly with fresh water to remove residue.
<b>CANOPY EXTERIOR, PLASTIC AND GLASS PANELS</b>					
Dust, dirt, grime, salt spray, paint overspray	P-P-560  A-A-50129	Plastic Polish Compound  Cloth, Flannel	Flush with fresh water to remove loose dirt. Rub gently with bare hands or clean cloth while applying fresh water. Dry with soft, clean cloth. Follow by applying polishing compound with a soft, clean cloth using a circular motion until clean. Polish with another soft, clean cloth.		
	Oil, grease	TT-N-95  P-P-560  A-A-50129		Aliphatic Naphtha Plastic Polish Compound Cloth, Flannel	<b>CAUTION</b> Do not use synthetic (non-cotton) cloths with naphtha. Do not rub dry plastic panel with dry cloth.  Apply naphtha with a soft, clean flannel cloth. Blot gently; solvent will evaporate and not leave a film. Apply polishing compound. Rub using a circular motion until clean and polish with another soft, clean cloth.
<b>CONTROL CABLES</b>					
Dust, dirt, oil, grease	MIL-PRF-680 Type II or MIL-PRF-32295 Type I	Degreasing Solvent Non-Aqueous Cleaner	<b>WARNING</b> Open all circuit breakers before cleaning.  Wipe with clean cloth dampened with solvent or cleaner. Apply MIL-PRF-81309 Type II. Recoat cables with MIL-PRF-16173 Grade 4.		
	MIL-PRF-81309 Type II	Corrosion Preventive Compound			
	MIL-PRF-16173 Grade 4	Corrosion Preventive Compound			
	<b>DOORS, LINKAGES, CYLINDER</b>				
Dust, dirt, oil, grease	MIL-PRF-680 Type II or MIL-PRF-32295 Type I	Degreasing Solvent Non-Aqueous Cleaner	<b>WARNING</b> Open all circuit breakers before cleaning.  Brush surfaces as necessary with solvent or cleaner. Cover rod ends and springs with MIL-PRF-16173 Grade 4. Where lubrication is not required, MIL-DTL-85054 may be applied.		
	MIL-PRF-16173 Grade 4 or MIL-DTL-85054	Corrosion Preventive Compound Corrosion Preventive Compound			
	<b>EJECTION SEATS</b>				
	Refer to specific ejection seat maintenance manuals.				



Table 2-3. Cleaning of Specific Areas and Components (Cont.)

Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
<b>ELASTOMERIC SEALS</b>			
Dust, dirt, oil, and grime	MIL-D-16791 CCC-C-440	1 oz. detergent in 1 gallon water Cheesecloth, Cotton	Wipe with cloth wet with cleaning solution and rinse with a cloth wet with fresh water. Dry with a clean cloth.
<b>ELECTRICAL CONNECTORS AND AVIONIC COMPONENTS</b>			
Dust, dirt, lint, and other loose foreign matter, grease, oil smudges, light tarnish, corrosion, or fungi			Refer to Volume III.
<b>ENGINES, RECIPROCATING</b>			
Dust, dirt, or oil	MIL-PRF-680 Type II or MIL-PRF-32295 Type I A-A-3100	Degreasing Solvent  Cleaning Pad	Apply solvent or cleaner with cleaning pad or brush. Repeat application and dry. Collect solvent runoff and dispose in accordance with local regulations.
<b>EXTERIOR SURFACES, PAINTED</b>			
Light soils (dirt, dust, mud, salt, loose soot)	MIL-PRF-85570 Type II or MIL-PRF-85570 Type I	1 part cleaner in 14 parts water  1 part cleaner in 14 parts water	Apply cleaner solution with foam generator, spray, sponge, soft brush, or cloth. Allow cleaner to dwell 5-10 minutes. Scrub and then rinse with fresh water and dry.
Moderate soils (hydraulic fluids, lube oils, light preservatives)	MIL-PRF-85570 Type II or MIL-PRF-85570 Type I	1 part cleaner in 9 parts water  1 part cleaner in 9 parts water	Apply cleaner solution with foam generator, spray, sponge, soft brush or cloth. Allow cleaner to dwell 5-10 minutes. Rub gently with a circular motion for up to one minute. Rinse with fresh water and dry.
Heavy soils (carbonized oil, aged preservatives, grease, gun blast & exhaust deposits)	MIL-PRF-85570 Type V or MIL-PRF-680 Type II CCC-C-440 MIL-PRF-85570 Type I or MIL-PRF-85570 Type IA or MIL-PRF-85570 Type II or MIL-PRF-85570 Type II RTU	Use undiluted  Degreasing Solvent Cotton Cheesecloth 1 part cleaner in 4 parts water Use undiluted 1 part cleaner in 4 parts water Use undiluted	Spray or brush on cleaner. After 5-10 minutes, brush and rinse thoroughly.  Preclean by wiping or solvent brushing soiled area with MIL-PRF-680. Then apply cleaner solution with foam generator, spray, sponge or cloth. Allow the cleaner to dwell for up to 1 minute without scrubbing then scrub for up to 1 minute. Rinse thoroughly, then dry. Do not allow cleaning solutions to dry on surfaces, or streaking will occur.
Stubborn soil on gloss painted aircraft (scuff marks, exhaust)	MIL-PRF-85570 Type III	Use undiluted	Apply cleaner with a damp cloth. Rub with a circular motion. Rinse thoroughly, then dry. Do not allow the cleaner to dry on surfaces or rinsing may be difficult.
Stubborn soil on Tactical Paint Scheme aircraft (scuff marks, exhaust)	MIL-PRF-85570 Type IV	Use undiluted	Apply cleaner with a non-abrasive cleaning pad. Allow 1-3 minutes dwell time. Rub with a circular motion. Rinse thoroughly, then dry. Do not allow the cleaner to dry on surfaces or rinsing may be difficult.



Table 2-3. Cleaning of Specific Areas and Components (Cont.)

Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
<b>EXTERIOR SURFACES, UNPAINTED</b>			
Gunblast residues, carbonized exhaust	MIL-PRF-85570 Type I or MIL-PRF-85570 Type IA or MIL-PRF-81309 Type II	1 part cleaner in 4 parts water  Use undiluted  Corrosion Preventive Compound	<b>CAUTION</b> Do not allow MIL-PRF-85570 Type I or 1A cleaning solutions to contact canopy plastic panels.  Wet surface with fresh water. Apply cleaning solution and scrub briskly with abrasive mat (MIL-A-9962 Type 1 Grade A or B). Rinse with fresh water and dry.  For stubborn deposits, spray area with MIL-PRF-81309 Type II, then scrub with flap brush.
<b>FABRIC PARTS, SOUNDPROOFING AND UPHOLSTERY</b>			
Light soil and oil spots	MIL-D-16791 or MIL-PRF-85570 Type II	1 part detergent in 16 parts water  1 part cleaner in 9 parts water	Remove loose dirt with vacuum cleaner. Apply soap solution with sponge and scrub briskly.  Rinse with clean, dampened cloth or sponge using clean, fresh water. Allow area to dry. Raise nap by brushing.
<b>GAS TURBINE ENGINE EXTERIOR, ENGINE BAY AND ENGINE BAY DOORS</b>			
Oxidized oil, dust, carbon, salt deposits	MIL-PRF-85704 Type II RTU (preferred) or MIL-PRF-85704 Type I or MIL-PRF-85570 Type II or MIL-PRF-85570 Type V	Do not dilute, this is a ready to use form  1 part cleaner in 4 parts water  1 part cleaner in 4 parts water  Use undiluted	Apply mixed cleaning solutions (MIL-PRF-85704 Type I or Type II RTU or MIL-PRF-85570 Type II) with a brush. Scrub, then rinse with fresh water. When using MIL-PRF-85570 Type V, apply concentrate with a brush, allow cleaner to remain on surface for 5 minutes, then brush and rinse thoroughly. Dispose of waste cleaner in accordance with local regulations.
<b>GAS TURBINE ENGINE INTERIOR, GAS PATH</b>			
Oxidized oil, dust, carbon, salt deposits	MIL-PRF-85704 Type II or MIL-PRF-85704 Type II RTU	1 part cleaner in 4 parts water  Do not dilute, this is a ready to use form	Use in accordance with applicable engine maintenance manual instructions. Dispose of waste cleaner in accordance with local regulations.  Navy: Refer to Appendix A for additional information.
<b>HELICOPTER AND PROPELLER BLADES</b>			
Grime, oil, grease, exhaust stains	MIL-PRF-85570 Type II  A-A-3100	1 part cleaner in 9 parts water  Cleaning Pad	<b>CAUTION</b> Do not use strong alkaline cleaners or concentrated abrasive compounds when cleaning rotor tip cap areas. Refer to aircraft technical manuals for specific cleaning instructions.  Apply cleaning solution with a cleaning pad or brush. Rinse with fresh water.
<b>HELICOPTER CARGO AND RESCUE HOIST CABLE, AND END FITTINGS</b>			
Salt, salt water	MIL-PRF-81309 Type II  A-A-50129	Corrosion Preventive Compound  Cloth, Flannel	Flush thoroughly with fresh water. Blow dry with clean, compressed air or thoroughly dry with a cotton cloth. Spray with MIL-PRF-81309 compound as cable is being rewound. Remove excess with clean dry flannel cloth.
<b>HELICOPTER CARGO AND RESCUE HOIST DRUM</b>			
Salt, salt water	MIL-PRF-85570 Type II	1 part cleaner in 14 parts water	Rinse with fresh water. Apply cleaning solution with sponge or clean cloth. Rinse thoroughly with fresh water. Blow dry with clean compressed air or dry with a clean dry cloth.

Table 2-3. Cleaning of Specific Areas and Components (Cont.)

Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
<b>HELICOPTER RESCUE SLING</b>			
Salt, salt water	MIL-PRF-85570 Type II or MIL-D-16791	1 part cleaner in 14 parts water  1 part detergent in 14 parts water	Rinse with fresh water. Apply cleaning solution with sponge or clean cloth. Rinse thoroughly with fresh water. Blow dry with clean compressed air or suspend and allow to dry. If suspended to dry ensure water will drain away from the buckle.
<b>INTERIOR AREAS</b>			
<b>COCKPIT INTERIOR</b>			
Dust, dirt, mud, and light debris	MIL-PRF-85570 Type II or MIL-D-16791	1 part cleaner in 14 parts water  1 oz. detergent in 1 gallon water	Loosen any accumulations of mud on control pedals, floor, or other cockpit equipment with brush and remove with vacuum cleaner. Wipe with cloth wet with cleaning solution and follow with a cloth wet with fresh water. Dry with a clean cloth.
<b>ENVIRONMENTAL CONTROL DUCTING</b>			
Light debris, dust, and grime	A-A-50129 MIL-PRF-85570 Type II or MIL-D-16791	Cloth, Flannel  1 part cleaner in 14 parts water  1 oz. detergent in 1 gallon water	Refer to applicable maintenance manuals.
<b>FLOOR AND DECK</b>			
Dirt, debris	MIL-PRF-85570 Type II (preferred) or MIL-PRF-85570 Type I (alternate)	1 part cleaner in 14 parts water  1 part cleaner in 14 parts water	Remove loose dirt with vacuum cleaner. Wipe with cleaning compound, rinse with fresh water.
<b>LAVATORIES</b>			
Urine residue	O-A-451  ASTM D928  USDA Reg 100-12-1	Ammonium Hydroxide, 1 part in 20 parts water  Sodium Bicarbonate, 6 oz. to 1 gallon of fresh water  Germicidal Tablets	<b>CAUTION</b> When using Ammonium Hydroxide, do not allow any solutions to contact aircraft wiring. Flush immediately with fresh water if spillage occurs.  Sponge with a solution of ammonium hydroxide. Flush with fresh water or wet surface with sodium bicarbonate solution, allow to dry, rinse with fresh water. Dry with a clean cloth.  Use germicidal tablets as toilet and urinal deodorants.
<b>RADOME AND EQUIPMENT COMPARTMENT (INTERIOR)</b>			
Dust, dirt, oil and debris	MIL-D-16791  A-A-1491	1 oz. detergent in 1 gallon water  Cotton Cheesecloth	<b>CAUTION</b> Avoid use of compressed air to clean electronic equipment. Do not use abrasives in radome compartment.  Remove loose dirt with vacuum cleaner. Wipe fiberglass with a cloth wet with cleaning solution and rinse with cloth wet with fresh water. Dry with a clean cloth.

Table 2-3. Cleaning of Specific Areas and Components (Cont.)

Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
<b>INTERIOR PLASTIC AND GLASS PANELS</b>			
Dust, dirt	A-A-50129	Cloth, Flannel	Vacuum and then dust with soft, clean, damp cloth. Keep cloth free of grit by rinsing frequently in water and wringing out.
<b>LANDING GEAR EXPOSED PISTON SURFACES</b>			
Sand, dirt, salt deposits, and other foreign particles	MIL-PRF-83282 CCC-C-440	Hydraulic Fluid Cotton Cheesecloth	Clean exposed surfaces with clean cloth dampened with hydraulic fluid. Take care not to scratch the surface. Wipe away from seals.
<b>OPTICAL GLASS</b>			
Dust, grease, oil	A-A-59199 A-A-50129	Optical cleaner Cloth, Flannel	Spray cleaner onto flannel cloth and carefully wipe the lens surface. Wipe dry.
<b>ORGANIC MATERIALS (Fabric, Rubber, Paint)</b>			
Fungi (mold)	TT-I-735 CCC-C-440 or NAVCLEAN	Isopropyl Alcohol Cotton Cheesecloth  Mix in accordance with manufacturer's instructions	Wipe with clean cheesecloth wet with isopropyl alcohol. To prevent recurring fungus growth, keep area dry and clean. For treatment of fuel system fungus contact appropriate engineering authority.  Apply solution to mold/mildew/fungus growth using cotton cheesecloth or a soft bristle brush. Let stand 5-15 minutes. Rinse thoroughly with fresh water to remove residue.
<b>OXYGEN LINES (EXTERIOR SURFACES)</b>			
Oil, grease	Refer to specific system manuals.		
<b>RELIEF TUBES (EXTERIOR)</b>			
Human waste (urine)	MIL-PRF-85570 Type II	1 part cleaner in 14 parts water	Wash thoroughly with solution using a soft, bristle brush, then rinse thoroughly with fresh water.
<b>REMOVABLE METAL FUEL TANKS</b>			
Fuel residue, grease, exhaust deposits	MIL-PRF-85570 Type I or MIL-PRF-85570 Type IA	1 part cleaner in 4 parts water  Use undiluted	Navy: use MIL-PRF-85570 in accordance with procedures in NAVAIR 01-1A-35. Army: use system specific manuals.
<b>WHEELS AND BRAKES</b>			
Oil, dirt, sand, and other foreign matter	MIL-PRF-85570 Type I or MIL-PRF-85570 Type IA	1 part cleaner in 4 parts water  Use undiluted	Clean exposed areas with cleaner solution by brushing. Rinse thoroughly with fresh water. Relubricate as required.

2-9.3.2. Detergent Cleaning (Preferred Method). The following procedure shall be used where fresh water is available for rinsing purposes. Dilute cleaner as recommended in Table 2-3. Where high outdoor temperatures are encountered (80°F (27°C) and above) and where shade is not available, cleaning operations should be scheduled for early morning and late afternoon or night. Wetting aircraft exteriors with fresh water before cleaning will cool surfaces and help prevent fast evaporation during hot weather. For cold weather procedures, refer to paragraph 2-9.3.8.

**CAUTION**

Do not use abrasive mats (A-A-58054) for cleaning painted surfaces.

a. Rinse aircraft surfaces where necessary to reduce skin temperature. Streaking will occur if cleaning solutions drip down hot painted surfaces.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

**CAUTION**

Do not use the 3M "Jet Pad" Melamine Wash Pads for cleaning transparency/canopy materials such as plastic or glass.

**NOTE**

3M "Jet Pad" Melamine Wash Pads do not have the durability of the traditional wash pad. It is recommended that a thorough post-wash inspection be completed to ensure that no small pieces of foam remain on the aircraft.

b. Apply diluted cleaning compound (MIL-PRF-85570 Type I or II) from a bucket, spraying equipment, or foaming equipment (see Figure 2-3). Scrub surfaces with 3M No. 33 Aircraft Cleaning Pad or 3M Jet Pad attached to the 3M No. 261 Pad Holder (see Figure 2-4). Use nylon bristle scrub brushes (MIL-B-23958) or the 3M Jet Pad for hard to remove soils. To prevent streaking, start at the lower surfaces, working upward and out (see Figure 2-5). Surfaces being cleaned should be exposed to cleaning solution for 5 to 10 minutes.



Figure 2-3. Washing and Rinsing of Aircraft Surfaces

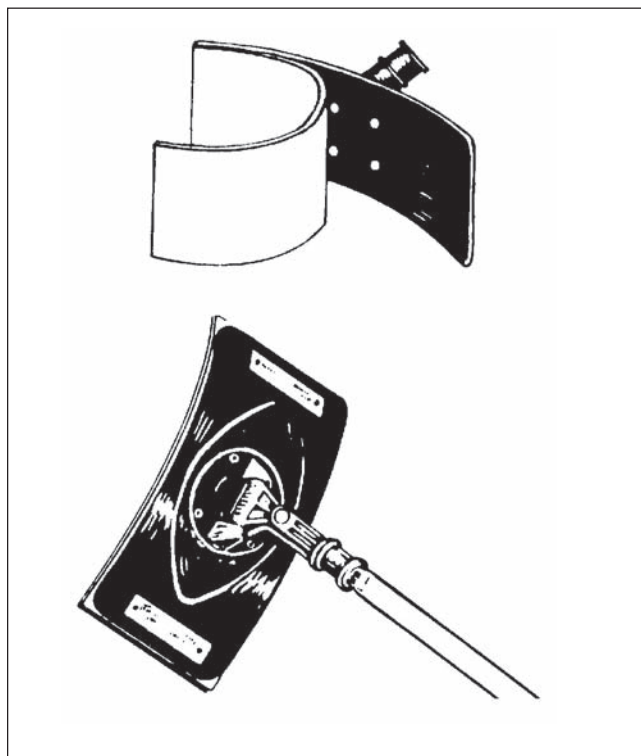


Figure 2-4. Use of Aircraft Washing Applicator

**WARNING**

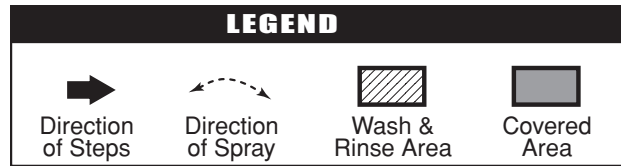
See applicable aircraft MIMs for no-step and water intrusion areas.

**CAUTION**

Canopies, windcreens and transparencies must be covered during washing to prevent scratching or crazing from aircraft cleaning detergents.

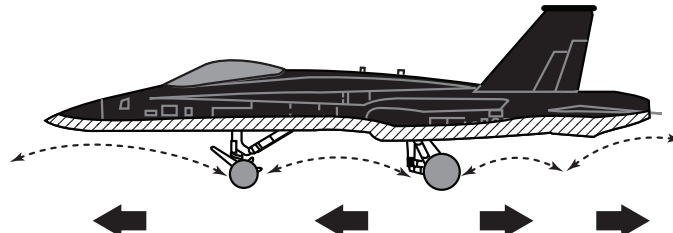
**NOTE**

Open doors and flaps to flapwells, intercoolers, oil coolers, speed brakes, spoilers, and controllable leading edges to permit cleaning of hidden areas.



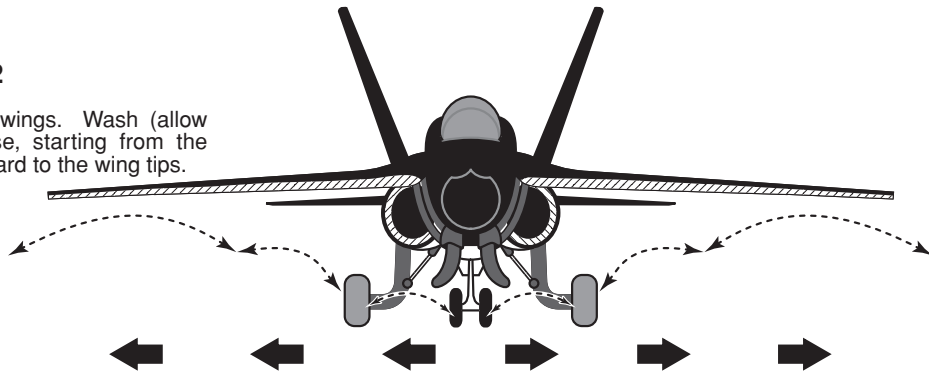
**STEP 1**

Clean the underside of the fuselage and tail section. Wash (allow detergent to dwell) and rinse, starting from the main landing gear and moving toward the forward and aft ends of the aircraft.



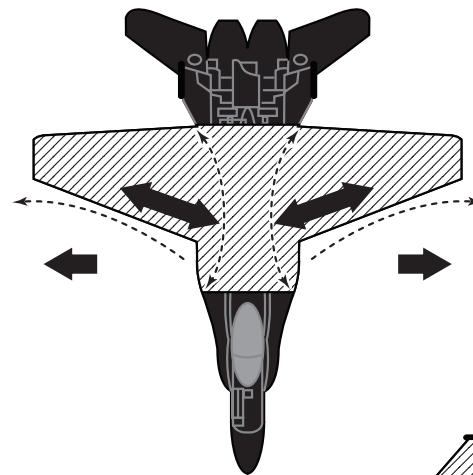
**STEP 2**

Clean the underside of the wings. Wash (allow detergent to dwell) and rinse, starting from the mid-section and moving outward to the wing tips.



**STEP 3**

Clean the center section of fuselage and topside of the wings. Wash (allow detergent to dwell) and rinse, starting from the center section of the fuselage and moving outward to the wing tips.



**STEP 4**

Clean the remaining topside area of the fuselage (except canopy). Wash (allow detergent to dwell) and rinse, starting from the mid-section and moving toward the forward and aft ends of the aircraft fuselage. Wash and rinse the tail section, starting at the bottom and moving up toward the top.

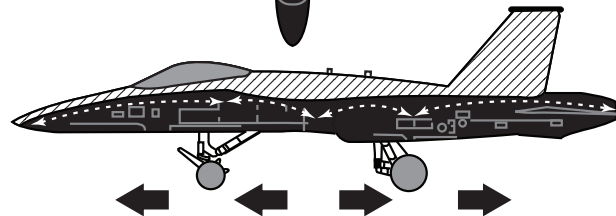


Figure 2-5. Aircraft Cleaning Procedure

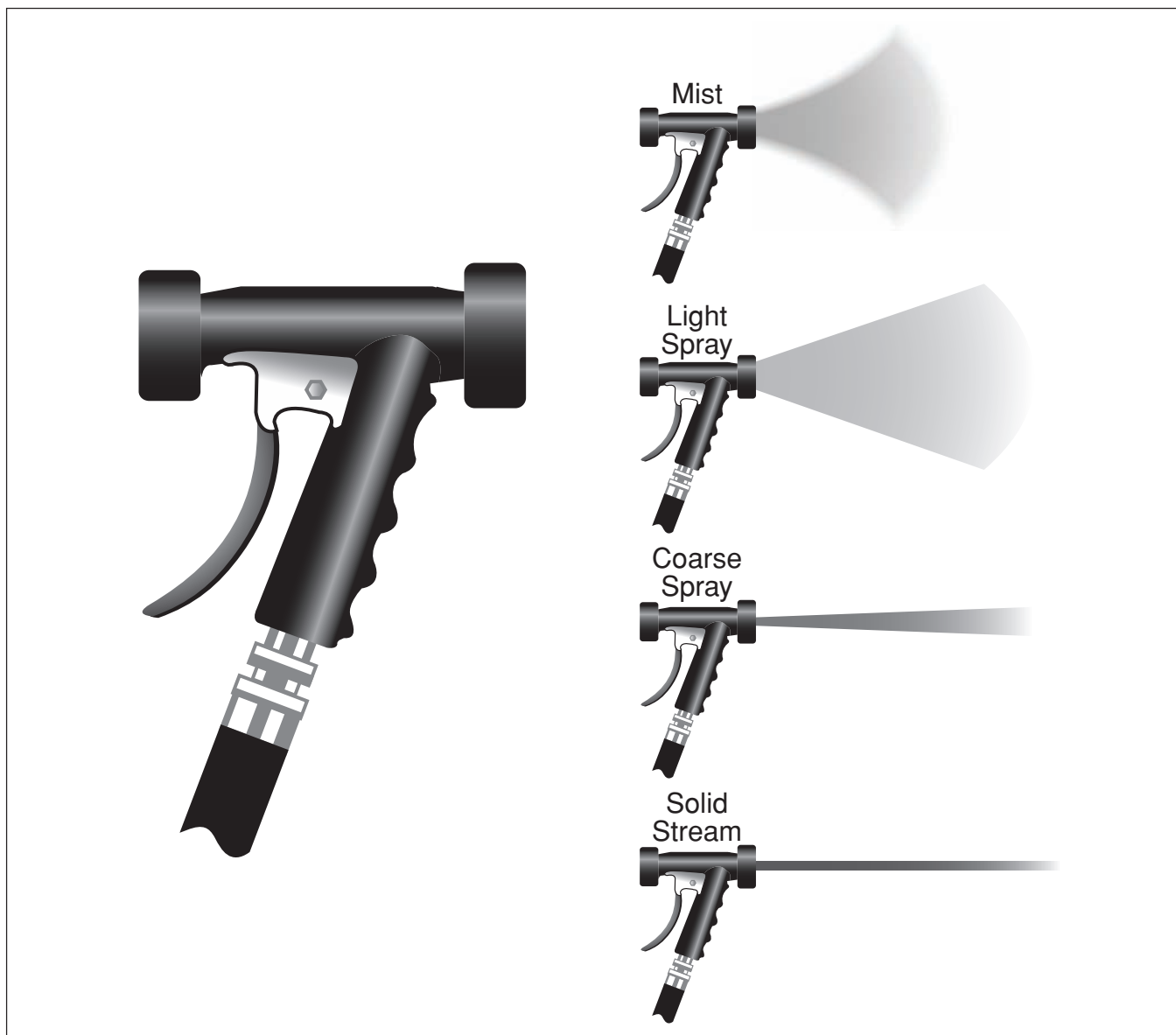


Figure 2-6. Automatic Water Spray Nozzle

c. Rinse away the loosened soil and cleaner with fresh water. For rinsing, a rubber padded shut-off spray nozzle is recommended (see Figure 2-6). Rinse the cleaner and loosened soil from aircraft surface with a fan spray nozzle, directed at an angle between 15 and 30 degrees from the surface. Continue rinsing until all evidence of cleaner and soils have been removed from aircraft.

d. For aircraft with gloss paint surfaces, ground-in soils (boot marks, smudges) can be cleaned with MIL-PRF-85570 Type III. Apply undiluted cleaner with a damp cloth. Rub area with a circular motion. Rinse thoroughly, then dry with a clean cloth. Do not allow cleaner to dry on surface.

**NOTE**

The 3M Jet Pad, used with MIL-PRF-85570 Type I or Type II, will also adequately remove boot marks, smudges, and ground-in soils.

e. For aircraft painted with a tactical paint scheme, ground-in soils (boot marks, smudges) can be cleaned with MIL-PRF-85570 Type IV spot cleaner. Blot undiluted cleaner on using a cleaning pad or sponge. After 1-3 minutes, scrub these areas with the pad in a circular motion. When the rubber particles in this cleaner are rubbed with the pad, removable soils are erased from the pores in the paint. Rinse thoroughly, then dry with a clean cloth. Do not allow cleaner to dry on surface.

f. Wheel wells, flap wells and other heavily soiled areas which can tolerate water rinsing can be cleaned with MIL-PRF-85570 Type V gel cleaner. This cleaner may be sprayed on using a hand operated pump spray or applied with a brush. Allow cleaner to dwell for five minutes. Brush if necessary, then rinse thoroughly with a coarse spray (see Figure 2-6).

2-9.3.3. Waterless Wipe Down. Waterless wipe down procedures for spot cleaning shall be used only when water is not available for rinsing, or when cold weather prevents the use of water. The preferred waterless wipe down method for removing soils and corrosive salt residues is as follows:



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

a. Using a plastic spray bottle, apply MIL-PRF-85570 Type I or II (one part cleaner to 14 parts water) to the exterior surfaces of the aircraft (several square feet at a time).

b. After 30 seconds, scrub, then wipe cleaner and soil from the surface with a clean cloth.

c. Rinsing with a cloth wet with fresh water following the use of cleaner is desirable.

d. Rinse the cleaned surface with fresh water when it becomes available.

2-9.3.4. Alternate Waterless Wipe Down. Use only when water is not available for rinsing or when cold weather prevents the use of water. The following is an alternate method of waterless wipe down:



Compound, Corrosion Preventive 4  
Water-Displacing  
MIL-PRF-81309

a. Apply a film of a water displacing corrosion preventive compound (MIL-PRF-81309 Type II).

b. Wipe with a cloth to remove the loosened soil.

c. Apply a second coat of MIL-PRF-81309 Type II.

d. Wipe the surface with a clean cloth.

2-9.3.5. Detergent Cleaning With Limited Water. Use the following procedure, only when sufficient rinse water is not available:

a. Mix either of the following in a bucket:



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MIL-PRF-85570

(1) One part MIL-PRF-85570 Type II and 14 parts water or

(2) One part MIL-PRF-85570 Type I and 14 parts water.

b. Apply the cleaner with a cleaning pad, sponge, cloth, or cleaning brush. Apply to one small area at a time.

c. Scrub the area and wipe clean with a soft cloth.



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MIL-PRF-680

d. For stubborn soils, clean with degreasing solvent MIL-PRF-680 Type II. Then scrub with one of the solutions below:

(1) One part MIL-PRF-85570 Type II and four parts water.

(2) MIL-PRF-85570 Type II RTU.

(3) One part MIL-PRF-85570 Type I and four parts water.

(4) MIL-PRF-85570 Type IA.

e. Wipe clean with a soft cloth.



Compound, Corrosion Preventive 4  
Water-Displacing  
MIL-PRF-81309

f. Apply MIL-PRF-81309 Type II and wipe with a clean, dry cloth.



**WARNING**

Do not use synthetic wiping cloths with flammable solvents. Synthetic cloths can generate static electricity which can result in sparks and fire. Cotton wiping cloths, such as terry cloth, flannel, or cheesecloth, are acceptable.

2-9.3.6. Solvent Cleaning. The use of MIL-PRF-85570 for stubborn or exceptionally oily areas on exhaust tracks, landing gears, wheel wells, and engine nacelles will normally be sufficient. When this material has not completely cleaned these areas, MIL-PRF-680 Type II or MIL-PRF-32295 Type I can be used in small quantities. The quantity used shall be limited to the minimum necessary to accomplish the required cleaning. In using MIL-PRF-680 for cleaning, remember that it will burn intensely once ignited. Solvent available at the aircraft or equipment shall not exceed three gallons under the use or control of each person authorized to accomplish the cleaning involved. The authorized person shall be thoroughly familiar with applicable safety precaution and disposal information. The time (dwell) the solvent is allowed to remain on painted surfaces shall be held to a minimum (10-15 minutes maximum) to prevent softening of the paint. Control drain off of dirty solvent resulting from the cleaning operation to prevent unauthorized entry into the sewer. Minor spillage (less than one gallon) is not considered significant; however, solvent spillage should be cleaned up according to local regulations. In no instance shall the solvent be allowed to drain into or enter a public sewer or otherwise be allowed to contaminate streams or lakes.

2-9.3.6.1. The following guidelines shall be followed in using MIL-PRF-680 Type II:

- a. Use only in areas approved by the local safety office.
- b. Ensure that the area within 50 feet of the solvent cleaning operation is clear and remains clear of all potential ignition sources.
- c. Use only explosion-proof electrical devices and power equipment. Power units used in servicing shall be placed upwind and beyond the 50 feet clearance. Ensure that the aircraft or equipment is grounded.
- d. No smoking shall be allowed in the solvent cleaning area.

e. Mixing of solvents with other chemicals, cleaning compounds, or water is strictly prohibited except as specified by this manual.

f. Suitable fire extinguishing equipment shall be available to the solvent cleaning area.

g. Wear ANSI Z87.1 Type II goggles, protective wet weather clothing, solvent resistant gloves, boots, and head covering. Use a respirator fitted with organic vapor cartridges when working in an enclosed area. Ensure that good ventilation is maintained. Consult the local safety office for PPE requirements

2-9.3.6.2. Clean the area as follows:



Solvent, Degreasing  
MIL-PRF-680 13



Cleaner, Non-Aqueous,  
Low VOC, HAP Free,  
MIL-PRF-32295 15

a. Apply MIL-PRF-680 Type II (or MIL-PRF-32295 Type I) using pad, cloth, or brush. Clean up spills as they occur.

b. Ensure that no solvent/cleaner is trapped or has entered the equipment interior. Remove by wiping with clean cotton wiping cloths or by blowing dry with clean, low pressure air (10-15 psi).

c. Collect waste solvent/cleaner and wiping rags and dispose in accordance with local regulations.

d. After cleaning with MIL-PRF-680, rewash the area using procedures in paragraph 2-9.3.2. to remove residue left by the solvent.

2-9.3.7. Interior Cleaning. Dirt, dust, small loose objects, and paper can be removed from an area by use of an industrial or domestic vacuum cleaner. A soft bristle brush on the inlet of the vacuum cleaner will aid in removal of soils.

a. Floor boards and areas underneath the floor boards (bilge) shall be inspected at depot-level maintenance and as necessary for cleaning and/or corrosion treatment. Particular attention shall be given to urinal areas and other areas that may trap water.



**CAUTION**

Accidental spills shall be investigated immediately after occurrence to determine if ingredients are corrosive. Neutralize corrosive spills by using procedures in Table 2-3. Failure to comply can result in extensive corrosion damage and possible unsafe operation of the equipment.

b. When it is determined that harmful contamination, (e.g. dirt spillage, foreign material) is present, remove the floor boards as necessary to allow proper cleaning of the area.

c. Clean area by vacuuming all loose foreign material, dirt, or spillage. The vacuum removal of dirt or soil may be aided by agitating with the brush. Be careful not to sweep or wipe the dirt into oily or wet areas.

**WARNING**

Use MIL-PRF-680 Type II with adequate ventilation and be sure bilge and/or other areas are properly ventilated (blown out) before floor boards are reinstalled or closed. Warning signs shall be conspicuously placed at all aircraft entrances to indicate that combustible materials are being used. The guidelines cited in paragraph 2-9.3.6.1. for solvent cleaning procedures apply.



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MIL-PRF-680



Cleaner, Non-Aqueous, 15  
Low VOC, HAP Free,  
MIL-PRF-32295

d. Oily areas and/or spots may be cleaned by wiping area with a clean cloth dampened with solvent, MIL-PRF-680 Type II or cleaner, MIL-PRF-32295 Type I, followed by immediate drying with a clean dry cloth. Do not over-saturate the cloth used for applying the solvent because this may result in the solvent puddling or entering recessed areas and creating a fire hazard. Precautions to prevent entry shall be taken when using the solvent around electrical equipment.

**CAUTION**

Before starting the following cleaning operation, be sure that the spray or other methods of application will not result in moisture damage to any components, especially electrical. Before using the spray methods, ensure all drain holes are open, that the material will drain and that the cleaning solution will not be forced into inaccessible areas. Do not apply the solution to any moisture absorbing material such as insulation, sponge rubber (open cell), or felt.

e. If further cleaning is required, use 1 part MIL-PRF-85570 Type II mixed with 14 parts fresh water. The cleaning solution can be applied by spraying or with a mop, sponge, or brush, provided that the solution can be adequately rinsed and/or removed from the surface.

f. After applying the cleaning solution with a non-metallic bristle brush, allow dwell time of approximately 10 minutes and flush or rinse with clean water. Check drain holes to assure that they are open and the water is draining properly. Remove any remaining water using clean cloths. The surface shall then be thoroughly dried using warm air or clean dry cloths.

g. In those areas where the above procedures cannot be used due to lack of drainage, or possible damage to components, hand cleaning procedures shall be used. Apply 1 part MIL-PRF-85570 Type II mixed with 14 parts water, by wiping or agitating the surface with a wet rag or sponge. Immediately following the application of the solution, wipe the same area with a rag wetted with clean water and then with a dry rag. The procedure may have to be repeated several times on extremely soiled areas.

h. Where corrosion is encountered or paint is removed, treat in accordance with this manual and the applicable maintenance instruction manual before the floor boards are replaced or area is closed.

2-9.3.8. Low Temperature Cleaning. Routine scheduled cleaning should not be performed at temperatures below 40°F (5°C). Instead, aircraft should be cleaned in an indoor wash rack. If such a facility is not available and aircraft are contaminated by corrosive materials (such as runway deicer or salt water), contaminated areas shall be cleaned even if the temperature is below 40°F (5°C). Normal cleaning solutions cannot be used in freezing weather. When the temperature is below or could drop below 32°F (0°C), clean as follows:

**WARNING**

Deicing fluid (AMS 1424) is mildly toxic. Contact with skin and eyes shall be avoided. Do not inhale deicing fluid mist. Operators should stay on the windward side of the aircraft during spray or brush application. Chemical or splash proof goggles shall be worn by all maintenance personnel.

**CAUTION**

Isopropyl alcohol (TT-I-735) or any other alcohol shall not be used for deicing acrylic canopies. Use deicing fluid (AMS 1424) for these applications.

Deicing fluid (AMS 1424) is glycol-based and may damage electrical/electronic circuitry with noble metal (gold, silver) coatings.

- a. If necessary, deice aircraft according to NAVAIR 01-1A-520 (Navy), TM 55-1500-204-25/1 (Army), or applicable maintenance manuals.



Solvent, Degreasing 13  
 MIL-PRF-680

- b. Solvent clean heavily soiled areas of aircraft by wiping or brushing with degreasing solvent (MIL-PRF-680 Type II).



Compound, Aircraft Cleaning 2  
 MIL-PRF--85570

- c. Dilute aircraft cleaning fluid (MIL-PRF-85570 Type II) with diluted deicing fluid (AMS 1424) to make a low temperature cleaner. If necessary, both materials should be warmed until the detergent can be poured into the deicing fluid. Mix thoroughly.

- d. Dilute this mixture as required by Table 2-4.

- e. Scrub the aircraft using a brush or aircraft washing kit.

- f. Rinse by deicing as in paragraph a. Heated deicing fluid mixtures will speed up the rinsing process.

Table 2-4. Recommended Dilution of Low Temperature Cleaner

Ambient Temperature	Dilution (parts mixture : parts water)
+30° F and above	1:4
+20° F to +30° F	1:2
+10° F and below	1:1

**2-10. FRESH WATER RINSING.** The purpose of fresh water rinsing is primarily to remove salt from aircraft surfaces that have become contaminated due to operations near salt water. Most salt deposits are readily dissolved and/or dislodged and flushed away by rinsing. Rinsing can be done in a taxi-through facility or by direct manual spraying.

**CAUTION**

Water in wheel wells, flap wells, or flight control wells, necessitates relubrication. Ensure that these areas are adequately drained and check the specific aircraft manual to determine lubrication requirements.

**NOTE**

Fresh water rinsing does not satisfy aircraft washing requirements.

**2-10.1. TAXI-THROUGH RINSING.** Deluge rinse facilities are automatic installations located in a taxiway area for use by aircraft after flight through salt air (see Figure 2-7). These installations provide multiple jet sprays of fresh water to cover the entire aircraft and rinse off salt and water soluble contaminants. Such facilities should be used as frequently as possible.

**CAUTION**

Do not rinse aircraft with a solid stream of water. Use a soft spray pattern to avoid damaging fragile sections or causing water intrusion. Water must not be directed at pitot tubes, static ports, vents, or openings. Critical areas shall be adequately protected with ground plugs, covers, or barrier material.

**2-10.2. MANUAL RINSING.** The manual application of fresh water is accomplished through the use of a hand held hose or some piece of spraying equipment.

The force or pressure used to apply the water is not as critical as the amount of water. Satisfactory results are achieved with an amount of water that will create a full flowing action over the surface. This will require a minimum flow rate of eight gallons per minute (gpm) of water at not less than 25 psi or standard pressure. Maximum nozzle pressure shall not exceed 175 psi. Rinse as follows:

a. Direct water at an angle of 15-30 degrees from the surface. Ensure that sufficient water flow is achieved on all surfaces.

b. Begin rinsing on lower surfaces and work upward (see Figure 2-5). Then rinse from the top down starting with vertical stabilizer, then upper fuselage, upper wing surfaces, and horizontal stabilizers. Lower areas will be rinsed in the same order and manner as upper surfaces.

**2-11. POST CLEANING PROCEDURES.** Corrosion prevention depends on carrying out the prescribed preservation and lubrication procedures. Strict compliance with the following procedures is essential. Post-cleaning procedures shall be done in the following order.

a. Remove covers and masking from all static vents, pitot tubes, air ducts, heater ducts and openings.

b. Remove tape from all other openings sealed with masking tape.

### WARNING

Do not use synthetic wiping cloths with flammable solvents. Synthetic cloths can generate static electricity which can result in sparks and fire. Cotton wiping cloths, such as terry cloth, flannel, or cheesecloth, are acceptable.



Naphtha, Aliphatic  
TT-N-95

11



Solvent, Degreasing  
MIL-PRF-680

13

c. Remove all tape adhesive residues with aliphatic naphtha (TT-N-95) or degreasing solvent (MIL-PRF-680 Type II).

d. Clean all drain holes by inserting a probe, such as a pipe cleaner.

e. Ensure that all areas accumulating water have been drained. Whenever this is a recurring problem, procedures shall be developed and implemented to remove entrapped water and prevent accumulation.



Figure 2-7. Aircraft at a Taxi-Through Rinse Facility

### **CAUTION**

Lubrication must be accomplished as soon as possible to prevent/minimize the occurrence of corrosion.

f. Upon completion of all cleaning operations, lubricate in accordance with applicable maintenance manuals to displace any entrapped water or cleaning materials. Water which is not displaced can cause corrosion and failure of lubricated parts.

g. Apply operational preservatives (Chapter 8) when necessary. Cleaning compounds tend to remove preservatives, making previously protected surfaces vulnerable to corrosion.

### **2-12. TREATMENT AND DISPOSAL OF WASH RACK WASTE.**

#### **NOTE**

Cleaning solutions which remove greases and surface contamination from aircraft and components may exceed discharge concentration limits on oil and grease (especially where oil/water separators are not installed or not operating properly), naphthalene (from cleaners containing aromatic hydrocarbons), chromium, cadmium, nickel or other heavy metals (from cleaning operations involving engines or plated parts). If the wash rack is a source of hazardous waste, consult the base safety or environmental office to determine corrective action.

a. Precautionary measures shall be taken to prevent wash rack waste from contaminating lakes, streams, or other natural environments. Some of the chemicals used for cleaning require treatment or other special control prior to disposal.

b. The disposal of materials shall be accomplished in accordance with applicable directives and in a manner that will not result in the violation of local, state, or Federal pollution criteria.

c. To minimize the problems associated with disposal and the actual cleaning process, all work shall be accomplished on an approved wash rack. The only exception to this requirement shall be for those facilities which are temporarily established to support combat operations or special missions.

d. Aircraft wash rack cleaning waste shall receive the equivalent of secondary sewage treatment. When MIL-PRF-85704 Type I solvent emulsion cleaning solution is used, waste shall be released so that the total effluent entering the waste treatment plant does not contain more than the amount limited by local environmental regulations or 100 parts per million (ppm) of cleaning compound.

**2-13. LUBRICANTS.** Lubrication performs a dual purpose. It not only prevents wear between moving parts, but also fills air spaces, displaces water, and provides a barrier against corrosive media. The lubrication requirements contained in maintenance manuals and maintenance cards are usually adequate to prevent corrosion of most lubricated surfaces under normal operating conditions at shore bases. However, these required intervals shall be shortened when operating aboard ship, especially under foul weather conditions. Aircraft lubrication shall be accomplished by personnel qualified in lubrication procedures. In the event that the specified lubricant is not available, request substitutions through the chain of command.

#### **NOTE**

Comply with relubrication time frame requirements outlined in the system specific manual or maintenance cards.

### **2-13.1. CONVENTIONAL LUBRICANTS (GREASES).**

#### **CAUTION**

Not all lubricating materials are compatible. Some are known to promote corrosion or cause paint or acrylic plastics to deteriorate. The use of the correct lubricating material is critical. Use only lubricants specified by appropriate manuals or maintenance cards.

2-13.1.1. Conventional Lubricants shall not be used in the following circumstances:

a. Do not use greases or oils with solid film lubricants.

b. Do not lubricate Teflon bearings and bushings. Clean Teflon bearings and bushings with degreasing solvent MIL-PRF-680 Type II.

c. Lubricants containing graphite, either alone or in mixture with any other lubricants, shall not be used, since graphite is cathodic to most metals and will cause galvanic corrosion in the presence of electrolytes.

**CAUTION**

The use of the correct lubricating material is critical. Use only lubricants specified by the applicable manual or maintenance card.

2-13.1.2. Table 2-5 contains the title, specification, intended use, and temperature range of the most frequently used conventional lubricating materials.

2-13.2. **APPLICATION OF CONVENTIONAL LUBRICANTS**. The proper method of application is important. Apply lubricant as specified in the appropriate maintenance manual. Lubricants can be applied by one of the following methods:

- a. Grease guns: lever or pressure type;
- b. Oil, squirt, and aerosol spray cans; or
- c. Hand or brush.

2-13.2.1. When lubricating hinges and pinned joints, apply MIL-PRF-81309 Type II or MIL-PRF-63460 before applying lubricant.

2-13.2.2. Always apply generous quantities of lubricant, and actuate the joint several times to make sure that the lubricant penetrates all crevices thoroughly.

**CAUTION**

Excess lubricant can attract dust, dirt, and other foreign material during aircraft service.

2-13.2.3. Wipe away any excess lubricant.

2-13.2.4. **Grease Gun Application**.

2-13.2.4.1. When applying lubricants through pressure type fittings with a grease gun, clean grease fitting with degreasing solvent (MIL-PRF-680) and a clean cloth before applying lubricant.

2-13.2.4.2. Be certain the grease gun is properly attached to the fitting prior to applying pressure.

2-13.2.4.3. Make sure the lubricant has emerged around the bushing. If no grease appears, check the fitting and grease gun for proper operation.

2-13.2.4.4. When applying grease to a flush type (high pressure) fitting, make sure that the grease gun is fitted with a flush type adapter and held perpendicular to the surface of the fitting before applying pressure. If the fitting does not accept lubrication, replace the fitting and lubricate.

2-13.2.4.5. Wipe excess grease from fitting with a clean, dry cloth.

2-13.3. **SOLID FILM LUBRICANTS**. These lubricants prevent galvanic coupling on close tolerance fittings and reduce fretting. Solid film lubricants are used where conventional lubricants are difficult to apply or retain, or where other lubricants may be contaminated with dust, wear products or moisture. Typical applications of solid film lubricants are sliding motion components such as flap tracks, hinges, turnbuckles and cargo latches. Solid film lubricants shall not be used in the following circumstances:

- a. Do not use solid film lubricants in areas subject to rotational speeds above 100 rpm under heavy loads.
- b. Do not use solid film lubricants on roller bearing elements.
- c. Do not use solid film lubricants in conjunction with oils or greases.
- d. Do not use where there is a potential contact with liquid oxygen.

2-13.3.1. Surface cleanliness and preparation is extremely important to the service wear life of solid film lubricants. They may be applied over bare metal surfaces, or over surfaces that have been pre-coated with other films, such as anodized aluminum and phosphated steel. They have also been successfully applied over organic coatings such as epoxy primers.

2-13.3.2. **SAE AS 5272 (Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting)**. This lubricant is a heat cured, corrosion-inhibiting solid film lubricant with extended wear life. AS 5272 Type I and Type II replaces MIL-L-46010 Type I and Type II. It can be used on aluminum, copper, steel, stainless steel, and titanium. AS 5272 Type II must be cured at 400°F (204°C) for one hour. If metallurgical damage is done at this temperature, AS 5272 Type I, which cures at 300°F (149°C) for one hour, must be used. Due to the temperature requirements, this lubricant is not suitable for all applications. AS 5272 is recommended for use under the following conditions:



Table 2-5. Common Military Greases and Their Uses

Specification and Nomenclature	Intended Use	Recommended Temperature Range
<b>AMS-G-4343</b> Grease, Pneumatic System (NATO Code G-392)	Lubrication between rubber and metal parts of pneumatic systems; pressurized cabin bulkhead grommets and other mechanisms requiring rubber to metal lubrication.	-65° F to 200° F (-54° C to 93° C)
<b>AMS-G-6032</b> Grease, Plug Valve, Gasoline and Oil Resistant (NATO Code G-363)	Tapered plug valves; gasket lubricant or seal; general plug valve and fitting use where gasoline, oil, alcohol, or water resistance is required.	-32° F to 200° F (0° C to 93° C)
<b>MIL-G-21164</b> Grease, Molybdenum Disulfide, for Low and High Temperatures (NATO Code G-353)	Heavily loaded steel sliding surfaces, accessory splines, or antifriction bearings carrying high loads and operating in wide temperature ranges where grease will prevent or delay seizure in the event of inadequate lubrication.	-100° F to 250° F (-73° C to 121° C)
<b>MIL-PRF-23827</b> Grease, Aircraft and Instrument, Gear and Actuator Screw (NATO Code G-354)	Sliding and rolling surfaces of such equipment as instruments, cameras, electronic gear and aircraft control systems that are subject to extreme marine and low temperature conditions; ball, roller and needle bearings; gears; low torque equipment; general use on aircraft gears and actuator screws.	-100° F to 250° F (-73° C to 121° C)
<b>MIL-G-25013</b> Grease, Aircraft, Ball and Roller Bearing (NATO Code G-372)	Lubrication of ball and roller bearings that operate at extreme high or low temperatures under low torque conditions, especially in applications where soap-type greases and oils cannot be used.	-100° F to 450° F (-73° C to 232° C)
<b>MIL-G-25537</b> Grease, Aircraft, Helicopter, Oscillating Bearing (NATO Code G-366)	Lubrication of aircraft bearings having oscillating motion of small amplitude.	-65° F to 160° F (-54° C to 71° C)
<b>MIL-PRF-27617 Type III</b> Grease, Aircraft Fuel and Oil Resistant (NATO Code G-399)	Lubrication of taper plug valves, gaskets, and bearings in fuel systems; lubrication of valves, threads, and bearings in liquid oxygen systems. Do not use on aluminum or magnesium dynamic bearings due to possible ignition hazard.	-30° F to 400° F (-34° C to 204° C)
<b>MIL-PRF-32014</b> Grease, Aircraft and Instrument	Multipurpose, water resistant, high speed grease for lubrication of aircraft wheel bearings, internal brake assemblies, antifriction bearings, gearboxes, plain bearings, engine and instrument bearings. May be used as a replacement for MIL-PRF-81322 grease with engineering approval. Not for use in torque sensitive applications (increased resistance in lower temperature range).	-65° F to 350° F (-54° C to 177° C)
<b>MIL-PRF-81322</b> Grease, Aircraft, General Purpose, Wide Temperature Range (NATO Code G-395)	Lubrication of aircraft wheel bearings and internal brake wheel assemblies, antifriction bearings, gearboxes, and plain bearings.	-65° F to 350° F (-54° C to 177° C)

- a. Sliding motion applications, such as plain spherical bearings, flap tracks, hinges, threads, and cam surfaces;
- b. Where conventional lubricants are difficult to apply or retain, or where other lubricants may be easily contaminated by dirt or dust;
- c. Where a solvent resistant lubricant is required.
- d. If mechanisms are operated at infrequent intervals or are lubricated for life.
- e. When long term corrosion protection is required under static conditions (2 years outdoor storage or 5 years indoor storage).

2-13.3.3. MIL-PRF-46010 (Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting, Low VOC Content). This lubricant is a heat cured, corrosion-inhibiting solid film lubricant with extended wear life. MIL-PRF-46010 replaces MIL-L-46010 Type III. Limitations and uses are the same as described for AS 5272 Type I above. In addition, engineering authorization to substitute MIL-PRF-46010 for AS 5272 is required prior to use.

2-13.3.4. MIL-L-23398 (Lubricant, Solid Film, Air Cured, Corrosion Inhibiting). This lubricant is an air-cured, corrosion-inhibiting solid film lubricant which may also be used to repair surfaces originally coated with AS 5272/ MIL-PRF-46010. It can be used on aluminum, steel and titanium. It provides moderate wear life and corrosion protection in areas where it is not feasible to use a solid film lubricant that requires curing at elevated temperatures.

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## CHAPTER 2 CLEANING

### SECTION II. SPECIAL CLEANING

**2-14. INTRODUCTION.** This section describes the special cleaning procedures required if an aircraft has been exposed to volcanic ash (paragraph 2-15) or sand/desert environments (paragraph 2-16).

**2-15. CLEANING AFTER EXPOSURE TO VOLCANIC ASH.** The primary concern in removing volcanic ash is the extreme abrasiveness of the ash. It is not a significantly corrosive material. Aircraft that have been exposed to volcanic ash shall be cleaned using the following procedures after exposure and before the next aircraft operation or flight:

a. All static ports, fuel vents, engine inlets, and air conditioning inlets should be vacuumed to remove as much ash as possible and then suitably covered to preclude additional ash entry. Special emphasis should be placed on ducting supplying cooling air to avionics equipment.

b. After covering all openings where ash may enter, the exterior of the airframe or equipment shall have ash removed initially using vacuum, low-pressure air, or by lightly dusting with clean rags. Avoid rubbing since this may damage surfaces due to the abrasiveness of the ash.



Compound, Aircraft Cleaning  
MIL-PRF-85570

2

c. Wash entire aircraft or equipment using one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts water and rinse thoroughly with low-pressure water. Ensure that critical parts, such as flap screws, tracks, and exposed hydraulic actuators are adequately cleaned. Caution should be taken when washing to avoid rubbing since ash is even more abrasive when combined with water as slurry.

d. Wiper blades should be checked to ensure that all contaminants are removed prior to operation.

e. If ash penetration is evident in the cockpit, cargo, or any other accessible interior areas, it should be thoroughly vacuumed.

f. Check lower aircraft structures for volcanic ash and water entrapment.

g. Clear all drains and air dry structures as much as possible.

h. Uncover all openings that were covered during paragraphs a. and b.

i. After washing, the aircraft shall be lubricated in accordance with applicable maintenance instruction manuals (MIMs).

### **2-16. CLEANING AFTER DESERT OPERATIONS OR EXPOSURE TO SAND ENVIRONMENTS.**

Environmental conditions in desert operations introduce salt-laden sand and other corrosive substances to the interior of the aircraft. These substances, if allowed to remain, can accelerate the corrosion process and lead to premature corrosion damage. Aircraft that have been exposed to sand/desert environments shall be inspected and cleaned no later than 60 days after leaving the desert environment, or as necessary during deployment.

#### 2-16.1. VISUAL INSPECTION.

a. Open all access doors and remove all non-permanently installed panels and fairings. Visually inspect structural surfaces such as skins, frames, ribs, bulkheads, longerons, fittings, and stringers, for sand intrusion. Borescopes may be used to inspect interior surfaces not accessible to visual inspection.

b. Inspection should also include the following general areas and/or components: acrylic plastic parts, arresting gear and wheel wells, avionics components, battery compartments, bearings, bilge areas, brakes, canopy exterior, cockpit ducting, control cables, doors, ejection seats, elastomeric seals, electrical connectors, engines, equipment compartments, exterior surfaces, flap screws, hinges, hydraulic actuators, landing gear exposed piston surfaces, linkages, optical glass, oxygen lines, radomes, tracks, wire bundles, and wheels.

c. Inspect all drain holes and verify that they are open and free of obstruction.

2-16.2. GENERAL CLEANING PROCEDURES.

a. Vacuum clean all loose sand and contaminants from all accessible areas inspected in accordance with paragraph 2-16.1.

b. Ensure sand is vacuumed from avionics bays, storage bays, and other enclosed compartments, such as battery compartments and battery vent openings. Pay particular attention to air inlets.

c. Use a soft bristle brush and air pressure (not to exceed 10 psi) to dislodge sand between close-fitting components. Repeat vacuum cleaning.

d. Hand wipe residual sand/dust film adhering to surfaces with isopropyl alcohol (TT-I-735), degreasing solvent (MIL-PRF-680 Type II), non-aqueous cleaner (MIL-PRF-32295 Type I), or cleaning compound (MIL-DTL-16791 or MIL-PRF-85570 Type II) on a clean cloth. If cleaning compound is used, dilute according to instructions for light soil, use sparingly and ensure that all areas are thoroughly dried.

e. Dry with wiping cloths or blow dry with air pressure less than 10 psi.

f. Wash aircraft exterior in accordance with paragraph 2-9. Remove all standing water and allow aircraft to dry thoroughly.

g. After washing, the aircraft shall be lubricated in accordance with applicable maintenance instruction manuals (MIMs).

h. Inspect for any remaining sand and re-clean until all sand is removed.

2-16.3. TREATMENT OF SPECIFIC AREAS.



Detergent, Non-Ionic 9  
 MIL-D-16791

a. Acrylic Plastic Parts (except Canopies). Wipe with cloth wet with cleaning solution (MIL-DTL-16791 1 oz cleaner per 1 gallon water) and follow with a flannel cloth wet with water. Dry with a clean cloth (A-A-50129).



Compound, Aircraft Cleaning 2  
 MIL-PRF-85570

b. Arresting Gear and Wheel Wells. Clean using MIL-PRF-85570 Type II RTU or mix one part aircraft cleaning compound, MIL-PRF-85570 Type II, to 4 parts water. Rinse thoroughly with fresh water.

c. Battery Compartments. Neutralize acid in accordance with paragraph 6-2, using sodium bicarbonate for lead acid batteries and sodium phosphate for nickel-cadmium batteries. Rinse with fresh water and dry with wiping cloths.



Solvent, Degreasing 13  
 MIL-PRF-680

d. Bearings. Clean sand from exposed bearings with degreasing solvent (MIL-PRF-680 Type II). Inspect bearings for sand damage. Contact cognizant bearing engineer for specific disposition if necessary.

e. Canopy Exterior. Flush with water to remove loose sand/dust. Clean using plastic polish (P-P-560) and flannel cloth (A-A-50129).



Solvent, Degreasing 13  
 MIL-PRF-680



Cleaner, Non-Aqueous, 15  
 Low VOC, HAP Free,  
 MIL-PRF-32295



Compound, Corrosion Preventive 6  
 MIL-PRF-16173

f. Control Cables. Clean using degreasing solvent (MIL-PRF-680 Type II) or non-aqueous cleaner (MIL-PRF-32295 Type I) and a clean wiping cloth. Preserve with CPC (MIL-PRF-16173 Grade 4) or as specified by the applicable maintenance instruction manuals.

g. Ejection Seats. Refer to specific Ejection Seat Manual.



Detergent, Non-Ionic  
MIL-D-16791

9

h. Elastomeric Seals. Wipe with cheesecloth (CCC-C-440) wet with detergent (MIL-DTL-16791 1 oz cleaner in 1 gallon water.) Rinse with cheesecloth wet with water. Dry with clean cheesecloth.



Alcohol, Isopropyl  
TT-I-735

1



Compound, Corrosion Preventive  
Water-Displacing  
MIL-PRF-81309

4

i. Electrical Connectors and Avionics Components. If contamination is suspected, use an acid brush (A-A-289) to apply isopropyl alcohol (TT-I-735) liberally to the internal and external sections of the connectors, both male and female. Mate and unmate connector several times to clean. Rinse again with isopropyl alcohol and allow to dry. Preserve with CPC (MIL-PRF-81309 Type III) or as specified by the applicable maintenance instruction manuals.



Cleaning Compound  
Turbine Engine Gas Path  
MIL-PRF-85704

3

j. Engines. Wash engine with cleaning compound (MIL-PRF-85704) in accordance with the applicable maintenance instruction manuals.



Fluid, Hydraulic  
MIL-PRF-83282

10

k. Landing Gear. Clean all sand from exposed reciprocating portions of landing gear shock struts by wiping with a clean, soft cloth (A-A-59323 Type II) moistened with hydraulic fluid (MIL-PRF-83282). Use care not to scratch exposed piston shafts or damage seals.

l. Optical Glass. Spray cleaner (A-A-59199) onto a clean flannel cloth (A-A-50129) and wipe lens surface. Wipe dry.

m. Oxygen Lines. Refer to specific maintenance instruction manual.

2-16.4. CORROSION INSPECTION. Perform corrosion inspections as specified by the applicable maintenance instruction manuals.

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## CHAPTER 3 INSPECTION AND CORROSION PRONE AREAS

### SECTION I. INSPECTION AND EVALUATION

#### 3-1. GENERAL.

#### CAUTION

3-1.1. PURPOSE. Frequent corrosion inspections are essential to the overall corrosion control program. The costs resulting from corrosion can be minimized by early detection, identification, and treatment. Without regular systematic inspections, corrosion will seriously damage aviation equipment. This chapter describes procedures for basic visual inspection for corrosion and illustrates some of the signs of corrosion damage.

3-1.2. RESPONSIBILITY. Corrosion detection is everyone's responsibility. Since corrosion can occur almost anywhere on aviation equipment, all maintenance personnel must be able to identify and report corrosion problems. Personnel performing any scheduled inspections shall be qualified in corrosion detection and shall have attended appropriate corrosion prevention and control courses as established by the parent service organization.

3-1.3. FREQUENCY OF INSPECTIONS. The minimum frequency and extent of these inspections are established by the aircraft programs of the parent service organization. However, during scheduled or unscheduled maintenance actions on aviation equipment or components, the area involved as well as those within 3 feet or 36 inches (18 inches on each side) of the repair or treatment area shall be visually inspected for corrosion. Additional inspections may be necessary in areas which are particularly prone to corrode, such as magnesium gear boxes, wheel and flap wells, and bilge areas. Areas which are corrosion prone are discussed in Section II of this chapter.

3-1.4. GENERAL INSPECTIONS. A general inspection of aviation equipment or components is performed as follows:

a. Clean the area thoroughly (as described in Chapter 2) or, for water sensitive areas, wipe the area with a clean cloth dampened with an approved solvent.

Prior to removing any access covers or panels primed with TT-P-2760 flexible primer, score the sealant at the edges of the cover/panel with a sharp plastic tool to prevent fraying the paint finish when the panel is removed.

b. If corrosion is suspected, examine the area with a 10X magnifying glass and flashlight. Examine edges of skin panels, rivet heads, and corrosion prone areas. If there are blisters, bubbles, or other coating irregularities present, attempt to dislodge the paint by scraping with a sharp plastic tool. If paint does not easily dislodge and corrosion is not suspected, the irregularity is probably confined to the paint film itself and no further action should be taken. When corrosion is suspected but no irregularities are present, apply a strip of ASTM D6123 Type II flatback masking tape over the clean, dry area. Hand rub the tape for several strokes in order to assure good adhesion, and remove the tape with an abrupt lifting motion. Where paint is removed, inspect and determine the degree of corrosion (see paragraph 3-4).

c. Remove corrosion (Chapter 4), clean and treat the surface (Chapter 5), and paint (Appendix A).

3-1.5. DETAILED INSPECTIONS. A detailed inspection of aviation equipment or components shall be performed as a result of damage found during general inspections if extensive or severe corrosion is suspected, and as specified in appropriate aircraft maintenance manuals. Parts shall be carefully inspected for signs of corrosion using the tools and procedures listed in Table 3-1. See Section II of this chapter for information on common corrosion prone areas.

Table 3-1. Inspection Equipment and Techniques

Equipment	Corrosion Type Detected or Evaluated (See Type Below)
Borescope	1, 2, 3, 4, 5, 10
Depth Gage	1, 4, 5
Optical Depth Micrometer	1, 2, 4, 5, 6, 7, 9
Fluorescent Penetrant	3, 4, 5, 7, 8
Eddy Current	1, 3, 4, 5, 7, 8
Ultrasonic	1, 3, 4, 7, 8
Radiography (can detect thickness loss of 2% or more)	1, 5
Type of Corrosion	
1 Uniform surface corrosion	
2 Galvanic or dissimilar metal corrosion	
3 Intergranular attack (general)	
4 Intergranular attack (exfoliation)	
5 Pitting	
6 Fretting corrosion	
7 Stress corrosion cracking	
8 Corrosion fatigue	
9 Filiform corrosion	
10 Hot corrosion	

**3-2. INSPECTION METHODS.**

3-2.1. VISUAL INSPECTION. Visual inspection is the most widely used method for the detection and evaluation of corrosion. It is very effective for detecting surface, exfoliation, pitting, and intergranular corrosion if done carefully and with knowledge of where and what to look for. Read Volume I, Chapter 3 (Corrosion Theory) before performing a corrosion inspection, paying particular attention to Table 3-1 of Volume I (Corrosion of Metals - Type of Attack and Appearance of Corrosion Products).

3-2.1.1. The following tools can be used to find and evaluate the extent of corrosion damage:

- a. Flashlight.
- b. 10X Magnifying Glass.
- c. Plastic Scraper.

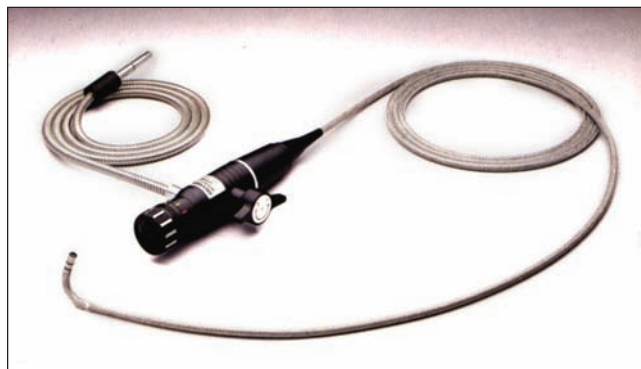


Figure 3-1. Fiber Optic Borescope

- d. Borescope.
- e. Depth Gage, Pin Micrometer Type.
- f. Optical Depth Micrometer.

3-2.1.2. Evidence of Corrosion. Aluminum corrosion products will be white, gray, or black and may appear as a paste when wet, or a hard, adherent film or easily crumbled deposits (i.e., powder) when dry. Magnesium corrosion products are white and form in large amounts with significant losses to the base metal. Steel corrosion products are red, brown, or black rust deposits which are easily detected. Copper corrosion products are blue or blue-green and are also easily detected. Titanium and stainless steels do not produce significant amounts of corrosion products but can exhibit stress corrosion cracking. When corrosion occurs beneath a paint system, the surface of the paint often appears blistered or distorted.

3-2.2. VISUAL INSPECTION WITH BORESCOPE. A borescope is an instrument with a small, high intensity light that can be used in the inspection of interior surfaces (e.g. tubing, ducts, and pipes) which are not accessible by any other method (see Figure 3-1). Examples of the different kinds of borescopes include flexible, rigid, micro, video, and fiberscopes. Insert the head assembly into any cavity having a large enough opening. With the cavity illuminated, visually inspect its interior for defects, such as damage to the paint system and corrosion.

3-2.3. DEPTH GAGE. Depth gages are tools for measuring the depth of corrosion pits and reworked areas to determine the extent of corrosion present and the amount of metal removed during rework.



**NOTE**

On thin sheet material, waviness in the material may result in false depth readings. Several readings may be necessary, or it may be necessary to improvise another method for determining the depth of the corrosion damage. The depth gage is not suitable for determining the depth of a corrosion crack due to the relatively large size of the indicator pin.

3-2.3.1. Use of Depth Gage. Several depth readings shall be taken in the affected area. Select the deepest reading as the depth of the corrosion damage. Where there are several damaged areas in the same skin panel or component part, plot or sketch a diagram of the depth and location of each damaged area. This diagram will be used for further evaluations, along with the applicable aircraft manuals, or when engineering assistance is required. The diagram should be forwarded to the engineer when requesting engineering assistance. The base of the depth gage shall be flat against the undamaged surface on each side of the corrosion damaged area. When taking measurements on concave or convex surfaces, place the base perpendicular to the surface (see Figure 3-2).

3-2.3.2. If the pits or depth of rework are within allowable tolerances, as given in the specific aircraft manuals or as described in paragraph 4-8.3, the pits can be acceptably cleaned, and the reworked area will require the re-application of a protective coating system. If the pits or depth of rework are not within allowable tolerances, the part must be replaced or repaired, if allowed, or a request for engineering assistance must be made.

**NOTE**

Wearing eyeglasses makes it difficult to place the eye at the ideal distance from the eyepiece and the view is distorted by external glare and reflections. Rubber eyeshields on optical instruments (e.g. borescope, optical micrometer) are designed to shut out external light, but are not as effective when glasses are worn. For these reasons, it is desirable that the inspector be able to adjust the instrument without wearing glasses to compensate for variations in visual acuity.

3-2.4. OPTICAL DEPTH MICROMETER. This inspection tool measures the depth of scratches, cracks, and pits and the height on spurs and other protrusions

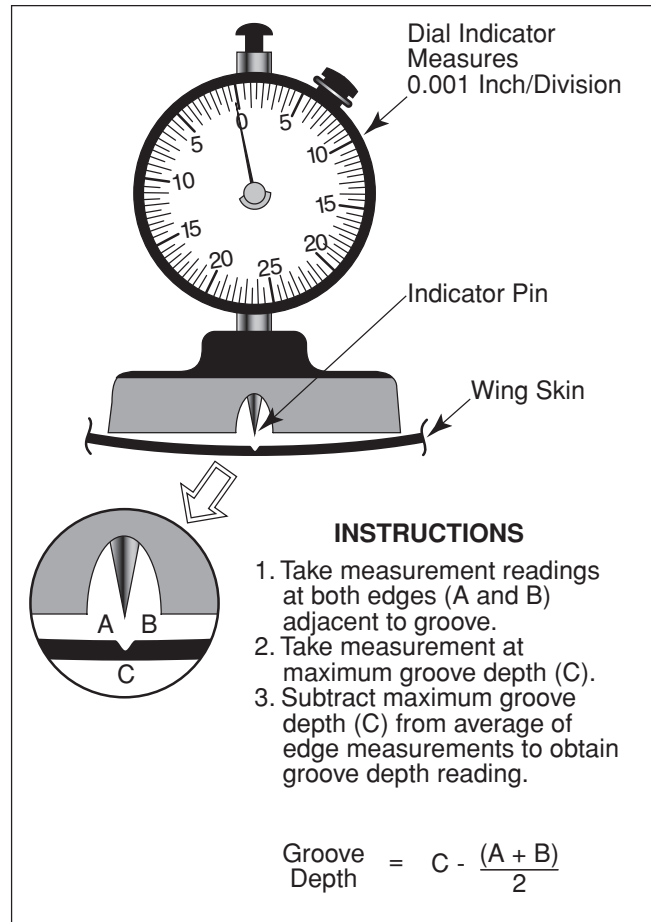


Figure 3-2. Measuring Corrosion with a Depth Gage

(see Figure 3-3). The micrometer is first focused on the highest surface in the area of interest and a reading is taken. A second reading is taken when the lowest surface is in focus. The difference between the readings is the distance between the two surfaces. Optical micrometers are available with 100 and 200 power magnification, reticle eyepieces, and accessory lighting. The procedures outlined below are to be used for determining the depth of corrosion pits and/or areas reworked due to corrosion damage on any surface.

- a. Select the appropriate base to be used for the surface (e.g., flat, curved, round, or inside/outside angle surfaces) on which the measurement is to be made.
- b. Position the micrometer solidly over surface A (undamaged surface close to surface B) with the lens directly over the area to be read. When the micrometer is set over the surface, a pinpoint of light will cover the area to be measured.

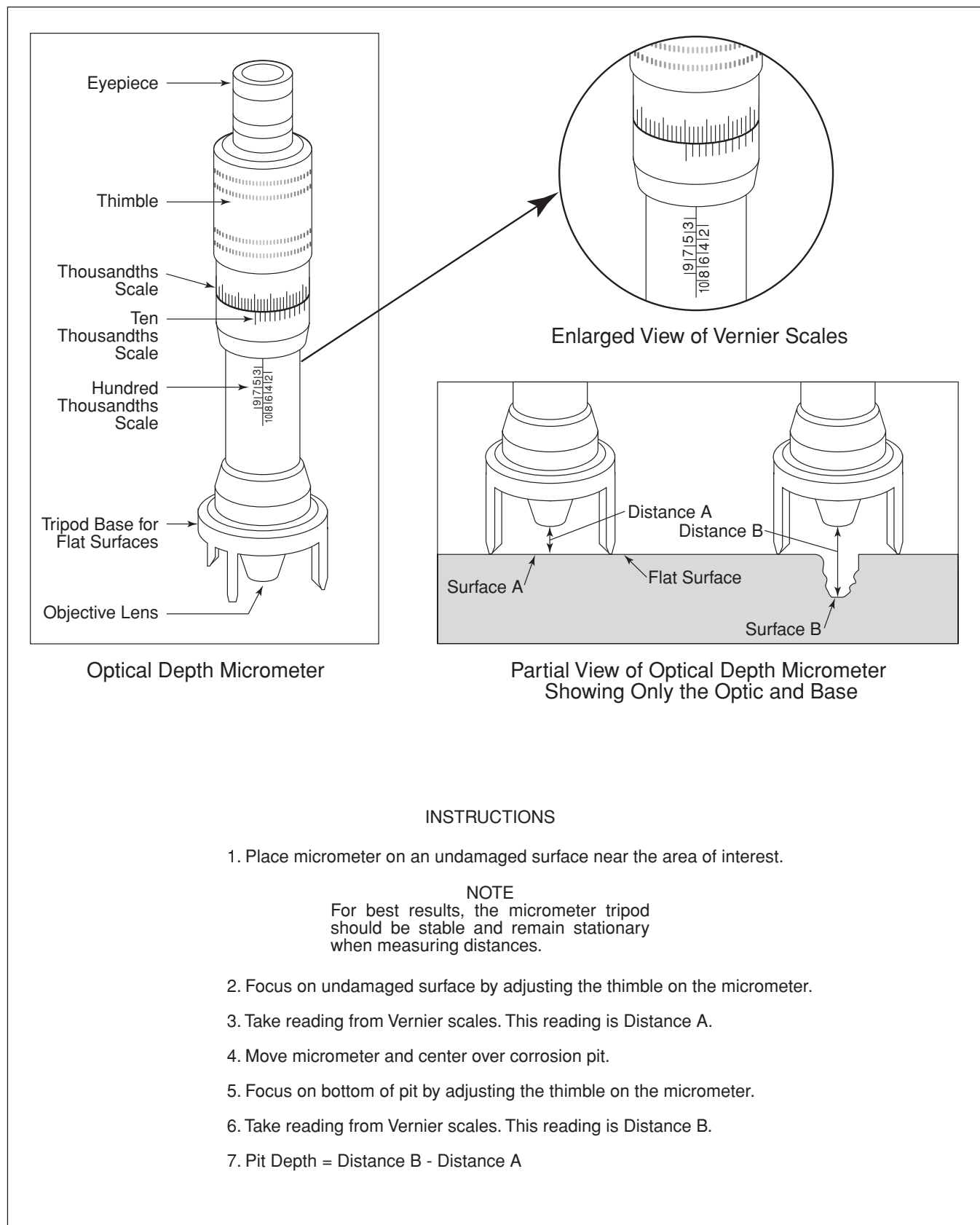


Figure 3-3. Optical Depth Micrometer



c. Look through the eyepiece of the micrometer and rotate the micrometer thimble clockwise or counterclockwise until surface A comes into sharp focus. Extreme care should be taken when focusing on the surface to be measured in order to reduce inaccuracy in the measured values.

d. Obtain the reading for surface A located on the vernier scale. Since a vernier scale is not one that can be easily read, an experienced, trained technician should read the scale or supervise/check the readings of less experienced personnel.

e. Position the micrometer over surface B (corrosion pit or area reworked due to corrosion damage) to be measured. When measuring the depth of corrosion pits or reworked areas, ensure that the surface being measured has a large enough area to be focused in order to obtain an accurate reading.

f. Repeat procedures c. and d. on surface B.

g. Take the distance readings from surface A and surface B and subtract the surface A reading from the surface B reading to obtain the depth of the corrosion damaged surface. Calculate the pit depth using the following equation:

$$\text{Pit Depth} = \text{Distance B} - \text{Distance A}$$

h. Take several readings from the corrosion damaged surface and select the deepest reading as the pit depth.

### **CAUTION**

The apparent simplicity of the penetrant inspection is deceptive. Very slight variations in performing the inspection process can invalidate the inspection by failing to indicate serious flaws. It is essential that personnel performing penetrant inspection be trained and experienced in the penetrant process.

### **NOTE**

The following inspection methods are to be accomplished only by NDI qualified and certified personnel (see COMNAVAIRFORINST 4790.2 and AIA/NAS 410). Refer to NAVAIR 01-1A-16, TM 1-1500-335-23, or specific NDI manual for more detailed inspection procedures.

**3-2.5. FLUORESCENT PENETRANT INSPECTION (FPI)**. In fluorescent penetrant inspections, the component is cleaned and then treated with a fluorescent penetrating liquid which is capable of entering surface cracks or flaws. After removing the penetrant from the surface, a developer (water-soluble, dry powder, or non-aqueous) is applied to absorb penetrant trapped in cracks. Under ultraviolet light, the absorbed penetrant is visible directly above the cracks from which it was drawn.

3-2.5.1. The penetrant inspection method is used to detect stress corrosion cracking and special cases of intergranular corrosion. Intergranular corrosion attacks the metallic grain boundaries and forms a network of very fine cracks. In the early stages, the crack indications are visible only under 10X or greater magnification. Penetrant indications of intergranular corrosion appear as a residual background and are resolved only under magnification. Developer is not used when evaluating a penetrant indication using a magnifying glass.

3-2.5.2. In addition, penetrant inspection is often used to monitor the surface for adequacy of corrosion removal by grinding. Caution must be exercised because mechanical removal methods cause smearing which may obscure indications of remaining corrosion attack. In monitoring corrosion grind-out areas, a developer is not used: following removal of excess surface penetrant, the area is examined using a low power magnifying glass (10X). The examination should be repeated after a minimum five minute dwell. When corrosion is no longer detected, the inspection process shall be repeated using non-aqueous developer.

**3-2.5.3. Limitations of Fluorescent Penetrant Inspection**.

3-2.5.3.1. **Flaw Location**. Penetrant inspection is applicable to all solid, nonporous materials provided that the flaw is open to the surface of the part. To detect subsurface flaws, another inspection method must be used.

3-2.5.3.2. **Restricted Flaw Openings**. The penetrant inspection process depends upon the ability of the penetrant to enter and exit the flaw opening. Any factor that interferes with the entry or exit reduces the effectiveness of the inspection. Organic surface coatings, such as paint, oil, grease, and resin are examples. Any coating that covers or bridges the flaw opening will prevent penetrant entry. Even when the coating does

not cover the opening, the material at the edge of the opening affects the mechanism of penetrant entry and exit and greatly reduces the reliability of the inspection. Coatings at the edge of the flaw may also retain penetrant, causing background fluorescence. An inspection method other than penetrant must be used if the organic coating cannot be stripped or removed from the surface to be inspected.

### **WARNING**

Chemical etching shall only be performed by personnel trained and certified in the proper handling and application of the materials due to their hazardous nature.

3-2.5.3.3. **Smear Metal.** Mechanical operations, such as shot peening, machine honing, abrasive blasting, buffing, wire brushing, grinding, or sanding, will smear or peen the surface of metals. This mechanical working closes or reduces the surface opening of any existing discontinuities. Mechanical working (smearing or blending) also occurs during service use when parts contact or rub against each other. Penetrant inspection will not reliably indicate discontinuities when it is performed after a mechanical operation or service use that smears or peens the surface. Chemical etching (e.g. Flicks on aluminum alloys and Shantz on Inconels) prior to penetrant operations is recommended to improve test sensitivity when smeared metal is present.

3-2.5.3.4. **Porous Surfaces.** Penetrant inspection is impractical on porous materials with interconnected subsurface porosity. The penetrant rapidly enters the pores and migrates through the network. This results in an overall fluorescence or color that masks any potential discontinuity indications. In addition, removal of the penetrant may not be possible after the inspection.

3-2.6. **EDDY CURRENT INSPECTION.** The eddy current inspection method may be used to detect or evaluate surface and subsurface corrosion. This method can detect and evaluate uniform surface pitting, intergranular, exfoliation (corrosion around fasteners), and stress corrosion. Detection of corrosion with eddy current techniques is used on aircraft skins where corrosion may occur on inaccessible interior surfaces. Corrosion usually occurs in areas where moisture is entrapped. If relatively uniform thinning is expected, corrosion detection may be simply a matter of thickness measurement. In most instances, corrosion is confined to smaller localized areas of relatively small diameter.

As skin thicknesses increase, sensitivity to small areas and shallow depths of corrosion is reduced. Corrosion on either member of a faying surface may be detected. Eddy current can also be used for corrosion removal inspections, but is less sensitive than liquid penetrant.

3-2.7. **ULTRASONIC INSPECTION.** Ultrasonic inspection provides good resolution to evaluate material loss and thickness. This method may be used to detect exfoliation, intergranular, uniform surface, and stress corrosion. Ultrasonic thickness gaging is included in this method. Ultrasonic inspection for far side pitting and internal exfoliation corrosion may be accomplished using shear ("S") wave and longitudinal ("L") wave techniques. The use of a delay line transducer is recommended for "L" wave inspection. The delay will improve resolution of both near and far surface corrosion. Technique development is required for specific applications.

3-2.8. **RADIOGRAPHIC INSPECTION.** Radiographic inspection provides the best resolution for detection of surface and subsurface corrosion flaws when no other method can accomplish the inspection. The drawback of radiography is the high equipment cost and the high man-hour requirements to perform an on-aircraft radiographic analysis. Radiographic inspection is used in combination with ultrasonics to determine the condition of aluminum honeycomb.

**3-3. EVALUATION OF CORROSION DAMAGE.** Visually determine if corrosion is in an area which has previously been reworked. If the corrosion damage is located in an area that has been previously ground out, measure the damage to include the material which has previously been removed. A straight edge and a 10X magnifying glass may be used to assist in determining if an area has previously been reworked. Place the straight edge across the area being examined at various angles and check for irregularities, low spots, or depressions (see Figure 3-4). If any irregularities, low spots, or depressions are found, and a visual determination cannot verify previous rework, closely examine the suspected area and the surrounding area using a 10X magnifier. After determining that the area has been previously reworked, evaluate the depth of the previous rework (i.e., grind-out) to determine if further metal removal will exceed grind-out limits specified in the applicable aircraft manuals or as specified in paragraph 4-8.3. Depth measurements can be made using the depth gage as described in paragraph 3-2.3.

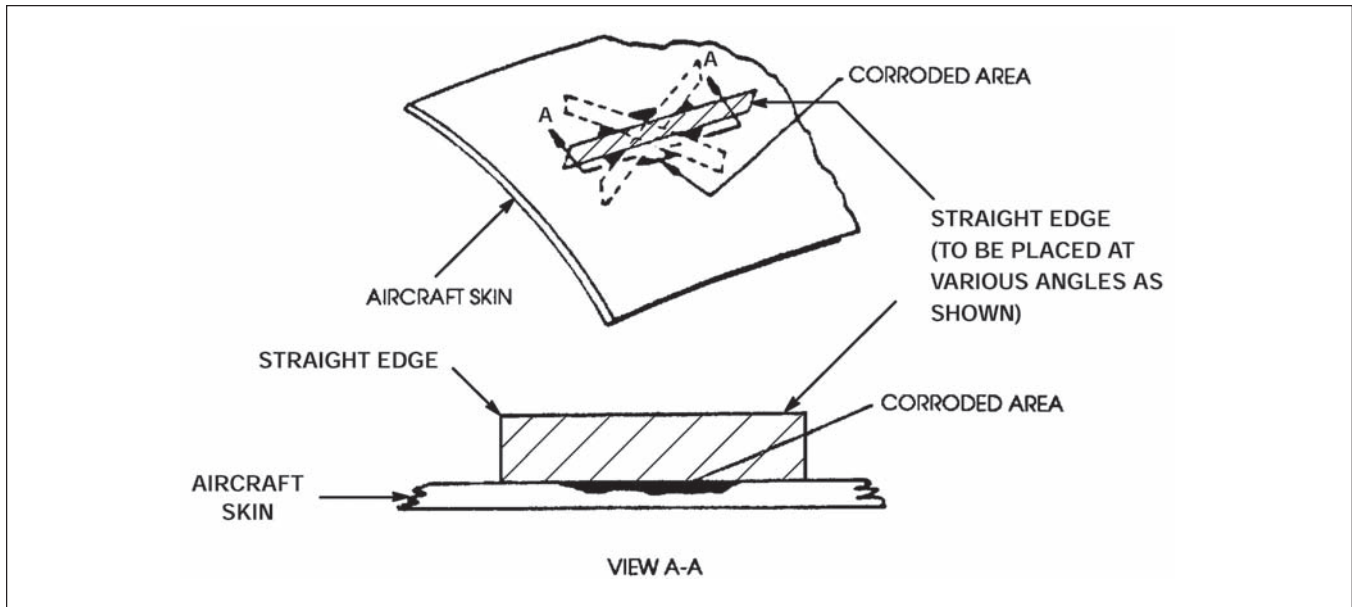


Figure 3-4. Usage of Straight Edge to Determine if Suspect Areas Have Been Previously Reworked

**3-4. DEGREES OF CORROSION.** Corrosion must be evaluated after the initial inspection and cleaning to determine the nature and extent of repair or rework needed. It is difficult to draw a distinct and specific dividing line among the degrees of corrosion. Consequently, the first requirement for a reliable evaluation is sound maintenance judgment. Use the following categories in reporting degrees of corrosion.

3-4.1. **LIGHT CORROSION.** At this degree, the protective coating is scarred or etched and the condition of the metal is characterized by discoloration and pitting to a depth of approximately one mil (0.001 inch) maximum. This type of damage can normally be removed by light hand sanding.

3-4.2. **MODERATE CORROSION.** This appears similar to light corrosion, with the addition of blistering or evidence of scaling and flaking of the coating or paint system. The pitting depths may be as deep as 10 mils (0.010 inch). This type of damage is normally removed by extensive hand sanding or light mechanical sanding.

3-4.3. **SEVERE CORROSION.** Its general appearance is similar to moderate corrosion, with the addition of severe intergranular corrosion, blistering, exfoliation, scaling, or flaking. The pitting depths are deeper than 10 mils (0.010 inch). This damage must be removed by extensive mechanical sanding or grinding.

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## CHAPTER 3 INSPECTION AND CORROSION PRONE AREAS

### SECTION II. CORROSION PRONE AREAS

#### 3-5. COMMON CORROSION PRONE AREAS.

There are certain corrosion prone areas common to all aircraft. Corrosion prone areas should be cleaned, inspected, and treated more frequently than less corrosion prone areas. The following paragraphs describe the areas and contain illustrations to aid in inspections. However, the list is not complete and should be expanded by referencing the maintenance manuals and maintenance cards for each specific aircraft, which will show other possible trouble spots.

**3-5.1. BATTERY COMPARTMENTS AND BATTERY VENT OPENINGS.** In spite of protective paint systems, corrosion preventive compounds, and venting provisions, battery compartments are severe corrosion problem areas (see Figure 3-5). Fumes from overheated battery electrolyte will spread to adjacent internal cavities causing rapid corrosion of unprotected surfaces. If the battery installation has an external vent opening to the aircraft skin, include this area in battery compartment inspection and maintenance procedures. Frequent cleaning and neutralization of deposits will minimize corrosion. Leakage of aircraft batteries with electrolytes of either sulfuric acid or potassium hydroxide will cause corrosion. Consult the aircraft maintenance manuals to determine which type of battery is used. Refer to



Figure 3-5. Battery Compartment

Chapter 6 and specific aircraft maintenance manuals for instructions on cleaning and neutralizing battery electrolytes.

**3-5.2. BILGE AREAS.** These areas are natural collection points (i.e., lower point/areas of aircraft) for water, dirt, loose fasteners, drill shavings, and other debris (see Figure 3-6). Keeping bilge areas free of debris and fluids, and application of recommended corrosion preventive compounds (CPCs) are the best protection against corrosion.

**3-5.3. CONTROL CABLES.** Control cables present a corrosion problem whether they are made of carbon steel or stainless steel. As shown in Figure 3-7, the presence of bare spots in the protective coating is one of the main contributing factors to the corrosion of cables. Dirt, dust, and grime that collect will lead to corrosion and cable failure.

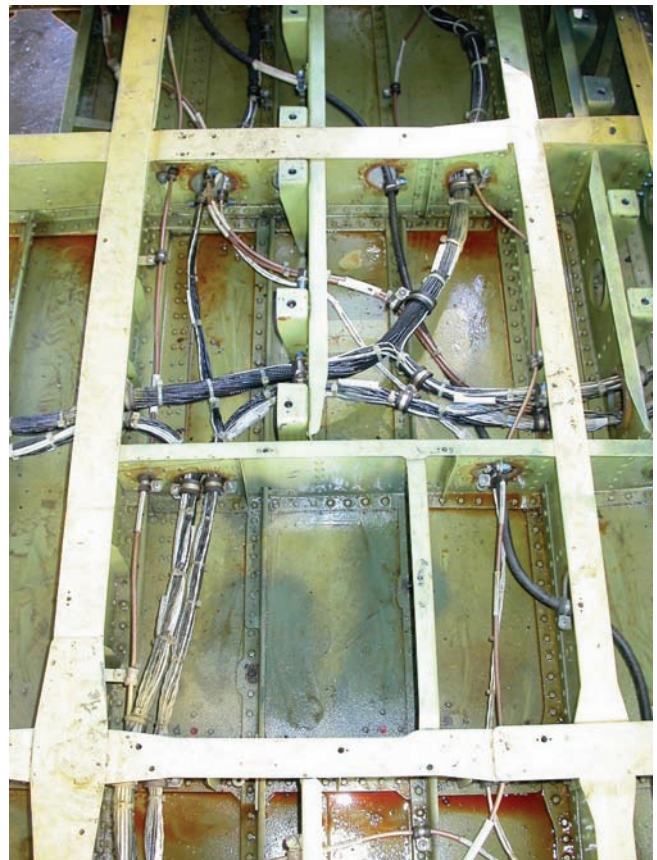


Figure 3-6. Helicopter Bilge Area



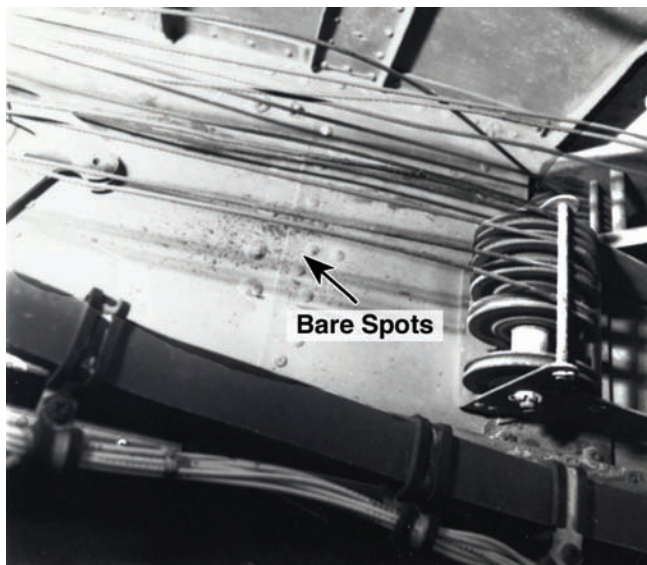


Figure 3-7. Control Cables



Figure 3-8. Jet Engine Frontal Area

3-5.4. ELECTRICAL CONNECTORS. Some electrical connectors are potted with a sealant compound to prevent the entrance of water into the areas of connectors where wires are attached to pins. Rubber O-rings are also used to seal moisture out of the mating area of pin connections. Moisture will get into electrical plugs and cause failure. It is necessary that such plugs be disconnected periodically for inspection and corrosion treatment. The use of unauthorized sealants or potting materials can cause severe damage to affected connectors or components. Refer to Volume III for authorized avionic materials and procedures.

3-5.5. ENGINE FRONTAL AREAS AND AIR INLET DUCTS. Since these areas are constantly abraded by dirt, dust, and gravel, and eroded by rain, special attention shall be given to:

- a. Engine frontal areas (see Figure 3-8).
- b. Leading edges of engine and air inlet ducts, including hardware inside ducts (see Figures 3-9 and 3-10).
- c. Due to heat dissipation requirements, oil cooler cores are not usually painted. Engine accessory mounting bases may have small, unpainted areas on the machined mounting surfaces. With moist, salt-laden air flowing over these surfaces, they are vulnerable to corrosion.

3-5.6. EXHAUST IMPINGEMENT AREAS. Exhaust impingement areas include areas exposed to engine, rocket, and missile exhausts, gun blast, or any other

surface that is exposed to exhaust gases of installed equipment. Exhaust gases cover the surface finish with deposits (e.g. corrosive ash and residual solids) and damage the finish. Surfaces located in the path of rocket and gun blasts, including gun compartment systems and spent ammunition collection chutes, are particularly susceptible to deterioration and corrosion (see Figure 3-11). In addition to the corrosive effect of the gases and exhaust deposits, the protective finish is often blistered by heat, blasted away by high velocity gases, or abraded by spent shell casings or solid particles from gun and rocket exhausts (see Figure 3-12). These areas require more attention during inspection cycles.

3-5.7. FASTENERS. There are thousands of fasteners on aircraft exterior surfaces, and areas around these fasteners are trouble spots (see Figure 3-13). These areas are subject to high operational loads, moisture intrusion, and susceptibility of the skin material to corrosion (see Figure 3-14). High operational loads cause the paint around the fasteners to crack, which provides a path for moisture intrusion. All paints will crack to some degree around fasteners.

3-5.8. FAYING SURFACES AND CREVICES. Similar to corrosion around fasteners, corrosion in faying surfaces, seams, and joints is caused by the intrusion of salt water and other corrosive agents. Entry of fluids by capillary action causes corrosive liquids to flow into the tightest of joints. The effect of corrosion resulting from fluid intrusion is usually detectable by bulging of the skin surface.

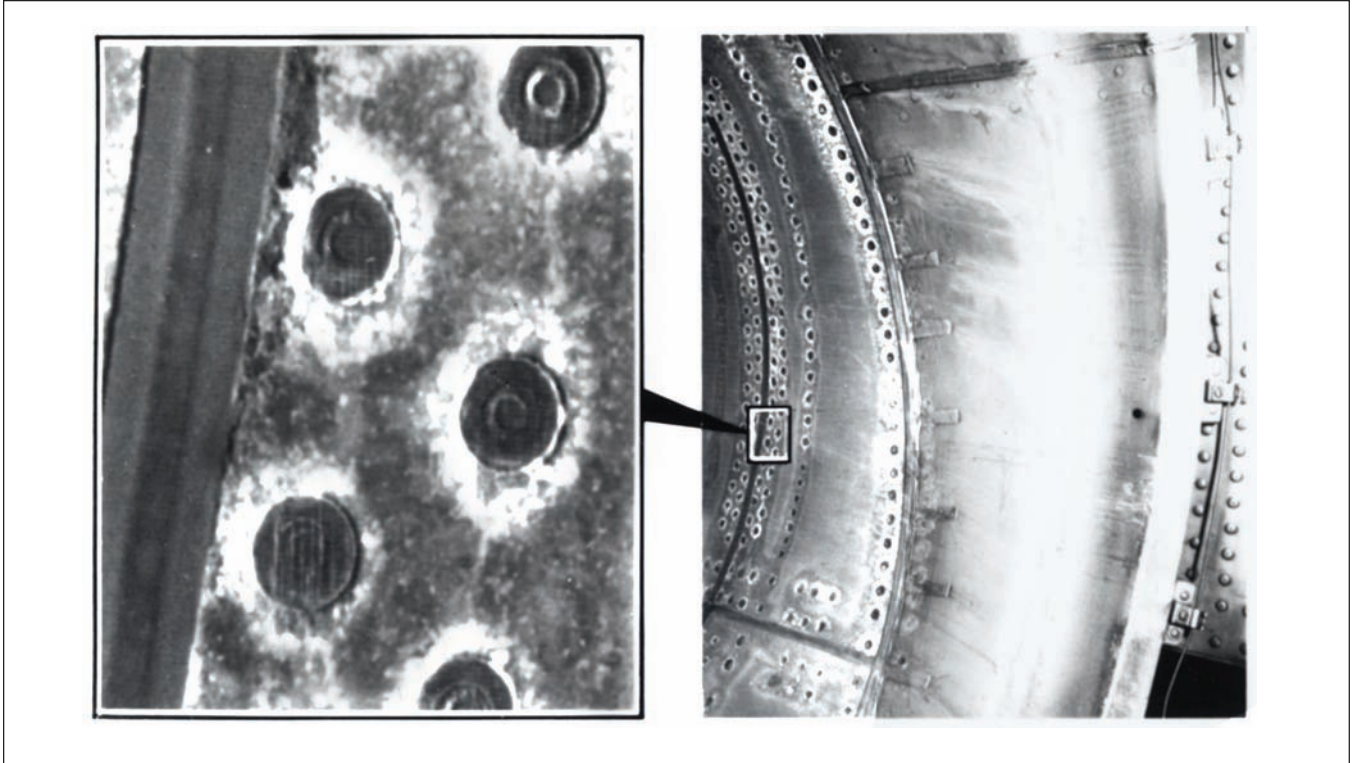


Figure 3-9. Corrosion in Air Intake Duct



Figure 3-10. Corrosion Prone Points of Air and Engine Inlet

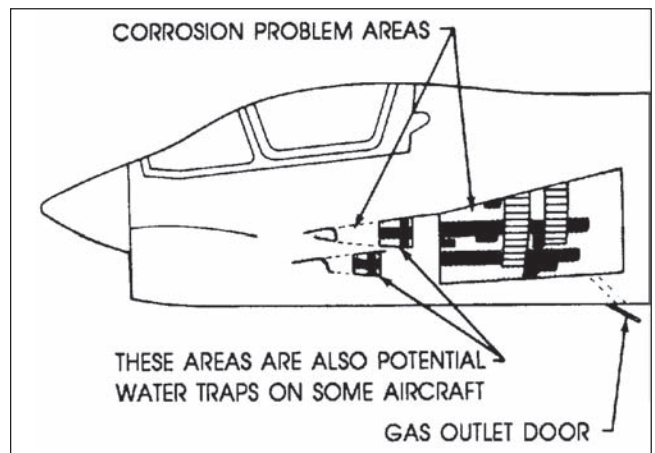


Figure 3-11. Gun Blast Area

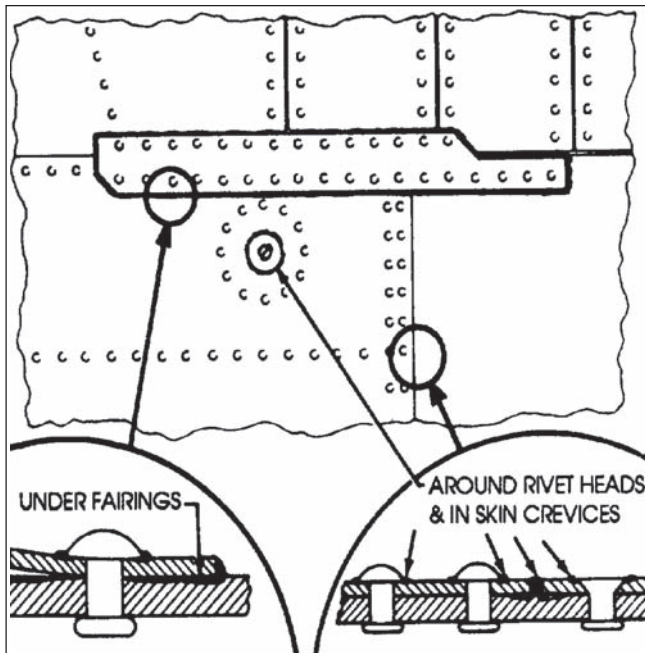


Figure 3-12. Exhaust Trail Area

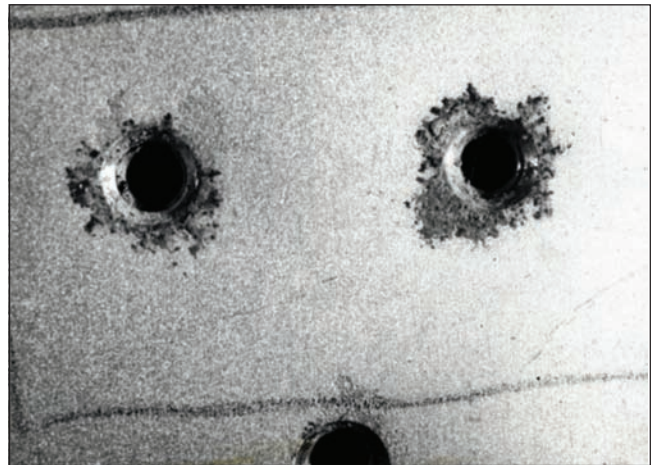


Figure 3-13. Corrosion Around Fasteners

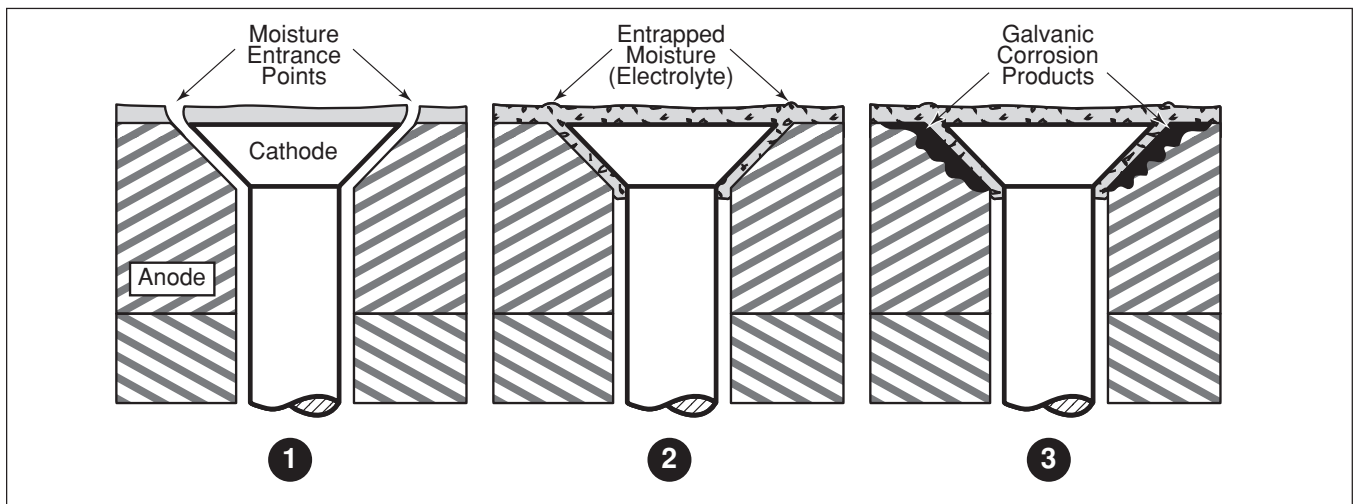


Figure 3-14. Galvanic Corrosion of Aluminum Alloy Sheet Adjacent to Steel Fasteners



3-5.9. FLAP AND SLAT RECESSES. Flap and slat recesses (see Figure 3-15) and equipment installed in these areas, which are normally closed, may corrode unnoticed unless special inspections are performed.

3-5.10. HINGES. Hinges (see Figures 3-16 and 3-17) are highly susceptible to corrosion because of dissimilar metal contact that results from wear and damage of protective metallic coatings. They are natural traps for dirt, salt, and moisture. Piano hinges, which are extensively used on aircraft, are especially vulnerable to attack.

3-5.11. MAGNESIUM PARTS. Magnesium parts are extremely corrosion prone. Special attention must be given to proper treatment of their surfaces, insulation, and paint coatings. Magnesium is commonly used for transmission and gearbox housings, and throughout avionic systems (antennas and frames).

3-5.12. RELIEF TUBE AREAS. Human waste products are very corrosive (see Figure 3-18). These areas should be cleaned frequently and the paint finish kept in good condition. The relief tubes are usually made of plastic and should not present a corrosion problem.

3-5.13. SPOT WELDED ASSEMBLIES. Spot-welded assemblies are particularly corrosion prone. As shown in Figure 3-19, corrosion is the result of the entrapment of corrosive agents between the parts of the assemblies. Corrosive attack causes skin buckling or spot weld bulging (see Figure 3-20) and eventual spot weld fracture. Skin and spot weld bulging in their early stages may be detected by sighting or feeling along spot-welded seams. The only way to prevent this condition is by keeping the potential moisture entry points, including gaps, seams, and holes created by broken spot-welds, filled with a sealant or suitable corrosion preventive compound (CPC).

#### NOTE

Organizational and Intermediate levels shall not drill drain holes unless authorized by the Aircraft Controlling Custodians (ACC) or System Program Manager (SPM) of the parent service organization.

3-5.14. WATER ENTRAPMENT AREAS. Figure 3-21 shows common water entrapment areas. Design specifications require that aircraft have drains installed in all areas where water may collect. However, in many cases, these drains are ineffective either because of improper location or because they are plugged by



Figure 3-15. Flaps Lowered to Expose Recess Areas

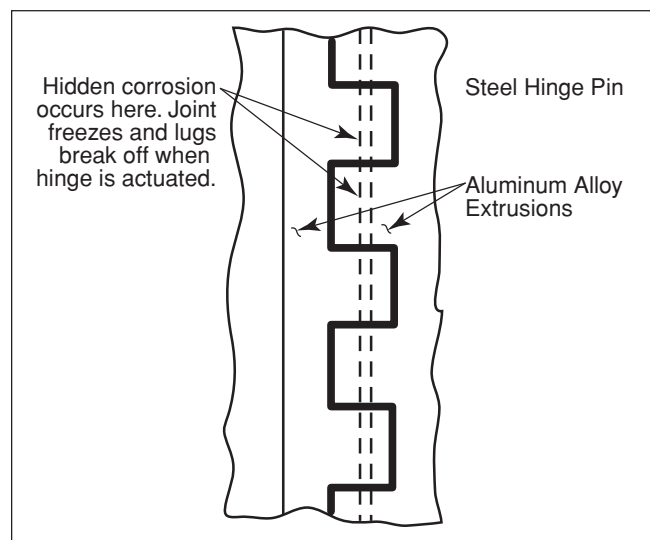


Figure 3-16. Hinge Corrosion Points

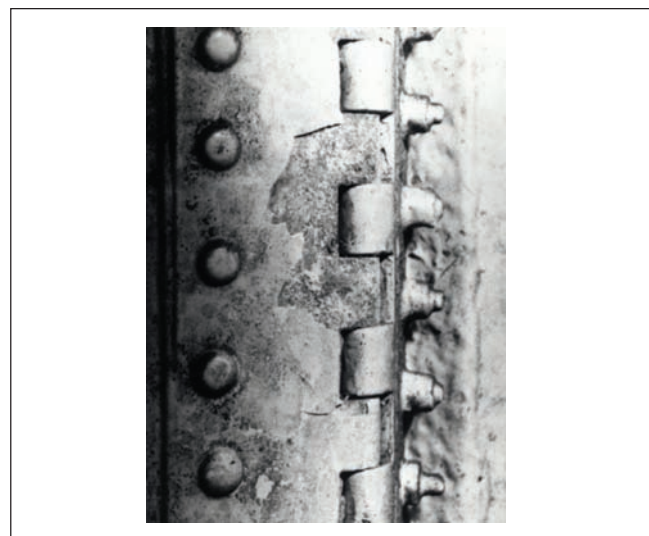


Figure 3-17. Piano Hinge Lugs

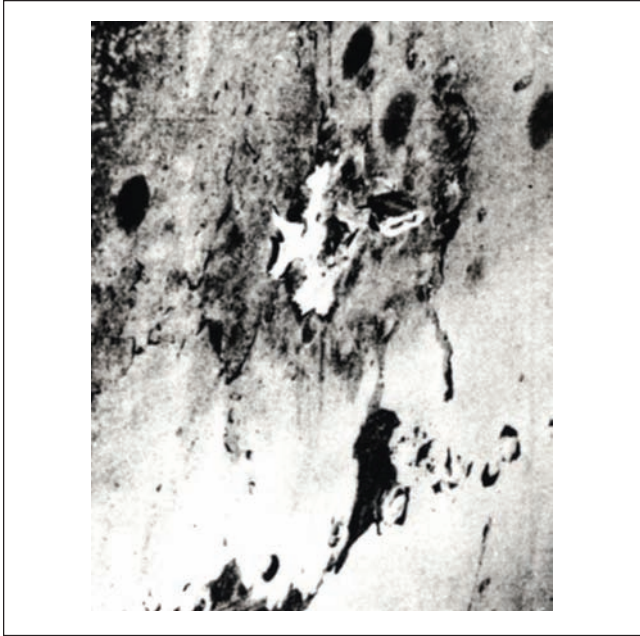


Figure 3-18. Typical Corrosion Around a Relief Tube Vent

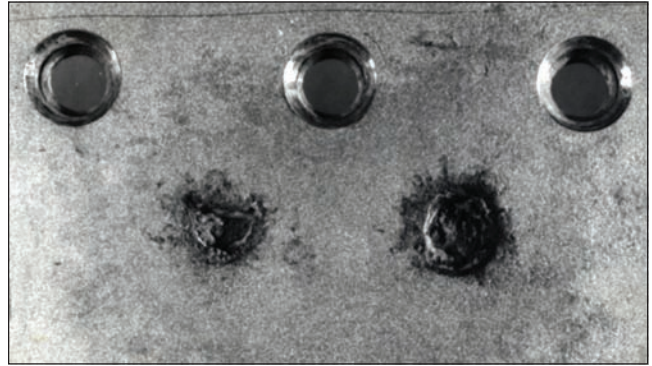


Figure 3-20. Spot Weld Corrosion

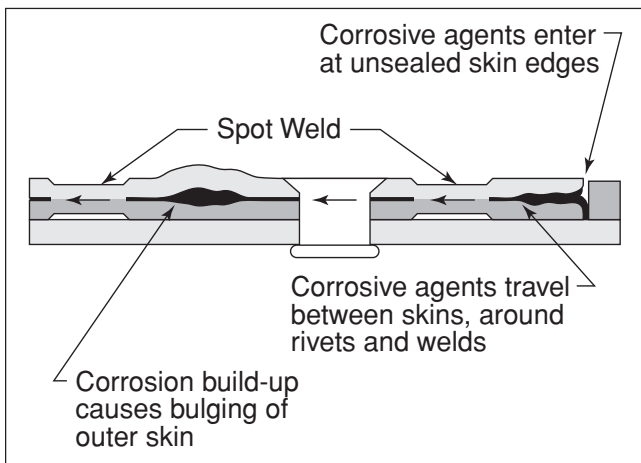


Figure 3-19. Spot Welded Skin Corrosion Mechanism

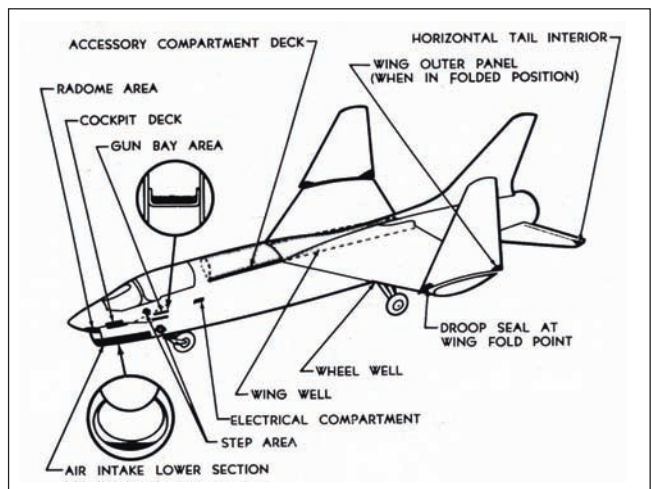


Figure 3-21. Common Water Entrapment Areas

sealants, fasteners, dirt, grease, and debris. Plugging a single drain hole or altering the attitude of the aircraft can cause a serious structural defect if salt water or other corrosives remain for any appreciable length of time in one of these entrapment areas. Daily inspection and cleaning of low point drains is a standard requirement. These areas may accumulate water following washing or rinsing of aircraft. Where this is a recurring problem, procedures shall be developed to prevent water accumulation.

**3-5.15. WHEEL WELL AREAS.** Wheel well areas probably receive more abuse than any other area on the aircraft (see Figure 3-22). They are exposed to mud, salt, gravel, and other flying debris from runways during taxiing, takeoff, and landing, and they are exposed to

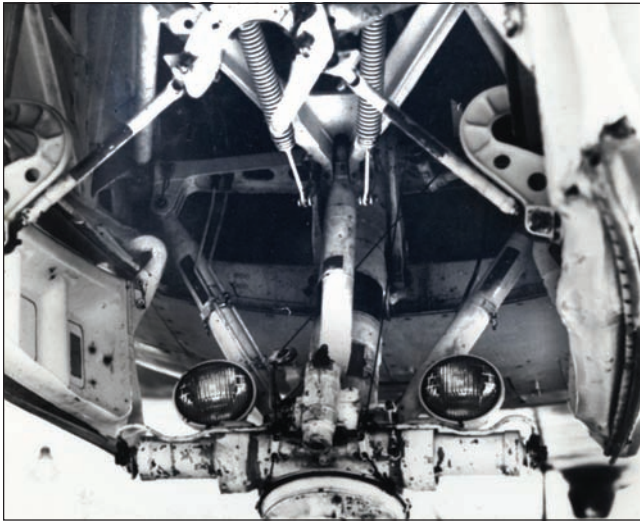


Figure 3-22. P-3 Nose Landing Gear Wheel Well

salt water and spray when aircraft are parked aboard ship. Because of the many complicated shapes, assemblies, and fittings in the area, complete coverage with protective coatings is difficult to maintain.

**3-5.16. WING-FOLD JOINTS AND LEADING EDGES OF WINGS AND CONTROL SURFACES.**

a. Because wing and fin-fold areas are vulnerable to corrosive attack when the wings are folded, they require special attention (see Figure 3-23).

b. Both leading edges of wings and control surfaces are constantly exposed to salt laden air, thus special attention should be given to these areas which are vulnerable to corrosion.

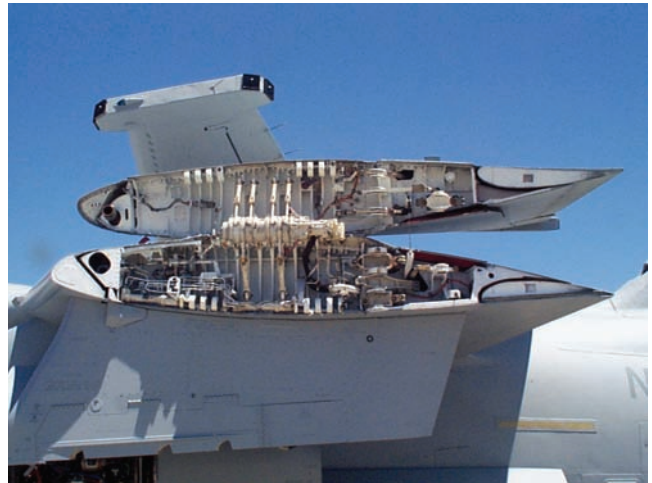


Figure 3-23. Wing Fold Joint

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## CHAPTER 4 CORROSION REMOVAL

**4-1. PURPOSE.** This chapter covers instructions for corrosion and paint removal. When corrosion is detected, a specific and immediate program for corrective action is required. Each type of corrosion has its own peculiarities and will require special treatment. Complete treatment involves thorough inspection of all corroded and adjacent areas and evaluation of the corrosion damage (Chapter 3), paint and corrosion removal (this chapter), application of chemical surface treatments (Chapter 5), sealing (Chapter 7), and application of paint finishes: Appendix A (Navy) or TM 55-1500-345-23 (Army). For additional procedures specific to Army maintenance, see Appendix B.

**4-2. RESPONSIBILITY.** Personnel assigned to corrective maintenance tasks must be specially trained in the use of chemical paint remover, abrasive materials, powered tools, and damage limits. Inadequate training will lead to further damage of equipment and poses a safety hazard to the individual.

### 4-3. CORRECTIVE MAINTENANCE.

4-3.1. Corrective maintenance depends on: (1) the type of surface involved (metallic or composite); (2) the area of damage (small corrosion spot or large heavily corroded area); and (3) the degree of corrosion, as determined in Chapter 3.

4-3.2. Corrosion shall always be removed by the mildest effective technique. Since composite materials do not corrode, corrosion removal techniques are not applicable and shall not be used.

### 4-4. PAINT REMOVAL.

#### 4-4.1. COMPOSITE SURFACES.

##### **CAUTION**

Propellers and helicopter blades have critical balance requirements. Refer to the appropriate propeller or blade manual for evaluation and repair limits of corrosion, erosion, and abrasion damage.

4-4.1.1. Paint Removal. Paint shall be removed from composite materials, such as fiberglass, carbon/epoxy,

graphite, and Kevlar using only mechanical paint removal equipment and techniques, unless specific exceptions are provided in the appropriate maintenance manuals. Due to the irregularities in composite surfaces, removal of the complete paint system (e.g. topcoat and primer) can damage fibers in the surface layers. Therefore, paint removal by scuff sanding shall not go beyond the primer coat unless repair is required.

4-4.1.2. Repair. Paint removed from composite surfaces for the purposes of performing repairs shall be performed by hand sanding or by using an orbital sander in accordance with NAVAIR 01-1A-21. The use of other types of powered sanders is prohibited due to the high potential for causing laminate damage. Paint system removal (to include removal of the majority of the primer) is required to prevent the compromising of the adhesive bond. Use extreme care during topcoat and primer removal to prevent sanding into the laminate. If the surface is to be subsequently prepared for structural adhesive bonding, prepare surface in accordance with NAVAIR 01-1A-21.

4-4.2. METAL SURFACES. For areas of several square inches, paint may be removed mechanically using abrasive mats or flap wheels and brushes, taking care not to remove underlying metal. Chemical paint removal, as specified in paragraph 4-6, may be used for areas larger than several square inches. Plastic media blasting, as specified in paragraph 4-5.4, may be used at Intermediate and Depot level maintenance activities to remove paint.

**4-5. MECHANICAL PAINT REMOVAL.** Paint removal is authorized when corrosion is suspected/verified prior to magnetic particle or fluorescent penetrant inspection, or to replace damaged paint systems. For paint removal from small areas (less than several square inches), use of medium grade abrasive mats is authorized. Use caution to remove as little metal as possible to properly finish the repair work. Abrasive wheels and brushes not specified in this manual shall not be used for removing paint.

### WARNING

Primers and paints may contain toxic materials such as chromates and lead. Use eye protection, gloves, and cartridge respirator during mechanical paint removing operations. Contact the local safety and health office for proper personal protection equipment (PPE).

4-5.1. ABRASIVE MATS, FLAP WHEELS AND BRUSHES. See paragraph 4-9 for a complete description of authorized materials, equipment, and procedures.

4-5.1.1. Composite Surfaces. Use medium grade (Grade C) abrasive mat (A-A-58054) for scuff sanding. The abrasive mat may be wet with fresh water or diluted cleaning compound (MIL-PRF-85570) to prevent clogging. See paragraph 4-4.1.1 for removal limits.

4-5.1.2. Metal Surfaces. Use a fine (Grade B) or very fine (Grade A) abrasive mat on an orbital sander, or fine or very fine flap brushes on a pneumatic drill, for scuff sanding.

4-5.1.3. Cadmium Plated Steel Surfaces. Sanding to smooth or remove paint from cadmium plated high strength steel components shall be done with great care to avoid penetrating the cadmium, which can be extremely thin. If unprotected, high strength steel aircraft parts can experience detrimental levels of corrosion within just a few hours. Hand sand with 240 grit or finer abrasive paper or cloth until the primer coat is reached, then switch to 400 grit or finer paper or cloth.

### CAUTION

Radial bristle discs are authorized for use only on aluminum, magnesium, high-strength steel, and titanium surfaces as a replacement/substitute for abrasive wheels and brushes cited in this chapter. Use of the discs on other metallic or composite surfaces is not authorized and may result in damage to the surface or structure.

4-5.2. 3M™ RADIAL BRISTLE DISC. The 3M™ radial bristle disc has been proven to be effective and less aggressive than abrasive wheels and brushes and is intended for spot paint removal. The 400 grit (orange) disc may be used for spot paint removal and will leave IVD aluminum or cadmium plating mostly intact on high-strength steel surfaces. Refer to paragraph 4-9.2.1 for operating instructions.

4-5.3. PORTABLE VACUUM SANDING SYSTEMS.

Air quality regulations mandate containment of airborne particulates from sanding and grinding operations on metallic and composite surfaces. Vacuum sanding systems are suction-type equipment used for collecting paint, metal, and carbon/epoxy dust from grinding and sanding operations. If appropriate filters (e.g. activated carbon) are used, then vapor, mist, gases, fumes, and odors can also be captured. Because the systems are portable, they allow for work to be done on location rather than in a booth. These compact, self-contained units are equipped with sanders, abrasives, adjustment tools, air supply and vacuum hoses, vacuum hose connectors, supply air hose fittings and a high efficiency filter vacuum system for dustless sanding.

### CAUTION

Abrasive blasting using glass beads or aluminum oxide shall not be used for removing paint. Glass bead and aluminum oxide blasting may be damaging to the underlying metal.

4-5.4. PLASTIC MEDIA BLASTING (PMB). PMB is an abrasive blasting method used to remove paint coatings on metal surfaces. PMB is a quick and environmentally preferred alternative to most types of chemical paint removers, but it can cause damage to underlying metal and injury to personnel if not performed by trained operators using approved methods. PMB of Army aircraft components and parts shall be performed using the requirements and controls in Appendix B, Section VII.

4-5.4.1. PMB Training. Prior to using any PMB equipment, operators shall receive specialized on-the-job training conducted by qualified operators. Operators with limited training or who are newly trained shall only perform PMB processes under the direct supervision of properly trained personnel.

a. Training shall include familiarization with the specific equipment manufacturer's operating and maintenance manuals, and the guidelines and parameters as outlined in this chapter.

b. Training shall also include lectures and demonstrations on equipment operation and maintenance, masking and blasting techniques, process parameters, damage recognition, media contamination prevention and removal, and safety requirements.

c. Training shall be documented in accordance with local requirements.

4-5.4.2. PMB Restrictions. The following restrictions apply to PMB operations:

a. PMB of aircraft component surfaces is authorized for use ONLY at Intermediate and Depot level maintenance activities.

b. PMB is NOT authorized for use at Organizational level maintenance activities.

c. PMB in a walk-in booth (open blasting) is not authorized at Intermediate level maintenance activities. At the Intermediate level, only the PMB of aircraft component surfaces in a blast cabinet (glove box) designed for plastic media is authorized.

d. PMB of aircraft component surfaces at Intermediate maintenance level activities is restricted to metallic surfaces 0.032 inch thick or greater.

e. Nonmetal surfaces, such as composites or fiberglass, and metal bonded structures are not authorized for PMB at the Intermediate level.

f. Corroded steel components shall not be processed in equipment used for aluminum and magnesium components without first removing all corrosion products (rust). Plastic media used to remove paint from rusted steel parts should be completely purged from blasting equipment, and the equipment should be thoroughly cleaned prior to blasting aluminum or magnesium parts. Best practice is to maintain and use separate equipment for steel components.

g. Plastic media used to remove non-slip, walkway coatings (such as A-A-59166), is considered contaminated and the media must be replaced prior to blasting aluminum or magnesium parts.

4-5.4.3. Fluorescent Penetrant Inspection Limitations. Because PMB canpeen or smear soft metals, it shall not be used to remove paint from aluminum or magnesium components requiring subsequent fluorescent penetrant inspection for cracks (see NAVAIR 01-1A-16) unless specifically directed by the engineering authority for that component. Distortion caused by PMB can limit crack detection. PMB is permitted prior to eddy current inspection. Chemical etching may be used to reopen cracks after PMB by removing distorted metal, however, this process shall be performed only in accordance with specific engineering authority, approval, and written detailed process and application instructions. Chemical etching also removes protective coatings such as anodize and chromate conversion coatings.

Instructions for reapplication of these protective coatings must also be provided by the engineering authority.

### WARNING

Hearing protection and air respirator shall be worn during plastic media blasting operations. Contact the local safety and health office for proper personal protection equipment (PPE).

4-5.4.4. Operator Safety. Operational safety compliance shall be in accordance with local regulations and the following:

a. PMB creates airborne particles which may be hazardous if inhaled or allowed to contact eyes or skin. Both eye protection (goggles) and respirator are required for all operating personnel. Do not allow unprotected personnel to come in contact with dust. Wash hands thoroughly before eating or smoking.

b. The PMB process is noisy; typically greater than 80 decibels. Hearing protection is mandatory.

c. All PMB equipment and components being blasted shall be properly grounded to dissipate static electricity.

4-5.4.5. PMB Equipment. The blast cabinet (glove box) shall be specifically designed for use with plastic media meeting the requirements of NA 17-600-191-6-2. The blast cabinet shall be the pressure pot design, capable of maintaining constant blast pressure and media flow using a 1/4 inch to 3/8 inch I.D. nozzle. The blast cabinet shall be equipped with an air pressure regulator and pressure gage to provide easy adjustment. The equipment shall allow for several successive cycles, and shall be equipped with a dust collection system to remove dust particles (recommend 60 mesh or finer). The dust collection system shall be accessible for removal of the collected dust to facilitate proper waste disposal. A magnetic particle separator shall be an integral part of the system to remove ferrous particles from recirculated media.

4-5.4.6. PMB Preparation.

4-5.4.6.1. Prior to PMB, all components to be blasted shall be thoroughly cleaned to remove dirt, oil, grease, and other soils. Refer to Chapter 2 for cleaning methods and materials. If not removed, these soils will contaminate the plastic media, causing possible damage to the surface(s) being blasted and leading to malfunction of the blasting equipment. Allow the surfaces to dry completely prior to blasting.



4-5.4.6.2. Surfaces or areas which are sensitive to contamination or impact damage from PMB shall be masked or covered to prevent damage. These surfaces include precision bearings and gears; grease fittings; fuel, oil, and hydraulic lines; tanks, pumps, passages, and actuators; nonmetal surfaces (i.e., glass, plastic, fiberglass); electrical wiring and connectors; and avionics components. Masking may be accomplished using one or more of the following materials:

**CAUTION**

Hydraulic, oil, pneumatic, and fuel system lines shall be protected from contamination as specified in NAVAIR 01-1A-20.

- a. Plastic, rubber, or metal plugs and caps, as specified in NAVAIR 01-1A-20.
- b. Aluminum or paper backed masking tapes, kraft paper, and plastic sheeting. These materials are not resistant to direct impact by PMB.
- c. Impact resistant tape (3M No. 500 or Intertape BT-100).
- d. Hot glue and hot glue gun to seal edges of impact resistant tape.

4-5.4.7. PMB Procedures.

4-5.4.7.1. Conduct pre-operational inspection of glove box in accordance with NAVAIR 17-600-191-6-1.

4-5.4.7.2. To prevent surface damage during blasting, the blast nozzle shall be kept moving at all times in a sweeping motion and shall not be allowed to dwell in one place. Do not continue blasting if any surface damage is suspected.

4-5.4.7.3. The following parameters shall be adhered to in the operation of PMB cabinets:

- a. Plastic bead media shall conform to MIL-P-85891 Type V (acrylic), size 20-30 mesh material.
- b. Blasting pressure shall be no higher than 50 psi output pressure, which corresponds to approximately 40 psi at the blast nozzle.
- c. Distance from nozzle tip to surface being blasted shall be greater than 10 inches. A distance of less than 10 inches may damage the surface and reduce the rate of coating removal.

- d. Nozzle angle shall be 80 degrees from horizontal.

**CAUTION**

Particulate residues from PMB operations can lead to catastrophic failure of aircraft systems.

4-5.4.8. Post-PMB Cleaning. All PMB residue must be removed following blasting operations to prevent damage.

**CAUTION**

Do not use compressed air to blow off parts outside of a glove box or with the glove box doors open.

- a. Inspect all openings to ensure no internal residues remain. Remove internal residue using a HEPA vacuum or oil-free compressed air. Reclean as necessary.

- b. Surface residue may impact downstream processing, such as painting operations. Clean surface residue using detergent washing methods and materials specified in Chapter 2. Reclean as necessary.

4-5.4.9. PMB Quality Control. Heavy particles, such as sand, steel or rust particles, and glass beads, shall be kept out of the plastic media. PMB with heavy particle contamination may decrease the overall fatigue life of fatigue critical materials. If contamination is suspected, an impact test may be performed to confirm contamination. The impact test is performed by blasting a bare (unclad) 2024 aluminum (AMS QQ-A-250/4) panel, approximately 3 inches x 5 inches x 0.040 inch, once over to simulate paint removal. Inspect the panel for evidence of nicks/pitting. If nicks/pitting are visually evident (without magnification), the media is considered contaminated and must be replaced prior to further blasting. Additionally, to prevent buildup of contaminants, blast cabinets will be thoroughly cleaned prior to each addition of new plastic media. Information concerning detection of contamination and equipment maintenance is provided in paragraph 4-5.4.2. and NAVAIR 17-600-191-6-2.

4-5.4.10. PMB Waste Disposal. Due to toxic materials commonly found in paint, residue generated from PMB processes must be considered a hazardous material unless otherwise directed by local environmental office. Dispose of used PMB in accordance with local environmental regulations.

**4-6. CHEMICAL PAINT REMOVAL.** Paint removal is authorized when corrosion is suspected/verified prior to magnetic particle or fluorescent penetrant inspection, or to replace damaged paint systems. Larger areas of metal aircraft surfaces shall be stripped using TT-R-2918 Type I or MIL-R-81294 Type I paint removers. The use of TT-R-2918 Type I is recommended if the use of methylene chloride, phenol, and/or chromate based paint removers is restricted/prohibited. Aircraft components (except honeycomb and composite parts) may be stripped by tank immersion using AMS-C-19853, which contains methylene chloride, phenol, and chromates. Alternatively, MIL-PRF-83936 (NMP and monoethanolamine based) hot tank paint remover may be used. This product requires a heated stripping tank.

### **CAUTION**

Use of acid based paint strippers is not authorized.

Hydrogen embrittlement. When high strength steels (typically 180 ksi and above), some high strength aluminum, and some stainless steels are exposed to acid paint removers, plating solutions, and other acidic chemicals and some alkaline materials, a cathodic reaction on the metal surface produces hydrogen. If the part is under load or contains residual manufacturing stresses, sudden catastrophic failure may occur when the part can no longer sustain the internal and/or applied stresses. See Volume I for additional information.

#### **4-6.1. TYPES OF CHEMICAL PAINT REMOVERS.**

4-6.1.1. MIL-R-81294 Remover, Paint, Epoxy, Polysulfide, and Polyurethane Systems. This material is a methylene chloride based paint remover that is applied using a nylon bristle brush or by immersing the part into a small covered metal tank. Use this chemical in accordance with paragraphs 4-6.2 through 4-6.4. MIL-R-81294 is not suitable for paint removal from composite materials as it attacks the resin, resulting in loss of strength in the composite fibers. MIL-R-81294 covers the following types of paint removers, which have been established for specific types of paint.

### **NOTE**

Types I and II are available with phenols (Class 1) and without phenols (Class 2). Class 1 products remove paint slightly quicker than Class 2 products, but may present a greater disposal problem because of the phenol content.

- a. Type I. For epoxy primer and polyurethane topcoat systems.
- b. Type II. For polyurethane topcoat systems.
- c. Type III. For polysulfides (sealants).
- d. Type IV. For paint systems with an elastomeric polyurethane intermediate coat.

4-6.1.2. TT-R-2918 Remover, Paint, No HAPs. This material is a nonhazardous air pollutant (non-HAPs) paint remover, ideal for use in areas where methylene chloride is restricted or prohibited. Type I is used for removing epoxy/polyurethane systems, while Type II products are designed to remove polysulfide based (sealant) systems. Comply with manufacturer's guidelines. TT-R-2918 is not suitable for paint removal from composite materials.

4-6.1.3. AMS-C-19853 Immersion Tank Paint Remover. This material is a liquid carbon remover used in immersion tank applications. Type I (phenolic) of this product can also function effectively as a paint remover. The material has a water seal top layer which prevents rapid evaporation of the methylene chloride. Dry blistered paint can be removed by brushing with a heavy nylon bristle brush and then rinsing with water. Spent stripper and rinse water are hazardous waste and shall be processed accordingly.

4-6.1.4. MIL-PRF-83936 Hot Tank Paint Remover. This material is a di-phase n-methyl- 2-pyrrolidone (NMP) and ethanolamine based hot tank paint remover with a mineral oil seal top layer. MIL-PRF-83936 is limited to intermediate level and above maintenance activities. The following shop practices shall be observed:

### **CAUTION**

Do not attempt to use MIL-PRF-83936 if shop facilities do not have heated (minimum 140°F) stripping tanks. Do not introduce water into the stripping tank, as MIL-PRF-83936 is extremely sensitive to water. Parts should be thoroughly dry before they are allowed into the stripping tank. Deviations from the following shop practices will degrade the performance of this chemical.

- a. Use in a heated tank with a thermostat temperature controller.

### **WARNING**

Never exceed the manufacturer's recommended temperature for heating and maintaining stripper solution.

- b. Use per manufacturer's instructions.
- c. Blistered paint can be removed by brushing with a heavy nylon bristle brush and then rinsing with water.
- d. Spent stripper and rinse water may be hazardous. Check with local hazardous waste management office prior to disposal.

### **CAUTION**

Chemical paint removers shall be stored in a protected area, out of direct sunlight, in a temperature controlled environment maintained between 40°F and 100°F to prevent freezing or exposure to excessively high temperatures. At temperatures out of the aforementioned range, chemical removers rapidly deteriorate, cannot be remixed to form a homogeneous solution, and will become corrosive/acidic.

4-6.2. SHELF LIFE. Chemical paint removers with an expired shelf-life can seriously degrade the structural properties of high strength metals, through hydrogen embrittlement resulting in a loss of ductility and cracking of the metal. On high strength steel aircraft components and structural fittings, do not use MIL-R-81294 (methylene chloride based) or TT-R-2918 (benzyl alcohol based) paint removers that are more than 12 months past the manufacture date unless otherwise authorized. On aluminum components and structures, MIL-R-81294

paint remover that is within 3 years of the manufacture date may be used. As a general rule, if there is evidence that the paint remover has separated into distinct layers or has become liquefied, do not use. Dispose of remover as hazardous waste.

4-6.3. PROTECTIVE MEASURES. Contact the local safety and health office for proper personal protective equipment (PPE).

### **WARNING**

Containers of chemical paint removers are under pressure, even when cold. If pressure is not bled off slowly, remover may splatter violently.

Chemical strippers are toxic and contain ingredients harmful to skin and eye tissues. No eating, drinking, or smoking is allowed in areas where paint removers or solvents are being used or stored. Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. In addition to good tank ventilation, use cartridge respirator and ensure good ventilation when in confined areas.

4-6.3.1. When opening a can of chemical remover or when applying chemical remover, the following items shall be worn:

- a. Chemical and splash proof goggles;
- b. Rubber gloves;
- c. Protective clothing (e.g. rubber apron and rubber boots); and
- d. Cartridge-type respirator with organic vapor cartridge.

4-6.3.2. When opening, cover the cap or bung of the container with a rag to reduce splatter and turn cap only far enough to break the seal. Allow internal pressure to release slowly and completely before removing cap.

4-6.3.3. First Aid.

4-6.3.3.1. If chemical remover is splashed on the skin, proceed immediately as follows:

- a. Rinse affected area with water.

b. Wash affected area thoroughly with soap and water.

c. Flush affected area again with fresh water for at least three minutes.

d. Get medical aid. Do not apply salves or other medications without specific medical department direction.

4-6.3.3.2. If chemical remover is splashed in the eyes, immediately do the following:

a. Flood the eyes with water for at least 15 minutes.

b. Get medical attention immediately.

4-6.4. **CHEMICAL PAINT REMOVAL PROCEDURES.** The following procedures shall be followed when using paint removers MIL-R-81294 and TT-R-2918:

### **WARNING**

Whenever possible, paint removal shall be accomplished in a corrosion control facility designed for paint removal. If not available, ensure adequate ventilation. Army and Navy personnel shall read paragraphs 4-6.2 and 4-6.3 prior to using any chemical remover.

### **CAUTION**

Paint removers shall not be used on plastics, fiberglass or graphite composites, or other organic matrix structural composite surfaces. Keep paint removers away from fuel or watertight seam sealants, since they will tend to soften and destroy the integrity of sealants. Synthetic rubber parts, aircraft tires, fabrics, and acrylic plastics must be completely protected against possible contact with paint removers.

a. Mask acrylic and plastic surfaces, rubber hoses and tubing, exposed wiring, and any other surfaces that can be damaged from contact with the paint remover. Use barrier material (MIL-PRF-131 Class 1) and aluminum foil tape (AMS-T-23397 Type II).

b. To chemically paint strip small surface areas, mask around the area to be stripped using barrier material and aluminum foil tape. Raise the tape about  $\frac{1}{2}$  inch along the bottom of the area as shown in Figure 4-1.

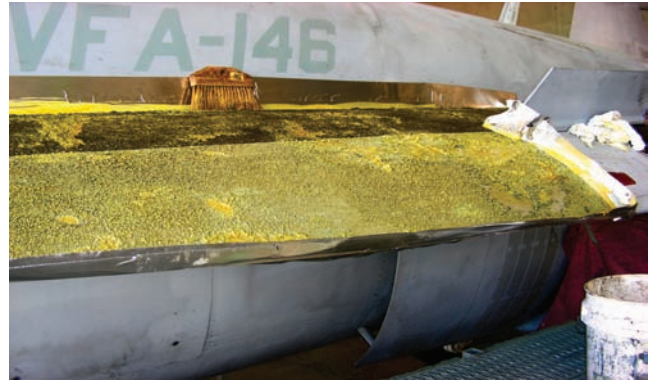


Figure 4-1. Masking Around Area to be Stripped

c. Prior to application of paint remover, remove excess sealant with a sharp plastic scraper. Then remove the remaining residue using the paint remover.

d. Application.

(1) MIL-R-81294: Apply a thick, continuous coating of paint remover to cover the surface to be stripped using a nylon bristle brush or equivalent.

(2) TT-R-2918: Apply a thin coating of paint remover using an acid or paintbrush. Keep material wet by reapplying thin coats of additional TT-R-2918 paint remover periodically.

### **NOTE**

Parts which are only coated with an epoxy primer are very difficult to strip and need to be scrubbed with nylon brushes. Parts coated with an epoxy primer and a topcoat are easier to strip.

e. Allow paint remover to remain on the surface for a sufficient length of time to wrinkle and completely lift the paint, usually 10-40 minutes depending on the temperature, humidity, and type of paint being removed. Paint removal rates may vary with temperature and humidity. The strip rate of the TT-R-2918 material is slower than that of MIL-R-81294. Reapply paint remover as necessary in the areas where paint remains tight or where the material has dried. Micarta scrapers, abrasive pads (A-A-58054) or fiber brushes (A-A-3118) may be used to assist in removing persistent paint. Do not rinse with water until all paint has been loosened. Water greatly reduces the paint stripping efficiency of the remover.

**WARNING**

Rinsing of epoxy paint removers shall be conducted in a suitable area specified by local safety and environmental directives.

f. Remove loosened paint and residual paint remover by washing and scrubbing the surface with fresh water and a stiff nylon bristle brush or an abrasive pad. If water spray is available, use a low pressure stream of water applied directly to the surface while it is being scrubbed. Do not allow rinsed paint remover or contaminated rinse water to contact other painted surfaces.

g. After thorough rinsing, remove masking materials and thoroughly clean the area in accordance with the cleaning processes outlined in Chapter 2, using MIL-PRF-85570 Type II (general cleaning) or MIL-PRF-29602 (aqueous parts washer).

h. Disposal. Process spent stripper and rinse water as hazardous waste in accordance with local regulations.

**4-7. MINOR PAINT DAMAGE REPAIR.** Minor nicks and scratches in paint films can be easily and quickly repaired as follows:

a. Clean the area around the damage to ensure that all traces of oil, dirt, salt, or other contaminants have been removed. Use a cleaning cloth dampened with MIL-T-81772 paint thinner or an approved solvent.

b. Remove any paint film not firmly adhering to the surface using a nonmetallic scraping tool.

c. Lightly abrade the area around the damage with a fine abrasive mat (A-A-58054 Grade B) or 320 grit abrasive cloth (ANSI B74.18). Feather the edge of the paint film while using care to prevent removal of metal, especially aluminum cladding.

d. Clean the area to be refinished using MIL-PRF-85570 Type II (diluted one part cleaner to 14 parts water) and rinse thoroughly with clean, fresh water. Ensure that all traces of oil and other contaminants have been removed from the metal skin. For water sensitive areas, use an approved cleaning solvent.

e. Apply chemical conversion coating (use of Touch-N-Prep Pen is recommended) to the clean, bare aluminum surface as described in Chapter 5.

f. Apply primer coating using a small, touch-up brush, a Sempen™, or an approved aerosol touch-up paint system as described in Appendix A (Navy) or TM 55-1500-3554-23 (Army).

g. Apply topcoat paint film, using the same techniques as described for primer. Two or three thin coats are preferred, rather than one heavy coat. The repaired area should have the same paint thickness as the surrounding area.

**4-8. CORROSION REMOVAL.** There are certain factors that must be considered prior to starting any corrosion removal operation. The most important of these considerations is that the removal of the corrosion products must be completed while not causing additional damage during the process. This can be accomplished by first removing all corrosion visible through a 10X magnifying glass, then removing an additional two mils (0.0020 inch) to ensure that all deposits have been eliminated. Failure to remove all the corrosion may allow the corrosion to continue after affected surfaces are refinished.

4-8.1. **CLEANING.** Before attempting to remove corrosion products, the surface must be stripped of paint and cleaned. Surface contaminants will interfere with corrosion removal procedures and increase the difficulty of the operation.

4-8.2. **PROTECTION.** Adjacent components and parts must be protected from corrosion residue and possible damage that could be caused by the removal operation. Corrosion residue can cause additional corrosion and damage the surface finish of the surrounding area. An accidental slip of a corrosion removal tool can quickly result in additional damage.

4-8.3. **DAMAGE LIMITS.** Complete removal of corrosion products may result in metal removal that exceeds the amount allowed by specific aircraft or equipment repair handbooks. Prior to corrosion removal, the allowable limits specified in aircraft and equipment manuals and technical orders must be checked. Metal removal damage is cumulative: prior metal removal, including areas on the opposite side of the part, must be considered when assessing corrosion damage. When removing corrosion on critical aircraft structure, the following steps shall be taken:

a. If allowable metal removal or damage limits will not be exceeded, remove corrosion completely.



b. If allowable limits will be exceeded, repair or replacement of the part shall be coordinated with the Aircraft Controlling Custodians (ACC) or System Program Manager (SPM).

c. If a critical structural component is affected, repairs shall be coordinated with the ACC/SPM in order to determine if the part should be repaired or replaced.

4-8.4. METHODS OF REMOVAL. There are various methods of mechanical corrosion removal from metal surfaces. Chemical corrosion removal techniques are not authorized for Navy organizational or intermediate level maintenance. Army: refer to Appendix B, Section III, for chemical corrosion stripping procedures.

4-8.4.1. The method used will depend on the type of metal, the location and accessibility of the corroded area, the degree of damage, and the type of corrosion involved. These factors will determine the types of tools and equipment selected for the removal operation. It is very important that the removal method and the tools and equipment selected be compatible with the metal surface. Compatibility involves two considerations:

a. The mechanical effect of the equipment on the surface and

b. The compatibility of metallic particles worn off the removal equipment which might become trapped in the metal surface.

4-8.4.2. Mechanical Compatibility. Mechanical compatibility refers to the selection of the right tools and equipment to prevent additional damage from occurring as a result of the removal process. Often it is necessary to select a series of removal techniques involving the use of different grades or classes of equipment and material to effectively remove the corrosion products. The initial use of a rapid and coarse removal method followed by a slower and finer removal method will produce a smooth metal surface finish (for example, the use of a vacuum blaster at first, and, once the surface is exposed, the use of a fine abrasive cloth or paper).

4-8.4.3. Material Compatibility. Material compatibility refers to using a cleaning medium during brushing, abrading, or blasting, that will not be the cause of additional corrosion. Material compatibilities are assured by using like metals during corrosion removal operations. For example, only aluminum wool shall be used to remove corrosion from aluminum alloys. Using steel wool is prohibited because it can embed in the surface and cause galvanic corrosion of the aluminum alloy.

#### 4-8.5. NOTES ON MECHANICAL CORROSION REMOVAL.

4-8.5.1. Aluminum. Intergranular exfoliation corrosion is not removed by abrasive blasting; however, blasting may be used in conjunction with powered corrosion removal to determine whether all exfoliation corrosion has been removed.

4-8.5.2. High Strength Steel. Use only the radial bristle disc, flap brush and wheel, or abrasive mat to remove corrosion on high strength steel parts. Other power tools are prohibited because of the danger of local overheating and the formation of notches which could lead to failure. Refer to specific maintenance manuals for additional corrosion removal procedures.

4-8.5.3. Stainless Steels and Nickel Alloys. Use abrasive blasting only on heavily corroded parts as a precursor to acid pickling.

4-8.5.4. Fasteners. Corrosion occurring on installed fasteners shall be removed using dry honing machine (i.e., vacu-blaster) or hand held abrasive materials

#### 4-9. **CORROSION REMOVAL EQUIPMENT AND MATERIALS.**

4-9.1. NON-POWERED TOOLS AND MATERIALS. Refer to Table 4-1 to determine the correct non-powered abrasive to use on various aircraft metals.

4-9.1.1. Abrasive Mats. Abrasive mats (9" x 11" sheets) are nylon webs containing various grades of aluminum oxide abrasive material (A-A-58054 Type I Class 1 Grade A - Very Fine, Grade B - Fine, Grade C - Medium). These mats are used by hand or with mandrels to remove small areas of corrosion and/or paint where the use of powered tools would be impractical or prevented by the shape or accessibility of the area. Table 4-2 is a guide to grades of abrasive materials.

4-9.1.2. Abrasive Cloth. Aluminum oxide and silicon carbide (ANSI B74.18) grit bonded to cloth are used for dry sanding of light to moderate corrosion products. The cloth is available in sheets (9"X11") and rolls (2" or 3" wide X 150" long) in 240 grit (Fine) and 320 grit (Very Fine) grades. Use of aluminum oxide is prohibited on composite surfaces.

4-9.1.3. Abrasive Paper. Silicon carbide grit bonded to heavy paper (ANSI B74.18) is used for wet or dry sanding of light to moderate corrosion products. It is available in sheets in 240 grit (Fine) and 320 grit (Very

Table 4-1. Recommended Non-Powered Abrasives for Corrosion Removal

Alloy	Non-Woven Abrasive	Abrasive Cloth/Paper	Metallic Wool	Brushes	Others
Aluminum Alloys	Abrasive Mat	Aluminum Oxide, Silicon Carbide	Aluminum Wool	Stainless Steel, Aluminum	Pumice Paste, Carbide-Tipped Scrapers
Magnesium Alloys	Abrasive Mat	Aluminum Oxide, Silicon Carbide	None	Stainless Steel, Aluminum	Pumice Paste, Carbide-Tipped Scrapers
Ferrous Metals (other than Stainless Steel)	Abrasive Mat	Aluminum Oxide, Silicon Carbide	Steel Wool	Carbon Steel, Stainless Steel	Carbide-Tipped Scrapers
Stainless Steel and Nickel Alloys	Abrasive Mat	Aluminum Oxide, Silicon Carbide	Stainless Steel Wool	Stainless Steel	None
Copper Alloys	Abrasive Mat	Aluminum Oxide (400 grit), Silicon Carbide (400 grit)	Copper Wool	Brass	None
Titanium Alloys	Abrasive Mat	Aluminum Oxide, Silicon Carbide	Stainless Steel Wool	Stainless Steel	Pumice Paste, Carbide-Tipped Scrapers
Cadmium or Zinc Plated Surfaces	Abrasive Mat	Aluminum Oxide, Silicon Carbide	None	None	None
Chromium, Nickel, Tin, or Copper Plated Surfaces	Abrasive Mat	Aluminum Oxide, Silicon Carbide	None	Stainless Steel	None
Phosphated Surfaces	USE METHOD RECOMMENDED FOR BASE METAL				
Composites	Abrasive Mat	Silicon Carbide	REFER TO NAVAIR 01-1A-21		

Fine) grades. Use of aluminum oxide is prohibited on composite surfaces. Silicon carbide is usually more effective than aluminum oxide on harder metals such as ferrous alloys. Other abrasives are available on paper or cloth (emery and flint) but suffer from poor efficiency and short working life.

4-9.1.4. **Metallic Wools.** Metallic wool is an abrasive material used for removing corrosion that is not tightly bonded to a metal surface. The four major types of metallic wools are: aluminum, copper, stainless steel, and steel. Metallic wools are available in five grades, ranging from very fine to extra coarse. Table 4-3 is a guide to help select the correct grade of metallic wool. These materials are very good for corrosion removal on tubing or extruded parts.

**CAUTION**

The use of metallic wools which are not galvanically compatible with the metal surface being treated is not authorized.

a. The type of corroded metal must be known before using metallic wool. Steel wool is used on ferrous metals; aluminum wool is used on aluminum, aluminum

alloys, magnesium, and magnesium alloys; copper wool is used on copper alloys, bronze, and brass; and, stainless steel wool is used on stainless steel.

b. After using metallic wools, remove all residue from the metal surface with a vacuum cleaner.

4-9.1.5. **Wire Brushes.** Wire brushes are used to remove heavy corrosion deposits or paint that is not tightly bonded to the metal surface. They are available with aluminum, steel, stainless steel, or brass bristles. Thick, short, and/or stiff bristles are more effective for rapid corrosion removal. The brushes must be compatible with the metal surface to prevent galvanic corrosion. Stainless steel can be considered to be neutral, and can be used on all aviation equipment. Do not use a wire gage or diameter above 0.010 inch, as gouging of the surface may occur. Remove the corrosion with a linear motion; do not cross-hatch. This will unnecessarily damage the surface. After wire brushing soft metal (such as aluminum or magnesium) the surface areas must be polished with fine abrasive paper.

4-9.1.6. **Pumice Powder.** Pumice powder is a very fine and soft abrasive used to remove stains or to remove corrosion on thin metal surfaces where minimum metal



Table 4-2. Grades of Abrasive Mats

Grade	Coated Abrasive (CA) Equivalent
Extra coarse	80 - 100
Coarse	100 - 120
Medium	120 - 150
Fine	180 - 220
Very Fine	280 - 320
Super Fine	320 - 400
Ultra Fine	400 - 500
Flint	500 - 600

removal is allowed. It is mixed with water and then rubbed over the area with a soft cloth. After drying, the powder is wiped off.

4-9.1.7. Scrapers. Scrapers are used primarily for the initial removal of heavy corrosion deposits in corners and crevices that cannot be reached with other equipment. Scrapers of this kind may be locally manufactured from phenolic plastic, fiberglass composites, aluminum or carbide-tipped steel. Plastic scrapers may be used on any metal surfaces; aluminum scrapers shall be used only on aluminum or magnesium surfaces; and steel scrapers shall be used only on steel surfaces. Failure to use the correct metal scraper can lead to galvanic corrosion after the part is returned to service. Normally, surface areas must receive further finishing after corrosion removal with scrapers due to the gouging action of scrapers and the difficulty in determining complete corrosion removal.

### WARNING

Power tool operations create toxic airborne particles often containing heavy metals, such as chromium (in the form of chromates), titanium, nickel, and beryllium, depending on the surface being treated. Eye protection, ventilation, and an adequate respirator for dust control is required. Do not use hands to probe for air pressure leaks, as injury can result. Before using any powered equipment, remove clothing which might become entangled in the equipment, as well as rings and other jewelry. Always wear proper personal safety equipment, such as goggles, faceshield, and/or respirator. Ensure that all electrical equipment is grounded.

Table 4-3. Grades of Steel Wool

Type	Grade	Use
I	Very Fine	Final smoothing
II	Fine	Most commonly used
III	Medium	General purpose
IV	Coarse	Rough work
V	Extra Coarse	Restoration work

### CAUTION

Corrosion removal accessories, such as bristle discs, flap brushes, or rotary files, shall only be used on one type of metal. For example, a flap brush used to remove aluminum shall not be used to remove magnesium or steel.

4-9.2. POWERED TOOLS AND MATERIALS. Power tools are used to remove heavy corrosion from metal surfaces, or mild to severe corrosion over large surface areas. Their use results in savings of time and money. However, care must be exercised when using power tools. Application of excessive pressure can easily damage metal surfaces and cause internal metallurgical changes in the metal due to excessive heat buildup. Powered tools are an aggressive method which shall only be used when authorized by cognizant aircraft engineering authority and where the extent of corrosion makes non-powered corrosion removal impractical. The indiscriminate use of powered corrosion removal methods will result in damage to protective surface finishes and excessive metal removal. Refer to Table 4-4 to determine the correct powered tools to use on various aircraft metals.

### CAUTION

Radial bristle discs are authorized for use only on aluminum, magnesium, high-strength steel, and titanium surfaces as a replacement/substitute for abrasive wheels and brushes cited in this chapter. Use of the discs on other metallic or composite surfaces is not authorized and may result in damage to the surface or structure.

4-9.2.1. 3M™ Radial Bristle Disc. Bristle disc technology has been proven to be effective and less aggressive than abrasive wheels and brushes and is intended for small corrosion repairs and paint removal. Other commercial off-the-shelf radial bristle discs are available, however, they have not been approved for

Table 4-4. Recommended Powered Abrasives for Corrosion Removal

Alloy	Flap Brush, Abrasive Wheels	Abrasive Cloth/Paper	Abrasive Blasting Parameters		Other Tools
			Media (Note 3)	Pressure (PSI)	
Aluminum alloys (Clad)	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13)	30-40 (Note 1)	None
Aluminum alloys (No cladding)	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13)	40-45 (Note 1)	Rotary files (fine fluted), Radial Bristle Disc
Magnesium alloys	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13)	10-35 (Note 1) 40-50 (Note 1)	Rotary files (fine fluted), Radial Bristle Disc
Ferrous metals (other than stainless steel)	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Aluminum oxide (Type I, A or B) Glass beads (Size 13)	40-50 (Note 1)	Rotary files, Wire wheels (steel or stainless steel), Radial Bristle Disc (high strength steel only)
Stainless steel and Nickel alloys	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	(See Note 2) Glass beads (Sizes 10-13)	40-50 (Note 1)	Wire wheels (stainless steel), Rotary files (fine fluted)
Copper alloys	DO NOT USE POWERED ABRASIVE METHODS DUE TO TOXICITY				
Titanium alloys	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13) Aluminum oxide (Type I, A or B)	40-50 (Note 1) 40-50 (Note 1)	Radial Bristle Disc
Plated and phosphated surfaces	DO NOT USE POWERED ABRASIVE METHODS DUE TO TOXICITY AND PLATE THICKNESS				
Composites	REFER TO NAVAIR 01-1A-21				
NOTES:					
(1) Indicated pressure is for direct pressure equipment. For suction equipment, use 50% higher pressure.					
(2) Use only on heavily corroded parts prior to acid pickling.					
(3) Media specifications: Glass beads: MIL-PRF-9954 Aluminum oxide: A-A-59316					

NAVAIR use. Thus, they are strictly prohibited for use on Navy aircraft. Use of non-approved discs on aircraft may result in serious damage to the substrate. It is recommended that only one disc be utilized at a time on the mandrel assembly. However, for larger surface areas, discs can be ganged/stacked on the mandrel assembly up to 4 discs thick (see Figure 4-2).

4-9.2.1.1. Two types of radial bristle discs with a diameter of 3 inches are available for corrosion repair and paint removal from aluminum, magnesium, high-strength steel, and titanium surfaces: 3M SPA (orange in color) is designed for light surface corrosion discrepancies such as filiform corrosion, and 3M 360 (green in color) is designed for heavier corrosion discrepancies, light sealant removal, and light to moderate surface pitting.

4-9.2.1.2 Radial Bristle Discs on High-Strength Steel (HSS). The 360 grit green disc is for removing light surface oxidation and corrosion, but it will also remove the IVD aluminum or cadmium plating. The 400 grit orange disc will leave the IVD aluminum or cadmium plating mostly intact. Therefore, it is recommended that the 400 grit orange disc be used where only paint removal is required, and the 360 grit green disc be used as a replacement for abrasive wheels and flap brushes to perform small corrosion repairs down to bare metal. Examples of high-strength steel material locations on aircraft include the nose and main landing gears, launch bars, and tail/arresting gear assemblies.



Figure 4-2. Bristle Discs Stacked on Mandrel Assembly

### **WARNING**

Improper mounting of the radial bristle disc on the grinder-mandrel assembly can cause personal injury due to separation of the disc fingers from the tool hub. Additionally, damage to the substrate and disc can occur.

4-9.2.1.3. **Disc Mounting Procedures.** Note the directional rotation arrow on the disc hub. The disc must be positioned on the mandrel assembly with the arrow pointing in the direction of the tool's rotation (clockwise). Also, note the angle of the tips of the disc fingers. The disc fingers should be angled away from the direction of the grinder rotation. Placing the disc on the mandrel in a counterclockwise direction will damage the aluminum substrate and the tool. Also, if the disc fingers are angled toward the direction of the grinder rotation, they will separate from the disc hub. Operating the tool in this manner will damage the substrate and personal injury will result from disc finger separation.

### **WARNING**

Utilization of the radial bristle disc generates dust particles that may contain chromates from primers. Therefore, eye protection is required when operating this tool. Consult with the local Industrial Hygienist (IH) concerning proper respiratory protection equipment.

4-9.2.1.4. **Operation of Radial Bristle Disc.** Disc operation requires an air source of 90-110 psig, along with a high-speed pneumatic grinder rated from 20,000-25,000 rpm and a 3M™ No. 990 mandrel assembly. The mandrel assembly includes two different end caps, one silver and one black, for thin or thick stacks. The silver cap is used to mount one or two discs

and the black cap is used to mount three or four discs. Operating the grinder at its maximum rated speed is required to ensure maximum efficiency and effectiveness of the radial bristle disc. In addition to speed, light hand pressure during operation is required to achieve optimum stripping results. The tips of the bristles are the working element of the tool. Therefore, to achieve the best overall result, maintain a light pressure on the grinder and move the grinder over the affected area on the work surface. Exerting hand pressure on the disc at a force of 2 pounds or greater will fold the bristle tip fingers making the tool inoperative. The disc is no longer effective when the bristle fingers are worn down to the disc hub. At this point, the disc must be replaced with a new disc.

4-9.2.2. **Pneumatic Drill Motors.** Pneumatic drill motors are the preferred power tools for removing heavy corrosion or reworking large surface areas. The drill motor is normally used with wire brush wheels, rotary files, flap brushes, sanding pads, abrasive wheels, or buffing wheels. These drills are available in many shapes and sizes to satisfy almost any requirement. Prior to use, check all pneumatic equipment air hoses for breaks or bulges in the coverings. The maximum chuck capacity of the portable powered drill is usually 1/4 inch. Insert the tool shank and tighten chuck securely with the chuck key prior to use. When it is difficult or impossible to reach the work area with a straight drill, use a flexible shaft or angle adapter. The flexible shaft permits working around obstructions with a minimum of effort.

a. To prevent the rotary file, abrasive wheel, or sanding disc from digging into the metal, keep the tool off the metal when initially starting the drill. When the abrading stroke is finished, lift the tool from the metal before releasing the power to the motor.

b. Holding the drill motor with both hands, apply moderate pressure while holding the rotary file, sanding disc, or abrasive wheel against the work. When using the pneumatic tool as a sander, be sure to check the size and type of the abrasive disc. Ensure that the type of disc is compatible with the metal. Keep the sanding disc tilted to approximately a 10 degree angle so that only one side of the disc is in contact with the metal surface. If the entire disc surface is in contact with the surface, a "bucking" effect will occur. Excessive pressure will cause a "chattering" effect.

c. Move the tool over the surface with slightly overlapping strokes. Do not grind, sand, or file in one area for any length of time without stopping and allowing the metal to cool. Excessive heating of the metal will alter its metallurgical structure.

4-9.2.3. Pneumatic Sanders. The proper technique for using pneumatic sanders with oscillating heads shall include the following:

a. To prevent the sander from digging into the metal, start the sander before it touches the metal. When the sanding strokes are finished, lift the sander from the metal before engaging the stop switch. Do not lay the unit down with the motor running.

b. For best results, apply moderate pressure while holding the sander against the work. Move the sander over the surface with parallel and slightly overlapping strokes. Move it as slowly as possible without overheating the metal. Generally, the cleaning rate should be about two square feet per minute.

### **CAUTION**

Do not use flap brushes down to within 2 inches of core. Continued use beyond this limit may cause gouging due to loss of flexibility of fiber. Excessive pressure on flap brushes will cause polyurethane paint to melt, gum up, and streak around the area being worked. Do not use on nonmetallic surfaces.

4-9.2.4. Scotch-Brite™ Finishing Flap Brushes. Flap brushes are made of non-woven, nylon, aluminum oxide webbing. The brushes are very effective for removing mild surface corrosion and prepping surfaces. They can also be used for mechanical removal and feathering of paint systems. The brushes are comprised of a series of flaps attached to a mandrel, with each flap impacting the surface as it spins. When used correctly, the brushes will lead to minimal metal removal. The flap brush and mandrel (see Figure 4-3) shall be assembled so that the arrow, painted on the brush, is facing the operator or the arrow is pointed in the direction of rotation (clockwise). When using flap brushes, apply minimal pressure to remove maximum paint and minimum metal. To achieve maximum effectiveness, use the specified RPM.

4-9.2.5. Abrasive Flap Wheels. Flap wheels (MIL-W-81319) are made of nylon paper impregnated with aluminum oxide abrasives (Figure 4-4). These wheels usually come with a spindle mount. Depending on grit size, the flap wheels can be used to remove medium to severe corrosion from thick materials. The wheels will also remove metal. Thus, caution must be used to minimize the amount of metal removal. For the most effective use of this equipment, use the specified RPM.

4-9.2.6. Abrasive Cloth and Paper. Aluminum oxide and silicon carbide cloth and paper can be used with sanders and buffers by cutting suitable pieces from stock.

### **CAUTION**

Unless authorized by the cognizant aircraft engineering authority, rotary wire brushes are not authorized for corrosion removal on soft metals, such as aluminum and magnesium.

4-9.2.7. Rotary Wire Brushes. Powered wire brushes are available with various types of wire (straight, twisted, or crimped), various lengths of wire (short, medium, or long), and various wire densities (light, medium, or heavy). Different actions can be obtained by varying wire type, trim length, and density.

### **CAUTION**

Improper use of the rotary file can damage aluminum structure by creating thin spots exceeding damage limits. Use of rotary files is authorized only for severe granular or exfoliation corrosion removal by qualified structural repair technicians. Do not use rotary files to remove corrosion from installed fasteners.

4-9.2.8. Rotary Files. Since it is one of the fastest ways to remove corrosion and underlying metal, a rotary file should be only handled by an experienced structural repair technician. This tool is a tungsten carbide cylinder or cone into which cutting edges have been machined. When installed in the chuck of a pneumatic drill, rapid metal removal can be achieved.

4-9.3. ABRASIVE BLASTING. During abrasive blasting, abrasive media is propelled toward the work piece with air pressure (conventional or vacuum blasting) or water (wet blasting).

### **WARNING**

Abrasive blasting operations create airborne particles which may be hazardous to the skin and eyes. A hood, gloves with gauntlets, and adequate ventilation are required.

4-9.3.1. Conventional Equipment. Two types of equipment are used to propel dry abrasives: direct pressure feed and suction feed. In direct pressure equipment, the abrasive holding tank is a pressure vessel from which abrasive media is forced, through a

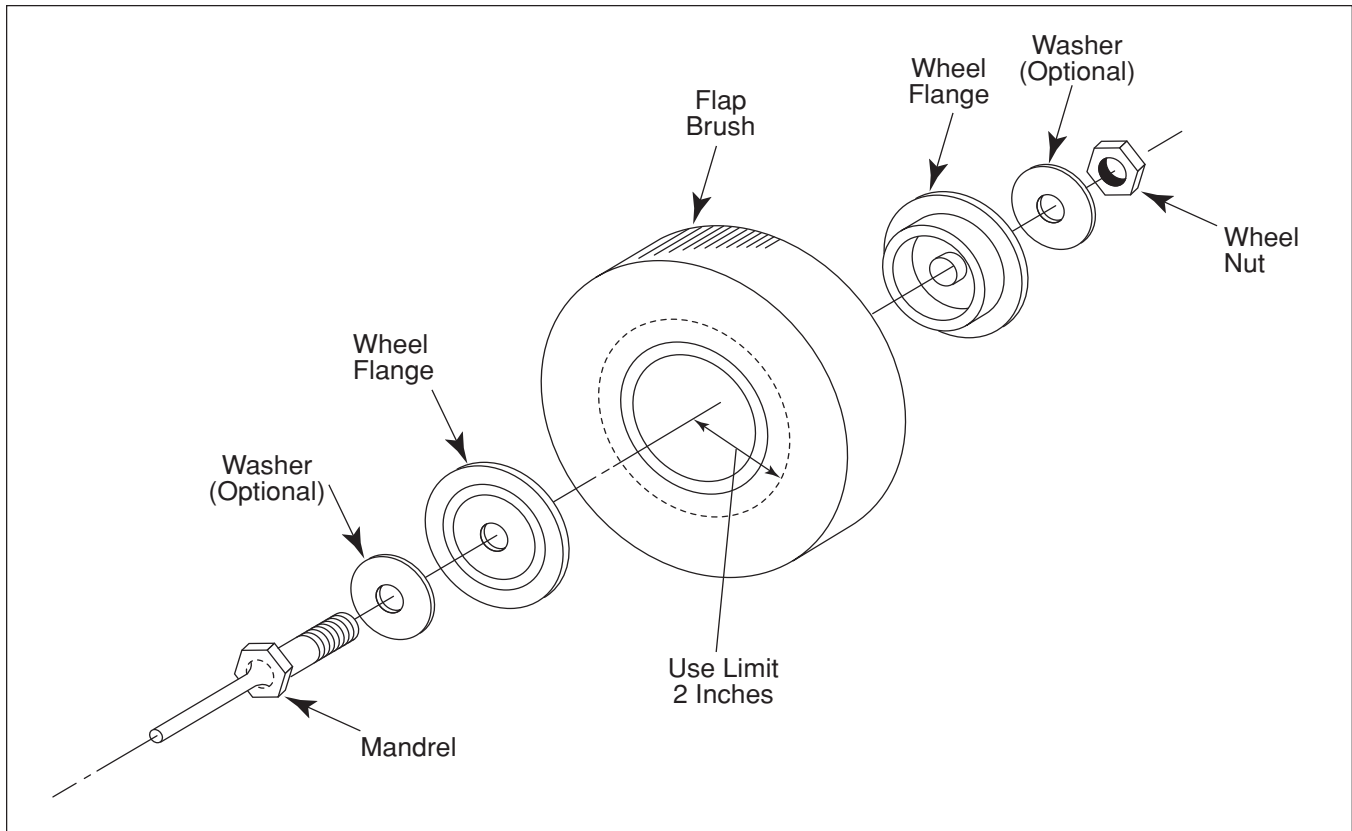


Figure 4-3. Scotch-Brite™ Flap Brush and Mandrel

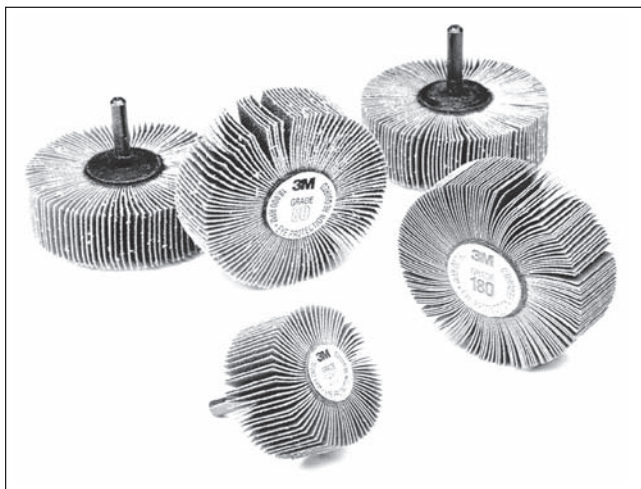


Figure 4-4. Abrasive Flap Wheels with Spindle Mount

metering device, into the pressurized blast line to the blast nozzle. In suction equipment, the abrasive holding tank is unpressurized and provides media, through a metering device, into a passing airstream which then propels it through the blast hose to the blast nozzle. Blast cabinets (Figure 4-5), built to accommodate small parts, have a recycling system which removes dust and light particle contaminants, such as paint or corrosion products. Blasting rooms, designed for large components, use a recycling and ventilating system. The operator works within the room, using a blast gun.

#### NOTE

Suction feed (also known as venturi equipment) requires higher nozzle pressure than direct pressure equipment to obtain the required abrasive action.

4-9.3.1.1. Blast Media. A wide variety of materials and sizes (usually measured by mesh size) are available for blasting applications. Some of the recommended abrasives include aluminum oxide (A-A-59316) and glass bead (MIL-PRF-9954). Table 4-4 specifies the correct material, mesh size, and air pressure at the blast nozzle to be used in blasting each type of alloy. Pressures



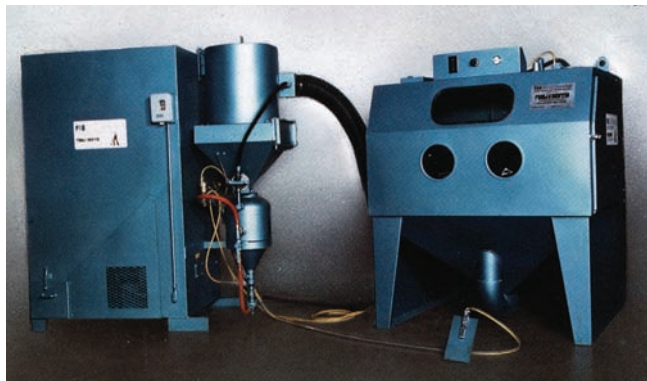


Figure 4-5. Glove Box Unit Blast Cabinet

given in Table 4-4 are for direct pressure equipment. As a general rule, increase the nozzle pressure by 50% when using suction feed equipment.

4-9.3.1.2. **Air Hoses.** The nozzle pressure of the blast stream is affected by the length and inside diameter of the air hoses. It is best to use the shortest hose possible, so that there will not be an excessive pressure drop. If it is necessary to couple lengths of hose, quick connect/disconnect external couplers are recommended.

4-9.3.1.3. **Blast Nozzles.** In general, larger nozzle sizes are preferable to smaller ones, because more area can be cleaned per hour with the same amount of labor. High efficiency nozzles (e.g. tungsten carbide) should be used, since they have a longer use life, require less replacement time, and direct the blasting particles more efficiently. Nozzles should be periodically inspected for wear and discarded when the orifice is worn to a diameter which is 50 percent greater than the diameter when new. A worn nozzle, like a larger nozzle, will require a larger volume of air flow from the compressor to sustain the needed pressure at the nozzle.

4-9.3.1.4. **Air Supply.** Frictional losses in the hoses reduce the pressure at the nozzle, and nozzle wear increases the volume of air needed to maintain the desired nozzle pressure. To allow for nozzle wear, it is generally good practice to have a compressor capable of twice the pressure required for a new nozzle. Moisture and oil in the air stream is collected in the abrasive during blasting operations and gradual accumulations will cause the abrasive to clog the blaster. A water and oil separator must be used in the compressed air supply line to reduce excessive moisture or oil.

4-9.3.2. **Portable Vacuum Blast Equipment.** Also known as a vacu-blaster or dry honing machine, these devices



Figure 4-6. Portable Vacuum Blast Equipment

are portable machines designed to recover the abrasive as it rebounds from the work piece. Vacu-blasters have an abrasive hopper, a reclaimer, a dust collector, a vacuum pump and a blast gun which contains both a blast nozzle and a vacuum duct for recovery of the media (Figure 4-6). This equipment is most effective on flat or slightly curved surfaces so that the media rebounds near the vacuum duct surrounding the blast nozzle. Refer to NAVAIR 17-5BM-1, 17-5BM-2, and 17-5BM-3, for Navy equipment and TM 55-1500 series manuals for Army equipment.

4-9.3.3. **Wet Abrasive Blasting.** Wet blasting is a technique using high pressure water as the medium for the delivery of abrasives. This method is not as harmful to the base metal as dry abrasive blasting, due to the cushioning effect of the water medium. Unfortunately, this effect inhibits the speed with which coatings and corrosion products are removed. The abrasive material is normally not recoverable in wet blasting operations, and only sand (MIL-A-22262), aluminum oxide (A-A-59316), or No. 13 glass beads (MIL-G-9954) shall be used. A corrosion inhibitor solution must be added to the water or applied to the blasted surface immediately after blasting to give some protection from rusting until the part can be painted.

**4-10. CORROSION REMOVAL PROCEDURES.**

4-10.1. WARNINGS AND CAUTIONS. The following warnings and cautions shall be observed during corrosion removal operations.

4-10.1.1. Personal Protection.**WARNING**

Many materials, such as copper alloys (especially beryllium-copper), cadmium plate, chromate conversion coatings, paints containing chromates, lead, barium, and strontium, are toxic. Use approved respirators, eye protection, and skin protection. Take proper safety precautions to avoid inhalation or ingestion during corrosion removal. Wash hands thoroughly before eating or smoking.

4-10.1.1.1. All powered corrosion removal procedures create airborne particles. Respirators and eye protection are required. Consult with the local Industrial Hygienist (IH) concerning proper respiratory protection equipment. Wear leather gloves when using metallic wools to prevent hand injuries.

4-10.1.1.2. Do not use flap brushes, abrasive wheels, or wire brush wheels above their authorized RPM. These tools can fly apart, causing serious injury. Exercise caution when using sharp or pointed tools to prevent injury.

4-10.1.1.3. Depleted uranium is extremely toxic and shall be worked only under a license from the Nuclear Regulatory Agency (NRA). Machining or other work, such as surface sanding, may be done only by the licensee. No drilling, sanding, or other mechanical work is permitted on depleted uranium by any service maintenance activity. If the protective finish (plating) which covers the depleted uranium is chipped, peeled, or otherwise removed so the dark gray or black depleted uranium (or uranium oxide) is visible, the part must be returned to the licensee for rework or disposal. Packaging and shipping procedures shall conform to current regulations for handling radioactive materials. Abrasive cleaning or sanding shall not under any circumstances be applied to depleted uranium.

4-10.1.2. Mechanical Damage.**WARNING**

Use extreme care to ensure that blast media does not contaminate hydraulic, fuel, oil, coolant, or oxygen systems. Blockages in flight critical components caused by abrasive media particles can result in loss of life and aircraft.

**CAUTION**

Do not use flap brush down to within two inches from the center of the hub. Continued use beyond this limit may cause gouging due to loss of flexibility of the fiber. Follow direction of rotation, as indicated by arrow imprinted on side surface of core.

4-10.1.2.1. Excessive pressure on the flap brush will cause polyurethane paint to melt, gum up, and streak around the area being worked.

4-10.1.2.2. When using abrasive blasting on aluminum or magnesium alloys, do not allow the blast stream to dwell on the same spot longer than 15 seconds. Longer dwell times will cause excessive metal removal.

4-10.1.2.3. Use of rotary files on aircraft or missile skin thinner than 0.0625 inch is prohibited unless authorized by the ACC/SPM.

4-10.1.2.4. Vigorous, heavy, continuous rubbing (such as with power driven wheels, discs, or flap brushes) can generate enough heat to cause metallurgical damage. Protect surfaces from severe abrasive action. Do not use rotary files to remove corrosion from installed fasteners.

4-10.1.2.5. Mechanical removal of corrosion from depleted uranium shall not be attempted at Organizational unit or Intermediate level maintenance activities.

4-10.1.2.6. Protect areas adjacent to corrosion removal operations from chips, dust, and other debris which could produce dissimilar metal corrosion on previously uncorroded surfaces.



4-10.1.2.7. Use only the materials recommended in Tables 4-1 and 4-4. Dissimilar metal particles may become embedded in surfaces, leading to rapid galvanic corrosion.

4-10.1.2.8. Be careful when removing corrosion from soft plated surfaces (such as zinc or cadmium). Soft plating is easily damaged or removed by mechanical methods.

#### 4-10.2. NON-POWERED CORROSION REMOVAL.

This method is accomplished by hand rubbing the corroded surface with tools or abrasives to remove the corrosion. This method is normally used to remove mild surface corrosion by scraping or wearing away the corrosion products and some base metal. The basic steps are:

a. Prior to removing corrosion, determine whether corrosion can be removed without exceeding the authorized allowable damage limits. See paragraph 4-8.3.

b. Protect adjacent components from scale, chips, corrosion products, and chemical agents. Mask lap joints, hinges, faying surfaces, access doors, air scoops, and other openings which would allow chips, dust, or other debris to enter interior areas. Use barrier paper (MIL-PRF-131) and masking tape.

c. Clean the affected area to remove grease and soil (see Chapter 2).

d. Using materials in Table 4-1, remove all corrosion using the mildest effective method. To determine whether corrosion has been completely removed, inspect with a 10X magnifier. A more sensitive evaluation can be made using fluorescent penetrant with a 10X magnifier.

e. When complete corrosion removal has been attained, blend or fair out the edges of the damaged areas using fine abrasive paper or cloth.

f. After removal of all corrosion, ensure that the allowable damage limits have not been exceeded.

g. Treat the surface in accordance with Chapter 5 and apply protective coatings in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

#### 4-10.3. POWERED CORROSION REMOVAL.

Powered corrosion removal is generally done using pneumatic drills with bristle disc, flap brush, rotary file, sanding pad, or abrasive wheel attachments. This

method is normally used to remove heavy corrosion by wearing away the corrosion products. Part of the base metal is abraded away with the corrosion products using this procedure. The basic steps in corrosion removal are:

### WARNING

All powered corrosion removal procedures create airborne particles. Adequate ventilation, respiratory protection, and eye protection are required.

a. Prior to corrosion removal, determine whether corrosion can be removed without exceeding the authorized allowable damage limits. See paragraph 4-8.3.

b. Protect adjacent components from scale, chips, corrosion products, and chemical agents. Mask lap joints, hinges, faying surfaces, access doors, air scoops, and other openings which would allow chips, dust, or other debris to enter interior areas. Use barrier paper (MIL-PRF-131) and masking tape.

c. Clean the affected area to remove grease and soil (see Chapter 2).

d. Using only recommended materials in Table 4-4, remove all corrosion using the mildest effective method. To determine whether corrosion has been completely removed, it may be necessary to use fluorescent penetrant inspection with a 10X magnifier.

e. When complete corrosion removal has been attained, blend or fair out the edges of the damaged areas using fine abrasive paper or cloth (see paragraph 4-11)..

f. After removal of all corrosion, ensure the allowable damage limits have not been exceeded.

g. Treat the surface in accordance with Chapter 5 and apply protective coatings in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

#### 4-10.4. ABRASIVE BLASTING.

4-10.4.1. Safety Precautions. Before beginning abrasive blasting operations, observe the following safety precautions. Failure to comply with these precautions may result in harm to personnel and equipment.

### **WARNING**

Use extreme care to ensure that blast media does not contaminate hydraulic, fuel, oil, coolant, or oxygen systems. Blockages in flight critical components caused by abrasive media particles can result in loss of life and aircraft.

4-10.4.1.1. Operators shall be adequately protected with complete face and head covering equipment, and provided with pure breathing air meeting the requirements of AFOSH Standard 161-1 and NAVOSH Standard A1-NAVOSH-SAF-000/P-5100-1 when blasting in confined areas.

4-10.4.1.2. Finely divided dry particles of many materials (metallic, organic, and inorganic) can form explosive mixtures with air. In dust form, certain metallic materials, notably titanium and magnesium, are capable of igniting spontaneously when exposed to air. Due to potential fire and explosion hazards, one should be careful with these materials when dry abrasive blasting.

4-10.4.1.3. Dry abrasive blasting of titanium alloys and high strength steel creates sparking. Take care to ensure that there is no hazardous concentration of flammable vapors present.

4-10.4.1.4. After blasting in confined areas, it is essential that all blasting media and other residue be completely removed. The blasting media can be very slippery and can cause dangerous falls.

4-10.4.2. Abrasive Blasting Procedures. The blasting operation should be accomplished in the following steps:

### **CAUTION**

When blasting aluminum alloys or magnesium alloys, do not allow the blast stream to dwell on the same spot longer than 15 seconds. Longer dwell times will cause excessive metal removal.

a. Inspect areas and surfaces to be blasted and decide what techniques will be used. Clean oil and grease from surfaces with diluted MIL-PRF-85570 Type II or an approved cleaning solvent (e.g. MIL-PRF-680 Type II or MIL-PRF-32295 Type I).

(1) Blasting shall not be used in areas or under conditions that would allow any escaped abrasive particles to contaminate any system, engine, or other component.

(2) Examine all corroded areas for corrosion blisters. If intergranular exfoliation is present, use other recommended mechanical removal methods.

(3) Blasting shall not be performed on surfaces where there is a danger of warping or distorting the base material. Sheet metal, 0.0625 inch (16 gage, U.S. Standard) or thinner, shall not be blasted without engineering approval. See the applicable aircraft manuals for limits on metal removal for the particular part.

b. Determine what areas should be protected from the blast stream and from entrapment of the media, and take action to mask or seal these areas. Composite surfaces and those requiring a high gloss surface finish must be effectively protected from the blast. Use impact resistant PMB tape (3M No. 500 or Intertape BT-100).

c. Static ground the blaster and equipment to be blasted.

d. Blast corroded areas using the pressures and materials given in Table 4-4. Do not attempt to use pressures higher than those specified, since higher air pressures tend to smear the metal and entrap corrosion products. When cleaning nonferrous (e.g. aluminum, magnesium) alloys, never use media which has been used for cleaning ferrous metals. Abrasives used for cleaning ferrous metals will contain many particles of metal which will remain in the abrasive and will contaminate any nonferrous metal being cleaned. Refer to applicable abrasive blasting equipment instructions.

(1) Direct the blast stream at an angle to sweep across the surface being cleaned (30-40 degrees from the surface). Several short passes over the corroded area with the blast nozzle are more effective than one sustained effort. The passes should start a few inches before and end a few inches beyond the area to be cleaned.

(2) Maintain the nozzle distance from the surface being cleaned wherever the best cleaning is obtained. The normal nozzle distance range is from two to six inches.

(3) Continue blasting with short passes over the corroded area to be cleaned until a near-white blast cleaned surface is obtained. A near-white blast cleaned finish is a surface finish from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint, or other foreign matter have been removed.

### **CAUTION**

Refer to the individual aircraft manuals for limits on metal removal. Do not exceed these limits without engineering approval.

(4) In critical areas it is necessary to fair out and smooth edges of pits to reduce stress concentrations (see paragraph 4-11). The most effective manner is to rotate the blast nozzle around the outer edge of the pit, keeping the nozzle at a constant distance from the work piece and moving at a constant rate. Several short passes over the corroded area with the blast nozzle are more effective than one sustained effort.

e. Upon completion of blasting, inspect for the presence of corrosion in the blasted area. It may be necessary to use fluorescent penetrant inspection with a 10X magnifier. Particular attention shall be given to areas where pitting has progressed into intergranular attack. This is necessary because abrasive blasting has a tendency to close up streaks of intergranular corrosion rather than remove them if the operator uses an improper impingement angle. If corrosion has not been removed in a total blasting time of 60 seconds on any one specific area, other mechanical methods of removal should be utilized.

f. Ensure that the limits of metal removal have not been exceeded, thereby affecting the structural integrity of the piece.

g. Completely clean all residue from the surface and exposed areas using a vacuum cleaner or low pressure air. The vacuum cleaner nozzle shall be plastic or covered with masking tape to protect surfaces from mechanical damage. Clean surface using materials

and procedures recommended in Chapter 2. Treat and protect all blasted areas as soon as possible after blasting in accordance with the procedures outlined in Chapter 5.

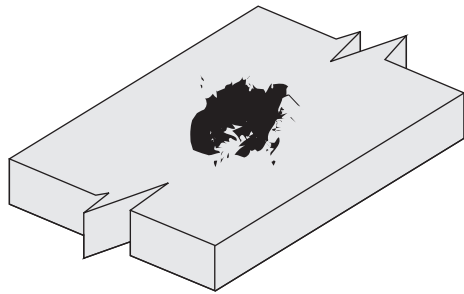
**4-11. SURFACE FINISH.** All depressions resulting from corrosion removal shall be blended smoothly and evenly with the surrounding original surfaces. In critical and highly stressed areas, all pits remaining after removal of corrosion products, by any method, shall be blended out to prevent stress risers which may cause stress corrosion cracking.

#### **4-11.1. PITTING ON A NON-CRITICAL STRUCTURE.**

On noncritical structure it is not necessary to blend out pits remaining after removal of corrosion products since this results in unnecessary metal removal. Check specific aircraft manuals for maximum allowable depth of depressions. The general guidelines for shaping and blending corrosion grindouts are shown in Figure 4-7. For additional information, contact ACC/SPM for blendout procedures.

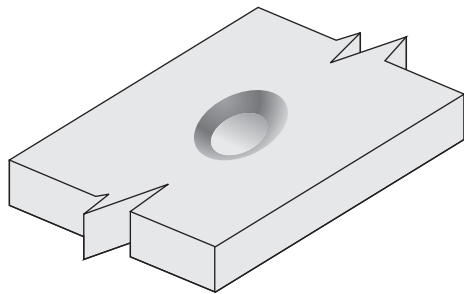
#### **4-11.2. PITTING ON A CRITICAL STRUCTURE.**

On critical structure having a large number of closely spaced pits, intervening material may be removed to minimize surface irregularity or waviness. The resulting depression shall have no sharp corners and shall be saucer-shaped, wherever clearance permits, with its major axis running spanwise on wings and horizontal stabilizers, longitudinally on fuselages, and vertically on vertical stabilizers (Figure 4-8). In areas where a true saucer shaped depression cannot be formed due to inadequate clearance, blend out a depression as nearly as possible to that shape so that there are no abrupt or sharp edges (see Figure 4-9).



**Corrosion Damage Before Rework**

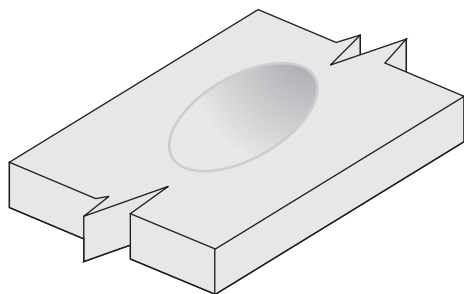
Pit has been cleaned up to the extent that all loose corrosion products have been removed.



**Depression After Corrosion Removal**

Rough edges have been smoothed and all corrosion has been removed.

However, depression has not been shaped.



**Dish-Out After Blending**

Blending has been accomplished.

Figure 4-7. Shaping Reworked Areas

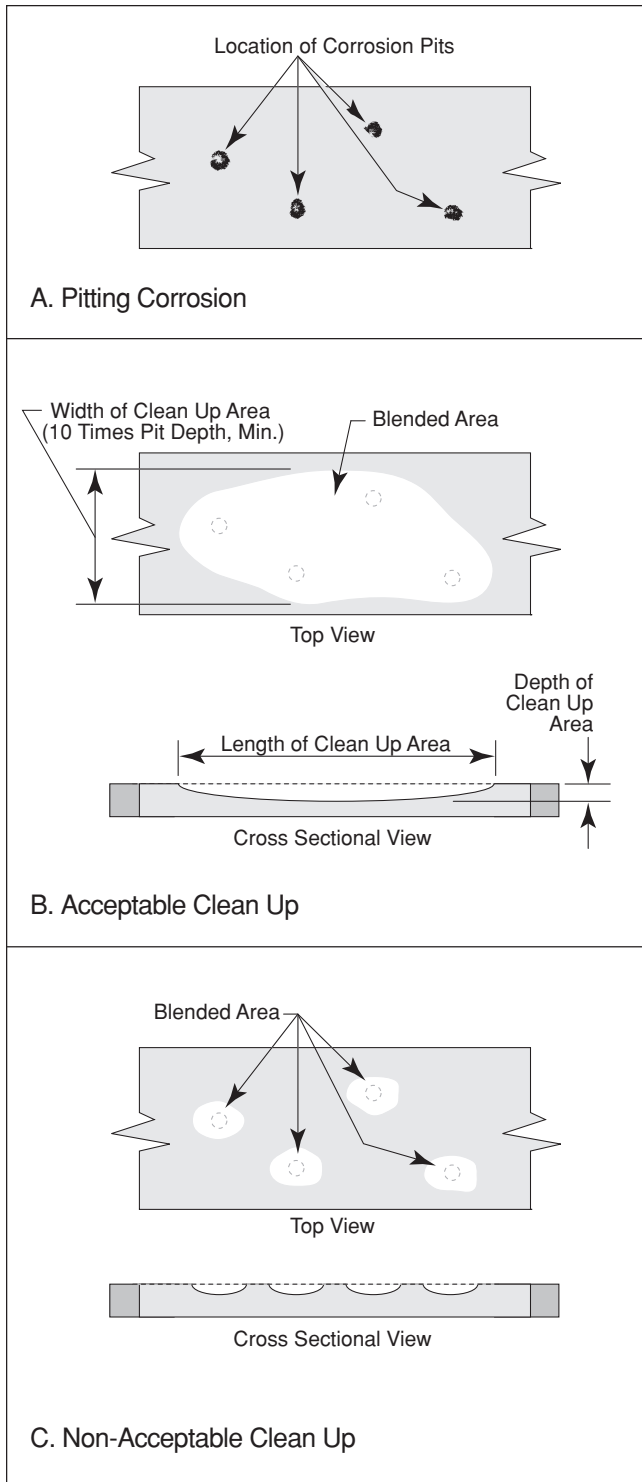


Figure 4-8. Clean-Up of Pitting Corrosion on Critical Structure

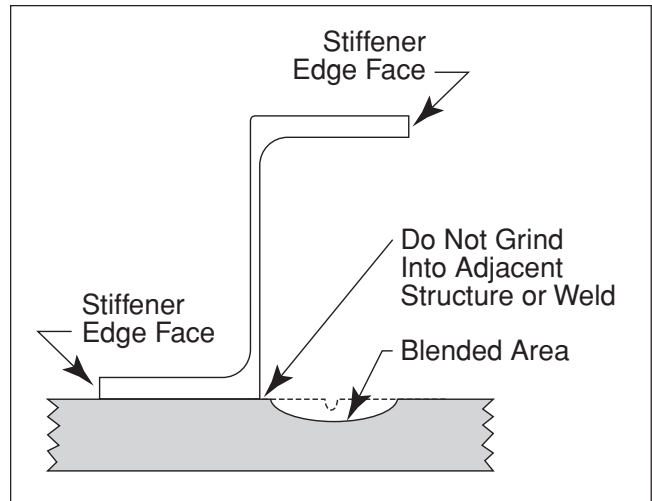


Figure 4-9. Clean-Up of Limited Clearance Areas

## CHAPTER 5 SURFACE TREATMENT

**5-1. PURPOSE.** A critical step in the corrosion prevention and control process is treating the surface of the metal with a prescribed chemical to form a protective oxide film. Properly applied chemical treatment imparts considerable corrosion resistance to the metal, and greatly improves the adhesion of subsequently applied paints or other coatings. Epoxy primers, for example, which do not adhere well to bare aluminum, adhere very well to chemical conversion coatings.

**5-2. SURFACE PREPARATION.** After completing corrosion removal in accordance with Chapter 4, proceed as follows:

a. **Feathering Edges of Paint.** Feathering of paint along the edge of areas that have been chemically or mechanically stripped is required prior to pre-treatment and repainting to ensure a smooth, overlapping transition between the old and new paint surfaces. A smooth, overlapping paint film will ensure the absence of a rough, soil accumulating junction between the old and new paint films. Feathering shall be accomplished using 240 or 320 grit aluminum oxide abrasive cloths (ANSI B74.18), fine or medium aluminum oxide abrasive mats (A-A-58054), or a fine or very fine powered finishing brush (3M Radial Bristle Disc with 240 or 320 grit aluminum oxide abrasive).

### NOTE

Aircraft that have been waxed, particularly with silicone based material, may require special cleaning to obtain a surface free of water breaks. When silicone wax is suspected, solvent clean using an approved cleaning solvent.

b. Clean surface with MIL-PRF-85570 Type II aircraft cleaning compound (dilute 1 part cleaner to 14 parts water) and an abrasive mat, then rinse with clean water. For water sensitive areas, use an approved cleaning solvent.

c. Lightly abrade the bare or clad surface with a fine or very fine abrasive mat (A-A-58054) to remove the oxide layer and any residual chemical conversion coating. This is the most effective means of preparing the surface so that it will accept a new chemical conversion coating. Care shall be taken to ensure that clad surfaces are not compromised during mechanical cleaning, as this can reduce the overall corrosion resistance of the alloy.

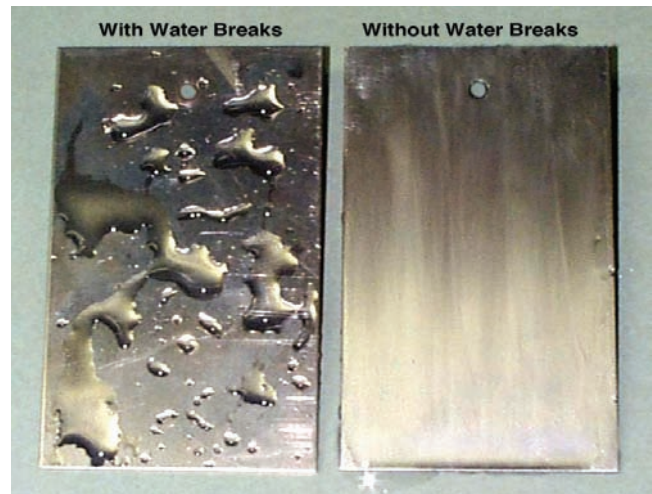


Figure 5-1. A Water Break-Free Surface Compared to One with Breaks

d. After abrading the surface, rinse the area by flushing with clean, fresh water. Particular attention should be given to fasteners and other areas where residues may become entrapped. At this stage of the cleaning process, the surface should be water break-free (see Figure 5-1). A surface showing water breaks (water beading or incomplete wetting) is indicative of contamination, which will later interfere with conversion coating, sealing, plating, and/or painting.

e. If the surface is not free of water breaks, reclean the area by repeating paragraphs b, c, and d.

**5-3. PRECAUTIONS.** Observe the following precautions when applying chemical conversion coating solutions on aluminum or magnesium surfaces:

5-3.1. Chemical conversion coating materials are acidic and require the use of chemical resistant gloves and chemical or splash proof goggles by personnel during handling and application. If the material accidentally contacts the skin or eyes, flush immediately with plenty of clean, fresh water. Report to dispensary and/or consult a physician if eyes are affected or skin is burned.

5-3.2. Mixing and application should be done in an adequately ventilated area. Avoid prolonged breathing of vapors.

5-3.3. Some chemical conversion coating materials are strong oxidizers and a fire hazard when in contact with combustible materials. Therefore, oxidizers must



be stored separately. Rags and other materials contaminated with conversion coating materials should be containerized and properly disposed of as soon as possible.

5-3.4. Do not use chemical conversion coating materials on high-strength steel. Catastrophic failure may occur due to hydrogen embrittlement.

5-3.5. Do not allow any aluminum or magnesium chemical conversion coating materials to enter faying surfaces or other areas where the solutions cannot be adequately removed by rinsing as the residue can cause corrosion.

5-3.6. Do not use steel, lead, copper, or glass containers for holding/storing chemical conversion coating materials. Use only acid-resistant plastic, rubber, or stainless steel. Brushes with tin plated steel handles or ferrules may be used, but contact with the treatment solution should be minimized.

**5-4. CHEMICAL CONVERSION COATING.** Also known as conversion coating, chemical film, paint pretreatment, "Accelagold", or "Alodine", these treatments are aqueous acid solutions of active inorganic compounds that convert aluminum or magnesium surfaces to a corrosion resistant film. This film improves the adhesion of paint coatings. The process specification governing aluminum conversion coating is MIL-DTL-5541, and MIL-DTL-81706 is the material specification for aluminum conversion coating materials. The process and material specification for pretreatment and prevention of corrosion on magnesium alloys is AMS-M-3171.

5-4.1. APPLICATION METHODS. Chemical conversion coating application methods include spray, brush-on or wipe-on, immersion, and applicator pens or pre-saturated applicator devices.

5-4.2. APPLICATION TOOLS. Chemical conversion coatings may be applied by Touch-N-Prep pens, pre-saturated wipes, acid resistant brushes, sponge stick moisteners, non-atomizing sprayers, or dip tank immersion.

**5-5. MIL-DTL-81706 CHEMICAL CONVERSION COATING FOR ALUMINUM ALLOYS.** MIL-DTL-81706 is a chemical treatment for both bare and clad aluminum

surfaces, including touch-up of scratched/damaged anodized aluminum. MIL-DTL-81706 has two types (Type I and II) and two classes (Class 1A and 3), and six forms. The majority of aircraft chemical conversion coating requirements are Type 1 Class 1A.

5-5.1. TYPES. Type I materials contain hexavalent chromium and Type II materials do not contain hexavalent chromium. Type II coatings may not be substituted for Type 1 coatings without engineering authorization.

5-5.2. CLASSES. Class 1A coatings provide maximum protection against corrosion when left unpainted and superior adhesion when paint systems are applied. Type 1 Class 1A coatings can be iridescent yellow, golden brown or iridescent blue in color and rarely exceed 0.005 mils in thickness. Class 3 coatings are intended for use as a corrosion preventative film for electrical and electronic applications where low resistance contacts are required. Class 3 coatings are often much thinner than Class 1A coatings and usually lighter in color. Type II coatings are the same thickness as Type I, but are an iridescent blue to gray color for both Class 1A and Class 3.

5-5.3. FORMS. Aluminum chemical conversion materials are available in the following forms:

#### NOTE

Form I concentrate and Forms II and V powder shall be mixed in accordance with the manufacturer's instructions.

a. Form I (Concentrated Liquid). When water, preferably deionized (DI), is mixed with the concentrate, a solution equivalent to Form III is created. The unused portions of the mixed solution may be stored in a container and used as required. Once mixed, service life is six months if the solution is not contaminated. Service life may be extended if solution successfully passes the test in paragraph 5-8.

b. Form II (Powder). When water, preferably deionized (DI), is mixed with the powder, a solution equivalent to Form III is created. The unused portions of the mixed solution may be stored in a container and used as required. Once mixed, service life is six months if the solution is not contaminated. Service life may be extended if solution successfully passes the tests in paragraph 5-8.



c. Form III (Premixed Liquid). Ready to use liquid for brush (wipe-on/wipe-off), spray, and immersion applications. The premixed liquid is the most commonly used form of MIL-DTL-81706.

d. Form IV (Premixed Liquid, Thixotropic). Thickened, ready to use liquid for touch-up brush applications on vertical or underlying surfaces.

e. Form V (Premeasured Powder, Thixotropic). After addition of water, a thickened liquid is created that is equivalent to Form IV.

f. Form VI (Premixed Liquid). Ready to use liquid for touch-up in a self-contained applicator device (e.g. Touch-N-Prep pens or pre-saturated wipes).

#### 5-5.4. APPLICATION OF MIL-DTL-81706 FORMS I-V.

##### NOTE

Cleaning shall take place immediately before application of the chemical conversion coating solution because oxides will form on the aluminum surface and interfere with the chemical reaction.

a. Surfaces to be treated must be clean and free of oils, greases, fingerprints, dirt, and corrosion products prior to treatment. Refer to paragraph 5-2 for surface preparation.



Coating, Chemical Conversion 7  
MIL-DTL-81706

b. Immediately following cleaning, apply aluminum conversion coating material to surface. Keep the surface wet with treatment material until a color change or iridescence is noted (approximately 2-6 minutes). Depending upon the aluminum alloy, the color change will vary from a light iridescent color to a darker golden brown in color for Type I. The color will range from a faint iridescent to a light blue, gray, or purple for Type II.

c. After the color change, rinse treated surfaces with clean, fresh water and allow to dry completely before painting.



Figure 5-2. Touch-N-Prep (TNP) Pen

##### NOTE

Expiration dates for the Alodine 1132 Touch-N-Prep (TNP) pens are noted on the individual pens. As a general rule for pens stored at room temperature, it is usually two years from the date of manufacture or one year after it is first used. However, the cap must be on the pen when not use to prevent evaporation.

#### 5-5.5. APPLICATION OF MIL-DTL-81706 FORM VI (TOUCH-N-PREP (TNP) PENS).

The repair of damaged chemical conversion coatings on aluminum surfaces can be accomplished by using Touch-N-Prep (TNP) pens (see Figure 5-2). The TNP pens are authorized for touching-up small surface areas requiring either Class 1A or Class 3 solution. Use of TNP pens does not require water rinsing or wiping-off following applications, thereby minimizing hazardous waste generation. Empty pens can be returned to manufacturer for recycling using the self-addressed adhesive label and the original box.

5-5.5.1. To use the TNP pen, remove cap and charge the tip by firmly pressing tip against a flat surface for 10-15 seconds. The conversion coating solution in the pen will saturate the tip. Do not over-saturate tip. Refresh solution during use by pressing tip against the surface. The acrylic tip of TNP pen can be modified or altered to form any shape to allow touch up of hard to reach areas.

5-5.5.2. Repair damaged coating as follows:

a. Clean the damaged area and prepare the surface to be repaired in accordance with paragraph 5-2. Surface must be water break free and dry prior to using the TNP pen.



Figure 5-3. Application of TNP Pen on Aluminum Substrate



Figure 5-4. Magnesium Treatment Kit



Coating, Chemical Conversion 7  
MIL-DTL-81706

b. Immediately following cleaning, use the TNP pen to apply a chemical conversion coating solution in overlapping parallel strokes (see Figure 5-3). Do not over apply the solution or allow puddles, drips, or runs to form.

c. Apply one coat of solution and allow coating to dry for 5-10 minutes.

### CAUTION

The newly formed conversion coating is soft and can be easily damaged. Do not disturb the coated surface until coating is completely dry.

d. The treated surface does not require rinsing or wiping-off, and can be air or forced dried with hot air. Maintain drying temperatures below 140°F to avoid compromising the integrity of the film. Minimum dry time is one hour. Once completely dried, the coating is ready for subsequent priming and/or painting.

e. If bare surface areas still exist, repeat paragraphs b through d.

f. If treated surface does not turn to an iridescent yellow color shortly following application, re-clean surface and re-apply (paragraphs a through d).

5-5.6. POWDERY CONVERSION COATING. Allowing the chemical conversion coating to dwell too long on the aluminum surface can result in a powdery coated surface. Aluminum prepaint treatments shall be rinsed immediately after the allotted pretreatment time. A brownish color, or dry/matte finish indicates too long a dwell time and produces a powdery coating. This will not provide a good surface to which the paint system can adhere. If a powdery coating is formed, clean the surface in accordance with paragraph 5-2 and reapply the solution with a shorter pretreatment time.

### **5-6. AMS-M-3171 CHEMICAL CONVERSION COATING FOR MAGNESIUM ALLOYS.**

#### CAUTION

Aluminum conversion coating solution (MIL-DTL-81706 Type I) is not authorized for treating magnesium surfaces.

5-6.1. AMS-M-3171 TYPE VI. This material, also known as Dow #19, is a brush-on chemical surface treatment for magnesium alloys that provides corrosion protection and improved paint adhesion. This material is primarily used to touch-up and repair small areas on magnesium parts such as transmission housings and gearboxes. It is available in ready-to-use plastic bottle kits (see Figure 5-4). Each kit contains an 8 ounce bottle of premixed magnesium surface treatment solution, two 250 ml polyethylene beakers for dispensing material to prevent contamination of the 8 ounce bottle, a 16 ounce trigger spray bottle for water rinsing, and two reusable nylon brushes. If the premixed AMS-M-3171 Type VI solution is not readily available, the solution may be prepared using the mixing instructions provided below.

Contact the Materials Engineering Laboratory at a depot level maintenance activity for assistance if necessary.

- a. Obtain a clean container made of stainless steel, aluminum, or acid-resistant plastic (such as polyethylene or polypropylene) that is at least one gallon in capacity.
- b. Add  $\frac{1}{2}$  gallon of water, preferably distilled or deionized (DI) water, to the container.

### **WARNING**

Chromic acid can cause burns of the skin, eyes, and mucous membranes, including irritation and ulcers of the nasal septum. Use rubber gloves, goggles, and a dust filter mask when mixing.

Chromic acid is a strong oxidizer and may ignite on contact with organic materials and reducing agents.

- c. Add  $1\frac{1}{3}$  ounces (37.8 grams) of chromic acid (A-A-55827) to the water and allow to dissolve completely.
- d. Add 1 ounce (28.3 grams) of calcium sulfate (O-D-210) to the chromic acid/water mixture.
- e. Top off with enough distilled or DI water to bring total volume to one gallon. Mix solution thoroughly until chromic acid and calcium sulfate are completely dissolved. Once mixed, the solution has a service life of about two years if not contaminated. The solution can be service life extended if it has not changed color, separated into different layers, and is tested successfully on a scrap part (see paragraph 5-8).

#### 5-6.2. APPLICATION OF AMS-M-3171 TYPE VI.

- a. Surfaces to be treated must be clean and free of oils, greases, fingerprints, dirt, and corrosion products prior to treatment. Refer to paragraph 5-2 for surface preparation.



Chemical Conversion Coating  
for Magnesium Alloy  
SAE AMS-M-3171

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- b. Immediately following cleaning, apply magnesium conversion coating solution to surface using a brush. Keep the surface wet with treatment solution until a

color change is noticed (approximately 1-3 minutes). Depending upon the magnesium alloy, the color can change to golden-brown, greenish-brown, brassy or gray.

- c. After the color change, rinse treated surfaces with clean, fresh water and allow to dry completely before painting.

**5-7. TROUBLESHOOTING.** If chemical conversion coatings do not form properly, check for one of the following causes.

- a. The metal surface is insufficiently cleaned. Cleaning must provide a water break-free surface. Refer to paragraph 5-2.
- b. There was insufficient dwell time. As the solution approaches its one year service life, or at temperatures below 50°F (10°C), more time may be required to form good films.
- c. The pretreatment solution has been allowed to contact lead, steel, copper, glass, or other incompatible materials that can reduce the effectiveness of the solution and may prevent adequate pretreatment.

**5-8. EXPIRED SERVICE LIFE.** The following test may be performed to determine if a chemical conversion solution is acceptable for use.

- a. Apply test solution to a small aluminum or magnesium coupon.
- b. Allow solution to react for up to five minutes.
- c. For aluminum, if a yellow to gold coating is produced the material is still usable. For magnesium, a color change to golden-brown, greenish-brown, brassy or gray indicates that the solution is acceptable for use.
- d. If the solution has separated into different layers or a color change is not noticed after five minutes, the solution is not acceptable for use and shall be disposed of in accordance with local hazardous material regulations.

**5-9. POST TREATMENT.** Allow the chemical conversion coated surface to dry for a minimum of one hour before applying paint or other coatings. More time may be required at low temperature or high humidity. The coating is soft until completely dried. Do not wipe the area with a cloth or brush when coating is still wet, since wiping will remove the coating.

5-9.1. To avoid contamination of the treated surface, apply primer according to procedures in Appendix A (Navy) or TM 55-1500-345-23 (Army) within 72 hours after conversion coating or perform temporary preservation procedures (see paragraph 5-10) as soon as possible.

5-9.2. If the surface becomes dirty or accumulates oil, grease, fingerprints, or other contaminants, wipe prior to painting with clean cheesecloth (CCC-C-440) and an approved solvent.

5-9.3. If the surface is scratched or the conversion coating is damaged, clean (refer to paragraph 5-2) and retreat the surface before applying paint coatings or sealants.

**5-10. TEMPORARY PRESERVATION.** Under adverse conditions or when the restriction of operations will not permit the application of a chemical conversion coating, apply a temporary corrosion preventive compound (CPC) in accordance with Chapter 8.



## CHAPTER 6 TREATMENT OF SPECIFIC AREAS

**6-1. INTRODUCTION.** This chapter describes the procedures recommended for treating and protecting against corrosion in specific, corrosion prone areas. The following paragraphs describe the treatment of these areas. The information in this chapter is general, and should be amplified and expanded by reference to the applicable maintenance instruction manuals for specific aircraft.

### WARNING

Observe precautions listed in other chapters or references when using cleaning compounds, solvents, surface treatments, sealants, and paints.

**6-2. AIR INTAKE DUCTS FOR JET AIRCRAFT.** Air intake ducts are fabricated from materials (usually 5000 series aluminum) which have high corrosion resistance. Certain components of these ducts may be cast aluminum or magnesium. Frequent cleaning of the ducts is usually sufficient to preclude attack by corrosion. Activities operating aircraft performing low level missions or take-off and landings over salt water or in highly saline atmospheres may need to paint the ducts to reduce corrosion attack. A requirement for a coating as determined by the operating activity shall be coordinated with the parent service organization. The standard epoxy primer/polyurethane topcoat paint system is recommended for painting the ducts.

**6-3. BATTERY COMPARTMENTS, BOXES, AND ADJACENT AREAS.** The battery, battery cover, battery box, and adjacent areas (especially areas below the battery compartment where battery electrolyte may have seeped) are subject to the corrosive action of the electrolyte. Two different types of batteries are encountered on aviation equipment: lead acid, having a sulfuric acid electrolyte; and nickel-cadmium, having a potassium hydroxide electrolyte.

**6-3.1. PREPARATION OF SOLUTIONS FOR CLEANING AND NEUTRALIZING BATTERY ELECTROLYTES.** Neutralizing solutions are required for cleaning areas contaminated with battery electrolyte.

**6-3.1.1. Sodium Bicarbonate Neutralizing Solution.** For small areas, pour one pint of fresh water into a 500 ml polyethylene wash bottle. Add two ounces of sodium bicarbonate (ASTM D928) and mix thoroughly. For large areas, pour one gallon of fresh water into a

bucket. Add six ounces of sodium bicarbonate (ASTM D928) and mix thoroughly.

**6-3.1.2. Boric Acid Neutralizing Solution.** For small areas, pour one pint of fresh water into a 500 ml polyethylene wash bottle. Add one-half ounce of boric acid powder (A-A-59282) and mix thoroughly. For large areas, pour one gallon of fresh water into a bucket. Add four ounces of boric acid powder (A-A-59282) and mix thoroughly.

**6-3.1.3. Monosodium Phosphate Neutralizing Solution.** For small areas, pour one pint of fresh water into a 500 ml polyethylene wash bottle. Add two ounces of monosodium phosphate (AWWA B504) and mix thoroughly. For large areas, pour one gallon of fresh water into a bucket. Add six ounces of monosodium phosphate (AWWA B504) and mix thoroughly.

**6-3.2. CLEANING AND NEUTRALIZING PROCEDURES.**

### WARNING

When handling electrolytes, splash proof goggles, rubber gloves, and rubber aprons shall be worn. If any electrolyte contacts the skin or eyes, flood the affected area immediately with water and consult the Base Medical Service. An emergency shower and an eye wash station in the area where work is being performed are required.

### CAUTION

Both lead acid and nickel-cadmium battery electrolytes will cause severe corrosion of metallic structure. Do not allow contaminated gloves, rags, or sponges, to come in contact with aircraft structure. Place all items contaminated with electrolyte in a leak-proof plastic container prior to removing them from the aircraft. Remove any battery box which contains spilled electrolyte from the aircraft prior to cleaning it. Electrolyte spilled on aircraft structure shall be cleaned up as soon as possible after it has been detected.

a. Apply the proper indicator to the spill area. For spills from lead-acid batteries, apply a strip of blue litmus paper to the wet surface. A color change to red

indicates an acid contaminated area. For spills from nickel-cadmium batteries, apply a strip of red litmus paper to the wet surface. A color change to blue indicates an alkaline contaminated area.

b. Apply the correct neutralizing solution to the areas where the litmus paper has been applied. Use a 10 percent sodium bicarbonate solution (see paragraph 6-3.1.1) to neutralize sulfuric acid from lead acid batteries. Use a boric acid solution (see paragraph 6-3.1.2) or a monosodium phosphate solution (see paragraph 6-3.1.3) to neutralize potassium hydroxide from nickel-cadmium batteries. Ensure that the area is well-saturated including all seams and crevices where electrolyte could collect. Use care to prevent neutralizing solutions 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 five minutes or until all bubbling action ceases, whichever is longer.

c. Rinse the area thoroughly with a liberal amount of clean water.

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

e. Reapply the litmus paper, as in paragraph a. If the litmus paper does not change color, rinse the area, as in paragraph c, and dry the areas with clean cloths or rags. If the litmus paper changes color, repeat paragraphs b and c.

f. Apply chemical conversion coating treatment (Chapter 5), sealant (Chapter 7), or paint coatings (Appendix A), as required.

6-3.3. PAIN T SYSTEMS. Special acid and/or alkali resistant coatings are usually required for battery compartments, boxes, and areas. Refer to the applicable aircraft manuals.

**6-4. BERYLLIUM-COPPER ALLOYS.** Surface discoloration of beryllium copper alloys is normal and removal is not advised. If removal is required, minimize the generation of fine beryllium dust particles as much as possible.

a. Wear disposable coveralls, gloves, hood, and cartridge respirator. Consult local safety office for requirements.



Solvent, Degreasing  
MIL-PRF-680

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b. Dampen abrasive mat (A-A-58054) with degreasing solvent (MIL-PRF-680).

**WARNING**

Dust, corrosion products, and other fine particles generated by beryllium and beryllium-copper alloys are toxic when inhaled or allowed to contact the skin. Severe poisoning can result if beryllium dust is inhaled. Beryllium-copper alloys shall be cleaned only in strict accordance with the following procedure or the procedure of the applicable maintenance manual.

c. To prevent the spread of toxic dust, keep mat wet throughout the corrosion removal process.

d. Clean fitting with disposable towels dampened with MIL-PRF-680 after the completion of corrosion removal.



Compound, Corrosion Preventive  
Water Displacing  
MIL-PRF-81309

4

e. Apply corrosion preventive compound, MIL-PRF-81309 Type II, on bushings, or MIL-PRF-81309 Type III, on contacts.



Solvent, Degreasing  
MIL-PRF-680

13

f. Wipe work area clean with disposable towels dampened with degreasing solvent (MIL-PRF-680).

g. Place disposable towels, abrasive mats, and coveralls in a plastic bag marked "Beryllium contaminated waste".

h. Seal plastic bag with tape (AMS D6123 Type II).

i. Discard plastic bag in accordance with local environmental protection directives.



j. Wash hands with soap and water immediately after completion of task.

**6-5. CABLES, STEEL.**

**WARNING**

Consult maintenance manuals for cable detensioning and tensioning requirements prior to performing any maintenance.

6-5.1. If the surface of a cable is corroded, relieve cable tension and carefully force the cable open by reverse twisting. Visually inspect the interior. Corrosion on the interior strands constitutes failure, and the cable must be replaced.

**CAUTION**

Do not use metallic wool to clean installed cables. The use of metallic wool will cause dissimilar metal particles to become embedded in the cables and create further corrosion problems (galvanic corrosion).

6-5.2. If no internal corrosion is detected, remove loose external rust and corrosion with a clean, dry, coarse-weave rag or fiber brush.

**CAUTION**

Excessive solvent will remove internal cable lubricant and allow cable strands to abrade and further corrode.



Solvent, Degreasing 13  
MIL-PRF-680



Cleaner, Non-Aqueous, 15  
Low VOC, HAP Free,  
MIL-PRF-32295

6-5.3. To clean control cables, use a clean cloth dampened with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I).



Compound, Corrosion Preventive 6  
MIL-PRF-16173

6-5.4. After thorough cleaning, apply MIL-PRF-16173 Grade 4 corrosion preventive compound (CPC) liberally. Wipe off excess. If excessive CPC is allowed to build up, it will interfere with the operation of cables at fair-leads, pulleys, or grooved bellcrank areas.

**6-6. DEPLETED URANIUM COUNTERWEIGHTS.**

6-6.1. Some aircraft have depleted uranium balance weights incorporated in the airframe. Refer to applicable maintenance manuals (Scheduled Depot Level Maintenance) to determine the location of depleted uranium parts.

**WARNING**

Do not abrade or sand depleted uranium under any circumstances. Depleted uranium is extremely toxic and shall be worked only under a license from the Nuclear Regulatory Commission. Machining or other work, such as surface sanding, may be done only by the licensee. No drilling, sanding, or other mechanical work is permitted on depleted uranium by any service maintenance activities. If the protective finish (plating) which covers the depleted uranium is chipped, peeled, or otherwise removed so the dark gray or black depleted uranium (or uranium oxide) is visible, the part must be returned to the licensee for rework or disposal. Packaging and shipping procedures shall conform to current regulations for handling radioactive materials.

6-6.2. Mechanical removal of corrosion from depleted uranium shall not be attempted at Organizational/Unit or Intermediate level maintenance activities. If corrosion occurs, apply a liberal, continuous coat of AMLGUARD (MIL-DTL-85054) and contact the local radiation safety officer immediately.

**6-7. ELECTRICAL AND ELECTRONIC EQUIPMENT.**

Avionic and electrical equipment are easily damaged by contamination with corrosion removal debris and by application of improper corrosion control materials. Many of the conventional corrosion treatment methods used on airframe components are also used on areas adjacent to or supporting avionic equipment, electrical equipment, wire bundles, and other electrical parts. Personnel performing airframe corrosion control tasks shall be familiar with avionic corrosion control materials and procedures to ensure that no damage to electrical or avionic equipment will occur. For more specific information, refer to Volume III, as well as the specific equipment maintenance manuals.

**6-7.1. GROUNDING AND BONDING CONNECTIONS.** After the grounding or bonding connection has been made, overcoat the entire connection, including all bare areas on the metal surface, with MIL-PRF-81733 sealant.

**6-7.2. CONDUIT AND JUNCTION BOXES.** If corrosion is found, remove by mechanical methods outlined in Chapter 4. Before applying primer, reworked and bare metal areas shall be treated with MIL-DTL-81706 for aluminum alloy parts or AMS-M-3171 for magnesium alloy parts. Electrical conduit (exterior) and junction boxes (interior and exterior) shall be primed with two coats of epoxy primer (MIL-PRF-23377 or MIL-PRF-85582) in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

**6-7.3. WIRES AND CABLES.** Electrical wires and cables having plastic jacket insulation or braided wire exterior shielding shall not be painted except as required for moisture and fungus proofing (see Volume III).

**6-7.4. ELECTRICAL CONNECTORS AND LEAD-IN ATTACHMENT POINTS.** Almost all corrosion problems on electrical and electronic equipment are caused by moisture intrusion at the connector or lead-in attachment points on cases and covers. While the design of this equipment is fixed, corrosion can be prevented by spraying MIL-PRF-81309 Type III corrosion preventive compound into the pin and/or pin receptacle end of connectors prior to mating the connector halves and on the connector shells after mating the connector halves. External electrical connectors and clamps that are cadmium plated may become discolored or tarnished during service. This is normal for cadmium plate and should not be removed. Loss of cadmium plating is evident by rusting or pitting. Consult Volume III for additional information.

**6-7.5. MOISTURE AND FUNGUS PROOFING OF ELECTRICAL AND ELECTRONIC EQUIPMENT.** See Volume III.

**6-7.6. ANTENNAS.** Dissimilar metal corrosion (galvanic corrosion) often occurs at antenna attachment points. Refer to Volume III for repair and replacement information on conductive gaskets and sealants, and to the maintenance instruction manuals for information on paint touch-up and finishing.

**6-8. EMI SEALS AND GASKETS.** To prevent malfunctions caused by electromagnetic interference (EMI), electrically conductive shielding is either built

into the avionic device or must be added to access panels, doors, or covers to: 1) prevent emission of EMI from its own circuits and; 2) prevent susceptibility to outside EMI. EMI seals and gaskets may also act as environmental seals in certain locations, especially around doors and access panels. However, since the seals must provide a conductive path to an aluminum or graphite/epoxy skin, corrosion often occurs at the junction of these dissimilar metals. When corrosion occurs, the conductive path is lost and so is the EMI protection, making the aircraft susceptible to electrical malfunctions caused by external radiation. Refer to Volume III for additional information on EMI causes and effects.

**6-8.1. EMI SHIELDING MATERIALS.** The following are typical EMI shielding materials: elastomeric seals and gaskets with an embedded or attached conductor (Figure 6-1), conductive elastomer gaskets (Figure 6-2), metallic screens installed under composite covers (Figure 6-3), bonding cables for access doors (Figure 6-4), and bonding washers for avionics enclosure (Figure 6-5).

**6-8.2. TREATMENT OF EMI SEALS AND GASKETS.** When corrosion is observed in such areas, disassemble only the affected area and remove the corrosion using the mildest available method.



Alcohol, Isopropyl  
TT-I-735

1

a. Carefully clean the area with cloths wet with isopropyl alcohol (TT-I-735). Dry with a clean cloth.

b. If replacement seals are available, install them in accordance with aircraft maintenance instructions or bulletins.



Compound, Corrosion Preventive  
Water Displacing  
MIL-PRF-81309

4

c. If replacement seals are not available or do not exist, spray the contacting surfaces with a light coating of MIL-PRF-81309 Type III, then reassemble. Periodically inspect repaired areas and areas known to be chronic problems.

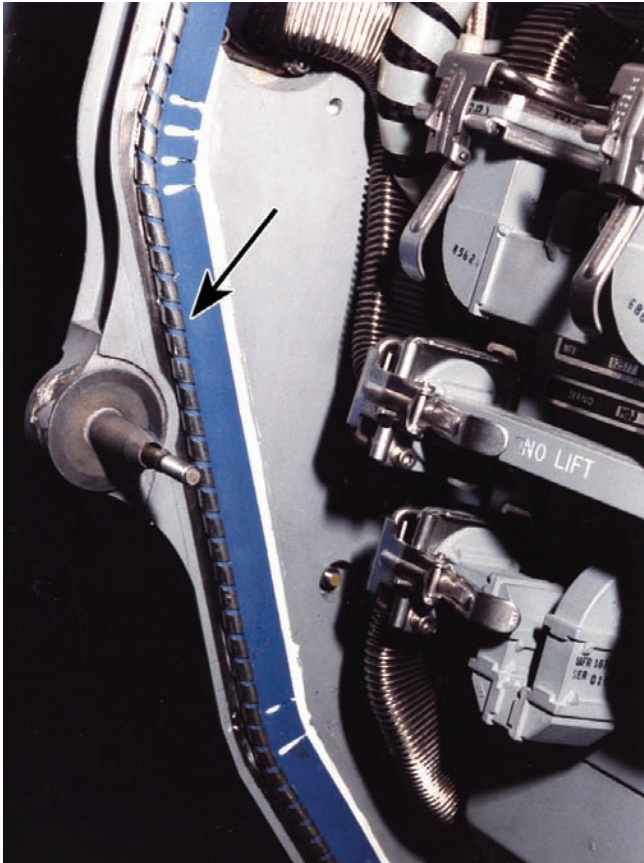


Figure 6-1. Beryllium-Copper Spiral Contact with Environmental Fluorosilicone Seal



Figure 6-3. Stainless Steel EMI Screen

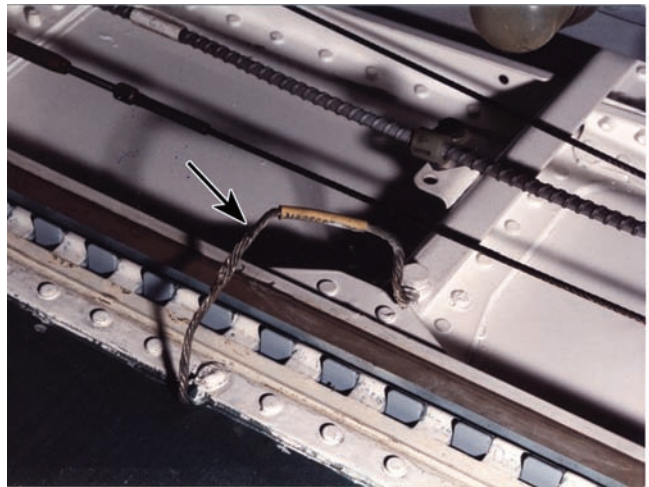


Figure 6-4. Bonding Cable From Airframe to Graphite/Epoxy Avionics Bay Door

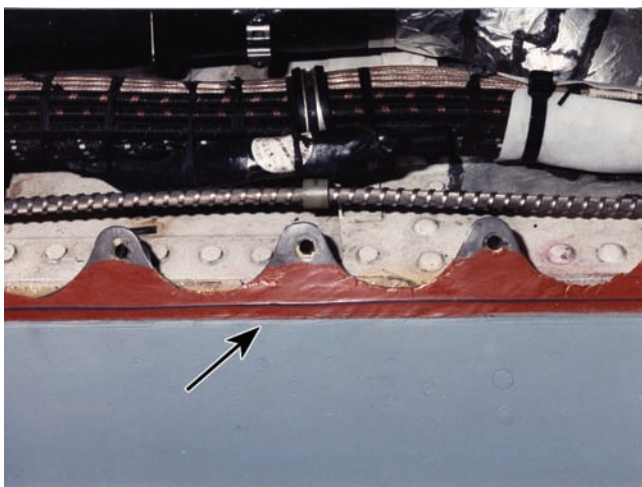


Figure 6-2. Dorsal Longeron EMI Seal



Figure 6-5. EMI Bonding Washers in Avionics Bay



## 6-9. FASTENERS AND ATTACHING PARTS.

### NOTE

The following does not apply to parts which are lubricated in the joint areas immediately before or after installation, or to close tolerance bolts and parts which are removed frequently for maintenance requirements. Additional information concerning wet installation with sealant can be found in Chapter 7, and wet installation with primer can be found in Appendix A.

6-9.1. Attaching parts, such as nuts, bushings, spacers, washers, screws, self-tapping screws, sleeves for shake-proof fastener studs, self-locking nuts, speed nuts, clamps, and bolts, do not need to be painted except when dissimilar metal contact is involved with the materials being joined. However, all parts shall be installed wet with sealant. For permanent installations, use MIL-PRF-81733 sealant and coat the entire mating surface of the parts. For removable installations, use AMS 3284 sealant and coat only the lower side of the heads of screws and bolts with sealant. For removable installations, coat the threads and shanks of screws and bolts or the holes into which they are inserted with a corrosion preventive compound (see Table 8-3).

6-9.2. CLOSE TOLERANCE PARTS. Close tolerance bolts and parts shall be coated with corrosion inhibiting solid film lubricant. Use AS 5272 (heat curing) on non-aluminum parts when 400°F (204°C) ovens are available. Use MIL-L-23398 (air curing) on aluminum parts and on all types of metallic parts when 400°F ovens are unavailable. The solid film lubricant shall be applied and completely cured prior to assembly. Bolts shall be coated on shanks and threads only. A thin bead of sealant shall be applied under the bolt head to impart a wet seal. If possible, bolt head, nut, and end shall be fillet sealed with MIL-PRF-81733 sealant after installation.

6-9.3. RIVETS, GENERAL. All rivets shall be installed wet with MIL-PRF-81733 sealant, except those in fuel contact areas.

6-9.4. RIVETS, MONEL. Corrosion of nickel-copper alloy (Monel) is evidenced by green corrosion products. Removal of this corrosion is not required. If desired, corrosion may be removed as follows:

a. Scrub with a brush wet with solution of one cup of sodium bicarbonate (ASTM D928) per gallon of water.

b. Thoroughly rinse the affected area with fresh water and dry with clean cloth or oil free, low pressure air.

6-9.5. FASTENERS AND MAGNESIUM. All machine screws, countersunk fasteners, bolts (head end) and nuts which are used in contact with magnesium shall be installed with 5056 aluminum alloy washers. These parts and washers shall be installed wet with MIL-PRF-81733 sealant and shall be completely fillet sealed with the same material after installation.

6-9.6. ADJUSTABLE PARTS. Adjustable parts, such as tie rod ends and turnbuckles:

a. If possible, surfaces and threads shall be lubricated and protected before assembly with corrosion inhibiting solid film lubricant (AS 5272 or MIL-L-23398) which shall be completely cured prior to assembly. After installation, apply a thin coating of DOD-L-25681 lubricant to all surfaces of these parts located in high temperature areas, or a thin coating of water displacing, corrosion preventive compound (MIL-PRF-81309 Type II) to all surfaces of these parts located in other areas.

b. If solid film lubricants cannot be applied, use a thin coating of DOD-L-25681 lubricant on all surfaces before and after assembly when located in high temperature areas. Apply a thin coating of water displacing lubricant (MIL-PRF-81309 Type II) before and after assembly, when parts are located in other areas.

6-9.7. SLIP FIT PARTS. Slip fit parts shall be assembled with MIL-PRF-81733 sealant between the mating surfaces. If this is not possible, coat the ID of the hole in the receiving part, which is normally the larger structure, with MIL-L-23398 and coat the OD of the mating part with AS 5272 or MIL-L-23398. The solid film lubricant shall be applied and completely cured prior to assembly.

6-9.8. PRESS FIT PARTS. Press fit parts shall be installed with MIL-PRF-81733 sealant between the faying surfaces, and the edges of these parts shall be fillet sealed with the same sealant after installation. The sealant should also be applied to the ID of the hole into which the part will be installed.

6-9.9. CUT EDGES AND HOLES. All cut edges and holes drilled or reworked for bolts, screws, rivets, studs, and bushings of aluminum and magnesium structure or parts shall receive chemical conversion coating treatment prior to the installation of the fasteners or bushings and prior to installing or refinishing the structure or parts. Apply MIL-DTL-81706 to aluminum parts and AMS-M-3171 to magnesium parts in accordance with Chapter 5.

6-9.10. SEVERELY CORRODED (RUSTED) HARDWARE. Severely corroded screws, bolts, and washers shall be replaced. When a protective coating, such as cadmium plating on bolts or screws is damaged, immediate action shall be taken to apply an appropriate protective finish to prevent further corrosion (rusting). Refer to Chapter 8 for proper corrosion preventive materials.

#### 6-10. FAYING SURFACES, JOINTS, AND SEAMS.

##### NOTE

Treat and process faying surfaces of parts, components, or structures which are assembled by adhesive bonding in accordance with the applicable equipment structural repair manual for adhesive bonding.

6-10.1. When repairs are made on equipment or accessories, or when components are installed or structures are reinstalled, the attaching or faying surfaces shall be protected by sealing all metal-to-metal contacts and composite-to-metal contacts.

6-10.2. REMOVABLE STRUCTURES. All removable structures (components requiring frequent removal for maintenance requirements) shall be installed at the faying surfaces with AMS 3284 sealant. Fillet seal all exterior seams on removable structure with AMS 3284 sealant (see Chapter 7 for details on sealant application).

6-10.3. PERMANENT STRUCTURES. All permanent structures shall be installed with MIL-PRF-81733 sealant at the faying surface. Fillet seal all exterior seams (those exposed to the outside environment) of permanent structures to make it flush with the adjoining surface.

6-10.4. The coating system on all attaching parts shall be touched up after installation to match the surrounding structure in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

**6-11. FUEL TANKS, INTEGRAL AND EXTERNAL.** For Navy materials and procedures, see NAVAIR 01-1A-35. For Army materials and procedures, see TM 55-1500-204-25/1 or applicable maintenance manuals.

**6-12. HINGES, PIANO TYPE.** Corrosion inhibiting solid film lubricants are often applied to hinge pins and nodes to provide lubrication and to reduce corrosion problems. See Chapter 2 for procedures on touch-up and replacement of these lubricants when hinges are disassembled.

6-12.1. Each time equipment is washed, make sure all hinges are cleaned in accordance with Chapter 2.

6-12.2. After washing, apply a coating of a water displacing corrosion preventive compound. Apply either MIL-PRF-63460, or MIL-PRF-81309 Type II and MIL-PRF-32033, to the node and hinge pin areas of all piano hinges, including those coated with solid film lubricants.

**6-13. RELIEF TUBE AREAS.** Interior and exterior relief tube areas shall be inspected and cleaned after each flight. Cleaning shall be accomplished in accordance with procedures outlined in Chapter 2. After cleaning, the areas shall be treated with a disinfectant (O-D-1435 or TT-I-735). After cleaning and disinfecting, if the treated areas have exposed bare metal, apply chemical conversion coating material for the specific metal or alloy as outlined in Chapter 5.

**6-14. RUBBER, NATURAL AND SYNTHETIC.** Natural and synthetic rubber shall not be painted or oiled. As a general rule, grease should not be applied to rubber parts, but some parts, such as "O" rings, require a grease coating (consult the appropriate maintenance manual). Many types of rubber are subject to fungus growth (e.g. mold, mildew) which can cause deterioration of the rubber and corrosion of surrounding metal surfaces. If fungus is noted on rubber parts, clean the parts and remove the fungus in accordance with Chapter 2.



Compound, Corrosion Preventive 4  
Water Displacing  
MIL-PRF-81309



Compound, Corrosion Preventive 6  
MIL-PRF-16173

**6-15. SPRINGS.** Springs which are so tightly coiled that the areas between the coils cannot be plated or painted for corrosion protection shall be coated with water displacing corrosion preventive compound (MIL-PRF-81309 Type II) by spraying or dipping, and allowed to dry for at least one hour. After drying, apply a coating of MIL-PRF-16173 Grade 4 to the springs by spraying or dipping. These requirements do not apply to springs operating in oil or hydraulic fluids.

**6-16. SURFACES AND COMPONENTS EXPOSED TO EXHAUST GASES, GUN GASES, AND ROCKET BLAST.** Residues from exhaust gases, gun gases, and rocket blast are very corrosive and can cause deterioration of paint systems. Frequent cleaning of these areas to remove residue is required and shall be accomplished in accordance with Chapter 2.

**6-17. TANKS, POTABLE WATER.** The interior surfaces of aluminum alloy potable water tanks shall not be painted or conversion coated. Remove corrosion by using the mechanical methods outlined in Chapter 4. Flush thoroughly with clean fresh water and ensure all debris is removed.

**6-18. THIN METAL (0.0625 INCH THICKNESS AND LESS).**

6-18.1. Severe pitting, intergranular, and exfoliation corrosion on thin metal requires removal by mechanical methods specified in Chapter 4 as appropriate for the type of metal involved. Use extreme care and consult the applicable maintenance manual for structural damage limits when removing corrosion from thin metal. When stains, surface corrosion, and mild to moderate pitting are found on thin structural skins (i.e., aircraft and missile skins), chemical methods, as appropriate to the type metal involved, are authorized for Army personnel (see Appendix B). Chemical methods are not authorized for Navy use. A convenient and effective mechanical method for the removal of minor corrosion or stains on all metals is as follows:

### CAUTION

Do not allow metallic or corrosion particles to build up around the polishing area or polishing tool (cloth or grit paper) during the polishing operation. Damage to thin metal may result.

a. Mix ground pumice abrasive (SS-P-821) with clean tap water to form a paste. Using a clean, soft cloth (such as cheesecloth, CCC-C-440), apply the paste to the area being treated and abrade the area with a light rubbing motion.

b. When pumice has dried to a white powder, wipe off with a clean, dry, soft cloth. If corrosion products (observed as stubborn stains) still exist, use number 600 grit wet or dry abrasive paper and water to remove the remaining corrosion. Wipe clean with a clean, soft, dry cloth.

c. Refer to Chapter 5 for the required surface treatment, and paint in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

**6-19. TUBING, NON-STRUCTURAL MEMBERS AND ASSEMBLIES.** Non-structural tubing is tubing that transfers a functional fluid (e.g. oxygen, hydraulic fluid, engine oil). Use the same procedures and materials specified for corrosion removal on structural tubing members and assemblies specified in paragraph 6-20.

#### 6-19.1. ALUMINUM TUBING.

### WARNING

Due to the possibility of combustion, do not use degreasing solvent (MIL-PRF-680) or other solvents that are not oxygen compatible on areas of oxygen storage, transfer systems, or surfaces of missiles using liquid propellant. Failure to observe these precautions can result in serious or fatal injury to personnel.

6-19.1.1. Treat aluminum tubing according to the following procedure.

a. Clean in accordance with Chapter 2.

b. Remove corrosion using non-powered mechanical methods specified in Chapter 4. Polish to a smooth surface.



c. Apply chemical conversion coating (MIL-DTL-81706) to the interior and exterior surfaces of tubing (see Chapter 5). Do not apply chemical conversion to the interior of oxygen tubing. Apply conversion coating after fabrication and prior to the installation of new tubes. If corrosion has been removed from tubing, apply conversion coating to all bare, reworked areas.

### **CAUTION**

Use extreme care to prevent the contamination of interior surfaces of hydraulic, oxygen, and air speed indicator tubing during painting operations.

d. Paint or corrosion preventative compound shall not be applied to the interior surfaces of non-structural tubing. Apply the specified exterior finish system to all exterior surfaces or reworked areas of tubing exposed to the environment. Take necessary precautions to prevent primer or paint from entering the interior areas of tubing. Where double flares are used (e.g. oxygen systems), cap the end and apply the finish system after the flaring operation. Paint end fittings after installation on the aircraft or equipment. Touch-up any coating systems damaged during tubing installation. Paint in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

6-19.2. **STAINLESS STEEL TUBING**. Austenitic (3XX series) stainless steels are highly susceptible to pitting, crevice corrosion, and stress corrosion cracking when exposed to moist, salt-laden air and when deposits of dirt and debris are allowed to collect on tubing areas covered by metal brackets or parts. Treat stainless steel tubing according to the following procedure.

### **WARNING**

Due to the possibility of combustion, do not use degreasing solvent (MIL-PRF-680) or other solvents that are not oxygen compatible on areas of oxygen storage, transfer systems, or surfaces of missiles using liquid propellant. Failure to observe these precautions can result in serious or fatal injury to personnel.

- a. Clean in accordance with Chapter 2.
- b. Remove corrosion using non-powered mechanical methods specified in Chapter 4. Polish to a smooth surface.

### **WARNING**

AMS 3166 wipe solvent is flammable and toxic to the skin, eyes, and respiratory tract. Eye and skin protection is required. Use only in a well ventilated area. To control solvent odor, used rags should be immediately placed in sealed bags or covered containers and disposed per local directives.

c. Immediately before painting, wipe areas which will be painted with a lint free cloth moistened with AMS 3166 or an approved wipe solvent, and dry with a clean cloth. Do not allow drying by evaporation, since soils will redeposit on the surface.

d. Apply the specified finish system for stainless steel tubing (consult the applicable maintenance manual). Paint in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

6-19.3. **CADMIUM PLATED STEEL TUBING**. Bare cadmium plating deteriorates rapidly when subjected to abrasion, most bases (alkali) and acids, and marine, industrial, and very humid environments. It should always be protected with a paint system to prevent corrosion. Treat cadmium plated steel tubing according to the following procedure.

- a. Clean in accordance with Chapter 2.
- b. Remove deteriorated plating and corrosion on base metal (steel) using non-powered mechanical methods specified in Chapter 4. Polish to a smooth surface.

### **WARNING**

AMS 3166 wipe solvent is flammable and toxic to the skin, eyes, and respiratory tract. Eye and skin protection is required. Use only in a well ventilated area. To control solvent odor, used rags should be immediately placed in sealed bags or covered containers and disposed per local directives.

c. Immediately before painting, wipe areas which will be painted with a lint free cloth moistened with AMS 3166 or an approved wipe solvent, and dry with a clean cloth. Do not allow drying by evaporation, since soils will redeposit on the surface.

d. Apply the specified finish system for steel tubing (consult the applicable maintenance manual). Paint in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

6-19.4. TUBING FITTINGS AND SLEEVES. Corrosion often occurs on sleeves and their fittings or on the tubing in contact with them, due to the crevices present at the attachment points. Galvanic corrosion often occurs because the type of sleeve or fitting chosen is not electrochemically compatible with the tubing. When corrosion is found on these areas, or when tubing, fittings, or sleeves are replaced, consult the applicable maintenance manual to determine the proper types of sleeves and fittings. Fittings located in areas which are inaccessible for inspection and refinishing during operational service shall be fillet sealed at the joint area with MIL-PRF-81733 sealant at the time of installation and prior to painting. After the sealant is tack-free, paint the tubing, fittings, and sealant in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).



Solvent, Degreasing 13  
 MIL-PRF-680



Cleaner, Non-Aqueous, 15  
 Low VOC, HAP Free,  
 MIL-PRF-32295

a. Clean all old preservative coatings and dirt from the fitting, sleeves, and tubing ends with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I) before reinstalling tubing and tightening fittings.

b. Do not apply the finish system on fittings and adjacent tubing for a distance of one inch from the back end of the fittings on tubing areas requiring periodic removal and/or opening during service.

**WARNING**

Do not use corrosion preventive compounds on oxygen line fittings. These materials contain petroleum solvents which are not liquid oxygen (LOX) compatible. Explosion may occur if oxygen contacts these materials.



Compound, Corrosion Preventive 4  
 Water Displacing  
 MIL-PRF-81309



Compound, Corrosion Preventive 6  
 MIL-PRF-16173



Compound, Corrosion Preventive 5  
 MIL-DTL-85054

c. Except for oxygen line fittings, apply water displacing, corrosion preventive compound (MIL-PRF-81309 Type II) by spray or brush to all fitting surfaces after they are tightened, including the exposed areas of the sleeves and the unfinished areas of the tubing. Allow the CPC to dry for at least one hour, and apply MIL-PRF-16173 Grade 4 or MIL-DTL-85054 over the same area by spraying or brushing.

d. After installation, apply the exterior paint system to exposed tubing, sleeves, and back portions of the B nuts of the fittings.

**6-20. TUBING, STRUCTURAL MEMBERS AND ASSEMBLIES.**

Structural tubing is used as a supporting member in a structure. It does not transport fluids. Only non-powered mechanical procedures and materials specified in Chapter 4 shall be used to remove corrosion on structural tubing. Reworked areas shall always be polished to a smooth surface, using 400 to 600 grit abrasive paper or cloth, as the final step in the corrosion removal procedure. The following steps outline general practices for the protection of structural tubing.

6-20.1. STRUCTURAL ALUMINUM ALLOY TUBING.

6-20.1.1. Apply chemical conversion coating (see Chapter 5) and paint to the exterior and interior surfaces

of structural tubing in accordance with the finish system designated in the applicable maintenance manual. Paint in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army). All bolted or riveted caps or components shall be installed with faying surfaces and fasteners wet using MIL-PRF-81733 sealant.

6-20.1.2. Interior surfaces of tubing having closed end(s) shall be coated with corrosion preventive compound (MIL-PRF-16173 Grade 2 or 4) using the fill-and-drain method of application through holes located near each end of the tubes. These holes shall subsequently be closed by installing blind rivets using MIL-PRF-81733 sealant and overcoating the rivet head with the same after installation.

#### 6-20.2. STRUCTURAL MAGNESIUM ALLOY TUBING.

All surfaces of tubing shall be treated with magnesium conversion coating (AMS-M-3171) in accordance with Chapter 5 and painted with the finish system designated in the applicable maintenance manual. Install all parts onto the tubing with all faying surfaces and fasteners wet with MIL-PRF-81733 sealant.

6-20.3. STRUCTURAL COPPER ALLOY, STAINLESS STEEL ALLOY, AND HEAT RESISTANT ALLOY TUBING. The interior and exterior surfaces of these types of tubing do not require a finish system. However, to prevent galvanic corrosion of other metals with which these types of tubing are in contact, install parts and

attach tubing with faying surfaces and fasteners wet using MIL-PRF-81733 sealant, or AMS 3374 sealant for high temperature areas.

#### 6-20.4. STRUCTURAL CARBON STEEL TUBING.

6-20.4.1. Exterior. All exterior surfaces of steel tubing assemblies shall be finished with one coat of MIL-PRF-23377 or MIL-PRF-85582 primer, followed by two coats of MIL-PRF-85285 polyurethane topcoat. The topcoat color is specified in the applicable maintenance manual. Apply primer and topcoat materials in accordance with Appendix A (Navy) or TM 55-1500-345-12 (Army).

6-20.4.2. Interior. For tubing assemblies without welded or crimped ends, coat all interior surfaces with MIL-PRF-23377 or MIL-PRF-85582 primer using a fill-and-drain procedure. Where practical, in lieu of fill-and-drain procedure, two coats of primer may be spray applied to interior surfaces of all assemblies.

6-20.4.3. After coating the interior, clean the exterior surfaces to remove any residual primer. Seal all holes in tube walls by installing blind rivets wet with MIL-PRF-81733 sealant in the holes and overcoat the rivet heads with the same after installation. Assemble all tubing assemblies manufactured by riveting or bolting members together on fittings with faying surfaces and fasteners wet with MIL-PRF-81733 sealant.

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## CHAPTER 7 SEALANTS

**7-1. PURPOSE.** This chapter covers recommended materials and procedures for the application of sealing compounds to aircraft structures. Sealants prevent the intrusion of moisture, rain, salt water, dust, and aircraft fluids, which can lead to extensive corrosion and possibly equipment failure. Sealants are one of the most important tools for corrosion prevention and control. For sealants to be effective, it is critical that the correct sealant be chosen for a specific area/situation and that it be applied correctly. Only qualified personnel thoroughly familiar with sealants and their application shall be permitted to handle and apply them.

**7-2. REASONS FOR SEALING.** Sealants are used for the following purposes:

- a. Fuel sealing (integral fuel tanks).
- b. Pressure area sealing (cabin areas and access doors).
- c. Weather sealing (exterior skin surfaces).
- d. Firewall sealing (engine and ordnance areas).
- e. Electrical insulation and sealing (bulkhead wiring, electrical connectors, and electrical components).
- f. Acid-resistant sealing (battery compartments and relief tanks).
- g. Window sealing (windshield and canopy).
- h. High temperature sealing (engine areas, anti-icing ducts, and some electronics).
- i. Aerodynamic smoothing (void filling) and sealing (exterior skin surfaces).
- j. Sealing conductive gaskets (communication and navigation antennas and static wicks).
- k. Corrosion inhibition.

**7-3. SEALANT PACKAGING.** Sealants are generally packaged and available as three different units of issue (U/I):

### CAUTION

Sealants are sensitive to mix ratio and will not cure or perform properly if incorrectly mixed.

a. Two Part Can Kit (KT): Package consists of a curing agent (part A) and a base compound (part B) that are pre-measured into separate containers. The entire contents of both containers are intended to be mixed at one time. Accurate weighing equipment shall be used to achieve the correct mix ratio for smaller mixes.

b. Semkit Cartridge (CA): A complete plastic cartridge assembly that stores, mixes, and applies sealant materials. Semkit packages are convenient because they eliminate the need to measure and handle materials, prevent contamination when opening and closing can kits, and reduce air entrapment which causes voids in mixed sealant.

c. Premixed and Frozen (PMF): Sealant that is pre-measured, mixed, and frozen at extremely low temperatures. PMF sealants are the most convenient package configuration for high usage applications; simply thaw material according to manufacturer's instructions and use. PMF sealants are available in a variety of sizes, but the 2½ ounce and 6 ounce are the most common.

**7-4. SEALING COMPOUNDS AND MATERIALS.** Table 7-1 lists approved sealing compounds, available types, classes, groups, properties, and intended use. Refer to the applicable aircraft/equipment maintenance manual and paragraph 7-7 for specific information concerning proper application of sealing compounds. Also, observe the warnings and cautions in paragraph 7-7 when using any sealing compound. If use of a sealant is required, and no specific instructions are available, the Sealant Decision Tree (Figure 7-1) may be used as a guideline to determine the most appropriate sealant.

Table 7-1. Sealing Compounds

SPECIFICATION	PROPERTIES	INTENDED USE
<b>TWO COMPONENT SEALANTS</b>		
<b>MIL-PRF-81733 Class 1</b> Sealing and Coating Compounds, Corrosion Inhibitive	Polysulfide sealant Room temperature cure Service temp: -65° to 250° F Peel strength: 15 lb/in (min) Contains corrosion inhibitors Resists fuel, oil, & hydraulic fluid	Sealing faying surfaces and wet installation of fasteners on permanent structure. Not intended for use as an integral fuel tank sealant.
<b>AMS-S-8802</b> (supersedes MIL-S-8802) Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion	Polysulfide sealant Room temperature cure Service temp: -65° to 250° F Peel strength: 20 lb/in (min) No corrosion inhibitors Resists fuel, oil, & hydraulic fluid	Faying surfaces sealing, overcoating fasteners, sealing joints and seams, fillet and brush sealing of integral fuel tanks and fuel cell cavities. Should not be exposed to fuel or overcoated until tack-free. Type I is the most commonly used.
<b>AMS 3265</b> Sealing Compound, Polysulfide Rubber, Fuel Resistant, Non-Chromated Corrosion Inhibiting, for Intermittent Use to 360° F	Polysulfide sealant Room temperature cure Service temp: -65° to 250° F Peel strength: 20 lb/in (min) Contains corrosion inhibitors Resists fuel, oil, & hydraulic fluid	Cabin pressure sealing, aerodynamic smoothing, fillet sealing, overcoating fasteners, sealing joints and seams. Prior to sealing, treat bond surfaces with AMS 3100 adhesion promoter to enhance sealant adhesion. Can be used as an alternate to MIL-PRF-81733.
<b>AMS 3276</b> (supersedes MIL-S-83430) Sealing Compound, Integral Fuel Tanks and General Purpose, Intermittent Use to 360° F	Polysulfide sealant Room temperature cure Service temp: -65° to 250° F Peel strength: 20 lb/in (min) No corrosion inhibitors Resists fuel, oil, & hydraulic fluid	Fuel tank sealing, cabin pressure sealing, aero-dynamic smoothing, faying surface sealing, wet installation of fasteners, overcoating fasteners, sealing joints and seams, and non-structural adhesive bonding. Prior to sealing, treat bond surfaces with AMS 3100 adhesion promoter to enhance sealant adhesion.
<b>AMS 3277</b> (supersedes MIL-S-29574) Sealing Compound, Polythioether Rubber, Fast Curing for Integral Fuel Tanks and General Purpose, Intermittent Use to 400° F	Polythioether sealant Low and ambient temperature cure Service temp: -80° to 320° F Peel strength: 20 lb/in (min) No corrosion inhibitors Resists fuel, oil, & hydraulic fluid	Multi-purpose aircraft structure and integral fuel tank sealant with rapid ambient and low temperature curing capability. Type 1 must be used with recommended adhesion promoter. Not recommended for use with plastics.
<b>AMS 3284</b> (supersedes AMS 3267) Sealing Compound, Low Adhesion, Corrosion Inhibiting, for Removable Panels and Fuel Tank Inspection Plates	Polysulfide sealant Room temperature cure Service temp: -65° to 250° F Peel strength: 4 lb/in (min) Type 1: No corrosion inhibitors Type 2: Non-chromated corrosion inhibitors Resists fuel & aviation gas	Fillet and faying surface sealing of removable structure, such as access doors, floor panels and plates, removable panels, and fuel tank inspection plates. Not for high temperature areas or permanent structure.



Table 7-1. Sealing Compounds (Cont.)

SPECIFICATION	PROPERTIES	INTENDED USE
<b>ONE COMPONENT SEALANTS</b>		
<b>MIL-A-46146</b> Adhesive - Sealants, Silicone, RTV, Non corrosive	Silicone sealant Room temperature cure Service temp: Group I & II: -70° to 400° F Group III: -70° to 600° F No corrosion inhibitors Not fuel or oil resistant	Convenient sealant for use with sensitive metals and electronic equipment. Do not use where resistance to fuels, oils, or hydraulic fluids is required. Each group comes in two types: Type I: paste Type II: self-leveling liquid
<b>AMS 3374</b> (supersedes MIL-S-38249) Sealing Compound, Aircraft Firewall	Silicone sealant Room temperature cure Service temp: -65° to 400° F Peel strength: 10 lb/in (min) No corrosion inhibitors Resists fuel, oil, & hydraulic fluid	Sealing firewall structures exposed to very high temperatures against the passage of air and vapors. Can withstand flash temperatures up to 2000° F. Type I is the most commonly used.
<b>SPECIALTY SEALANTS</b>		
<b>AMS 3255</b> Sealing Tape, Polytetrafluoroethylene, Expanded (ePTFE)	Preformed tape with adhesive No mixing, masking, or curing required Service temp: -65° to 450° F No corrosion inhibitors Resists fuel, oil, & hydraulic fluid	Sealing of faying surfaces, access panels, floorboards, and windscreens where gaskets are required. Non-hazardous material alternative to two component sealants. Tape intended for areas exposed to aircraft fluids (fuel, oils) should be applied with fluid resistant rubber cement. Available in two classes: Class 1: Continuous, ribbed Class 2: Continuous, non-ribbed
<b>Reinforced Polyurethane Gel Sealing Tape</b> (HI-TAK Tape® TufSeal™)	Preformed tape No mixing, masking, or curing required Service temp: -65° to 250° F No corrosion inhibitors Not fuel or oil resistant	Environmental sealing of floorboard faying surfaces. Not for fuel or hydraulic fluid-soaked or high temperature applications. Non-hazardous alternative to standard two component sealants and an alternative to ePTFE Sealing Tapes for floorboards.

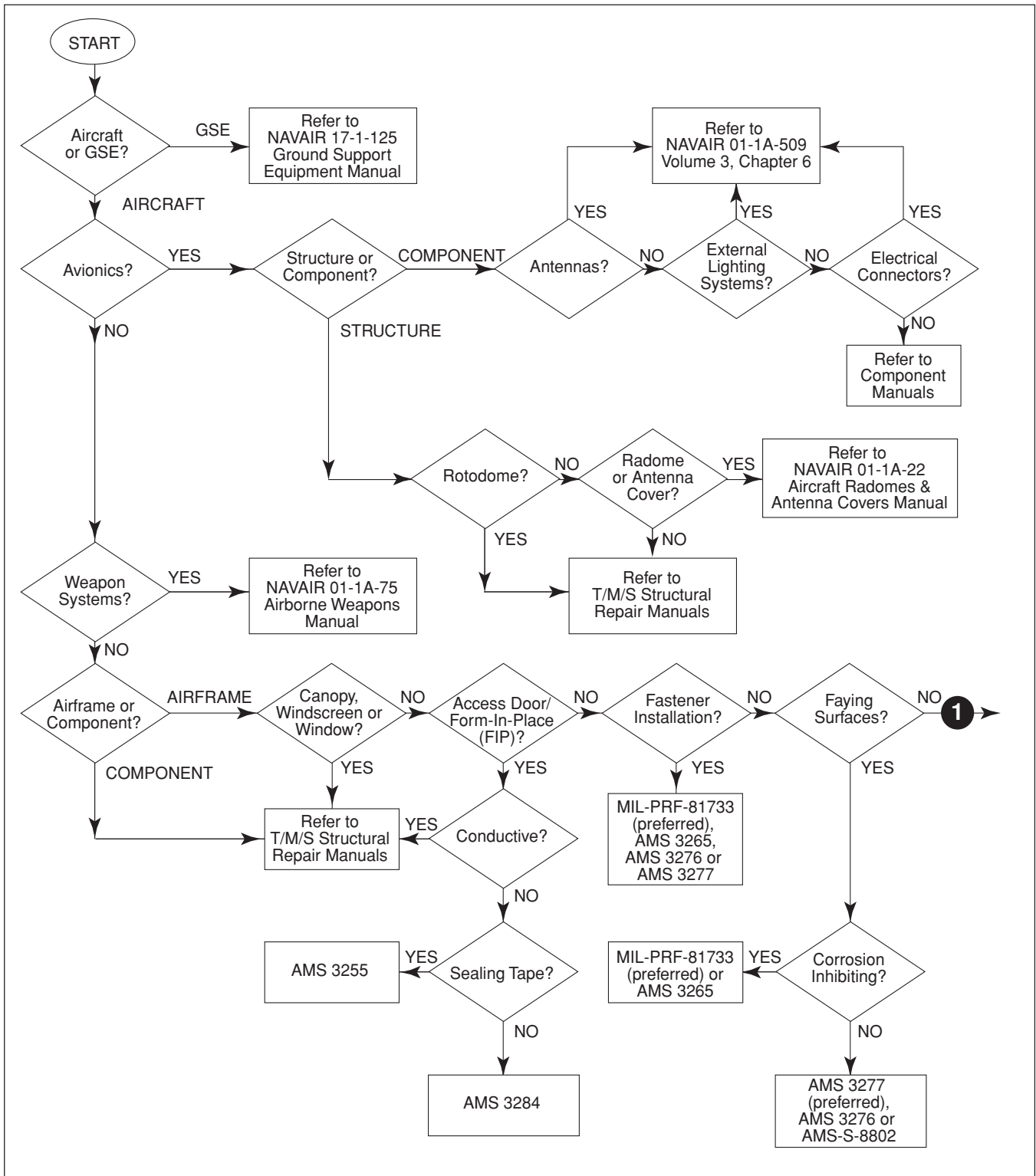


Figure 7-1. Sealant Decision Tree (Sheet 1 of 2)

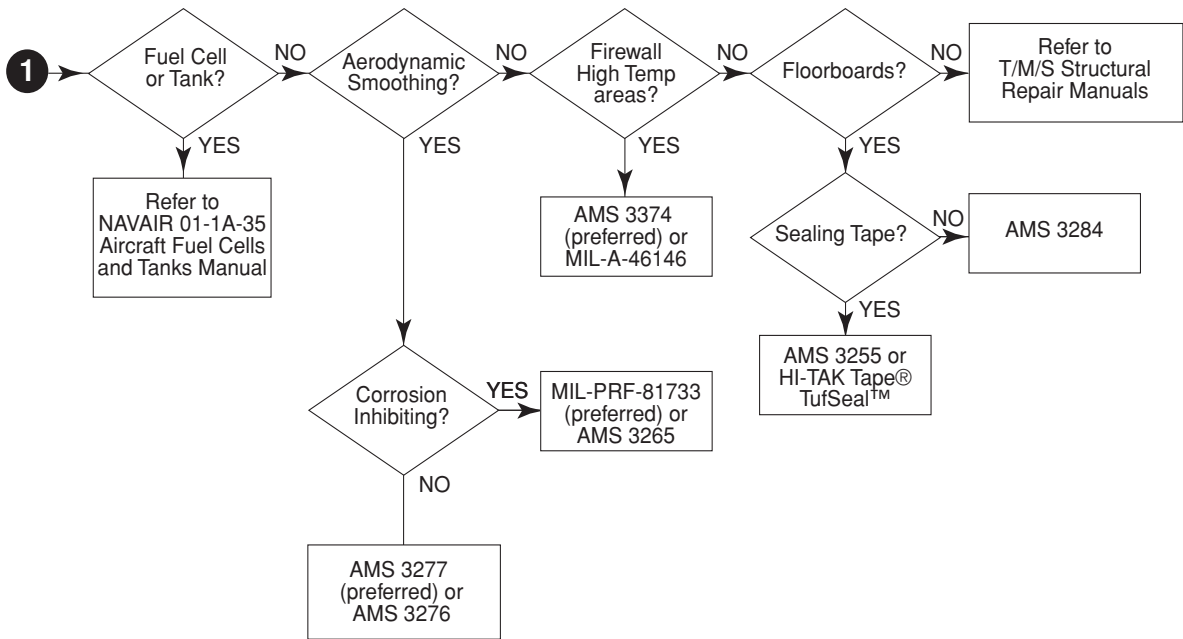


Figure 7-1. Sealant Decision Tree (Sheet 2)

7-4.1. POLYSULFIDE AND POLYTHIOETHER SEALING COMPOUNDS. These materials consist of two components: the base compound (containing the prepolymer) and the accelerator (containing the curing agent). When thoroughly mixed, the accelerator cures the prepolymer to a rubbery solid. Rates of cure depend on the type of prepolymer, accelerator, temperature and humidity; full cure may not be achieved for as long as 7 days.

#### **CAUTION**

MIL-A-46106 materials shall not be used on aircraft or components. MIL-A-46106 can be identified by its vinegar-like smell. If RTV sealants are required by the structural repair manual (SRM), ensure that the sealant conforms to MIL-A-46146, or is a noncorrosive, authorized sealant.

7-4.2. SILICONE SEALING COMPOUNDS. Room temperature vulcanizing (RTV) silicones generally consist of one component which cures by reacting with moisture in the air. If silicones are applied too thickly or in such a way as to prevent moisture from entering the material, they may not cure at all. In addition, many unauthorized silicone sealing compounds produce acetic acid (identified by a vinegar smell) while curing, which can lead to severe corrosion problems. There are two silicone sealant specifications, MIL-A-46146 and MIL-A-46106. Only MIL-A-46146 materials are noncorrosive.

#### **NOTE**

Use of the ePTFE sealing tape requires authorization from the cognizant Type, Model, Series (TMS) engineering authority for the aircraft.

7-4.3. ePTFE SEALING TAPE (AMS 3255). The ePTFE (expanded polytetrafluoroethylene) sealant tape consists of an extruded gasket with a pressure sensitive adhesive backing. No mixing is required and there are no application life constraints or cure times. The sealing tape does not require removal and replacement unless damaged. The adhesive backing is only required to hold the sealing tape in place until an access panel is (re)installed. Tapes may be special ordered without adhesive backing for use in areas where fluid exposure (e.g. hydraulic fluid or fuel) is expected; such tape is applied with a fluid resistant rubber cement such as MMM-A-189.

7-4.4. REINFORCED POLYURETHANE GEL SEALING TAPE. These tapes consist of a preformed polyurethane gel reinforced with a loose fiberglass weave and a thin translucent backing. No mixing is required and there are no application life constraints or cure times. The sealing tape does not require removal and replacement unless damaged. Integrity of the tape is affected by long-term exposure to hydraulic fluids and oils, which cause swelling and softening. Exposure to fluids will not degrade corrosion protection but may reduce reusability and make removal messy. Tapes may be ordered in a variety of widths, indicated by the last three numbers in the part number (i.e. IS-HT3000-015 is 1½ inches wide).

7-4.5. CONDUCTIVE GASKETS. Sealants and conductive gaskets used for weather sealing antennas and static discharge wicks and materials for weather sealing mated connectors are discussed in Volume III.

#### **CAUTION**

Use only those primers or adhesion promoters recommended by the manufacturer for their products.

#### **NOTE**

Solvent based adhesion promoters are hygroscopic (absorb moisture) and must be kept away from moisture. Discard material if it becomes cloudy or a precipitate is formed.

7-4.6. ADHESION PROMOTERS. Some sealing compounds require the application of a special primer or adhesion promoter prior to sealant application in order to develop a good adhesive bond with the surface. Adhesion promoters are one part, water or solvent-based compounds which, after drying, leave behind coupling agents which promote adhesion with certain sealants. Adhesion promoters are especially important when using AMS 3277 Type I, AMS 3276, and most silicone based sealants. It is essential that AMS 3100 adhesion promoter be used before new sealant is applied over aged, fuel soaked polysulfide sealant. In all cases where polythioether sealants (e.g. AMS 3277) are applied over polysulfide sealants (e.g. AMS-S-8802), especially in integral fuel tanks, a polythioether adhesion promoter is required for use at the sealant interface.

7-4.7. RELEASING/PARTING AGENT. VV-P-236 (Petrolatum) or MIL-PRF-32033 (light lubricating grease) can be used as release agents for sealant applications by applying a very thin film. Do not allow release agent

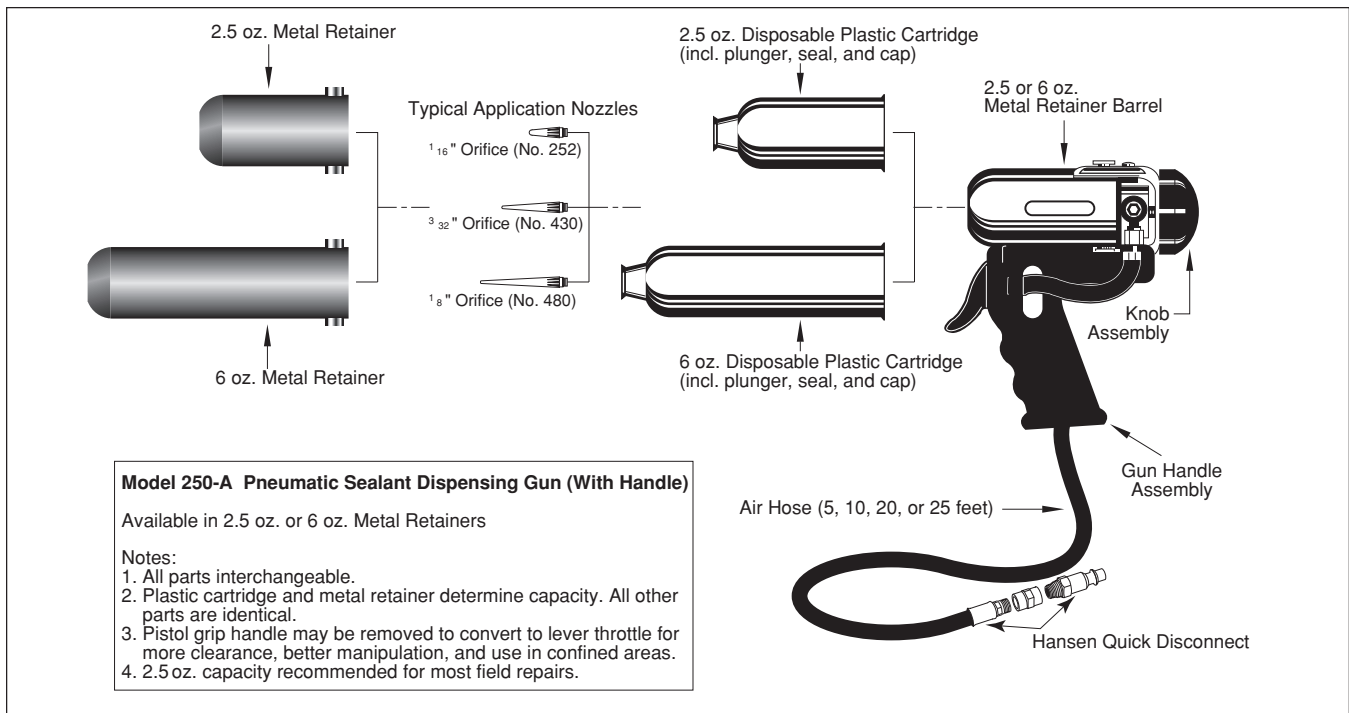


Figure 7-2. Pneumatic Sealant Gun

to contact any surface(s) where sealant is to adhere. Sealant will not adhere to surfaces coated with release agent. If contact surface to be sealed becomes contaminated with the release agent, remove contaminant using a clean cloth moistened with an approved solvent. Reapply adhesion promoter as necessary.

**7-5. SEALING EQUIPMENT.** The following sealing equipment is available.

**7-5.1. SEALANT GUN.** Sealant guns are available for both pneumatic and manual application of sealants, adhesives, and potting compounds (see Figures 7-2 and 7-3). The Semco Model 250-A gun, or equivalent, is fitted with one of the nozzles from Figure 7-4 and used for the application of fillet seals. When using a sealant gun, the nozzle tip must be pointed into the seam and maintained at a 45 degree angle to the line of travel, forcing the bead of sealant to precede the gun tip to minimize entrapment of air. Use fairing/smoothing tools (i.e., spatulas and spreaders) shown in Figure 7-5 to work sealants into seams.

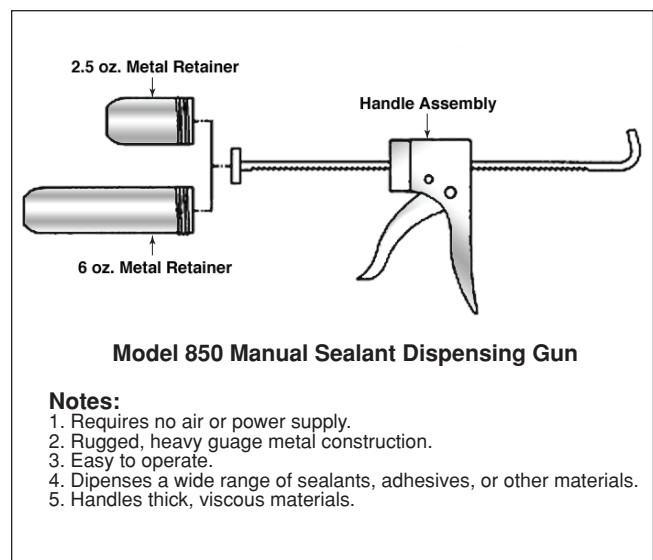


Figure 7-3. Manual Sealant Gun

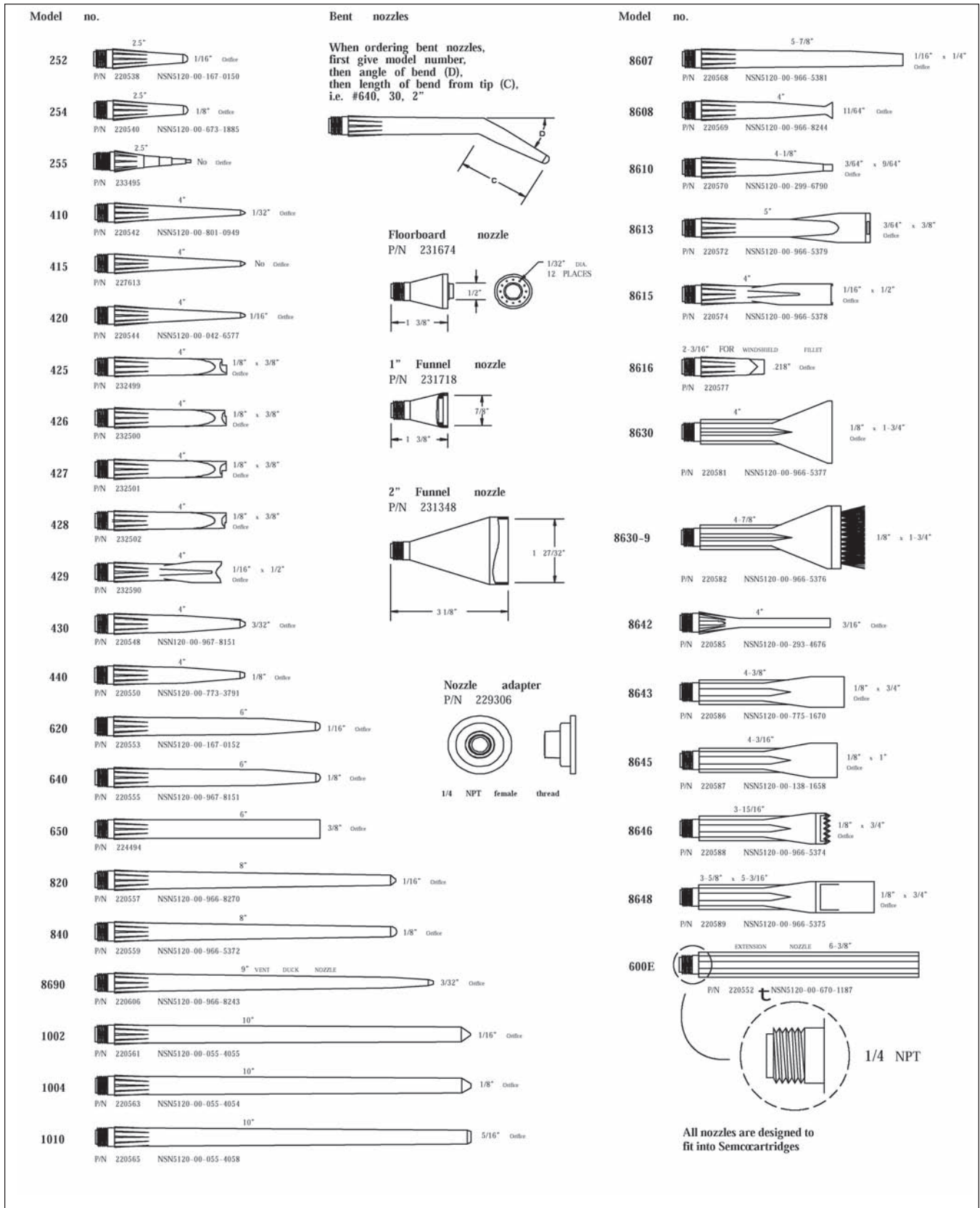
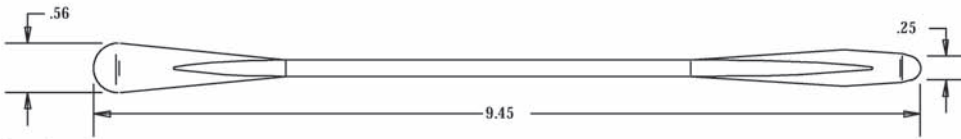


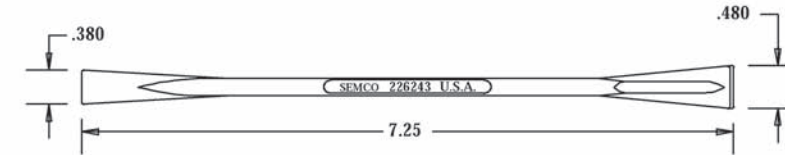
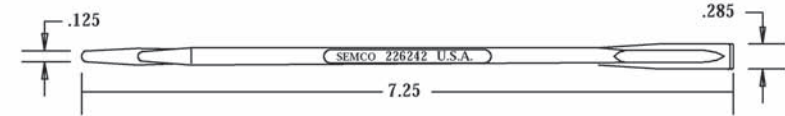
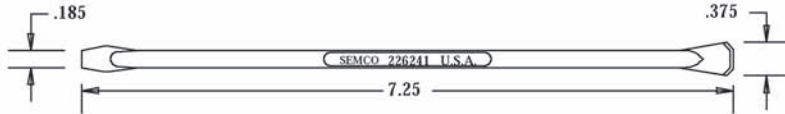
Figure 7-4. Sealant Application Nozzles



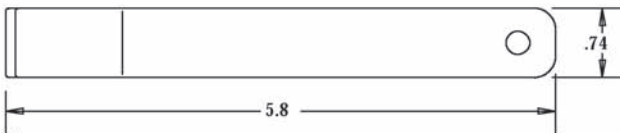
Fiberglass reinforced plastic spatulas and spreaders  
for smoothing sealants and adhesives.



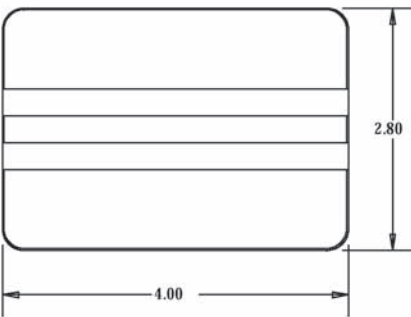
Spatula  
P/N 231349



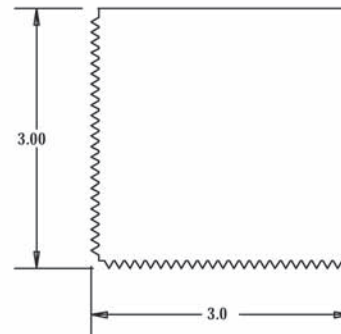
Spatula kit (all 3 spatulas)  
P/N 226244



Scraper  
P/N 234350



Sealant spreader  
P/N 229394



Comb spreader  
P/N 229395

All dimensions shown are in inches.

Figure 7-5. Sealant and Adhesive Smoothing Tools

### **CAUTION**

Care should be taken when using rivet nozzles to prevent sealant material from filling fastener holes.

7-5.2. **APPLICATION NOZZLES**. In addition to the standard, fillet, and ribbon nozzles in Figure 7-4, the countersink and rivet nozzles in Figures 7-6 and 7-7, respectively, can also be used with the sealant guns. Countersink nozzles are used to apply sealants into the countersink of fastener holes prior to fastener installation. Rivet nozzles are used to apply sealants through the hole prior to fastening parts with rivets. The rivet nozzles have a spring-loaded tip, which serves as a check valve and allows for dispensing a precise amount of sealant material.

7-5.3. **HIGH-PRESSURE INJECTION GUN**. Figure 7-8 illustrates injection guns used for injecting sealant into confined holes, slots, structural voids, and joggles, including channel sealing. Follow the procedures outlined in the aircraft SRM for the proper preparation and use of these guns. For hard to reach areas, attach an extension nozzle to the injection tip.

7-5.4. **SEALANT KITS (SEMKIT OR TECHKIT)**. Most sealants are available as ready to use kits (Semkits or Techkits). These kits are compact, two-part mixing application units designed for convenient storage, easy mixing, and proper application of the sealant in small quantities. The base sealant is packaged in standard 2½ ounce and 6 ounce cartridges which are placed in a sealant gun for application. There are two styles: the Barrier style, which holds proportioned amounts of the two components separated by an aluminum barrier; and the Injection style, which stores the accelerator material within the injection rod to separate it from the base compound prior to use (Figure 7-9). When using Semkits or Techkits, note that the handle or dasher contains a pre-measured amount of accelerator and should be retained until the ramrod has been operated to release the seal at the bottom of the dasher. All of the material contained inside the two-component Semkit or Techkit package is mixed within the cartridge.

7-5.5. **SEALANT APPLICATION TOOLS**. When applying or fairing out sealants and adhesives, use the smoothing tools shown in Figure 7-5. These tools are

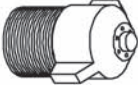
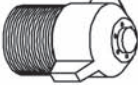
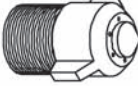
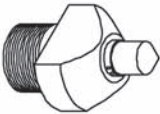
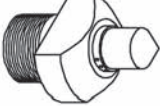
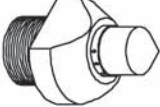
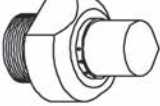
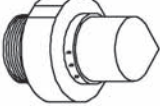
commonly used in sealing maintenance work, but other tools may be manufactured/fabricated as needed to fit a specific situation. Only phenolic/plastic material shall be used to manufacture sealant application tools.

**7-6. TWO COMPONENT SEALANT MIXING AND HANDLING**. The proper weighing and mixing of components is essential to assure proper curing and adhesion of sealants. Use a weight scale to accurately measure the materials before mixing. Mixing shall be accomplished in one central area in each organization. Polysulfide and polythioether sealants consist of two separately packaged components, a base compound (part B) and an accelerator (part A) in 6 ounce, 12 ounce, and 24 ounce kits. The base-to-accelerator ratio varies with different manufacturers. It is important, therefore, to mix the material according to the manufacturer's instructions. The accelerator should be added to the base in the correct ratio and mixed until a uniform color is obtained. Difficulties with polysulfide and polythioether sealants are frequently caused by incomplete mixing or inaccurate weighing. The two-part sealants are chemically cured and do not depend on solvent evaporation for curing. Slow mixing by hand is recommended for two-part can kits. A high speed mechanical mixer should not be used as internal heat will be generated, reducing application life and introducing air into the mixture. Mix Semkit or Techkit in accordance with manufacturer's mixing instructions.

### **CAUTION**

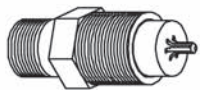
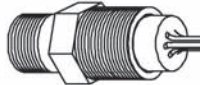
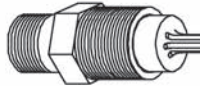
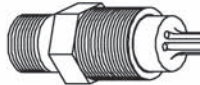
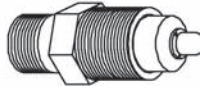
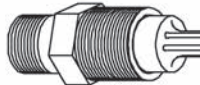
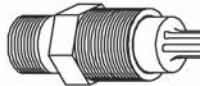
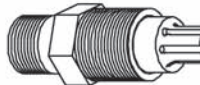
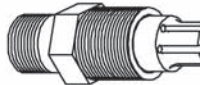
Do not use any two-part sealant after it has been mixed and its rated application time has expired, as poor adhesion may result.

7-6.1. **APPLICATION TIME AND CURE TIME**. Sealant application time and cure time are dependent upon ambient environmental conditions. Maintenance personnel should be aware of the effects of temperature and humidity on the application time of a sealant. Mix only the amount of material that can be applied during the rated application (work) time of the sealant. This time (in hours), known as a dash number, is denoted as the last number in a sealant designation (e.g. MIL-PRF-81733 Type II-2 has an application time of two hours). Table 7-2 indicates application times, tack-free times, and full cure times for each sealant type and dash number at 75°F (24°C) and 50% relative humidity.

	Part number	Color	Size	Quantity holes
	233244	Red	3/32" - 1/8"	6 holes
	233243	White	3/16" - 1/4"	6 holes
	233451	Blue	5/16" - 3/8"	6 holes
	231319	Yellow	1/4" hole	6 holes - .028"
	231320	Grey	5/16" hole	6 holes - .028"
	231321	Green	3/8" hole	6 holes - .028"
	231560	Red	7/16" hole	6 holes - .028"
	231559	Blue	1/2" hole	4 holes - .028"

**NOTE:** Fastener sealing (countersink) nozzles are used to apply the required amount of sealant in the countersink of fastener holes, prior to installation of fastener. When properly used, sealant will be applied to the perimeter of the countersink and not inside the hole. The assorted fastener sealing nozzle sizes are color coded for identification.

Figure 7-6. Countersink Application Nozzles

		<b>Part number</b>	<b>Color</b>	<b>Fits hole size</b>	<b>Size and quantity of dispensing holes</b>
	3/32"	234285	Germaine green	3/32"	.030" dia., 6 ea. equally spaced
	1/8"	226837	Blue	1/8"	.031" dia., 6 ea. equally spaced
	5/32"	226838	Black	5/32"	.035" dia., 6 ea. equally spaced
	3/16"	226839	White	3/16"	.060" dia., 6 ea. equally spaced
	3/16" - 120_	234260*	Green	3/16" - 120_	.030" dia., 6 ea. equally spaced
	7/32"	234284	Light Blue	7/32"	.046" dia., 6 ea. equally spaced
	1/4"	226840	Red	1/4"	.044" dia., 6 ea. equally spaced
	5/16"	233051	Orange	5/16"	.062" dia., 6 ea. equally spaced
	3/8"	233052	Yellow	3/8"	.062" dia., 6 ea. equally spaced

\*P/N 234260 applies sealant to countersink only.

**NOTE:** Rivet nozzles are used to apply the required amount of sealant into the counter-sink and through hole prior to fastening parts with rivets. The spring-loaded tip of the rivet nozzle acts as a check valve allowing precise shots of material to be dispensed. The assorted sizes are color coded for easy identification.

Figure 7-7. Rivet Application Nozzles

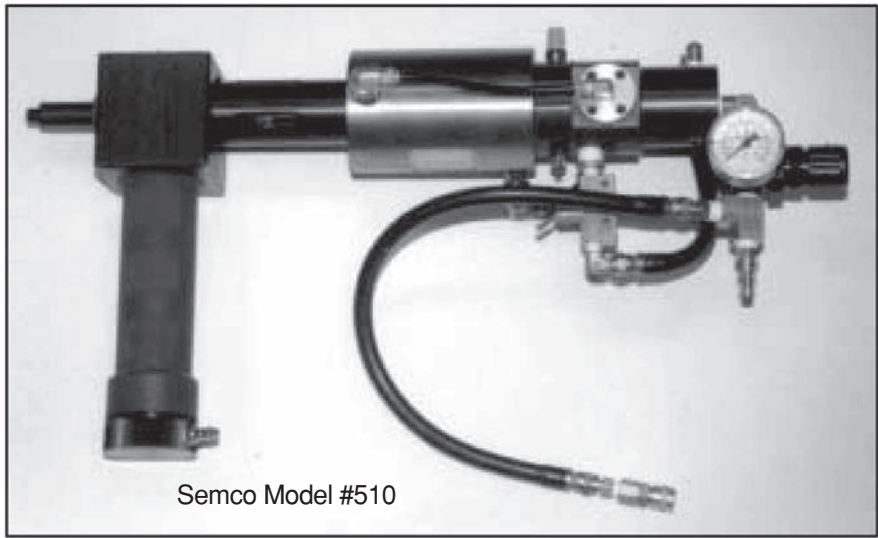


Figure 7-8. High-Pressure Sealant Injection Guns



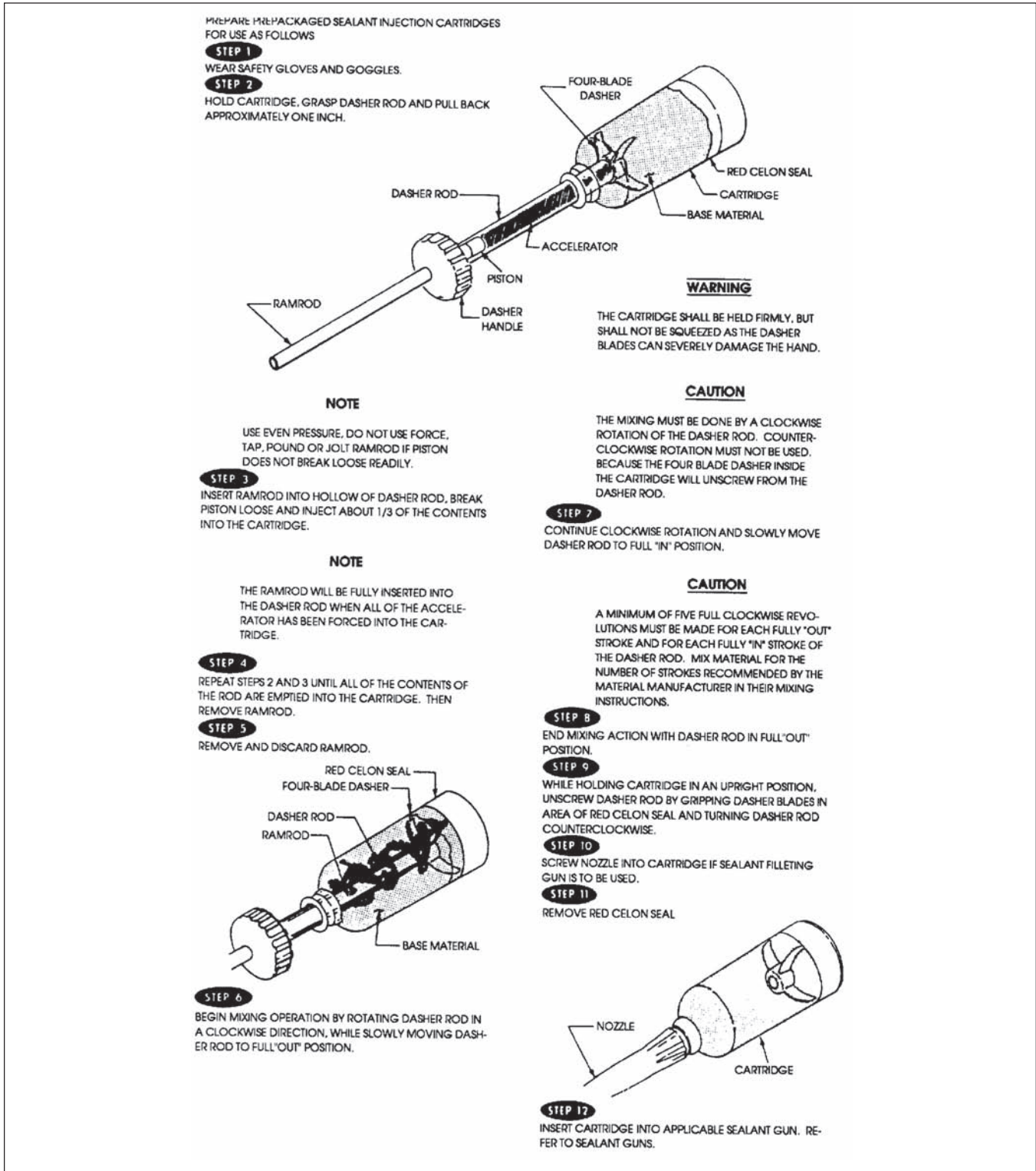


Figure 7-9. Injection Style Semkit



Table 7-2. Time Requirements for Two Component Sealants

Specification	Type or Class*	Application or Assembly Time (hr)**	Tack-Free Time (hr)	Cure Time (hr)	Application Method(s)
MIL-PRF-81733 Class 1	I-1/2	1/2	16	7 days	Brush
	I-2	2	24	7 days	Brush
	II-1/2	1/2	16	14 days	Gun or spatula
	II-2	2	24	14 days	Gun or spatula
	II-4	4	----	14 days	Gun or spatula
	III-1	1	8	7 days	Spray
	IV-12	12	----	14 days	Gun or spatula
	IV-24	24	----	21 days	Gun or spatula
IV-48	48	----	56 days	Gun or spatula	
AMS-S-8802 (supersedes MIL-S-8802)	A-1/2	1/2	10	40	Brush
	A-1	1	20	55	Brush
	A-2	2	40	72	Brush
	B-1/2	1/2	10	30	Gun, spatula, brush, or roller
	B-1	1	20	55	Gun, spatula, brush, or roller
	B-2	2	40	72	Gun, spatula, brush, or roller
	B-4	4	48	90	Gun, spatula, brush, or roller
	C-8	8 (20)	----	168	Gun or spatula
	C-24	24 (80)	----	28 days	Gun or spatula
AMS 3265	B-1/2	1/2	12	32	Gun or spatula
	B-2	2	24	72	Gun or spatula
	C-8	8 (24)	96	168	Gun, spatula, brush, or roller
	C-48	48 (168)	----	56 days	Gun, spatula, brush, or roller
AMS 3276 (supersedes MIL-S-83430)	A-1/2	1/2	10	30	Brush
	A-2	2	24	72	Brush
	B-1/4	1/4	6	16	Gun or spatula
	B-1/2	1/2	10	30	Gun or spatula
	B-2	2	24	72	Gun or spatula
	B-4	4	36	90	Gun or spatula
	B-6	6	48	120	Gun or spatula
	C-1/2	1/2	10	30	Brush or spatula
	C-2	2	24	72	Brush or spatula
	C-8	8(20)	96	----	Brush or spatula
AMS 3277 (supersedes MIL-S-29574)	A-1/4	1/4	1	2	Brush
	A-1/2	1/2	3	4	Brush
	A-2	2	12	16	Brush
	B-1/4	1/4	1	2	Gun or spatula
	B-1/2	1/2	3	4	Gun or spatula
	B-2	2	12	16	Gun or spatula
	C-4	4	24	30	Brush or spatula
AMS 3284 (supersedes AMS 3267)	A-1/2	1/2	10	24	Brush
	A-2	2	24	72	Brush
	B-1/2	1/2	10	24	Gun or spatula
	B-2	2	24	72	Gun or spatula

\* The number after the letter indicates the room temperature application time (in hours) of the sealant after it is mixed.

\*\* Assembly time in ( ). If not noted, the application time and the assembly time are the same.

NOTE: Times apply to environmental conditions of 75° F (24° C) and 50% RH.

See paragraph 7.6.1 for time adjustments for other environmental conditions.

7-6.1.1. Effect of Temperature. Increases in temperature will shorten application and cure time. Conversely, lower temperatures will lengthen application time and cure time. For polysulfide sealants, each 18°F (10°C) increase in the temperature above 75°F (24°C), cuts the application time by approximately half, with a similar reduction in tack-free and cure time. Similarly, for each 18°F (10°C) decrease in the temperature below 75°F (24°C), the application time is approximately doubled with a similar increase in tack-free and cure time. Tack-free and cure times may increase for polyioether sealants (e.g. AMS 3277) at temperatures below 40°F (4°C).

7-6.1.2. Effect of Humidity. When sealants, especially polysulfides, are applied in an environment where the humidity is greater than 50% RH, application time is shortened to some degree; when humidity is less than 50% RH, application time and cure time may be extended. Polythioether sealants (e.g. AMS 3277) cure independent of humidity conditions.

7-6.1.3. Tack-Free Condition. Sealant is considered to be in a tack-free condition if, when lightly touched, the sealant does not transfer onto the skin.

7-6.2. STORAGE INSTRUCTIONS. When large quantities of sealant are used, it may be advantageous to pre-mix and freeze the sealant to provide a ready supply of mixed sealant when it is needed.

7-6.2.1. Two-part kits and Semkit or Techkit package sealants should be stored according to instructions on the container.

7-6.2.2. Polysulfide sealants in a pre-mixed and frozen (PMF) form should be stored in a freezer at -40°F (-40°C) or below for optimal retention of application properties.

7-6.2.3. Polythioether sealants (e.g. AMS 3277) require extremely low temperature refrigeration at -80°F (-62°C) or below for optimal retention of application properties.

7-6.2.4. Thawing of PMF can be accomplished in two ways.

a. For ambient temperature thaw, place the PMF cartridge in a vertical position. Let stand at ambient temperature for approximately 30 minutes. Dry any condensation from the exterior of the cartridge prior to use.

b. For water bath thaw, place the PMF cartridge upright in a 120°F (49°C) water bath for approximately 4-6 minutes with plunger cup out of water bath. Upon removal from the bath, carefully dry the exterior of the cartridge before using.

### WARNING

MIL-T-81772 Type I thinner solvent is flammable. Never store, open, or apply near ignition sources (e.g. lighted cigarettes, sparks, electrical arcing, or heat sources).

7-6.3. MIXING MIL-PRF-81733 TYPE III. MIL-PRF-81733 Type III has a tendency to settle out during storage. The base compound must be thoroughly mixed, using a standard paint shaker, to obtain a uniform consistency before the addition of the accelerator. After both components, base and accelerator, have been mixed separately, add the proper amount of accelerator to the base compound and mix the combined materials, preferably with a paint shaker, for at least five minutes. For proper application time and cure, the base compound and accelerator must be combined in the proper ratio and mixed prior to the addition of any thinners (solvents). After mixing, the sealant may be thinned for spraying to a viscosity of 20 to 25 seconds in a Zahn No. 2 cup (refer to Appendix A) using MIL-T-81772 Type I. A 20 to 30 volume percent addition is usually required. The application time and tack-free time will not change using this solvent blend.

## 7-7. SEALANT APPLICATION PROCEDURES.

### WARNING

To control solvent odor, used rags should be immediately placed in an appropriate HAZMAT container and disposed of per local directives.

7-7.1. CLEANING. If the surfaces to be sealed have been contaminated following surface treatment, clean the area with a clean cheesecloth (CCC-C-440), cleaning cloth (AMS 3819), or nonwoven cleaning cloth (CCC-C-46) saturated with solvent (AMS 3166, A-A-59281 Type I or II, or equivalent), beginning at the top of the area to be sealed and working downward. Always pour solvent on the cloth to avoid contaminating the solvent. Dry the surfaces immediately with a clean cloth. Do not allow surface to air dry, as the oil or dirt may remain on the surface and is impossible to remove with a dry cloth. Use a stiff bristle brush to clean around bolts, rivets, or fasteners. Always use a clean cloth as each new area is cleaned.

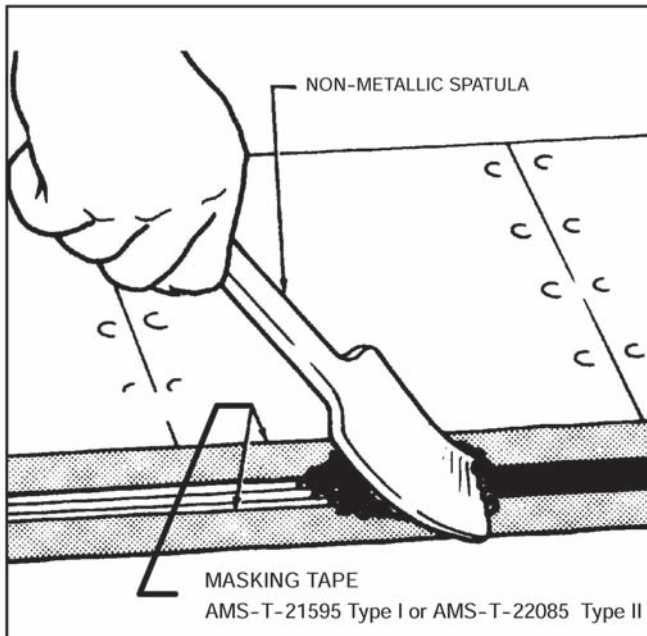


Figure 7-10. Application of Sealant with Non-Metallic Spatula

7-7.2. **PRIMING.** All surfaces to be sealed, with the exception of internal fuel tank surfaces, shall be primed with MIL-PRF-23377 or MIL-PRF-85582 in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army), and allowed to dry one to two hours at ambient temperatures before sealing.

### **CAUTION**

After surface treatment and primer application, do not contaminate areas to be sealed with hands or tools.

7-7.3. **MASKING.** To prevent sealant from contacting adjacent areas during application and smoothing out operations, the surrounding area not being sealed can be masked off with AMS-T-21595 Type I masking tape (Figure 7-10). In cases where the tape is likely to remain in place for more than two days on items exposed to direct sunlight and where tape residue on the surface cannot be tolerated, use AMS-T-22085 Type II preservation and sealing tape. An example where masking tape may be useful is during fillet sealing of exterior surface lap and butt seams.

### **NOTE**

Always pour solvent onto a new cloth to avoid contaminating the solvent supply. Clean one small area at a time. Reclaimed solvents or soiled cleaning cloths shall not be used.

7-7.4. **ADHESION PROMOTER.** If adhesion promoter is required, the surfaces shall be cleaned with a solvent (AMS 3166, A-A-59281 Type I or II, or equivalent) immediately before applying adhesion promoter. Contaminants such as dirt, grease, and/or lubricants must be removed to insure good adhesion. Apply a very thin coat of the adhesion promoter to the solvent cleaned surface with a clean cloth (AMS 3819), wipe off any excess with a clean cloth, and allow the surface to dry for 30 minutes to one hour. If surface becomes contaminated or sealing is not accomplished within an hour after application and drying of adhesion promoter, repeat cleaning procedure and reapply adhesion promoter.

### **WARNING**

Sealants, with the exception of ePTFE sealing tapes, are toxic; therefore, rubber or polyethylene gloves and goggles shall be worn when using these materials. Wash hands thoroughly with soap and water before eating or smoking.

7-7.5. **BRUSH, SPATULA, OR SEALANT GUN APPLICATION.** Prior to masking and sealing, prepare surface in accordance with paragraphs 7-7.1 and 7-7.2

### **CAUTION**

After surface treatment and primer application, do not contaminate areas to be sealed with hands or tools.

a. To prevent sealant from contacting adjacent areas during application and smoothout, outline the areas being sealed with masking tape (AMS-T-21595 Type I) so that each tape strip is  $\frac{1}{8}$  to  $\frac{1}{4}$  inch from the edge of the seams (see Figure 7-10).

b. If required, apply adhesion promoter in accordance with paragraph 7-7.4.

c. Apply sealant between tape strips.

(1) Paste sealants may be applied with a nonmetallic spatula or spreader as shown in Figure 7-10. Avoid the entrapment of air. Work sealant into recesses by sliding the edge of the spatula firmly back over the recesses. Smoothing will be easier if the nonmetallic spatula is first dipped in water.

(2) Sealant applied with a brush is applied and smoothed until the desired thickness is reached.

(3) Sealant applied with a sealant gun will not usually require masking and is especially adaptable to filling seams or the application of form-in-place gaskets.

d. Remove masking tape after the sealant has been applied and before it becomes tack-free. Cure time will depend upon the application life of the materials used.

e. If tape residue on these surfaces is excessive, remove residue using aliphatic naphtha (TT-N-95 Type II) or equivalent.

f. When sealant no longer feels tacky, prime with MIL-PRF-23377, MIL-PRF-85582 or other primers as specified. Apply topcoat if specified.

7-7.6. SPRAY GUN APPLICATION. Prior to masking and sealing, prepare surface in accordance with paragraphs 7-7.1 and 7-7.2.

### **CAUTION**

After surface treatment and primer application, do not contaminate areas to be sealed with hands or tools.

### **NOTE**

The dried film of the spray sealant shall have a minimum thickness of 6 mils (0.006 inch).

a. Mask off adjacent areas with barrier material (MIL-PRF-131) held in place with masking tape (AMS-T-21595 Type I).



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b. Apply MIL-PRF-81733 Type III sealant in a solid, continuous pattern when spraying over seams whose configuration is less than 14 inches apart. On seam connections greater than 14 inches apart, minimize overspray to adjacent areas.

c. Allow at least four hours for the spray sealant to dry before subsequent processing.

7-7.7. ePTFE SEALING TAPE (Skyflex™), PEEL AND STICK APPLICATION. Prior to application, prepare surface in accordance with paragraphs 7-7.1 and 7-7.2.

### **CAUTION**

After surface treatment and primer application, do not contaminate areas to be sealed with hands or tools.

a. Examine faying surfaces to be sealed and build up any uneven areas on the aircraft frame with compensation tape (P/N: GSC-21-95158-011 or equivalent) to create a level faying surface for panel sealing.

b. Select from Skyflex™ P/Ns: GSC-21-95201-0111, GSC-21-95241-011, GSC-21-95261-011, GSC-21-98006-021, GSC-21-95811-022, GUA-1059-1, GUA-1301-1, or equivalent. The sealant tape should cover the full width of the faying surface to be sealed.

c. Measure and cut the desired length of ePTFE sealant tape that is required. Excess tape width should be trimmed to the width of the faying surface.

d. For corners on aircraft/panels, cut ends of tape at approximately a 30 degree angle so that the sealant tape from the converging side will overlap by a minimum of one quarter to one half inch. The overlap is required to assure a complete perimeter seal; butt joints are not acceptable and will allow moisture intrusion and potential corrosion. Do not fold the tape in corners. This will result

in triple layer thickness which may adversely affect environmental sealing capability.

e. Tape may be applied to either the aircraft frame or panel faying surface. Application of tape to the panel faying surface is recommended, especially for panels in corrosion prone areas of the aircraft, for ease of subsequent airframe corrosion inspections.

### **CAUTION**

Use care not to pull or stretch the ePTFE tape as it is applied. The stretched ePTFE tape will retract even if it is clamped between faying surfaces which may reduce or eliminate overlaps and allow water intrusion.

f. Peel the nonstick backing paper off the sealant tape a little at a time as the tape is applied to the aircraft/panel.

(1) Applying extra pressure to the sealant tape will cause the pressure sensitive adhesive to better adhere to the faying surface and will create indentations/discoloration at the fastener holes allowing for easy identification.

(2) For some areas and fasteners, it may be necessary to pre-punch holes in the sealant tape at the fastener locations. To locate holes and avoid mismatch, either use the panel as a template for hole locations or hold sealant tape in place and use pressure to create discoloration at fastener holes. Pre-punch using a leather punch with a diameter no greater than  $\frac{1}{4}$  inch more than the fastener hole diameter.

g. If sealant without adhesive backing has been ordered for use in areas where fluid exposure is expected, MMM-A-189 plastic adhesive, or equivalent, may be used to hold the ePTFE sealing tape in place. Apply adhesive to airframe sill or panel and apply ePTFE sealing tape within 20 minutes or before adhesive is tack free.

h. After applying the full length of the sealant tape, run fingers back and forth on the sealant to press tape against the aircraft structure/panel surface to activate adhesive and identify fastener holes. No curing time is required.

i. Puncture all fastener holes using an object with a sharp point such as an awl/scribe or scissors.

### **NOTE**

As fasteners are installed, the ePTFE sealant material pushed into the fasteners will help to seal against moisture intrusion.

j. Install access panel. All fasteners should be wet installed with corrosion preventive compound (MIL-PRF-16173 Grade 4 or equivalent) as specified in the aircraft maintenance manual.

7-7.8. REINFORCED POLYURETHANE GEL SEALING TAPE (HI-TAK TAPE® TUFSEAL™), PEEL AND STICK APPLICATION. These materials are currently approved only for floorboard applications on platforms where their use has been authorized. Prior to application, prepare surface in accordance with paragraphs 7-7.1 and 7-7.2.

### **CAUTION**

After surface treatment and primer application, do not contaminate areas to be sealed with hands or tools.



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a. Examine surfaces to be sealed and build up any uneven areas on the floorboard frame with MIL-PRF-81733 Type II-1/2 sealant (preferred), AMS 3255 compensation tape (P/N GSC-21-95158-011 or equivalent), or AMS 3277 sealant to create a level faying surface for sealing.



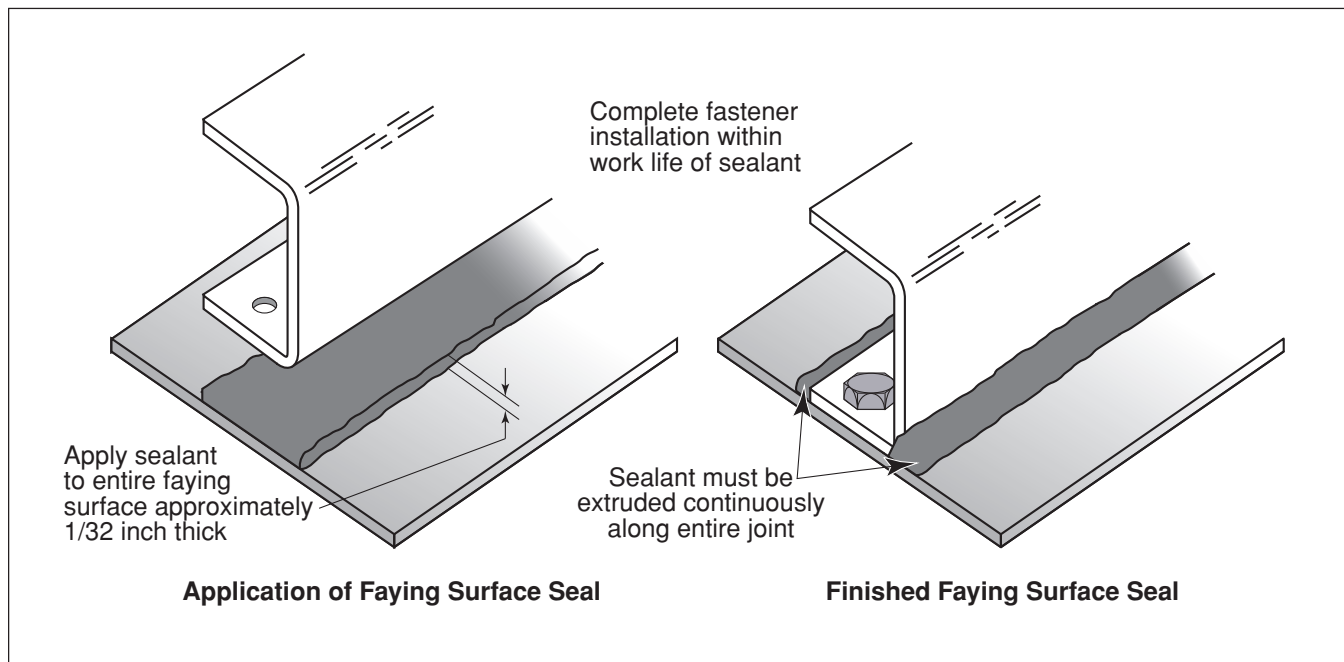


Figure 7-11. Faying Surface Sealing

b. The reinforced polyurethane gel sealant tape should cover the full width of the surface to be sealed. Apply tape directly from supplied roll onto floorboard support structure/spar.

c. Install tape with the tacky polyurethane side of the tape applied to the surface. The top side of the tape is covered with a translucent protective film that remains on the tape.

d. Create butt joints at floorboard spar joints. Do not overlap tape sections, but make sure gaps greater than  $\frac{1}{8}$  inch are not created at butt joints. A slight excess of tape ( $\frac{1}{8}$  to  $\frac{1}{4}$  inch) is preferred over insufficient tape to cover mating surface.

e. There is no need to pre-punch fastener holes prior to installation of floorboard panels.

#### NOTE

As fasteners are installed, the polyurethane gel will help to seal against moisture intrusion.

f. Install floorboard panels. All fasteners should be wet installed with corrosion preventive compound (MIL-PRF-16173 Grade 4 or equivalent) as specified in the aircraft maintenance manual. Fasteners may be pushed through the tape by applying pressure to the fastener with the installation tool.

## 7-8. SEALING OF SPECIFIC AREAS.

### CAUTION

Do not use any two-part sealant after it has been mixed and its rated application time has expired, as poor adhesion may result.

To determine if a sealant is suitable for a specific application, review the guidelines provided in Table 7-1 and Figure 7-1.

7-8.1. FAYING SURFACE SEALING. Faying surfaces are sealed by applying sealants to the contacting surfaces of two or more parts (Figure 7-11). It is a very effective seal and should be used for all assembly or reassembly. When possible, it should be used in conjunction with fillet sealing. There are two types of faying surface seals, removable and permanent. Removable seals are used around access doors, removable panels, and inspection plates. A removable seal can be formed using a standard sealant on one surface and a parting agent on the mating surface. Permanent seals are created using sealants between permanently fastened structures. To create a permanent seal, coat both mating surfaces with sealant before assembling part. Apply enough sealant to force a bead to squeeze out along the joint after assembly. Assemble parts and torque fasteners within the rated application life of the sealant.



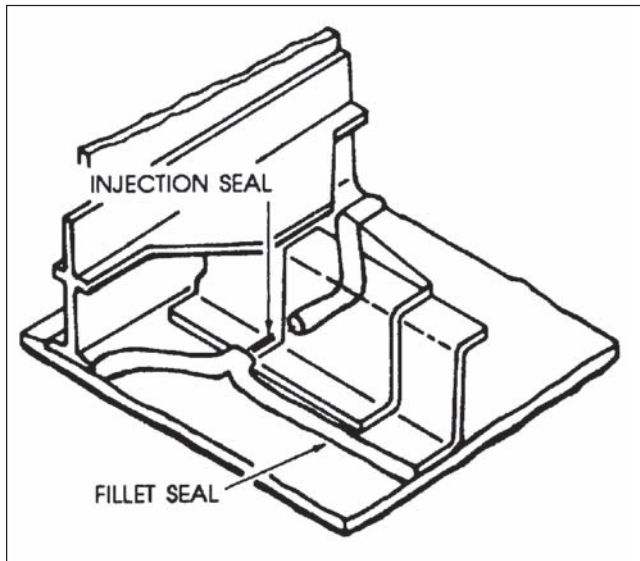


Figure 7-12. Typical Fillet Seal

**NOTE**

Avoid air bubbles as much as possible during the sealing operation. Allow the sealant to cure to, at least, the tack-free stage before moving the assembly.



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a. All faying surfaces, seams, and lap joints shall be protected with MIL-PRF-81733 sealant (or sealant specified in aircraft specific manual). Apply the sealing compound to one or both surfaces and squeeze the part together to ensure the complete coating of the entire surface. Excess material squeezed out shall be removed so that a fillet seal remains. The fillet width shall not be less than  $\frac{1}{4}$  inch. Joint areas which could hold water shall be fillet sealed with MIL-PRF-81733 (or aircraft specific) sealant (see paragraph 7-8.2). If sealing is impossible because of mechanical or other factors, prime both surfaces with two coats of MIL-PRF-23377 or MIL-PRF-85582 in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army).

b. Faying surfaces that are to be adhesively bonded shall be treated and processed as specified by the approved bonding procedure in the applicable maintenance manual.

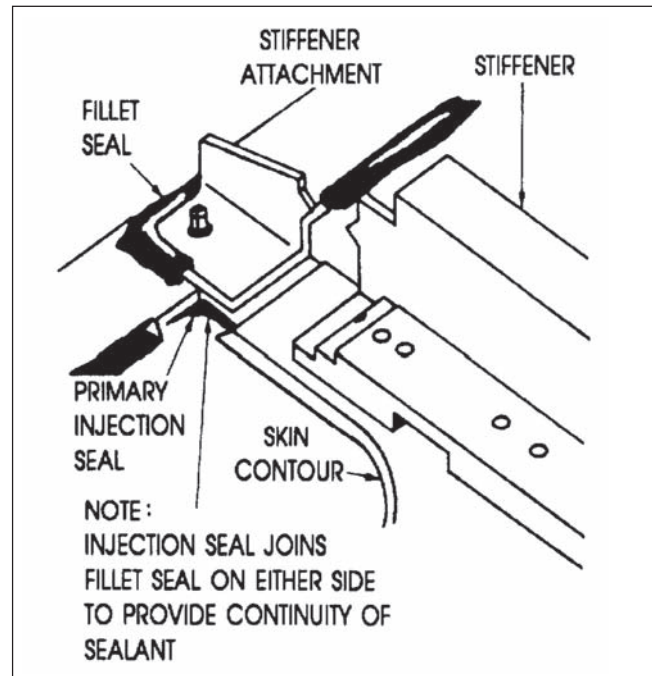


Figure 7-13. Typical Injection Seal

c. For plastic components, the joint shall be suitably sealed and faired into the adjacent surfaces with MIL-PRF-81733 sealant, unless otherwise specified in the applicable maintenance manuals, to stop the formation of pockets which will entrap moisture and dirt. MIL-PRF-81733 sealant shall be used for rivets that require wet installation on plastic components.

7-8.2. **FILLET SEALING.** The fillet, or seam seal, shown in Figure 7-12, is the most common type found on an aircraft. Fillet seals are used to cover structural joints or seams along stiffeners, skin butts, walls, spars, and longerons, and to seal around fittings and fasteners. This type of seal is the most easily repaired. Fillet sealing shall be used in conjunction with faying surface sealing, or alone if the assembly sequence restricts the use of faying surface sealing.

7-8.3. **INJECTION SEALING.** This type of seal, shown in Figure 7-13, is used primarily to fill voids created by structural joggles, gaps, and openings. Use only those sealants recommended by the aircraft/equipment manufacturer. Force sealant into the area using a sealant gun. This method produces a continuous seal when it becomes impossible to lay down a continuous bead of sealant while fillet sealing. Clean the voids of all dirt, chips, burrs, grease, and oil before injection sealing.

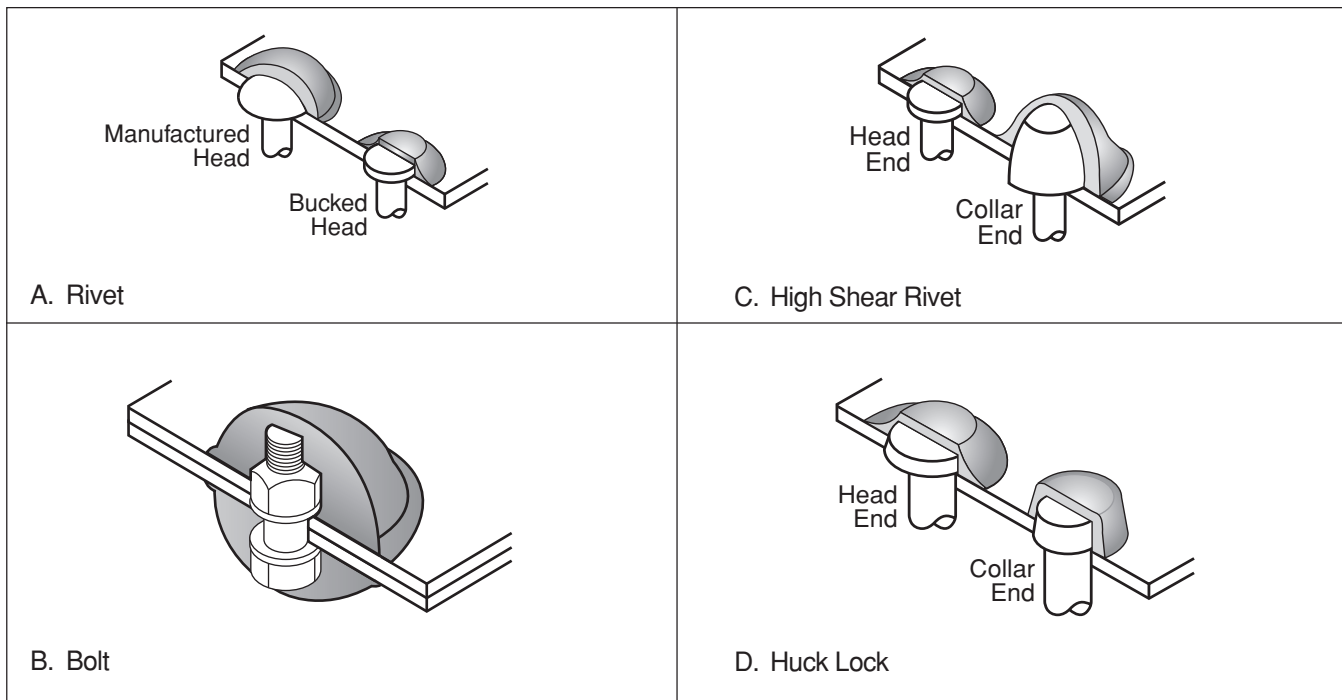


Figure 7-14. Typical Methods of Sealing Fasteners

**CAUTION**

AMS 3284 may only be used for wet installation of fasteners. Do not use AMS 3284 sealants in high temperature areas or for structural installations.

7-8.4. **FASTENER SEALING.** Figure 7-14 illustrates techniques used to seal different types of fasteners. Fasteners are sealed either during assembly or after assembly.

a. To seal during assembly, apply the sealant to the hole or dip the fastener into sealant, and install fastener while sealant is wet. Fasteners in permanent structures shall be wet installed in accordance with the aircraft maintenance manual. For removable parts, coat the lower side of the fastener head only. Do not coat the hole or the fastener shank or threads, as this makes future removal almost impossible without damage to the part.

b. To seal after assembly, cover the pressure side of the fastener with sealant after installation. As a general rule, sealant should be approximately 1/8 inch thick over the top of the fastener, and extend a minimum of 1/4 inch from the edge of the fastener onto the surface of the part (see Figure 7-14).

c. Corrosion damaged areas in the countersinks around removable and fixed fasteners may be filled with the fastener in place. Cadmium coated fasteners that have been blasted or abraded during corrosion removal shall be primed in accordance with Appendix A (Navy) or TM 55-1500-345-23 (Army) and coated with MIL-PRF-81733 sealant.

**WARNING**

MIL-PRF-81733 is not suitable for use on the insides of integral fuel tanks and shall not be used for these applications. AMS-S-8802 or AMS 3276 is the authorized sealant for the insides of integral fuel tanks of most aircraft platforms. AMS 3277 may be used for repair of integral fuel tanks only if recommended adhesion promoter is used during the repair. Adhesion of repair sealant is critical as disbond of repair sealant during aircraft operation could cause clogging of fuel filters and result in loss of aircraft or personnel.

**CAUTION**

AMS-S-8802, AMS 3276, or other fuel tank sealants should not be exposed to fuel or overcoated until tack-free.

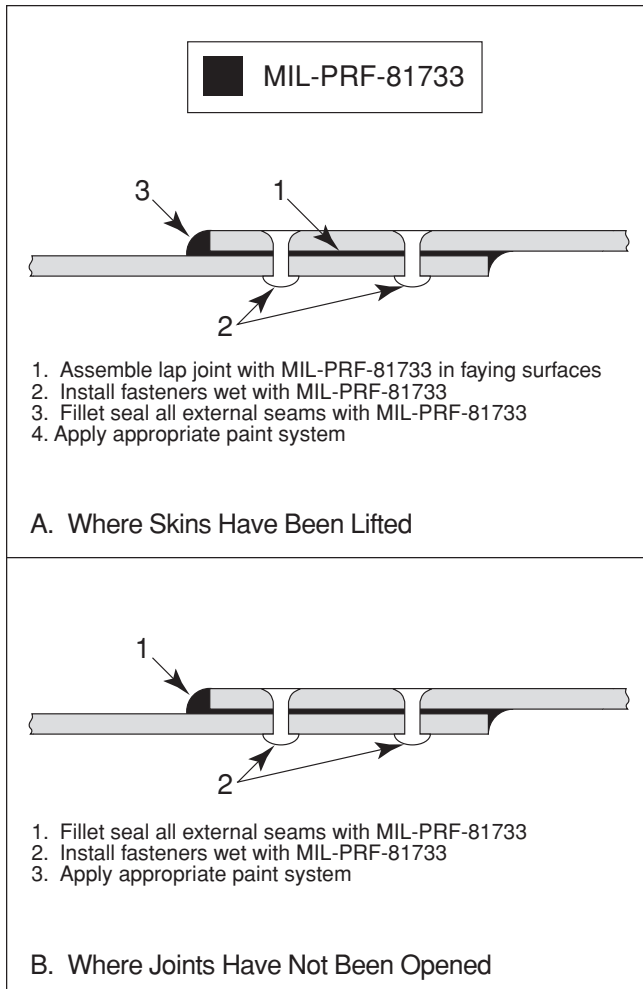


Figure 7-15. Typical Lap Skin Sealing

7-8.5. **FUEL CELLS.** Refer to NAVAIR 01-1A-35, TM 55-1500-204-25/1, or applicable Structural Repair Manual (SRMs) for sealant procedures.

7-8.6. **EXTERNAL AIRCRAFT STRUCTURE.** If, during normal maintenance, it becomes necessary to remove and replace components (wing planks, skin, spar caps, fasteners, or fittings), they shall be sealed when reinstalled, even if they were not sealed originally. The only exception to this requirement is temporary repair accomplished for a one time flight to a Depot or overhaul facility. See Figures 7-15 through 7-18 for typical sealing methods.

7-8.7. **DEPRESSIONS.** When the thickness of metal is reduced by more than 15 mils (0.015 inch) during removal of corrosion damage, fill the depression with

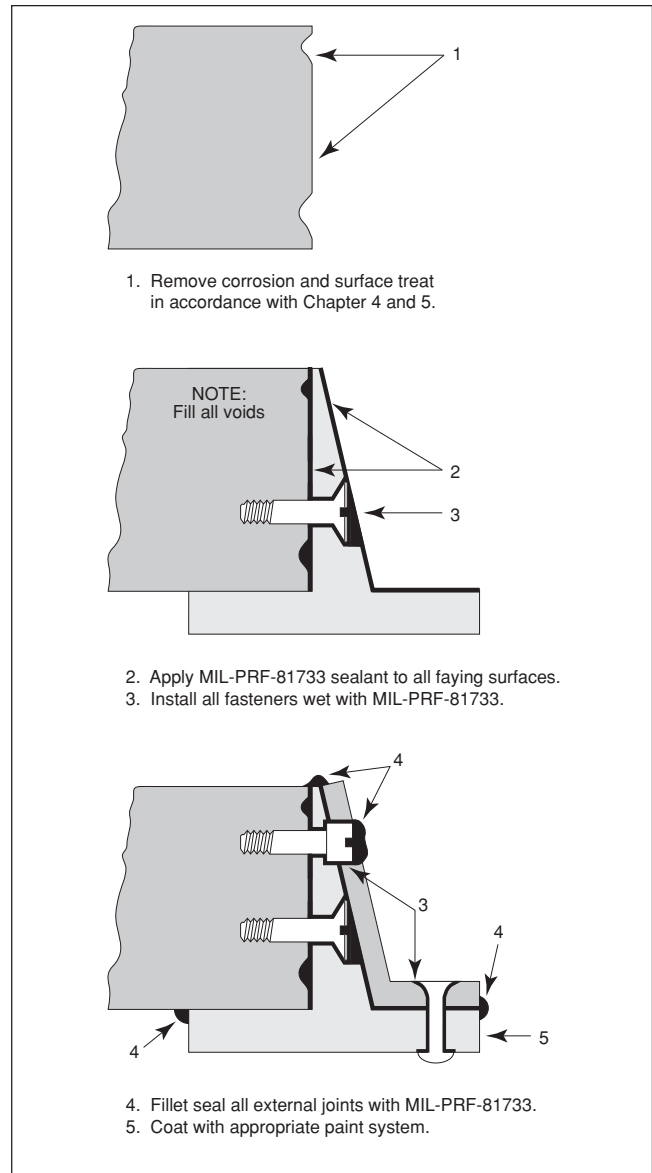


Figure 7-16 Sealing Procedures for Typical Aircraft Fitting

MIL-PRF-81733 Type II sealant after applying chemical conversion coating (MIL-DTL-81706) and priming (MIL-PRF-23377 or MIL-PRF-85582). Depressions on surfaces that will be sealed with AMS 3255 sealing tape require filling with compensation tape (see paragraph 7-7.7). Depressions on the inside of integral fuel tanks do not require filling.

7-8.8. **EXTENSIVE CORROSION REPAIR.** If corrosion damage is so extensive that structural repair is necessary, all faying surfaces between patches (or doublers) and skins shall be painted with one coat of

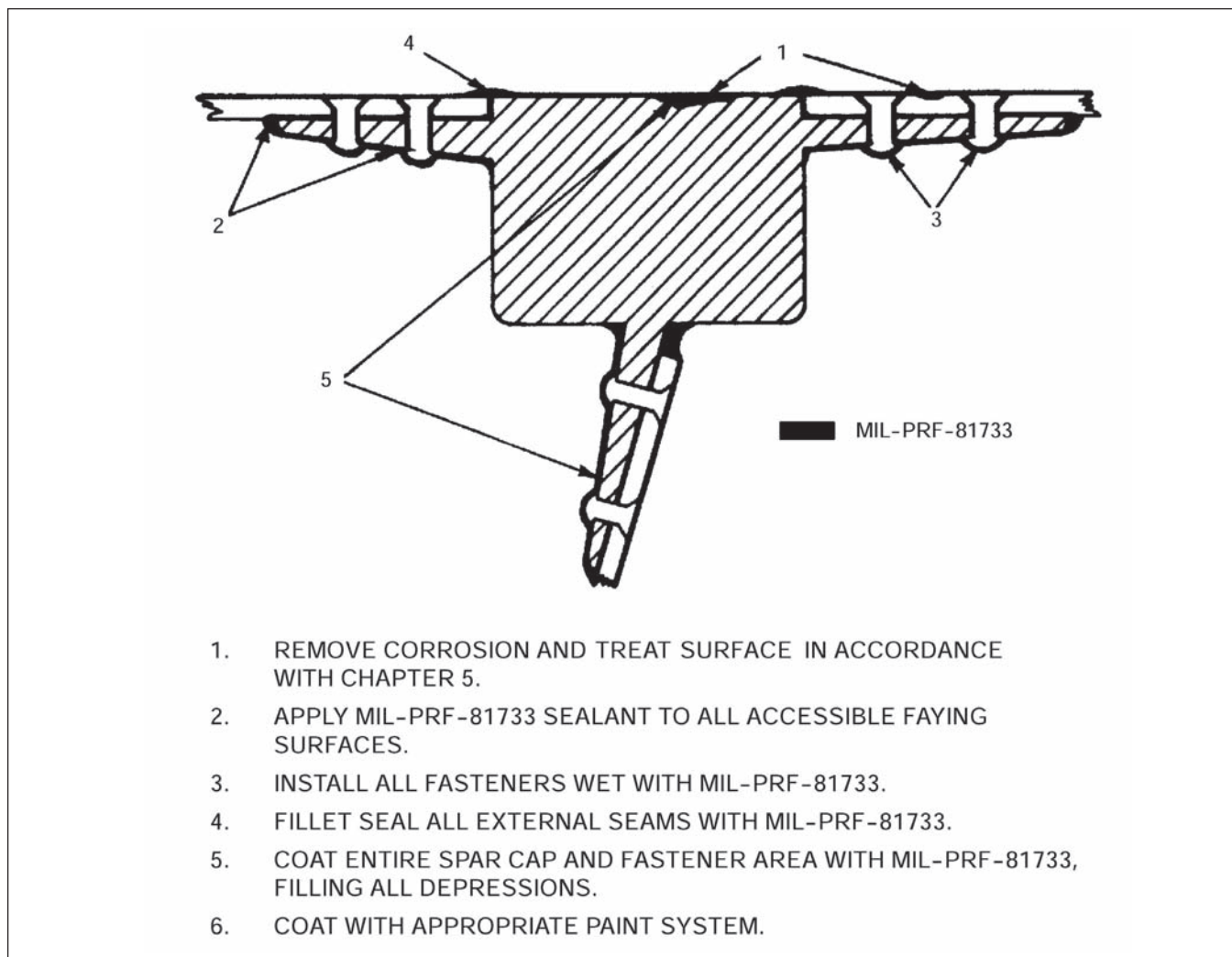


Figure 7-17. Typical Spar Cap Sealing

MIL-PRF-23377 or MIL-PRF-85582 primer. When the primer is dry, coat with MIL-PRF-81733 sealant prior to installation of patch. Permanently installed fasteners shall be wet installed with MIL-PRF-81733 prior to installation. Removable panel fasteners shall be wet installed with AMS 3284.

7-8.9. HIGH TEMPERATURE AREAS. In areas where high temperatures are expected, MIL-A-46146 Group III, AMS 3374 Type I, or AMS 3277 Type I should be used

for sealing. Adhesion promoter is required when sealing with AMS 3277. Application of these sealants is similar to spatula-applied sealants (refer to paragraph 7-7.5).

7-8.10. LOW TEMPERATURE CURING. When cold climates interfere with sealing operations by prolonging the sealant curing reaction, use AMS 3277 Type I. Adhesion promoter is required when sealing with AMS 3277. AMS 3255 (ePTFE sealing tape) may be used in approved applications, as it does not require curing.

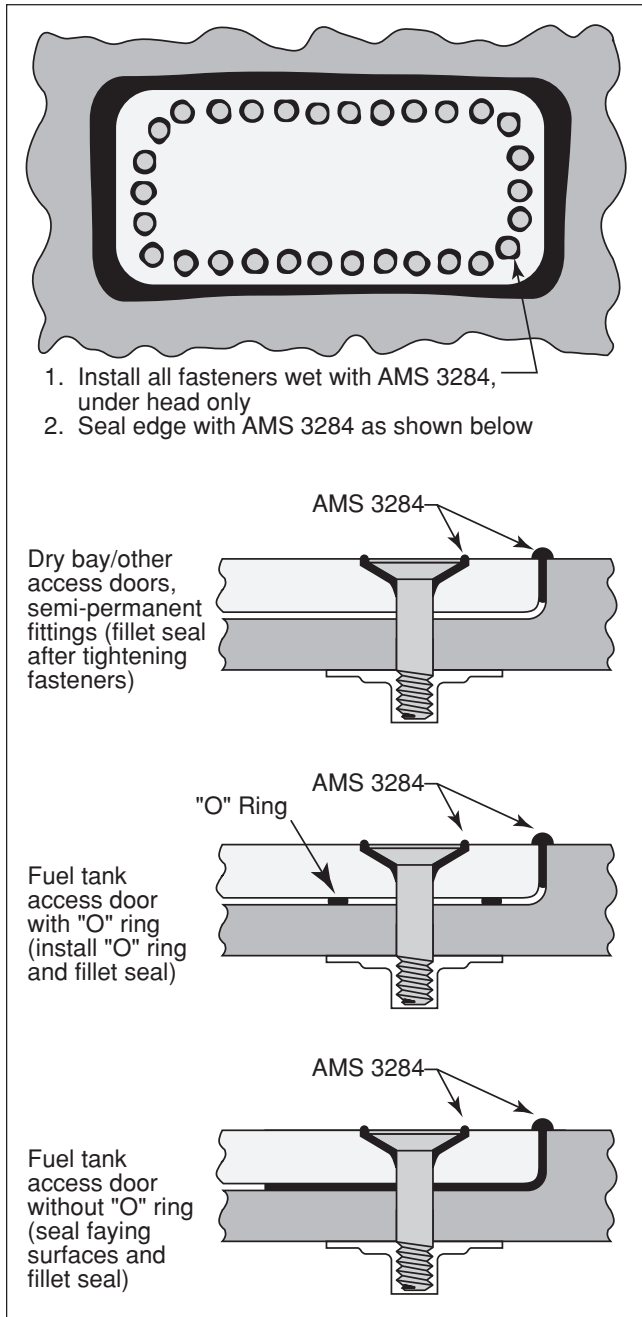


Figure 7-18. Sealing of Access Doors

**7-9. REPAIR OF DAMAGED SEALANT.**

7-9.1. DAMAGED SEALANT. Many areas on aircraft are sealed either at the factory or by Depots during rework. Fresh sealant shall be applied whenever the previously applied sealant is damaged. Remove the damaged sealant with a plastic scraper or mechanical sealant removal tool (paragraph 7-5.5.) and, if necessary, prepare the metal surface in accordance with Chapter 5. Slightly roughen a strip of the undamaged sealant approximately one inch wide around the boundary of the stripped area using an abrasive cloth and then clean with solvent (AMS 3166 or approved equivalent) using a clean cloth (AMS 3819) or cheesecloth (CCC-C-440). Apply the new sealant by brush or spatula (see paragraph 7-7.5) onto smaller areas, or by spraying (see paragraph 7-7.6) onto larger areas. The new sealant should overlap the existing coating onto the roughened area.

7-9.2. FORM-IN-PLACE SEALANT REPAIR. After removal of all loose sealant material, thoroughly clean the area to be resealed (see paragraph 7-7.1). Areas of old seal to which new sealant will be added must be cleaned and abraded using an abrasive mat or abrasive cloth to expose a clean, fresh surface.



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a. Apply MIL-PRF-81733 Type II-1/2 or aircraft specific sealant, preferably with a sealant gun. The new sealant should match the configuration of the removed sealant but should be of sufficient depth to ensure contact with the mating surface.

b. Apply a very thin film of release agent (VV-P-236 or MIL-PRF-32033) to the nonstick mating surface and close the access door.

c. Do not open the door for a minimum of 24 hours or the published tack free time of the aircraft specific sealant, if applied at 75°F (24°C) and 50% relative humidity (RH).



7-9.3. ePTFE SEALING TAPE (Skyflex™) REPAIR. In order to preserve sealant integrity, it is necessary to inspect the sealant tape each time an access panel is removed.

**NOTE**

The main function of the adhesive backing is to hold the ePTFE sealant tape in place. Peeling/delamination of the adhesive from the aircraft structure/panel requires replacement of any section of the sealant tape that is not located in the faying surface.

- a. Visually inspect ePTFE sealant material for nicks, cuts, gouges and delamination/separation.
- b. Cut and remove only the damaged section of the sealant tape. Lift damaged tape section from surface to cut with scissors; do not cut tape directly on surface to avoid damage to airframe.
- c. Measure and cut a new piece of sealant tape approximately one inch longer than the removed section.

**CAUTION**

Ends of repair splice must overlap the existing sealant to ensure sealant integrity. Use care not to pull or stretch the ePTFE tape as it is applied. The stretched ePTFE tape will retract even if it is clamped between faying surfaces, which may reduce or eliminate overlap and allow water intrusion.

- d. Install new sealant tape so it overlaps the previously installed sealant by  $\frac{1}{4}$  to  $\frac{1}{2}$  inch on each side of the repair site.
- e. Once sealant tape is applied, run fingers back and forth on tape to further activate the adhesive. No curing time is required.
  - (1) Applying extra pressure to the sealant tape will cause the pressure sensitive adhesive to better adhere to the faying surface and it will create indentations/discoloration at the fastener holes allowing for easy identification.
  - (2) For some fasteners, it may be necessary to pre-punch holes in the sealant tape at the affected fastener locations. Locate holes in repair section and pre-punch using leather punch with diameter no greater than  $\frac{1}{4}$  inch more than the fastener hole diameter.

f. If sealant without adhesive backing is used for repair in areas where high fluid exposure is expected, MMM-A-189 plastic adhesive or equivalent may be used to hold the ePTFE sealing tape in place. Apply adhesive to entire length of repair section and apply ePTFE sealing tape within 20 minutes or before adhesive is tack free.

g. Puncture any affected fastener hole with a sharp pointed object such as an awl/scribe or scissors.

**NOTE**

As fasteners are installed, the ePTFE sealant material pushed into the fasteners will help seal against moisture intrusion.

h. Install access panel. All fasteners should be wet installed with corrosion preventive compound (MIL-PRF-16173 Grade 4 or equivalent) as specified in the aircraft maintenance manual.

7-9.4. REINFORCED POLYURETHANE GEL SEALING TAPE (HI-TAK® TAPE TUFSEAL™) REPAIR. In order to preserve sealant integrity, it is necessary to inspect the sealant tape each time a floorboard is removed.

- a. Visually inspect reinforced polyurethane gel sealant tape on floorboard spars for nicks, cuts, gouges, dry appearance, missing gel, and other indications of damage which might compromise sealing integrity.
- b. Cut and remove only the damaged section of the sealant tape. Lift damaged tape section from surface to cut with scissors; do not cut tape directly on surface to avoid damage to airframe.
- c. Clean any residue from the surface using a solvent (AMS 3166, A-A-59281 Type I or II, or equivalent) and cheesecloth (CCC-C-440) or a clean cloth (AMS 3819 or equivalent).
- d. Measure and cut a new piece of sealant tape approximately the same length as the removed section.
- e. Install new sealant tape, creating a butt joint with remaining tape sections. Gaps greater than  $\frac{1}{8}$  inch shall not be created at butt joints. A slight excess of tape ( $\frac{1}{8}$  inch to  $\frac{1}{4}$  inch) is preferred over insufficient tape to cover the exposed surface.
- f. If the repaired section is over a fastener hole, there is no need to pre-punch fastener holes prior to installation of floorboard panels.



**7-10. STORAGE AND SHELF LIFE.** All sealants have a specified shelf life. The date of manufacture and the expiration date or inspect/test date are listed on each container. The shelf life is dependent on storing the sealant in its original, unopened container in an area where the temperature does not exceed 60°F (27°C), unless otherwise specified on the package. Prior to use, sealant containers shall be visually inspected to determine if the material has exceeded its expiration date. If the sealant has exceeded the expiration date, dispose of the container in accordance with local regulations. If the sealant has exceeded its inspect/test date, then it shall not be used until update testing has been performed. Procedures for update testing are usually provided in the sealant specification. No sealant shall be used if it fails testing. Minimum update testing can be performed as follows:

a. Select one sample of sealant from each manufacturer's batch of material to be tested for updating.

b. Visually examine the content of each component in the sample. No separation, layering, or settling that will not disperse to a homogeneous mixture when mixed is allowed. If the base compound is lumpy, partially cured, or cannot be mixed with the curing agent, dispose

of the opened sample and all kits from that batch of sealant in accordance with local regulations.

c. If the sample can be blended to form a homogeneous mixture, determine whether the application time is suitable for the intended purpose by applying the mixture to a clean piece of scrap aluminum at the application time of the sealant (i.e., B-1/2, apply after 30 minutes). If the sealant is too thick or does not stick to the metal at application time, the sealant is not acceptable. Dispose of the opened sample and all others from that batch in accordance with local regulations.

d. If the application time is acceptable, periodically check the applied sealant for cure time by checking its hardness. The batch of sealant represented by the applied sealant can be extended if it achieves approximately the same hardness as sealants which are not overaged.

e. This updating process may be repeated for a maximum of three extensions ( $\frac{1}{2}$  original shelf life,  $\frac{1}{3}$  original shelf life, and  $\frac{1}{6}$  original shelf life). Affix an extension label to the container in accordance with FED-STD-793.

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## CHAPTER 8 PRESERVATION

**8-1. INTRODUCTION.** Corrosion preventive compounds (CPCs), or preservatives, are used to protect metal aircraft parts and components. They function by preventing corrosive materials from contacting and corroding bare metal surfaces. Many of these compounds are also able to displace water, sea water, and other contaminants from the surfaces to be protected. Some provide lubrication, as well as corrosion protection. Generally, CPCs are mixtures of special additives in petroleum derivative bases (special oils or greases). CPCs range in appearance and consistency from the thick, black types, such as MIL-PRF-16173 Grade 1, to light oils, such as MIL-PRF-32033 (formerly VV-L-800). The thicker CPCs provide the best corrosion protection, are longer lasting, and are more difficult to remove. The thinner materials provide some lubrication and do not crack, chip or peel but must be removed and replaced regularly to provide continuing protection. Navy: refer to NAVAIR 15-01-500 for detailed information on preservation of aircraft and components.

**8-2. OPERATIONAL PRESERVATION.** The day to day application of CPCs to prevent corrosion on operational aircraft is known as operational preservation. Areas which are corrosion prone or where paint has been damaged should be routinely protected by CPCs until more permanent treatment (such as paint touchup or sealing) can be accomplished.

**8-3. NON-OPERATIONAL PRESERVATION.** Preservation of aircraft or components during periods of prolonged inactivity, storage, or shipment is known as non-operational preservation.

**8-4. TYPES OF CPCS.** CPCs can be separated into two major categories: water displacing and non-water displacing compounds.

8-4.1. WATER DISPLACING COMPOUNDS. Water displacing CPCs can be used to remove water, sea water, or other electrolytes from metal surfaces. MIL-PRF-81309, MIL-DTL-85054, MIL-PRF-63460, and MIL-PRF-32033 are examples of water displacing CPCs. These CPCs are able to penetrate into cracks, crevices, voids in faying edges, around fastener heads, and into hinges. They usually provide very thin coatings, one mil (0.001 inch) or less in thickness (a dollar bill is five mils thick), and are usually clear or translucent. Most water displacing compounds are soft, oily compounds which

cannot provide long term protection outdoors or in areas which are frequently handled. MIL-DTL-85054 differs from the other water displacing compounds by forming a relatively hard, dry film, and can be used for protection outdoors and in areas of frequent handling.

8-4.2. NON-WATER DISPLACING COMPOUNDS. Non-water displacing CPCs may be used on dried surfaces or on surfaces which have been first treated with a water displacing CPC. MIL-PRF-16173, Grades 1, 2 and 4, are examples of non-water displacing CPCs. They are heavier bodied oils or greases which provide long term corrosion protection. These CPCs provide thicker coatings and are light brown to very dark brown in color, with a waxy greasy appearance. They provide good corrosion protection in areas where large amounts of water collect on or run off of structures. MIL-L-87177 Grade B is a corrosion inhibiting and lubricating CPC that provides longer outdoor protection than MIL-PRF-81309 and MIL-PRF-32033 and can be used for corrosion protection when ultra-penetrating properties are not required.

**8-5. TIME LIMITATIONS OF CPCS.** Because of their temporary nature, CPCs must be regularly removed and replaced to provide continuing corrosion protection. Table 8-1 provides the recommended time intervals for indoor and outdoor CPC application. Navy: Refer to NAVAIR 15-01-500 for further information on usage of CPCs.

**8-6. DESCRIPTION OF CPCS.** A list of CPCs and their intended uses is summarized in Table 8-2.

### WARNING

MIL-PRF-81309 and MIL-DTL-85054 have been revised to eliminate Ozone Depleting Substances (ODS). Some products that have been reformulated are now flammable. Pay close attention to all CAUTION/WARNING labels on solvents and solvent-based products.

8-6.1. MIL-PRF-81309 (CORROSION PREVENTIVE COMPOUND, WATER DISPLACING, ULTRA THIN FILM). MIL-PRF-81309 is a general purpose corrosion preventive compound which can be used whenever a CPC or a water displacing compound is called for but no specification is referenced. MIL-PRF-81309 is used for

Table 8-1. Time Limitations for CPCs

CPC	Outdoor <sup>1</sup>	Indoor <sup>2</sup>	Indoor Covered <sup>3</sup>
<b>Soft Thin Films</b> MIL-PRF-81309 Type II MIL-PRF-81309 Type III	14 days 5 days	30 days 14 days	180 days 90 days
<b>Lubrication and Protection</b> MIL-PRF-32033 MIL-PRF-63460	5 days 5 days	30 Days 30 Days	180 days 180 days
<b>Hard or Thick Films</b> MIL-L-87177 Grade B MIL-DTL-85054 MIL-PRF-16173 Grade 4 MIL-PRF-16173 Grade 2 MIL-PRF-16173 Grade 1	28 days 90 days 90 days 90 days 210 days	60 Days 210 days 210 days 210 days 365 days	180 days 365 days 365 days 365 days 365 days
1. Outdoor: Without cover; exposed to elements in a mild climate; absence of rain and other washing forces; free from air and water borne pollutants. 2. Indoor: Hangars, shop areas, storage or parts accumulation areas, warehouses. 3. Indoor covered: Items are wrapped or sealed in a water-resistant material, and stored indoors in a hangar, warehouse, or shop area. Soft thin film CPCs were designed for indoor use and ease of removal.			

indoor protection and short term protection where surfaces can be recoated when required. MIL-PRF-81309 materials are excellent water displacing compounds which provide an ultra thin (0.5 mil or less), soft film. The specification covers two types, both of which can be applied by dipping, spraying, brushing, or aerosol container. They provide temporary protection from corrosion and are easily removable with a solvent. They should not be used around liquid oxygen fittings.

8-6.1.1. Type II. A soft, thin film for general use, particularly on moving or sliding parts where some lubrication is needed, such as hinges or bomb racks. It may be washed away by rain or wash procedures. Type II shall be used to protect areas which cannot be properly drained or contain recesses that are particularly difficult to reach.

8-6.1.2. Type III. An ultra thin, soft film primarily for use on avionics and electronic equipment. Although this coating is nonconductive, it will allow electrical contact because it is soft and very thin.

8-6.2. MIL-DTL-85054 (CORROSION PREVENTIVE COMPOUND (AMLGUARD)). AMLGUARD is a water displacing CPC which forms a clear, dry, flexible film. It is intended for use as a protective coating until painting is practical. Because of its paint-like characteristics, it provides no lubrication.

**CAUTION**

Ensure that all areas where MIL-DTL-85054 is applied are fully dried before sealing an area. Although MIL-DTL-85054 is a corrosion preventive compound, its solvent vapors may cause corrosion if not allowed to dissipate.

8-6.2.1. AMLGUARD can be applied by dipping, brushing, spraying, or from aerosol containers; however, dipping provides a very thin coating with less corrosion protection. AMLGUARD is primarily applied by spraying from aerosol cans. After each use of an aerosol can, invert the can and spray until spray tip (nozzle) is clear of entrapped material. If an aerosol can does not spray, invert and depress the spray tip several times to clear the delivery tube and spray head. If the can still does not spray, remove and clean the plastic spray head then spray again to clear the delivery tube.

8-6.2.2. AMLGUARD should be removed if it is damaged due to abrasion, when there are cracks in the coating, or if there is evidence of corrosion below the coating. Since AMLGUARD buildup is difficult to remove, especially after prolonged exposure to direct sunlight, previously applied coatings should be removed before reapplication. If the solvents do not remove old films of AMLGUARD, spraying on fresh AMLGUARD to soften the film and wiping or rubbing while wet is often effective.

Table 8-2. Aircraft Corrosion Preventive Compounds

Specification and Nomenclature	Intended Use	Type of Coating
<b>WATER-DISPLACING CPCs</b>		
<b>MIL-PRF-32033</b> Lubricating Oil General Purpose, Preservative (Water Displacing, Low Temperature)	Lubrication of hinge areas and wherever a low temperature, water displacing lubricant is required; requires frequent reapplications.	Soft, oily coating
<b>MIL-PRF-63460</b> Lubricant, Cleaner, and Preservative for Weapons and Weapons Systems	Lubrication and short term preservation of aircraft hinges and small and large caliber weapons; facilitates the effective removal of firing residues, gums, and other contaminants from weapons components.	Thin, corrosion preventive lubricant
<b>MIL-PRF-81309</b> Corrosion Preventive Compounds, Water Displacing, Ultra-thin Film	<b>Type II</b> Displacement of water; short term corrosion protection of metal surfaces during shipment, storage, and in-service use; corrosion protection of moving parts where some lubrication is required, such as hinge areas, bomb racks, and sliding parts. Also used as a waterless cleaner.	Soft, very thin (0.5 mil) translucent, light amber color
	<b>Type III</b> Displacement of water; corrosion protection of avionics equipment, electrical connector plugs and contact pins.	Soft, ultra thin film (0.2 mil), translucent, light amber color
<b>MIL-DTL-85054</b> Corrosion Preventive Compound, Water Displacing, Clear (AMLGUARD)	Corrosion protection and water displacement for nonmoving parts, such as skin seams, installed fastener heads where paint has cracked, access panel edges, and areas with damaged paint.	Dry, thin (1.0 mil), clear, colorless
<b>NON-WATER DISPLACING CPCs</b>		
<b>MIL-PRF-16173</b> Corrosion Preventive Compound, Solvent Cutback, Cold Application	<b>Grade 1</b> Protection of metal surfaces against corrosion when exposed with or without covering indoors or outdoors.	Hard, tack-free, thick (4.0 mils), dark brown or black color
	<b>Grade 2</b> Protection of metal surfaces against corrosion during rework or storage.	Soft, non-drying, thick (2.0 mils), light brown color
	<b>Grade 4</b> Protection of metal surfaces against corrosion during indoor storage when a transparent coating is required; coating of interior cables.	Soft, tack-free, thick (2.0 mils), light brown color
<b>MIL-L-87177 Grade B</b> Lubricants, Corrosion Preventive Compound, Water Displacing, Synthetic	Corrosion protection of components with moving parts requiring minimal lubrication. Not as water-displacing or penetrating as MIL-PRF-81309 or MIL-PRF-32033.	Soft, translucent, non-tacky film (2.0 mils)

8-6.3. MIL-PRF-16173 (CORROSION PREVENTIVE COMPOUND, SOLVENT CUTBACK). MIL-PRF-16173 covers five different grades of CPCs which can be applied by brushing or dipping. Grades 1, 2, and 4 do not displace water and must be applied to dried surfaces or to surfaces which have first been treated with MIL-PRF-81309.

8-6.3.1. Grade 1. A thick, hard, black CPC which can be removed with difficulty using mineral spirits or paint removers. It offers the most corrosion protection of all the CPCs indoors and outdoors, and may be used at temperatures down to 0°F (-18°C).

8-6.3.2. Grade 2. A thick, soft, greaselike, brown CPC that remains tacky and can be removed with mineral spirits. It protects under relatively severe conditions and, given adequate maintenance touch-up as necessary, can be used for most maximum protection requirements. It may be used at temperatures down to -40°F (-40°C).

8-6.3.3. Grade 3. A thin, soft film, water-displacing CPC. It is not recommended for use on aluminum or magnesium parts. Use MIL-PRF-81309 Type II as a substitute.

#### NOTE

Remove MIL-PRF-16173 Grade 4 with degreasing solvent (MIL-PRF-680 Type II) if the coating is dark and prevents visual inspection of the underlying surface for cracks and hydraulic leaks.

8-6.3.4. Grade 4. A thin, relatively dry, semitransparent film through which identification can be read. It may be used at temperatures down to -40°F (-40°C).

#### CAUTION

If MIL-PRF-63460 is used in an area which will later be sealed, allow at least 4 hours for the solvent to evaporate prior to sealing. Although MIL-PRF-63460 is a corrosion preventive compound, its solvent vapors may cause corrosion if not allowed to dissipate.

Do not use MIL-PRF-63460 on rubber or other elastomeric parts. MIL-PRF-63460 contains solvents which attack rubber "O" rings and other elastomeric parts. Do not use as a direct substitute for MIL-PRF-32033.

8-6.4. MIL-PRF-63460 (LUBRICANT, CLEANER, AND PRESERVATIVE FOR WEAPONS AND WEAPON SYSTEMS). MIL-PRF-63460 is a thin, water displacing, protective, penetrating lubricant used for cleaning, lubrication, and preservation of aircraft hinges and small or large caliber weapons. This material has good lubricating properties between -65° and 150°F (-54° and 65°C). It may be applied by brushing, dipping, spraying, or from an aerosol container.

#### CAUTION

MIL-PRF-32033 suffers a loss of viscosity at very low temperatures; therefore, it shall not be used when temperatures can drop below -40°F (-40°C).

8-6.5. MIL-PRF-32033 (LUBRICATING OIL, GENERAL PURPOSE, PRESERVATIVE (WATER DISPLACING, LOW TEMPERATURE)). MIL-PRF-32033 (supersedes VV-L-800) is a general purpose, water displacing, lubricating oil with preservative properties, and is intended for the lubrication and preservation of aircraft components. It may be applied by brushing, dipping, spraying, or from an aerosol container. It should not be used in fuel cells or fuel systems.



**NOTE**

Current formulation of MIL-L-87177 Grade B contains Halon 141B, which may be subject to environmental restrictions in some locations.

8-6.6. MIL-L-87177 (LUBRICANTS, CORROSION PREVENTIVE COMPOUND, WATER DISPLACING, SYNTHETIC). MIL-L-87177 Grade B is a synthetic lubricant with added corrosion inhibitor. This material creates a non-tacky film on the surface. MIL-L-87177 does not displace water or penetrate as thoroughly as MIL-PRF-81309 or MIL-PRF-32033 and should only be used on surfaces that have been wiped dry. Tight crevice locations should have a coating of MIL-PRF-81309 applied prior to use of MIL-L-87177 to ensure proper protection.

**CAUTION**

Do not use corrosion preventive compounds on the interior of fuel tanks or fuel cells, engines, or engine fuel systems.

Do not use corrosion preventive compounds on engine parts or accessories which exceed 800°F (427°C). Hot corrosion reactions may occur.

CPCs are not compatible with liquid oxygen and should not be used on oxygen equipment, lines, fittings or storage bottles.

**NOTE**

Use only corrosion preventive compounds (CPCs) authorized by the parent service organization and described in this manual.

**8-7. PRESERVATION OF SPECIFIC AREAS.** Table 8-3 provides procedures for the preservation of specific areas and components where the use of a CPC on exposed metal surfaces is generally recommended for reducing corrosion. This list does not constitute authority to use CPCs on specific equipment. The use of some or all types of CPCs in certain areas or on equipment may be detrimental. Therefore, consult the appropriate corrosion and maintenance manuals before applying a CPC in a new area and determine which, if any, compounds should be used in that area. If application of a CPC is required, and no specific instructions are available, the CPC Decision Tree (Figure 8-1) may be used as a guideline to determine the most appropriate CPC.

**WARNING**

CPCs and solvents can produce toxic vapors. Use only in well ventilated areas. Avoid contact with skin. Consult local safety office for personal protective equipment requirements. Do not use synthetic wiping rags or cloths with these materials. Keep CPCs and solvents away from open flames or sparks.

**8-8. PRESERVATION APPLICATION METHODS.** CPCs can be applied by brushing, dipping, or spraying. The area of application, viscosity of the material, and conditions under which they need to be applied are factors which determine which method of application to use. Low viscosity (thin) materials are best applied by spraying, whereas high viscosity (thick) materials are more suited for brushing or dipping. Dipping can be used for all types of materials, but the thickness of the coating obtained with low viscosity materials may be too thin to provide adequate corrosion protection. Prior to application of preservatives, remove old preservative coatings, then apply using one of the following methods.

8-8.1. BRUSHING. Brushing may be accomplished using an ordinary paint brush. This method is most appropriate for applying thick materials, for use on small areas, or where it is necessary to prevent material from getting on surrounding areas or nearby equipment.

8-8.2. DIPPING. Dipping may be accomplished using any suitable container for the CPC. It is most suitable for smaller disassembled parts. It cannot be used for assemblies which contain any part or area adversely affected by the CPC.

**CAUTION**

For spray application, do not thin or dilute bulk preservative unless absolutely necessary. Do not use synthetic wiping cloths. Mask off adjacent areas to prevent overspray.

8-8.3. SPRAYING. Spraying may be accomplished using paint spraying equipment, various types of trigger sprayers, or aerosol containers. This method is very effective for application to large areas and where confinement is not a problem. The viscosity of the material will determine which type of spraying equipment to use.

Table 8-3. Preservation of Specific Areas and Components

Area or Component	CPC	Application Instructions	Removal Instructions
<b>NOTE</b> Prior to the application of preservatives, ensure removal of old coatings.			
<b>ARMAMENTS</b>	Refer to specific instruction manual.		
<b>CONTROL CABLES (INTERIOR)</b>	MIL-PRF-81309 Type II and MIL-PRF-16173 Grade 4	Apply a continuous coating of MIL-PRF-81309 using aerosol can or wiping with cloth wet with CPC. Follow with a coating of MIL-PRF-16173 applied with a cloth.	Use a non-synthetic wiping cloth dampened with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I).
<b>EJECTION SEATS</b>	Refer to specific ejection seat maintenance manuals and ACC/SPM instructions.		
<b>ELECTRICAL AND ELECTRONIC EQUIPMENT</b>	Refer to Volume III.		
<b>ELECTRICAL CONNECTOR PINS (ALL)</b> Connector pins and sockets.	MIL-PRF-81309 Type III	Apply a continuous thin, wet coat. If handled or exposed to water, reapply.	Use an acid brush with non-synthetic bristles to apply degreasing solvent (MIL-PRF-680 Type II). Lightly dab all pins and blot dry. Repeat using isopropyl alcohol (TT-I-735).
<b>ELECTRICAL CONNECTOR SHELLS (EXTERIOR)</b> Connector shells located in flap wells, wheel wells, bilge areas.	<b>NOTE</b> For additional information refer to Volume III.		
	MIL-DTL-85054  or  MIL-PRF-81309 Type II and MIL-PRF-16173 Grade 4	Wipe off dirt and excess moisture. When disassembly is infrequent, apply a thin coat of AMLGUARD. Do not allow CPC to contact internal surfaces. Allow to dry one-half hour. Apply a second coat.  Wipe off dirt and excess moisture. When disassembly is frequent, apply coating of MIL-PRF-81309, followed by a coating of MIL-PRF-16173.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or paint thinner (MIL-T-81772). For stubborn AMLGUARD, refer to paragraph 8-6.2.2.  Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I).
<b>ELECTRICAL CONNECTOR SHELLS (INTERIOR)</b> Connector shells located in aircraft interior.	<b>NOTE</b> For additional information refer to Volume III.		
	MIL-PRF-81309 Type II	Wipe off dirt and excess moisture. Apply a thin, uniform coating of CPC.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I).
<b>EXTERIOR SURFACES NOT REQUIRING HIGH PERFORMANCE LUBRICANT OR HYDRAULIC FLUID</b> Sliding or moving parts requiring only minor lubrication (bomb racks, hinges, door locks).	MIL-PRF-63460  or  MIL-PRF-81309 Type II and MIL-PRF-32033	Apply a continuous wet coat of MIL-PRF-63460. If handled, reapply.  Apply a coating of MIL-PRF-81309, followed by a coating of MIL-PRF-32033. If handled, reapply.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I).

Table 8-3. Preservation of Specific Areas and Components (Cont.)

Area or Component	CPC	Application Instructions	Removal Instructions
<b>EXTERIOR SURFACES NOT REQUIRING LUBRICATION</b> Unpainted areas and areas with damaged paint which do not require lubrication (fastener heads, faying surfaces, access panel edges, doors and frames, attachment points, non-moving attachment hardware, wheel well areas, ram air ducts, flap/slat cavities).	MIL-DTL-85054  or  MIL-PRF-81309 Type II and MIL-PRF-16173 Grade 4	Wipe off dirt and excess moisture. Apply thin coating of AMLGUARD. Allow to dry one-half hour. Apply a second coat.  Wipe off dirt and excess moisture. Apply a coating of MIL-PRF-81309, followed by a coating of MIL-PRF-16173.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or paint thinner (MIL-T-81772). For stubborn AMLGUARD, refer to paragraph 8-6.2.2.  Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I).
<b>HELICOPTER CARGO HOIST DRUM</b>	MIL-PRF-81309 Type II  or  MIL-DTL-85054	Spray with MIL-PRF-81309. Wipe with a clean cloth to remove excess.  Spray MIL-DTL-85054, with a continuous film. Allow to dry one half hour. Apply a second coat.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I).  Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680 Type II) or paint thinner (MIL-T-81772). For stubborn AMLGUARD, refer to paragraph 8-6.2.2.
<b>HYDRAULIC PISTON SURFACES</b>	System Hydraulic Fluid	Wipe exposed surface with low lint cloth dampened with hydraulic fluid, wiping away from seals. Take care not to scratch surfaces.	Do not remove. Reapply as necessary.
<b>THREADED SURFACES</b> Screws, various fasteners.	MIL-PRF-63460 or MIL-PRF-81309 Type II  or  MIL-PRF-81309 Type II and MIL-PRF-16173 Grade 4  or  MIL-PRF-16173 Grade 4	When disassembly is frequent, use MIL-PRF-63460 or MIL-PRF-81309. Dip screws or fasteners in CPC and install.  When disassembly is infrequent, spray fastener with MIL-PRF-81309. Wipe with a clean cloth to remove excess. Follow with a coating of MIL-PRF-16173 for long term protection.  <b>DEPOT ONLY:</b> When disassembly is infrequent, use MIL-PRF-16173 for long term protection. Dip screws or fasteners in CPC and install.	Immerse screws or fasteners in degreasing solvent (MIL-PRF-680 Type II) or cleaner (MIL-PRF-32295 Type I) and blot or blow dry.

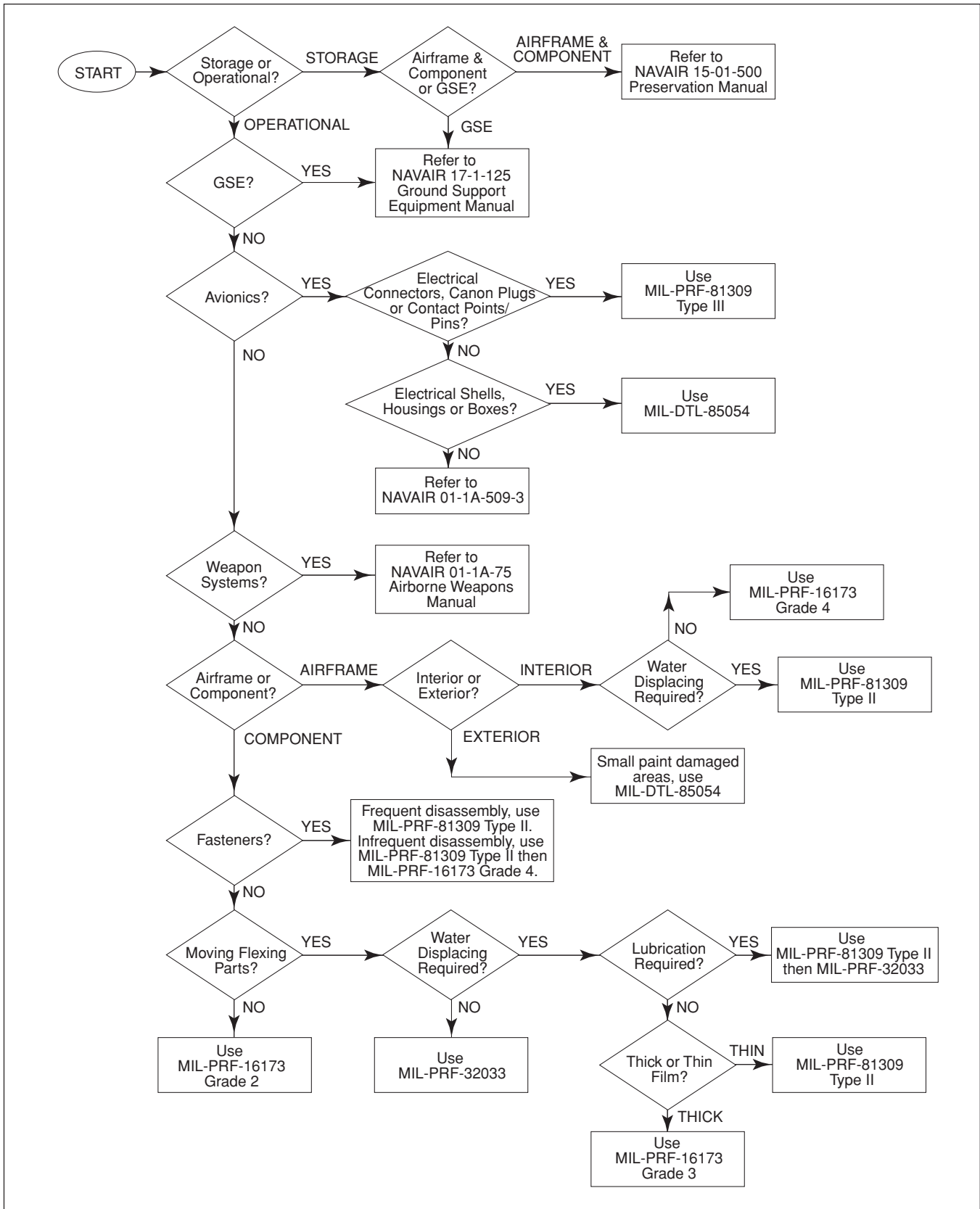


Figure 8-1. CPC Decision Tree

**8-9. APPLICATION OF POLISH AND WAX.** Polishing and waxing of aircraft exterior surfaces is prohibited unless authorized by parent service organization directives.

**8-10. PRESERVATION OF ASSEMBLIES AND PARTS REMOVED FROM AIRCRAFT DURING MAINTENANCE.**

**8-10.1. SHORT TERM STORAGE (30 DAYS OR LESS).** Short term storage shall be defined as any period up to 30 days for the purposes of this manual. When assemblies or parts are removed from the aircraft for repair, or to gain access to areas of the aircraft for maintenance, they shall be treated to prevent corrosion prior to placement into short term storage. All items shall be stored indoors in a covered area to protect them from the elements. Navy shall refer to NAVAIR 15-01-500 or to the applicable maintenance or equipment storage manuals for specific details on storage of a particular part or assembly. In the absence of other requirements, the following procedures apply:

- a. Clean part or assembly in accordance with Chapter 2.
- b. Assemblies or parts having bare metal surfaces, such as internal and working surfaces on landing gear components, shall be properly lubricated with the aircraft greases or oils normally applied in service.
- c. High strength steel components which are stripped of their protective coatings shall be protected using one of the following methods:



Compound, Corrosion Preventative 4  
Water-Displacing  
MIL-PRF-81309

- (1) Apply a film of CPC (MIL-PRF-81309 Type II) to all bare surfaces whenever there is a lapse of two hours or more in the repair cycle. The part shall then be loosely overwrapped with barrier material (MIL-PRF-131 Class 1).

- (2) Wrap part in VCI film, MIL-PRF-22019 or VCI paper, MIL-PRF-3420, and seal with tape, SAE AMS-T-22085.

- d. Completely painted parts need no other special protective measures, except in marine or high humidity environments. In these cases, the part shall be loosely overwrapped with barrier material (MIL-PRF-131 Class 1).



Solvent, Degreasing 13  
MIL-PRF-680



Cleaner, Non-Aqueous, 15  
Low VOC, HAP Free,  
MIL-PRF-32295

- e. Prior to rework or reapplication of protective coatings, remove CPC with degreasing solvent (MIL-PRF-680 Type II or III) or non-aqueous cleaner (MIL-PRF-32295 Type I) as required. Reapply the appropriate aircraft lubricant to areas requiring lubrication. CPCs shall not be used for lubrication in lieu of the lubricant specified for use on a particular part or assembly.

**8-10.2. LONG TERM STORAGE (OVER 30 DAYS).** If the storage of assemblies or parts will exceed 30 days, increased protective measures are required, particularly on critical parts and high strength steel components. All items shall be stored indoors in a covered area to protect them from the elements. Refer to the following manuals, or to the applicable maintenance or equipment storage manuals, for specific details on storage of a particular part or assembly: NAVAIR 15-01-500 (Navy) or TM 743-200-1 (Army). In the absence of other requirements, the following procedures apply:

- a. Clean part or assembly in accordance with Chapter 2.
- b. All bare metal surfaces, and surfaces with damaged plating or paint, shall be protected using one of the following methods:



Compound, Corrosion Preventative 4  
Water-Displacing  
MIL-PRF-81309



Compound, Corrosion Preventative 6  
MIL-PRF-16173

(1) Apply water displacing CPC (MIL-PRF-81309 Type II) followed by long term CPC (MIL-PRF-16173 Grade 4). The part shall then be overwrapped with barrier material (MIL-PRF-131 Class 1) and sealed with tape (SAE AMS-T-22085 Type II).

(2) Wrap part in VCI film, MIL-PRF-22019, or VCI paper, MIL-PRF-3420, and seal with tape, SAE AMS-T-22085.

c. Completely painted parts need no other special protective measures, except in marine or high humidity environments. In these cases, the part shall be overwrapped with barrier paper (MIL-PRF-131 Class 1) and sealed with tape (SAE AMS-T-22085 Type II).

d. Depending upon the length of time in storage, reapplication of protection may be required.

(1) Refer to Table 8-1 for time limitation information on CPCs.

(2) Replace torn or damaged VCI film or paper. Intact VCI film or paper has a storage limit of one year.



Solvent, Degreasing 13  
MIL-PRF-680



Cleaner, Non-Aqueous, 15  
Low VOC, HAP Free,  
MIL-PRF-32295

e. Prior to returning the part or assembly to service, remove CPCs with degreasing solvent (MIL-PRF-680 Type II or III) or non-aqueous cleaner (MIL-PRF-32295 Type I) as required. Reapply the appropriate aircraft lubricant to areas requiring lubrication. CPCs shall not be used for lubrication in lieu of the lubricant specified for use on a particular part or assembly.



## CHAPTER 9 EMERGENCY PROCEDURES

**9-1. PURPOSE.** This chapter describes the emergency procedures to be followed after aircraft incidents or accidents involving exposure to vast amounts of salt water or fire extinguishing agents. The procedures described herein are used to prevent further damage and will usually require further treatment at a higher level of maintenance.

### 9-2. RESPONSIBILITY.

#### CAUTION

Exposure of metal surfaces to salt water, Purple-K-Powder (PKP), and protein foam requires immediate action to prevent serious corrosion damage.

#### **NOTE**

In cases involving aircraft accidents, permission must be obtained from the senior member of the accident investigation board prior to the initiation of emergency procedures.

9-2.1. Under emergency conditions, all personnel shall assume responsibility for minimizing damage. Removal of equipment shall be supervised by the Maintenance Officer (MO). Each reporting custodian shall designate a Corrosion Prevention and Control Program Manager to supervise the emergency reclamation team. Maintenance control shall 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. If required, additional squadron personnel shall be selected and placed under the direction of the Corrosion Prevention and Control Program Manager. In case of fire damage, the Materials Engineering Division of the Fleet Support Team (FST) shall be contacted to determine the effects of heat or excessive salt water contamination prior to continued use or repair of affected parts or components.

9-2.2. (N) AIRCRAFT FIREFIGHTING. Firefighting in and around crashed aircraft is highly specialized. Refer to NAVAIR 00-80R-14 (NATOPS U.S. Navy Aircraft Firefighting and Rescue Manual) for approved fire extinguishing agents, methods of application, and

firefighting equipment. Naval Air Systems Command's PMA-251 has sole responsibility and authority to establish policy for all aircraft fire fighting programs for the Office of the Chief of Naval Operations. PMA-251 serves as the Navy and Marine Corps technical authority for aircraft fire fighting and manages this program in accordance with OPNAVINST 5100.8G and DODI 6055.06.

**9-3. EMERGENCY PREPARATIONS.** In preparation for an emergency, priority lists shall be developed for removal of equipment, emergency reclamation planning, and the required materials and equipment.

#### 9-3.1. PRIORITY REMOVAL LIST OF AIRCRAFT COMPONENTS.

#### CAUTION

Magnesium parts are particularly susceptible to corrosion attack when exposed to salt water or fire extinguishing materials. Avionic, electrical, and ordnance equipment known to contain magnesium components shall be given high priority for cleaning.

9-3.1.1. Table 9-1 is a list of aircraft component groups arranged in order of recommended priority for treatment. Among the factors to be considered when removing equipment are dollar value, corrosion rate, availability of replacement parts, and probability of successful salvage. Whenever manpower or facility shortages prohibit simultaneous processing of all components, treatment shall be given in the order of the priority listing. The table should be considered as a guide, and operations may deviate from the assigned priority when directed by qualified production planning or engineering personnel or the cognizant maintenance officer.

9-3.1.2. Variations in aircraft designs, configurations, and mission equipment installations may make it necessary to contact custodians of the aircraft to obtain a listing of equipment and the preferred priority of removal and treatment. Priority of removal and treatment should always be oriented toward recovery of salvageable equipment.

Table 9-1. Recommended Priority Removal Guide for Emergency Treatment of Aircraft

Priority Number	Gas Turbine or Reciprocating Engine Aircraft	Turboprop/Turboshaft Engine Aircraft	Helicopters
1	Engine and accessories	Propeller drive gear mechanisms	Rotor dynamic components
2	Avionic and fire control equipment	Engine, propeller, and accessories	Engine, rotors, and accessories
3	Instruments	Avionic and fire control equipment	Avionic and fire control equipment
4	Fuselage, wings, and empennage	Instruments	Instruments
5	Turrets and rocket and missile launchers	Fuselage, wings, and empennage	Fuselage
6	Drained fuel and oil systems	Turrets and rocket and missile launchers	Drained fuel and oil systems
7	Photographic equipment	Drained fuel and oil systems	Photographic equipment
8	Landing and arresting gear	Photographic equipment	Landing gear or floats
9	Safety and survival equipment	Landing and arresting gear	Safety and survival equipment
10	Electrical equipment	Safety and survival equipment	Electrical equipment
11	Armament equipment	Electrical equipment	Armament and rescue equipment
12	Fixed equipment (seats, etc.)	Armament equipment	Fixed equipment (seats, etc.)
13	Miscellaneous equipment	Fixed equipment (seats, etc.)	Miscellaneous equipment

9-3.2. INTERMEDIATE LEVEL EMERGENCY RECLAMATION TEAM. The intermediate level emergency reclamation team shall provide expertise and facilities for processing equipment received from operational activities. This team shall be responsible for processing equipment received from Organizational/Unit activities. The size of the team, its organization, and the specific equipment requirements will be geared to the needs of the units supported. Recommended equipment includes wash/rinse facilities, drying ovens, dip tanks (for water displacing compounds and preservatives), and cleaning compounds.

9-3.3. EMERGENCY RECLAMATION EQUIPMENT. The availability of the necessary tools, materials, and equipment for prompt removal, cleaning, and drying will significantly aid in reducing damage. Refer to material and equipment lists (see Table 9-2) and Volume III. Additional items of equipment that may be useful are:

- a. Drying ovens.
- b. Portable air blowers.

c. Heaters.

d. Dehumidifiers.

9-3.4. PRODUCTION PLANNING. Whenever possible, all salvageable components of the aircraft shall be treated simultaneously. To minimize damage and ensure that the work is accomplished in a thorough and competent manner, the most experienced personnel available shall be assigned to disassemble and process the aircraft. Whenever possible, examination and evaluation personnel shall be assigned to work with the disassembly and preservation crew in order that those items obviously beyond reclamation may be scrapped immediately; and that only those areas exposed to corrosive water or fire fighting chemicals are disassembled and treated. The time saved by this procedure may be utilized in preserving salvageable components.

Table 9-2. Recommended List of Emergency Reclamation Items

<b>Item Number</b>	<b>Consumable Materials (see Volume IV, Chapter 2)</b>	<b>Specification/ Part Number</b>
1	Aircraft Cleaning Compound	MIL-PRF-85570 Type II
2	Aircraft Preservation Tape	AMS-T-22085 Type II
3	Barrier Material	MIL-PRF-131 Class 1
4	Cleaning & Scouring Pads, Non-metallic	A-A-3100
5	Cleaning Sponges	A-A-2073
6	Corrosion Preventive Compound, Water Displacing (5 gal minimum)	MIL-PRF-81309 Types II & III
7	Degreasing Solvent	MIL-PRF-680 Type II
8	Drying Rags, Flannel Cloth	A-A-50129
9	Engine Gas Path Cleaner	MIL-PRF-85704 Type II RTU
10	Fire Extinguishing Agent (AFFF)	MIL-F-24385
11	Full Facepiece Respirator & Cartridges	-----
12	Isopropyl Alcohol (IPA)	TT-I-735
13	Leather Chamois	KK-C-300
14	Water/Crash/Fire Damage Labels	NAVAIR 4035/13
15	Water/Crash/Fire Damage Tags	NAVAIR 3750/1
<b>Item Number</b>	<b>Equipment (see Volume IV, Chapter 3)</b>	<b>Specification/ Part Number</b>
16	Aircraft Grounding Straps	-----
17	Aircraft Washing Kits (Pad, Pad Holder, Handle)	3M No. 261, 3M No. 33, A-A-1464
18	Air Hose Assembly	Z-H-500/Z-H-521
19	Air Nozzle Gun	A-A-55543
20	Backpack Pump (5 gallon)	P/N: 5100-254B
21	Disposable Coveralls, " Bunny Suit"	A-A-55196 Type I
22	Face Shield, Industrial	ANSI Z87.1
23	Goggles, Chemical Resistant	A-A-1110
24	Heat Gun, Electric	A-A-59435
25	Large Trash Cans & Plastic Liners	-----
26	Leather Palm Gloves (for handling composite materials, medium size only)	A-A-50016
27	Rubber Apron	A-A-3104
28	Rubber Gloves, Industrial	MIL-G-12223
29	Soft Bristle Scrub Brushes	A-A-2074
30	Spray Gun, Pneumatic	MIL-G-952 Type I
31	Utility Pails, Rubber	L-P-65
32	Vacuum Cleaner, Pneumatic (Wet/Dry Vac)	-----
33	Water Hose	A-A-59270
34	Water Nozzle	A-A-50461

#### 9-4. GENERAL PROCEDURES.

##### WARNING

Before starting emergency treatment, particularly in those instances where fuel cells have been ruptured and fuel or fuel vapors are present, it is imperative that a GFE, GFET, or the safety officer supervise purging or inerting procedures and certify that the aircraft is fire and explosion safe. Qualified ordnance personnel shall be assigned to handle all ordnance and associated items, such as ammunition and pyrotechnics.

9-4.1. For cases involving aircraft accidents, permission for any treatment shall be obtained from the senior member of the accident investigation board prior to initiating procedures for emergency reclamation. Failure to obtain permission will jeopardize the ability of the accident investigation team to determine the cause of the incident.

##### **NOTE**

Procedures for decontamination of aircraft exposed to chemical, biological, or radiological (CBR) materials are contained in NAVAIR 00-80T-121 (Navy) or FM 3-5 (Army).

a. The fire department shall determine which extinguishing agent was used on the aircraft. A review of photographs taken by public affairs or other media personnel may provide information concerning areas that had corrosive extinguishing material exposure.

b. Ensure that the aircraft is safe for maintenance. Electrically ground the aircraft. Attach the ground lead to the aircraft at a point outside the area which could contain explosive vapors. Turn off all electrical power and disarm aircraft, including the ejection seat.

c. Closely inspect the aircraft to determine areas affected. Traces of foam type extinguishing agents may not be present; however, moist residues often indicate previous foam application. Dry powders may be present in joints and faying surfaces, so a careful examination will be necessary.

d. Wherever possible, remove components from affected areas. Open, loosen, or remove covers, access plates, and inspection doors. Allow accumulated salt water to drain thoroughly wherever possible. If dry chemical fire extinguishing materials have been used, refer to paragraph 9-6.

e. Remove gross amounts of contaminants by flushing with fresh water and draining.

f. Remove components in accordance with paragraphs 9-4.2 and 9-4.3.

g. Clean the aircraft in accordance with paragraph 9-4.4.

h. Inspect the aircraft and determine whether it can return to flight status following local maintenance action or whether additional maintenance will be necessary.

##### 9-4.2. REMOVAL OF CONTAMINATED EQUIPMENT.

After salt water immersion, salt water entry, or exposure to any corrosive agents, equipment must be cleaned promptly and thoroughly. Follow the procedures in this chapter for decontaminating specific areas and equipment. Refer to Table 9-1 for assigning priority to equipment removal and treatment.

##### 9-4.3. REMOVAL OF COMPONENTS.

9-4.3.1. The mechanical cutting of fuel, hydraulic and oil lines, and electrical leads, and other drastic operations necessary to expedite removal of components are left to the discretion of the MO directing the operations.

9-4.3.2. When aircraft are involved in water crashes, it shall be assumed that all components, including hollow structural and mechanical members, are contaminated internally. All components shall be disassembled and treated or forwarded to the next highest level of maintenance for disassembly and treatment as required. It shall be established that contaminants have been removed and that all corroded surfaces have been effectively inhibited against further attack prior to returning to operational status.

9-4.4. **CLEANING.** Equipment and components shall be cleaned by the team, in accordance with paragraphs 9-5, 9-6, and 9-8, and then delivered to the designated shops for further inspection and maintenance. Equipment that cannot be removed shall be cleaned in place and inspected.

9-4.5. **TAGGING.** All parts and components removed from the aircraft shall be tagged for identification (see Volume IV for Water/Crash/Fire Tags and Labels). Indicate preservation method (e.g. CPC) used on component.

9-4.6. **PROCESSING.** All equipment subject to emergency reclamation team procedures must be certified operationally ready before returning to serviceable status. Inspect equipment for corrosion, cracks and heat damage. Obtain the maximum available engineering assistance to determine evaluation of damage. Particular attention shall be given to dissimilar metal joints. Avionic electrical equipment will most likely contain dissimilar metals.

## 9-5. GENERAL CLEANING PROCEDURES.

### **CAUTION**

Do not expose plastic items, avionic components, wiring, or other components susceptible to heat damage to temperatures in excess of 130°F (54°C) during emergency cleaning procedures. Also, do not expose any other areas to temperatures in excess of 150°F (66°C) during emergency cleaning procedures.

### **NOTE**

The mildest chemical and cleaning cycle which will assure proper decontamination shall be used at all times. Even though fresh water/detergent wash should not significantly affect accident investigations, permission must be obtained from the senior member of appointed accident investigation board before cleaning.

9-5.1. Use the specified methods in paragraph 9-8 for emergency treatment of specific areas. Do not use the following general procedures when specific methods are available.

9-5.2. Contaminated areas may be cleaned by several methods. The primary method is fresh water flushing. Alternate methods may be used when fresh water is not available.

9-5.3. **PRIMARY CLEANING METHOD.** The primary method of removing salt water is as follows:

- a. Immerse removed unit or component in clean, fresh water whenever possible.
- b. Flush all areas with clean fresh water and allow to drain.
- c. Dry the item or areas by vacuum cleaning excess water, blotting with cloth or paper, or blow-drying with air pressure not greater than 10 psi. If visual evidence of salt remains, a second cleaning should be accomplished as follows:



Compound, Aircraft Cleaning  
MIL-PRF-85570

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- (1) Mix a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts water.
- (2) Apply the solution to the affected areas and scrub with soft bristle brushes, sponges or cloths.
- (3) Flush thoroughly with clean fresh water and drain thoroughly.
- (4) Dry the item or areas as before.



Compound, Corrosion Preventive  
MIL-PRF-81309

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d. After flushing and drying, apply water displacing preservative (MIL-PRF-81309 Type III) on all avionic components and connectors. Ensure that all areas and crevices are coated. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all other areas that cannot be properly drained or contain recesses which are difficult to reach. Ensure that all surfaces are coated.

**NOTE**

Water displacing CPC (MIL-PRF-81309 Type II) will deposit a thin, non-conductive film that must be removed prior to use for proper function of contact points and other electro-mechanical devices where no slipping or wiping action is involved. Water displacing CPC is easily removed using degreasing solvent (MIL-PRF-680 Type II) or non-aqueous cleaner (MIL-PRF-32295 Type I).

9-5.4. ALTERNATE CLEANING METHODS. Use only when fresh water is not available or is available only in limited supply or when time prevents immediate flushing with fresh water.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

9-5.4.1. Method One (Preferred). Spray, brush, or wipe the exterior of the affected areas and components with liberal amounts of water displacing CPC (MIL-PRF-81309 Type II).

9-5.4.2. Method Two (Alternate).



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MIL-PRF-85570

a. Apply a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts water.

b. Brush over affected areas until contaminants and cleaner become intermixed or emulsified.

c. Wipe-off thoroughly with clean cloth, removing both contaminants and cleaner.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

d. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to affected areas.

**9-6. REMOVAL OF FIRE EXTINGUISHING AGENTS.**

**NOTE**

Refer to NAVAIR 00-80R-14 for approved fire extinguishing agents usable on aircraft.

**9-6.1 PURPLE-K-POWDER (PKP) AND OTHER DRY CHEMICAL FIRE EXTINGUISHING AGENTS.**

9-6.1.1 Purple K Dry Chemical Powder. The principal base chemical for Purple-K-Powder (PKP) is potassium bicarbonate. Since it is a purple powder, the PKP fire extinguishers are marked with a purple band around the tank. PKP is primarily used to extinguish flammable liquid and gas fires such as gasoline, greases, oils, and paints. When combined with water, PKP could corrode or stain surfaces. As soon as possible, PKP should be completely removed from all surfaces.

9-6.1.2. Removing Purple K Powder (PKP) and Other Dry Chemical Fire Extinguishing Agents. To remove powdered extinguishants, proceed as follows:

a. Remove as much extinguishant as possible by vacuum cleaning.

b. Use a soft bristle brush and air pressure not greater than 10 psi to dislodge contaminants between close-fitting components.

c. Vacuum clean again.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

d. Remove the residual film of dry powder adhering to the surface by wiping, brushing, or spraying with a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts of water.

e. Rinse thoroughly with fresh water.

f. Dry with cloths or paper towels, or blow dry with air pressure not greater than 10 psi.





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g. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to affected areas.

h. Enter location of affected areas and list components that were exposed to PKP fire extinguishing agent in the appropriate section of the aircraft logbook, corrosion folder, or other appropriate documents to ensure that the area is re-inspected in the future as a corrosion prone area.

#### 9-6.1.3. Treatment Procedures for Engines Exposed To or Contaminated with Fire Extinguishing Powder (i.e., PKP).

a. With the ignition off/disconnected, vacuum clean all excess and loose material, then crank the engine and rinse thoroughly with water.



Cleaning Compound 3  
Turbine Engine Gas Path  
MIL-PRF-85704

b. Flush all surfaces and passages with either a solution of one part engine gas path cleaner (MIL-PRF-85704 Type II) in four parts fresh water or use the ready-to-use form of the cleaner (MIL-PRF-85704 Type II RTU).

c. Drain engine lubricant and refill.

d. At the next inspection, re-check previously contaminated areas and, if necessary, repeat the above procedure.

#### 9-6.2. AQUEOUS FILM-FORMING FOAM (MIL-F-24385).

9-6.2.1. Aqueous Film-Forming Foam (AFFF). AFFF is a specially formulated synthetic concentrate made from surfactants, solvents, and additives. When mixed with either fresh or salt water, it will form a dense foam over the liquid fuel to rapidly smother and cool hydrocarbon fuel fires such as gasoline, kerosene, and diesel.

9-6.2.2. Removing Aqueous Film Forming Foam (AFFF). To remove residues of salt water solutions of AFFF fire extinguishing agent, proceed with paragraphs a. through h. below. To remove residues of fresh water solutions of AFFF, use the same procedure but omit paragraphs b. through d.

#### NOTE

The following procedure applies to AFFF and salt water mixtures normally used aboard ship. AFFF and fresh water mixtures usually do not present a corrosion problem. However, cleanup of all residues after a fire is required for corrosion prevention due to water intrusion into gaps, joints, cracks, and crevices.

a. Flush all affected areas with clean, fresh water while draining. Whenever possible, units or components which have been removed should be immersed in fresh water and then flushed thoroughly with fresh, clean water. Drain away the water.

b. Mix a solution of one pint of AFFF fire extinguishing agent in 10 gallons of fresh water.

c. Apply solution to affected areas using one of the following methods:

(1) Use any type of spray equipment such as a foam generator, solvent wash gun, or back pack.

(2) Use an applicator such as aircraft washing pads, sponges, or low lint cloths, or pour AFFF solution directly over affected areas if foaming equipment is not available.

d. Keep affected areas wet with AFFF solution for 3 to 5 minutes.



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e. Clean surfaces with a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts of water. Scrub affected areas and rinse with clean, fresh water. Drain away excess water.

f. Dry with cloths, paper towels, or air pressure not greater than 10 psi.



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g. Apply water displacing preservative (MIL-PRF-81309 Type III) to all avionic components and electrical connectors. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all other areas that cannot be properly drained or have recesses which are difficult to reach.

h. Enter location of affected areas and list components that were exposed to AFFF fire extinguishing agent in the appropriate section of the aircraft logbook, corrosion folder, or other appropriate documents to ensure that the area is re-inspected in the future as a corrosion prone area.

9-6.3. CARBON DIOXIDE, HFC-125, AND HALON FIRE EXTINGUISHING AGENTS.

9-6.3.1. Carbon Dioxide (CO<sub>2</sub>). Carbon dioxide is a dry, non-corrosive, inert gas that is used on flammable liquids and electrical fires because it does not leave any residues which might further harm the damaged electrical equipment. Also, CO<sub>2</sub> is ideal for use on fires when it is important to avoid water damage. CO<sub>2</sub> works by reducing the amount of oxygen available for combustion by smothering it. Although CO<sub>2</sub> is non-poisonous, asphyxiation can result from breathing it and supplied air must be worn when CO<sub>2</sub> is used below decks or in confined spaces.

9-6.3.2. HFC-125 (Pentafluoroethane). HFC-125 is a fluorocarbon fire extinguishant that is electrically non-conductive, non-corrosive, free of residue, has zero ozone depletion potential (ODP), and is an environmentally approved replacement for Halon systems. HFC-125 works by absorbing the heat generated from the combustion reaction.

9-6.3.3. Halon 1211 (Bromochlorodifluoromethane) and Halon 1301 (Bromotrifluoromethane). Halons are colorless, odorless gases. They will extinguish most type of fires without leaving a residue and are suitable for discharge in confined spaces. Typically, they are used in areas that contain sensitive or irreplaceable equipment that could be damaged or destroyed by water, foam, dry chemical, or carbon dioxide. Like PKP, Halons do not extinguish by smothering or cooling, instead they interrupt the chemical reaction of the fire as

it decomposes upon contact. Halons have been found to be an ozone depleting agent; however, some Halons are still required for aircraft and shipboard applications as no safe and effective alternative exists. Halon 1211 extinguishers are marked with a reflective silver band around the tank.

**NOTE**

Carbon Dioxide, HFC-125, or Halon fire extinguishing agents will not leave residues. However, smoke, smudges, or other grime from a fire is corrosive and shall be removed from affected items that are to be retained for future use.

9-6.3.4. CO<sub>2</sub>, HFC-125, Halon 1211 and Halon 1301 evaporate rapidly. Therefore, no cleanup is required unless moisture or high temperature was present at the area of application. However, ventilation should always be provided to remove the vapors. If moisture or high temperature was present, use the following clean-up procedures.

a. After fire has been extinguished, purge area and surface with clean, dry air (dust free, low moisture content, compressed air).



Compound, Aircraft Cleaning 2  
 MIL-PRF-85570

b. Clean surfaces with a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts of water. Scrub affected areas and rinse with clean, fresh water. Drain away excess water.

c. Dry with cloths, paper towels, or air pressure not greater than 10 psi.



Compound, Corrosion Preventive 4  
 MIL-PRF-81309

d. Apply water displacing preservative (MIL-PRF-81309 Type III) to all avionic components and electrical connectors. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all other areas that cannot be properly drained or have recesses which are difficult to reach.

e. Enter location of affected areas and list components that were exposed to fire extinguishing agent in the appropriate section of the aircraft logbook, corrosion folder, or other appropriate documents to ensure that the area is re-inspected in the future as a corrosion prone area.

9-6.4. PROTEIN FOAM AND SODA ACID.

9-6.4.1. Protein Foam. A general category of fire extinguishing agents that use protein based foam concentrate. When mixed with water, protein foam is highly effective on fuel fires and provides excellent heat resistance. Types of firefighting foams include AFFF, AR-AFFF, Protein Foams, Fluoroprotein Foams, Class A Foams, and Training Foams.

9-6.4.2. Soda Acid. Soda acid and other inverted foam extinguishers are not approved portable fire fighting equipment for use on or around aircraft because they are very corrosive. Soda acid type extinguishers operate by turning the extinguisher upside down. Acid spills out of a glass jar and reacts with the soda contents.

9-6.4.3. Removing Protein Foam and Soda Acid. The residues left from the use of these materials can be extremely corrosive to aircraft and equipment. Remove residues as follows:

a. Thoroughly flush the affected area with fresh water. Ensure that the rinse water is completely flushed from the aircraft or equipment.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

b. Clean surfaces with a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts of water. Scrub affected areas and rinse with clean, fresh water. Drain away excess water.

c. Dry with cloths, paper towels, or air pressure not greater than 10 psi.



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d. Apply water displacing preservative (MIL-PRF-81309 Type III) to all avionic components

and electrical connectors. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all other areas that cannot be properly drained or have recesses which are difficult to reach.

e. Enter location of affected areas and list components that were exposed to fire extinguishing agent in the appropriate section of the aircraft logbook, corrosion folder, or other appropriate documents to ensure that the area is re-inspected in the future as a corrosion prone area.

**9-7. TREATMENT AFTER LANDING ON A FOAMED RUNWAY.** Materials used to foam runways are corrosive to aircraft. As soon as possible after a landing on a foamed runway, exterior areas, wheel wells, any interior areas exposed, and engines shall be cleaned. Clean the exterior and wheel wells, interior areas, and engines in accordance with Chapter 2.

**9-8. TREATMENT OF SPECIFIC AREAS.**

9-8.1. SPECIFIC INTERNAL AREAS. The following internal areas require special emergency cleaning.

9-8.1.1. Avionic and Electrical Equipment. Effective cleaning ensures that salt water, fire fighting chemicals, and other corrosive agents are completely removed to prevent corrosion damage. Refer to Volume III for specific cleaning procedures.

9-8.1.2. Cockpit Area. Emergency cleaning procedures for the cockpit are as follows:

a. If the interior is undrainable, drill out fasteners at low point. If still undrainable, drill a hole at the low point.

b. Remove avionics equipment, relay boxes, circuit breakers, and switches, and clean as specified in accordance with Volume III.

c. Turn over avionic equipment to the activity that has the authority and capability to disassemble.

d. Dry equipment that has been cleaned as much as possible with air pressure (less than 10 psi), drying machines, electric fans, or hand fans in a hot room of 150°F (66°C) maximum, or in a well ventilated room where the humidity is low.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

e. Apply water displacing CPC (MIL-PRF-81309 Type II) by spraying or brushing onto all areas that cannot be properly drained or contain recesses which are difficult to reach.

9-8.1.3. Ejection Seats. The following emergency cleaning procedure shall be used for cleaning ejection seats.

**WARNING**

Disarm ejection seat mechanism before cleaning. Ensure that only authorized personnel disarm seats and perform cleaning operations.

a. Remove parachutes, drogue parachutes (where applicable), and seat pans. Return to local work center for cleaning or replacement.

b. Remove ejection seat in accordance with the applicable maintenance manual.

c. Rinse seat thoroughly with fresh water. Continue rinsing while directing water into crevices and close fitting parts until contaminants are removed.

d. Wipe down cartridge activated devices, rockets, and inertia reels with a clean cloth wet with fresh water. Disarm and remove from seats. Metal cap all gas lines and ports.

e. Remove as much water as possible from equipment with vacuum or low-pressure, clean, dry air.

f. Dry excess water deposits with clean cloth or clean paper towels.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

g. Apply water displacing CPC (MIL-PRF-81309 Type II) by either spray or brush application to critical metal surfaces and recess areas that may not be completely dry. Water displacing CPC will protect equipment during necessary inspections and during transfer to repair custodian.

h. Wash all survival gear and pilot safety equipment with fresh water and dry thoroughly. Refer to applicable maintenance requirements for detailed preservation procedures. Lubricate and control corrosion in accordance with maintenance cards.

i. If necessary, send ejection seat to next highest level of maintenance.

j. Aircraft mounted escape system components (mechanically activated CADS) shall be wiped and dried with a clean cloth and fresh water. If internal contamination is suspected, remove and replace. Forward to a Depot Level Maintenance Activity for further disassembly, inspection, and repair.

9-8.1.4. Fluoroelastomer (Viton™) Hazards. Viton is a rubber-like compound used in aircraft applications for its excellent resistance to heat, abrasion, and aircraft fluids. It is used as an engine duct coating for fire suppression, and as gaskets on the backside of doors and access panels (e.g. F/A-18s). Viton poses no harm under normal temperature conditions. However, at temperatures encountered during an aircraft fire, Viton will break down and produce small amounts of toxic hydrogen fluoride gas. Hydrogen fluoride can combine with water to produce hydrofluoric (HF) acid, which is extremely corrosive to human tissue. Refer to NAVAIR 00-80R-14 and/or aircraft specific maintenance instruction manuals for guidance as to the appropriate PPE, handling, clean-up, and first aid procedures when dealing with decomposed Viton or contaminated equipment.

9-8.1.5. Photographic Equipment. The following procedure is applicable for cleaning photographic equipment.

a. Immediately rinse with fresh water, drain, and rinse again.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

b. Apply water displacing preservative (MIL-PRF-81309 Type III).

c. Return to the appropriate photographic technician for prompt servicing.

9-8.2. SPECIFIC EXTERNAL AREAS. The following external aircraft areas require special emergency cleaning.

9-8.2.1. Airframes. The following procedure is applicable for cleaning airframes:

a. If the aircraft fuselage, hull, or wings are in a salvageable condition, drain holes may be made for draining water by drilling out rivets at the lowest points. All repairable/reusable parts shall be collected and returned with the aircraft when shipment is made.

b. Flush all areas with clean, fresh water while draining. If possible, units or components that have been removed should be immersed in fresh water and then flushed thoroughly with fresh water. Drain away the water and dry the areas with cloths, paper towels, or air pressure less than 10 psi.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

c. Clean surfaces with a solution of one part of aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts of water. Scrub affected areas using the solution. Flush thoroughly with fresh water and drain away the excess water. Dry with cloths, paper towels, or air pressure less than 10 psi.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

d. To aid in the removal of water, liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all other areas that cannot be properly drained or have recesses which are difficult to reach.

e. All repairable/reuseable parts shall be collected and returned with the aircraft when shipment is made.

9-8.2.2. Antennas. Remove the antenna according to instructions in the aircraft maintenance manual. Treat in accordance with Volume III. In-place cleaning may be accomplished as follows:

- a. Check antenna insulators for damage or cracks.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

b. Brush or spray a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts water onto the affected area.

c. Scrub the area with a small, soft brush or wiping cloth dipped in the above cleaning solution.

- d. Rinse with clean, fresh water.

- e. Dry the area with a clean, dry cloth.

9-8.2.3. Armament. The following instructions are for initial treatment of armament equipment that has been immersed in salt water or subjected to fire extinguishing chemicals.

9-8.2.3.1. Safety Precautions. Before performing any cleaning tasks, make certain that preliminary safety precautions are followed:

- a. Ensure that the aircraft is safe for maintenance.

b. Disconnect all electrical power and ensure that all armament switches are in the OFF or SAFE positions.

**NOTE**

For removal of armament equipment, refer to the applicable manual for the respective aircraft.

c. Remove all ordnance from the armament equipment and dispose of contaminated ammunition as required.

9-8.2.3.2. Cleaning Procedure. After completion of safety precautions, clean armament equipment as follows:

- a. Rinse equipment with clean, fresh water.





Solvent, Degreasing 13  
MIL-PRF-680



Cleaner, Non-Aqueous, 15  
Low VOC, HAP Free,  
MIL-PRF-32295

b. Disassemble as required and remove excess oils and greases using a clean cloth dampened with degreasing solvent (MIL-PRF-680 Type II) or non-aqueous cleaner (MIL-PRF-32295 Type I).



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

c. Immerse and agitate parts in a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts of fresh water.

d. Rinse with fresh water to ensure complete removal of contaminants.

e. Wipe away excess water with clean, dry cloth.

f. Blow dry the cleaned equipment as thoroughly as possible with clean, dry air pressure less than 10 psi.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

g. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to disassembled parts.

h. Inspect disassembled parts to determine whether the equipment can be returned to service or should be forwarded to a higher maintenance activity for rework.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

i. If shipment to a higher level of maintenance is required, reassemble parts and apply water displacing CPC (MIL-PRF-81309 Type II) to the outer surfaces. Permit excess CPC to drain off, then wrap gun in barrier material (MIL-PRF-131 Class 1) sealed with tape (AMS-T-22085) and prepare for shipping.

#### 9-8.2.4. Composite Materials, Graphite or Carbon/Epoxy.

#### WARNING

The inhalation of carbon composite fibers resulting from aircraft fires and/or aircraft material damage may be harmful to personnel. Wear a full facepiece respirator when exposed to these materials, and, in addition, wear close weave cotton gloves when handling these materials.

#### CAUTION

Aircraft construction utilizing carbon/epoxy fiber composite materials and metal structure or substructure creates a high potential for establishing galvanic corrosion cells. This can result in corrosion of the metal components if the structure is exposed to an electrolyte medium, such as salt water.

9-8.2.4.1. The carbon fibers of composite materials may be released into the atmosphere if their epoxy binder burns; this occurs at temperatures in excess of 600°F (316°C). In addition, fibers may be released by an explosion or a high impact crash. The procedures for treating fire damaged composite materials are listed in NAVAIR 01-1A-21 (Navy) or TM 55-1500 series (Army).

#### NOTE

Appropriate ship maneuvering, to direct the smoke and debris away from parked aircraft and the island structure, can materially reduce fiber contamination and reduce the cleanup process.

9-8.2.4.2. Cleanup. When damaged aircraft have composite surfaces that are broken or burned, the following procedures should be followed.



**WARNING**

Do not put power to or start up aircraft or electronic/electrical equipment that has been exposed to debris until decontamination by vacuuming and/or washing is completed. Failure to observe these procedures may result in electrical short circuits and fires.

**NOTE**

It is recommended that industrial hygiene/safety personnel be contacted to provide specific information regarding hazards to personnel during cleanup.

a. If ventilation inlets are known to be exposed to debris, take immediate action to ensure that the filtration system is properly operating. If the system is not operating properly, shut down the system and provide temporary filtration at outlets leading to compartments with electrical and electronic equipment.

b. Warn adjacent aircraft and ships that the smoke may contain hazardous electrical contaminants.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

c. Spray water displacing CPC (MIL-PRF-81309 Type II) on damaged composite surfaces. This will prevent the spread of carbon fiber contamination by causing the fibers to stick to the damaged surface. Cover damaged surfaces securely with thick plastic sheets (A-A-3174) and seal with tape (AMS-T-22085 Type II).

d. Aircraft, equipment, clothing and facilities that have been exposed to carbon fiber or other debris from an aircraft fire must be vacuumed and/or washed down prior to reuse or prior to moving to another location.

e. Decontamination of the immediate area of the aircraft wreckage may require vacuuming, washing, and bagging of composite material fragments. Use a sealed industrial vacuum cleaner. Store collected debris in sealed, plastic bags for the accident investigation. Dispose of in accordance with applicable environmental and safety regulations when so directed by the investigation team.

f. If wrapping and secure taping of the aircraft wreckage is not possible, transportation of the wreckage must be planned. Bypass heavily populated and industrial areas. Aircraft parked along the planned route must have their canopies and access doors closed and engine inlet and exhaust covered. In addition, the doors and windows of surrounding buildings should be closed to minimize the probability of having wind-blown fibers enter areas containing electrical and electronic equipment.

9-8.2.5. Composite Materials, Boron/Tungsten. The extinguishing, containing, and cleaning practices for boron fibers are the same as those for carbon/epoxy fibers.

9-8.2.6. Engines, Reciprocating.

a. Determine the extent of contamination.

b. Drain all fluids. Partial disassembly is authorized to accomplish thorough draining. Ensure that pressure systems and cylinders are drained.

c. Thoroughly flush all surfaces and passages with clean, fresh water.



Solvent, Degreasing 13  
MIL-PRF-680

d. Apply dry cleaning solvent (MIL-PRF-680 Type II).



Cleaning Compound 3  
Turbine Engine Gas Path  
MIL-PRF-85704

e. Flush all surfaces and passages with either a solution of one part engine gas path cleaner (MIL-PRF-85704 Type II) in four parts fresh water or use the ready-to-use form of the cleaner (MIL-PRF-85704 Type II RTU).

f. Thoroughly rinse all areas with fresh water.

g. Allow to drain thoroughly. Dry using paper towels, cloths, or air pressure less than 10 psi.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

h. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all surfaces. This may be accomplished by fill and drain (preferred), flushing, or spraying. Rotate the propeller shaft to coat cylinder walls. Drain excess CPC.

i. Reassemble engine finger tight.

j. Lubricate any pressure lubrication points to completely displace all contaminated lubricant.

k. For shipping, place engine in an approved dehydrated metal container, using twice the normal amount of desiccant.

9-8.2.7. Engines, Turbine. Engines that are contaminated with small amounts of seawater entering the intake shall be cleaned using engine gas path cleaner (MIL-PRF-85704) in accordance with Table 2-3. For engines which have been completely submerged in water or seawater, decontaminate as follows:

a. Drain all fluids. Partial disassembly is authorized to accomplish thorough draining.

b. Thoroughly flush all surfaces and passages with fresh water.



Cleaning Compound  
Turbine Engine Gas Path 3  
MIL-PRF-85704

c. Flush all surfaces and passages with either a solution of one part engine gas path cleaner (MIL-PRF-85704 Type II) in four parts fresh water or use the ready-to-use form of the cleaner (MIL-PRF-85704 Type II RTU).

d. Thoroughly rinse all areas with fresh water.

e. Drain thoroughly.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

f. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all surfaces. This may be accomplished by fill and drain (preferred), flushing, or spraying. Drain excess CPC. Repeat this procedure until all traces of water have been removed.

g. Lubricate any pressure lubrication points to completely displace all contaminated lubricant.

h. For shipping, install in an approved dehydrated metal container, using twice the normal amount of desiccant. Notify the Aircraft Controlling Custodians (ACC) or System Program Manager (SPM) to arrange special handling as required.

9-8.2.8. Helicopter Blades, Main and Tail Rotor. Helicopter blades that have been exposed to an excessive amount of salt water or fire fighting chemicals shall be treated as follows:

a. Thoroughly flush all contaminated surfaces with clean, fresh water. Pay particular attention to recesses that tend to trap debris such as mud, dirt, or salt deposits.

### **CAUTION**

Some rotor blades have areas commonly known as pockets or blade boxes with very small drain holes. If blades have been immersed in salt water, the drain holes may require enlargement to facilitate decontamination of the blade spar. Enlarging drain holes destroys the affected pockets or blade boxes and requires repair at a Depot Level Maintenance Activity before the blade can be reused.

b. Allow water to drain. Enlarge drain holes in pocket/blade box if required. Enlargement of pocket/blade box requires authorization from the appropriate ACC/SPM for each blade involved.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

c. Wash with a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts fresh water.

d. Rinse thoroughly with fresh water.

e. Dry with cloth, paper towels or air pressure less than 10 psi.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

f. Where possible, flush with water displacing CPC (MIL-PRF-81309 Type II). Preserve and package blade before sending to the appropriate ACC/SPM for engineering evaluation and repair.

9-8.2.9. Helicopter Transmission, Rotor Head, and Rotor Hub. Helicopter transmission, rotor head, and rotor hub cases are often constructed of magnesium. Magnesium parts exposed to salt water or fire fighting chemicals require immediate and thorough decontamination and preservation.

9-8.2.9.1. External Surface Contamination. Treat helicopter transmissions, rotor heads, and rotor hubs with external surface contamination as follows:

a. Rinse with fresh water.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

b. Wash with a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts fresh water and rinse thoroughly.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

c. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all affected areas.

d. Lubricate all pressure lubrication points to completely displace all contaminated lubricant.

9-8.2.9.2. Internal Surface Contamination. If internal surface contamination of helicopter transmission rotor heads and gearboxes is suspected, immediately contact the appropriate ACC/SPM for assistance and decontamination procedures. Treat helicopter transmissions, rotor heads, and rotor hubs having internal contamination as follows:

a. Drain all fluids. Partial disassembly is authorized to accomplish thorough draining. Ensure that pressure systems are drained.

b. Thoroughly flush all surfaces and passages with fresh water.



Compound, Aircraft Cleaning 2  
MIL-PRF-85570

c. Flush all surfaces and passages with a solution of one part aircraft cleaning compound (MIL-PRF-85570 Type II) in 14 parts fresh water.

d. Thoroughly rinse all areas with fresh water.

e. Allow to drain thoroughly.



Compound, Corrosion Preventive 4  
MIL-PRF-81309

f. Liberally apply water displacing CPC (MIL-PRF-81309 Type II) to all surfaces. This may be accomplished by fill and drain (preferred), flushing, or spraying. With the housing full of CPC, rotate the main shaft approximately five revolutions. After the CPC has remained in the housing for 4 hours, drain and replace plugs.

g. Service transmission in accordance with maintenance instruction manuals (MIMs) if going back in service or leave as preserved if shipping out.

h. Lubricate all pressure lubrication points to completely displace all contaminated lubricant.

9-8.3. AIRCRAFT FUEL SYSTEMS. For emergency treatment of aircraft fuel systems contaminated with seawater through means other than water, crash, or fire damage, refer to NAVAIR 01-1A-35 (Navy) or Appendix B, Section V (Army).

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## APPENDIX A SUPPLEMENTAL REQUIREMENTS FOR NAVY AIRCRAFT

### SECTION I. PAINT FINISHES AND TOUCH-UP PROCEDURES

**A-1. SCOPE.** This section describes materials and procedures used for applying protective paint finishes to interior and exterior surfaces of Navy and Marine Corps aircraft. This information is intended for use in conjunction with system specific paint finishing instructions. This section describes the following:

- a. Safety precautions when storing and handling paint materials;
- b. Storage and shelf life considerations;
- c. Paint systems used on Navy and Marine Corps aircraft;
- d. Paint application equipment;
- e. Preparation of surfaces prior to painting;
- f. Paint application techniques; and
- g. Specific mixing and application information for standard paint finishing materials.

**A-2. SAFETY.** Paint materials, including primers and solvents, are toxic and flammable. It is essential to properly store, handle, and apply these materials to prevent fires and to minimize exposure to solvent vapors and paint overspray mist. All personnel involved with paint operations shall read, understand, and follow OPNAVINST 5100.23. Consult the local Occupational Safety and Health Office or Industrial Hygiene Activity for these references and appropriate safety precautions pertinent to specific sites. Consult applicable material safety data sheets (MSDSs) supplied by the manufacturer for information on specific material hazards. Additional safety information may be obtained from the Hazardous Material Users Guide (HMUG) and DoDI 6050.05.

**A-2.1. RESPIRATOR USE.** Respiratory protection programs shall be established per OPNAVINST 5100.23. Whether painting operations are performed indoors or outdoors, it is necessary to avoid inhalation of vapors and dust. Solvents and thinners used for paint processes, including those used for equipment cleanup, are harmful if inhaled for prolonged periods and should be handled with the same care as paint materials.

Contact the local Industrial Hygiene Activity or Occupational Safety and Health Office for proper selection of respiratory protection equipment. Refer to Volume IV for ordering information for various respirators and supplied air devices.

**A-2.2. PROTECTIVE CLOTHING.** Eye and skin contact with paint materials and solvents shall be avoided. Wear protective goggles or face shield, rubber gloves, and coveralls. If paint materials or solvents contact the eyes, rinse with fresh water for 15 minutes and seek immediate medical attention. If contact with the skin occurs, wash affected area with soap and water; if there is excessive exposure or a severe reaction, seek medical attention immediately.

**A-2.3. VENTILATION.** Adequate ventilation shall be provided in all painting and storage areas to prevent the buildup of solvent vapors. Painters and all other personnel involved in the paint operation shall take appropriate precautions to minimize exposure to solvent vapors and paint overspray mist.

**A-2.4. FIRE PREVENTION.** Paint materials are extremely flammable. These materials shall be stored, mixed and applied in approved areas away from heat, flame, sparks, and other sources of ignition. Ensure that fire fighting equipment is readily available and in working order. Consult the local Fire Department, Fire Marshall, or Occupational Safety and Health Office for specific fire prevention and safety requirements during painting operations.

**A-3. STORAGE AND SHELF LIFE.** All paint materials shall be stored in tightly closed containers away from excessive heat and cold. As a general rule, store paint materials between 40°F and 100°F, away from direct sunlight. Extreme storage temperatures can degrade material quality and will reduce the effective shelf life of paint materials.

**A-3.1. IDENTIFICATION.** All paint materials shall be properly identified when stored. Containers should be relabeled when necessary to ensure legibility. Previously opened containers shall be closed and sealed tightly. Paint thinners shall be stored with the same care as paints.

A-3.2. SHELF LIFE. The shelf life or storage life of paint materials can vary from several months to several years. The manufacturer's recommended shelf life is usually printed on the container label. However, if properly stored, material usability may exceed these recommendations. Additional shelf life information may be obtained from <https://www.shelflife.hq.dla.mil>.

A-3.3. SHELF LIFE EXTENSION. Shelf life action codes determine how long the shelf life can be extended if the material passes testing.

A-3.3.1. If the inspect/test date of the material has been exceeded, shake the container, or containers as in the case of multicomponent paint materials, and examine the contents. The material shall be homogenous with no skinning and lumps. The resin component of multicomponent materials shall be clear with no visible cloudiness, white precipitate, or sediment. Containers shall be free from rust and other contaminants. Discard any unsuitable materials according to local regulations.

A-3.3.2. If the material appears satisfactory, mix and apply it to aluminum test coupons. Periodically check the coating on the test specimens for appropriate drying and film characteristics.

a. If the material dries properly, the shelf life may be extended for a period of six months (first extension), four months (second extension), or two months (third extension). Affix an extension label to the container in accordance with FED-STD-793.

b. If the coating does not dry in the specified time, dispose of the material according to local regulations.

A-3.3.3. Shelf life for paint-type materials can be extended three times if the material is found suitable, for a total extension period of 12 months.

**A-4. PAINT SYSTEMS.** The primary objective of any paint system is to protect exposed surfaces against corrosion and other forms of deterioration. Operational uses for particular paint schemes include:

a. Flat (lusterless or non-specular) coatings for glare reduction;

b. Special finishes for heat reduction and thermal protection;

c. Camouflage/stealth (LO) and other detection countermeasures;

d. Corrosion protection;

e. Dissipation of static charge;

f. Resistance to abrasion, rain erosion, fungus, and operational fluids;

g. High visibility requirements; and

h. Identification markings.

A-4.1. PAINT SYSTEM MATERIALS. Aircraft paint systems usually consist of a primer and topcoat combination applied over a properly prepared surface. The primer contains corrosion inhibitors and also promotes adhesion of the paint system. The primer may also provide low infrared reflectance properties. The topcoat provides durability to the paint system, including weather and chemical resistance, along with coloring necessary for tactical requirements. On some aircraft, spray sealant is applied between primer and topcoat to improve paint system flexibility and to add additional corrosion protection. Aircraft paint systems often make use of specialty coatings, such as conductive paints and low-observable coatings. Consult specific maintenance instructions for guidance on specialty coatings application and repair.

A-4.1.1. Environmentally Compliant Coatings. The Environmental Protection Agency (EPA), along with many local and state air pollution control districts, has implemented rules that limit the volatile organic compound (VOC) content, or solvent content, of paints applied to aircraft. VOC content is reported as grams of solvent per liter of paint or "g/l". Currently, the national maximum permissible VOC content is 340 g/l for aircraft primers, and 420 g/l for aircraft topcoats. These limits may be less in certain local or state air pollution control districts. It is the responsibility of the user activity to ensure that applicable rules are understood and obeyed. Failure to comply with current rules can result in large fines and revocation of air emission permits. Consult the local Environmental Affairs Office or appropriate permitting authority for guidance.

A-4.1.2. Common Materials. Table A-1 lists the primary coatings used on Navy aircraft and some specific material characteristics.

A-4.2. PAINT COLORS. FED-STD-595 (color fandeck) provides a list of paint colors represented by five digit numbers. The first digit describes gloss value: 1 = high gloss, 2 = semigloss, and 3 = flat (lusterless). The second digit describes the color family: 0 = browns,



Table A-1. Primary Coatings Used on U. S. Navy Aircraft

Specification	Material Description	VOC, (g/l) maximum	Dry Film Thickness (mils)	Drying Time (hours)	
				TACK FREE	DRY HARD
<b>PRIMER</b>					
MIL-PRF-23377	Epoxy Primer, High-Solids	340	0.6 - 0.9	1/2 - 2	8
MIL-PRF-85582	Epoxy Primer, Waterborne	340	0.6 - 0.9	1 - 2	6
TT-P-2760	Polyurethane Primer, Elastomeric	340	1.5 - 2.0	5	8
<b>TOPCOAT</b>					
MIL-PRF-22750	Epoxy Topcoat, High-Solids	340	1.7 - 2.3	2 - 6	8
MIL-PRF-85285 Type I	Polyurethane Topcoat	420	1.7 - 2.3	4	12

1 = reds, 2 = oranges, 3 = yellows, 4 = greens, 5 = blues, 6 = grays, 7 = blacks, whites, and metallics, and 8 = fluorescent. The remaining three digits describe the color value or hue. For example, color number 36440 is a flat, gray color and color number 17925 is a high gloss, white color. See Volume IV for information on ordering a color fandeck.

A-4.3. **PAIN SYSTEM IDENTIFICATION.** Paint finish materials, application date, and application activity are identified by decal or stencil located on the aft starboard side of the aircraft fuselage, and should be used as a guide for selection of materials when paint system repair is necessary. Refer to MIL-STD-2161 or system specific instructions for paint color schemes, aircraft markings/MODEX, and specific material requirements.

A-4.4. **TOUCH-UP.** Table A-2 lists original coating materials and specified touch-up materials used for common aircraft paint systems. All activities shall be familiar with paint scheme requirements, particularly the importance of using appropriate materials. Refer to MIL-STD-2161 and system specific instructions for paint finishing details.

A-4.5. **COSMETIC PAINTING.** Repainting solely for the sake of cosmetic appearance is not authorized. Since common paint materials may take as many as seven days to completely cure, a faded or stained but well-bonded paint finish is more durable than a fresh touch-up treatment. Refinishing shall be performed only when existing paint finishes have deteriorated or have been damaged, or when removal of the existing paint system is necessary for corrosion corrective actions.

A-4.6. **TEMPORARY MARKINGS.** Where local environmental regulations permit, lacquer paint such as MIL-PRF-81352 Type I may be used for temporary markings. Lacquer can be easily removed using solvents,

such as MIL-T-81772 Type I Aircraft Paint Thinner, without affecting the underlying paint system. In instances where local environmental regulations do not permit the use of lacquer, use only the prescribed environmentally compliant coatings listed in Table A-2.

#### NOTE

Non-approved aerosol coatings are not authorized for aircraft touch-up and painting.

A-4.7. **AEROSOL COATINGS.** Aerosol paint delivery systems using approved coatings are recommended for small touch-up processes. Refer to Table A-2 and paragraph A-9 for authorized materials. Non-approved aerosol coatings do not provide adequate corrosion protection, weather resistance, and durability, nor are they resistant to operational fluids.

A-4.8. **WET INSTALLATIONS.** Fasteners and bushings are often wet-installed with corrosion inhibiting primer or sealant to provide additional corrosion protection. Waterborne materials, such as MIL-PRF-85582 Waterborne Epoxy Primer, shall not be used for wet installation of fasteners and bushings since entrapped moisture may promote corrosion. In general, MIL-PRF-23377 Epoxy Primer and MIL-PRF-81733 Polysulfide Sealant are preferred materials for wet installation purposes. Consult specific maintenance instructions for appropriate selection of materials.

A-4.9. **SPECIAL SURFACES.** Some aircraft surfaces require specialized coatings to satisfy service exposure and operational needs. Radomes, antenna covers, and parts with similar elastomeric coatings shall be repaired in accordance with NAVAIR 01-1A-22 and system-specific repair instructions. Coatings on propeller blades, helicopter rotor blades, leading edge erosion resistant coatings, and anti-chafe coatings shall also be repaired in accordance with system-specific repair

Table A-2. Original Coating Systems and Corresponding Touch-up Systems

Paint System and Description	Original Coatings	Touch-Up Coatings
<p><b>TACTICAL PAINT SCHEME or LAND CAMOUFLAGE PAINT SCHEME</b></p> <p>A color scheme designed for specific aircraft types to reduce visual detection by matching the reflectance of operational surroundings.</p> <p>Tactical paint schemes are comprised mainly of flat gray colors (35237, 36081, 36118, 36231, 36320, 36375, or 36495).</p> <p>Land camouflage paint schemes are comprised of flat green (34095), gray (36375), and black (37038).</p>	<p><b>Primer</b>            MIL-PRF-23377 Type II or MIL-PRF-85582 Type II</p> <p><b>Topcoat</b>            MIL-PRF-85285 Type I</p>	<p><b>Primer</b>            MIL-PRF-23377 Type II or MIL-PRF-85582 Type II</p> <p><b>Topcoat</b>            MIL-PRF-85285 Type I, MIL-PRF-22750, or MIL-PRF-81352 Type III</p>
<p><b>HIGH GLOSS PAINT SYSTEM</b></p> <p>The traditional, highly reflective glossy paint scheme, usually composed of insignia white (17925) and gull gray (16440), with other colors and markings.</p>	<p><b>Primer</b>            MIL-PRF-23377 Type I, MIL-PRF-85582 Type I, or TT-P-2760 Type I</p> <p><b>Topcoat</b>            MIL-PRF-85285 Type I</p>	<p><b>Primer</b>            MIL-PRF-23377 Type I, MIL-PRF-85582 Type I, or TT-P-2760 Type I</p> <p><b>Topcoat</b>            MIL-PRF-85285 Type I, MIL-PRF-22750, or MIL-PRF-81352 Type III</p>
<p><b>INTERIOR SURFACES (WITHOUT TOPCOAT)</b></p> <p>Many hidden interior surfaces do not require protective topcoats since they are not exposed to direct sunlight, heavy soils, or overly corrosive conditions.</p>	<p><b>Primer</b>            MIL-PRF-23377 Type I, MIL-PRF-85582 Type I, or TT-P-2760 Type I</p>	<p><b>Primer</b>            MIL-PRF-23377 Type I or MIL-PRF-85582 Type I</p>
<p><b>INTERIOR SURFACES (WITH TOPCOAT)</b></p> <p>Many interior surfaces require a topcoat due to operational necessity. This includes surfaces requiring frequent cleaning or additional corrosion protection.</p>	<p><b>Primer</b>            MIL-PRF-23377 Type I, MIL-PRF-85582 Type I, or TT-P-2760 Type I</p> <p><b>Topcoat</b>            MIL-PRF-85285 Type I, or MIL-PRF-22750</p>	<p><b>Primer</b>            MIL-PRF-23377 Type I or MIL-PRF-85582 Type I</p> <p><b>Topcoat</b>            MIL-PRF-85285 Type I, MIL-PRF-22750, or MIL-PRF-81352 Type III</p>

instructions. Refer to Volume III for touch-up of avionics equipment. Refer to NAVAIR 17-1-125 for touch-up of ground support equipment.

**A-5. PAINT EQUIPMENT.** Paint coatings are typically applied using brushes, touch-up pens, rollers, and spray guns. Selection of an appropriate application method depends upon the size of the area to be painted, where the paint is to be applied, and what equipment is allowed. Specific coating application procedures are controlled by environmental and safety regulations, and some equipment may be prohibited. Therefore, anyone performing painting operations shall be knowledgeable about local, state, and federal regulations governing equipment and procedures. Consult the local Environmental Affairs Office for specific requirements.

**A-5.1. HIGH-VOLUME LOW-PRESSURE (HVLP) GUN.** HVLP spray equipment (see Figure A-1) atomizes paint into a soft pattern of low speed particles using an air cap pressure up to 10 psi maximum. Due to the low velocity of the coating particles, more of the coating is deposited on the intended object with less overspray.



Figure A-1. HVLP Paint Spray Gun

Since there is less overspray, it is easier to see the surface being coated. Film build is faster than with conventional spray equipment due to higher transfer efficiency. Benefits include less material usage and less paint booth maintenance due to less overspray. The proper working distance of an HVLP gun is usually closer than with a conventional paint spray gun. Due to environmental regulations, an HVLP system must not be operated at air cap pressures exceeding 10 psi. Refer to manufacturer's literature supplied with the paint gun for proper operation and adjustment. Figure A-2 illustrates the components of a typical HVLP paint spray gun. Refer to Volume IV for ordering information of the HVLP paint spray guns.

A-5.1.1. Transfer Efficiency. Application methods shall be selected to minimize the amount of paint waste and solvent emissions. Transfer efficiency is used to gage the effectiveness of paint equipment and is represented as a percentage of the amount of paint deposited on the surface compared with the total amount of paint used. Spray painting produces overspray and has much less transfer efficiency than brush or roller application, but produces a more uniform, higher quality paint film. The EPA has established specific requirements for paint spray equipment used on aircraft surfaces. High-volume low-pressure (HVLP) spray equipment or electrostatic spray equipment is recommended since they have higher transfer efficiencies than conventional high-pressure spray equipment. In addition, conventional high-pressure spray equipment is no longer allowed in most localities for use on aircraft surfaces due to environmental restrictions. Consult the local Environmental Affairs Office for guidance on selection of proper paint spray equipment.

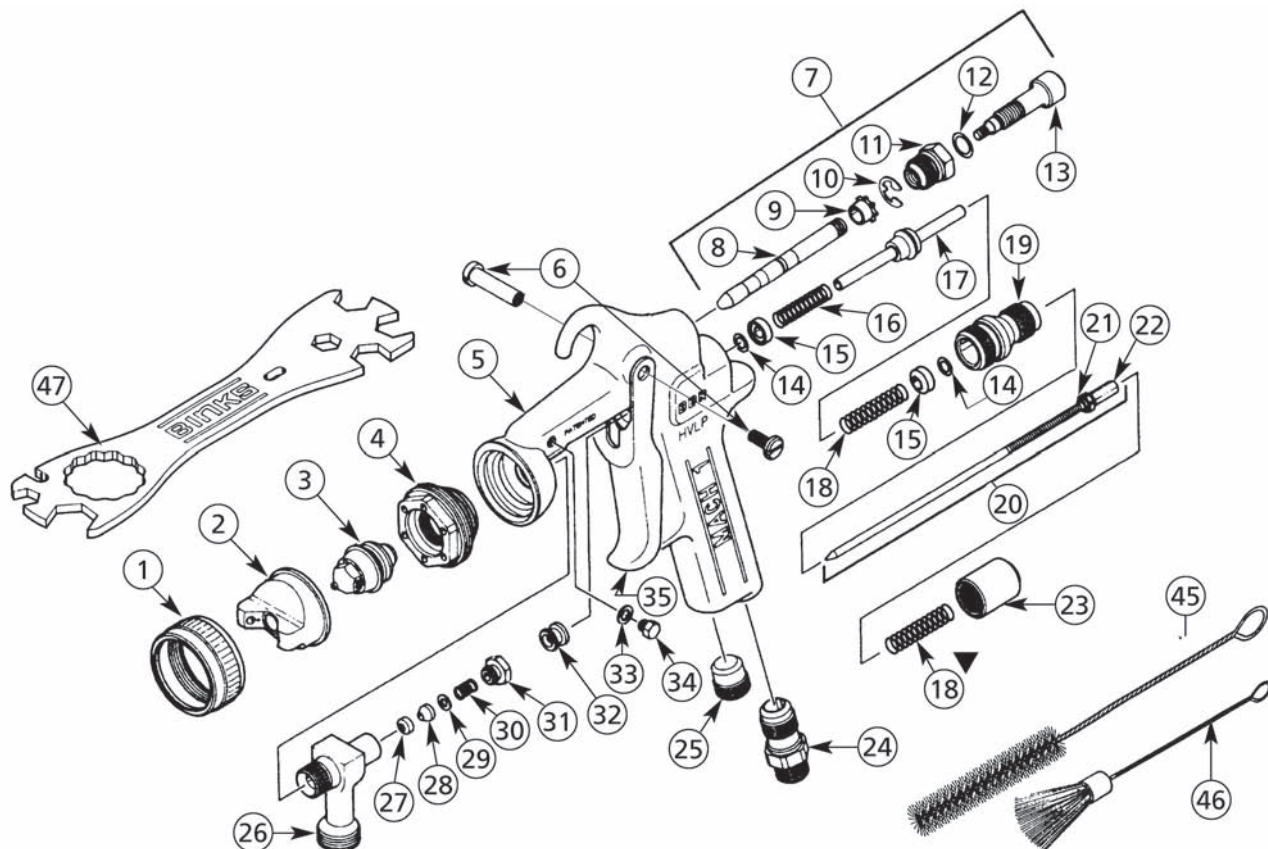
A-5.1.2. HVLP Equipment Options. HVLP spray guns are suitable for painting both large areas and small components. These guns can be fitted with a small cup, usually a pint or quart capacity, or a pressure pot. A pressure pot holds two or more quarts of paint and is pressurized to force paint through a hose to the paint spray gun. The amount of pressure supplied to the pot is determined by the paint viscosity and length of paint supply hose. Follow manufacturer's recommendations to set pot pressure.

A-5.2. TOUCH-UP SPRAY GUN. A touch-up spray gun is used to apply paint to small areas using a small spray pattern. Since these guns are used for small areas, they are often acceptable under environmental regulations. Consult the local Environmental Affairs Office for guidance on the use of touch-up spray guns.

A-5.3. 3M PAINT PREPARATION SYSTEM (PPS). PPS is a closed paint system that connects to both siphon and gravity feed HVLP spray guns, allowing mixing and spraying of paint materials from the same disposable liner bag (see Figure A-3). Adapters are available to convert existing spray guns to use PPS. Instead of traditional rigid cups made of polyethylene, aluminum, or stainless steel, the PPS includes a collapsible liner bag in a plastic cup fitted with a lid and built-in filter. As paint is sprayed, the liner bag collapses, allowing the spray gun to function at any angle (i.e., sideways, upside down). This multi-angle capability is especially useful for painting inside compartments, under wings, or the bottom of the fuselage. Collapsed liner bags and lids with built-in filter are disposable, leaving only the spray gun and adapter to be cleaned. Unused paint can be sealed in the liner with a sealing cap and stored appropriately. PPS provides an efficient means of applying paint materials, thus reducing paint waste and minimizing time and cleaning solvents required for cleaning paint spray gun assemblies.

A-5.4. ELECTROSTATIC EQUIPMENT. Electrostatic paint spray equipment deposits paint on surfaces by means of static electric attraction. The surface to be painted and the coating material have opposing charges which causes the coating to be attracted to the surface. Electrostatic painting is useful for painting large areas and, if used properly, produces little overspray with high transfer efficiency. Due to electrical conductivity requirements, this equipment is highly dependent upon the type of coating (i.e., waterborne vs. solvent based) and substrate conditions (i.e., metallic or nonmetallic). Follow manufacturer's recommendations and safety precautions when operating this equipment.

A-5.5. BRUSH AND ROLLER. Brushes and rollers are environmentally preferred alternatives for touch-up painting since they produce little paint waste and do not require solvent clean up. However, spray painting is preferred where allowed by local regulations and availability of proper personal protective equipment (PPE), since the quality and uniformity of the paint film is better than that achieved by brush or roller application. Brushes and rollers must be constructed of durable materials that will not be affected by solvents in the coatings. Do not use foam brushes or foam rollers since they are not solvent resistant. Refer to Volume IV for appropriate brushes and rollers. Note that in addition to the standard 1" wide brush, there are "acid brushes" and "artist brushes" available for small or hard to reach areas. Use rollers with the shortest nap possible in order to achieve the best surface finish. Brushes and rollers



ITEM NO.	DESCRIPTION
1	Retaining Ring (Metal)
2	Air Nozzle
3	Fluid Nozzle
4	Head Insert
5	Gun Body Assembly
6	Trigger Stud & Screw Kit
7	Side Port Control Assembly #6
8	Control Stem
9	Guide Bushing
10	Retaining Ring
11	Control Body
12	O-Ring
13	Control Screw
14	O-Ring (Teflon)
15	Seal Retainer
16	Spring (Yellow)
17	Spindle Assembly
18	Spring (Blue)
19	Housing
20	Needle Assembly (Stainless Steel)
21	Needle Lock Nut
22	Needle Cap
23	Fluid Control Knob
24	Air Connection
25	Plug
26	Fluid Inlet (Stainless Steel)
27	Gland Adapter
28	Needle Seal
29	Seal Backup
30	Spring
31	Packing Nut
32	Valve Spindle Cap
33	Gasket
34	Plug
35	Trigger
36	Adjustable Fluid Inlet (Assembly For Mach 1 W/Adj Fluid Inlet)
40	Vitreous Fluid Inlet
41	O-Ring (Buna)
42	Packing Spacer
43	Nut Assembly
44	Seal Cartridge Assembly (For Adjustable Fluid Inlet)
45	Gun Brush
46	Gun Brush
47	Wrench

ITEM NO.	DESCRIPTION
24	Air Connection
25	Plug
26	Fluid Inlet (Stainless Steel)
27	Gland Adapter
28	Needle Seal
29	Seal Backup
30	Spring
31	Packing Nut
32	Valve Spindle Cap
33	Gasket
34	Plug
35	Trigger
36	Adjustable Fluid Inlet (Assembly For Mach 1 W/Adj Fluid Inlet)
40	Vitreous Fluid Inlet
41	O-Ring (Buna)
42	Packing Spacer
43	Nut Assembly
44	Seal Cartridge Assembly (For Adjustable Fluid Inlet)
45	Gun Brush
46	Gun Brush
47	Wrench

Figure A-2. HVLP Paint Spray Gun Parts Breakdown





Figure A-3. 3M PPS Mounted on a Spray Gun

are considered disposable. As such, they should not be cleaned or reused.

**A-5.6. ZAHN NO. 2 VISCOSITY CUP.** Viscosity of paint materials can be checked by measuring the time required for the material to flow from a cup with a specified volume through a specified orifice size in the bottom of the cup (see Figure A-4). A Zahn No. 2 Cup is constructed of corrosion resistant steel. This cup will hold 44 milliliters (1.47 ounces) of material and has a calibrated orifice in the bottom. The cup must not be damaged or altered to ensure consistent volume; the size of the orifice must also remain the same. Do not use abrasive materials or metallic objects to clean the cups since damage to the volume or orifice may occur. Viscosity is measured using the Zahn No. 2 Cup as follows:

- a. Prepare the paint to be tested. Mix and strain per manufacturer's recommendations.
- b. Fill the cup by submerging it into the material. Make sure that enough material is available to completely fill the cup.
- c. When the cup is full, raise it completely out of the material and immediately start a stopwatch. Carefully observe the flow of paint from the orifice.
- d. When the constant stream or flow of the material breaks, stop the watch. The time required (in seconds) for the stream to break is the viscosity value. Viscosity

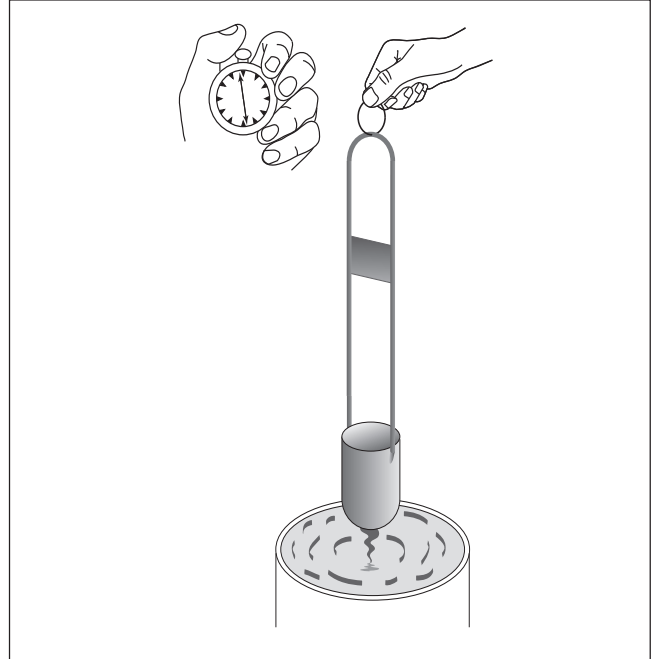


Figure A-4. Zahn No. 2 Viscosity Cup

values will vary among coatings. Primers are usually applied at lower viscosities (15-25 seconds), and topcoats, such as MIL-PRF-85285, are usually applied at higher viscosities (18-30 seconds). Refer to the application instructions for specific coating requirements. To avoid exceeding VOC limits, do not add additional paint thinner unless specifically authorized by the manufacturer's instructions.

**A-5.7. WET FILM THICKNESS GAGE.** Wet film thickness of coatings is used to estimate the dry film thickness. Wet film thickness is easily obtained using a comb-type thickness gage (refer to Figure A-5). As a general rule, dry film thickness will be approximately 50 percent of the wet film thickness. Wet film thickness is obtained as follows:

- a. Place gage on wet paint film at a 90° angle. This is done on test panels sprayed at the same time as the actual component or on masking tape adjacent to the actual component just after the coating is applied.
- b. Press gage into film. Withdraw and note deepest tooth having paint on it and next higher tooth that is not coated.
- c. The wet film thickness lies between these two readings.
- d. Clean gage with a suitable solvent immediately after use.

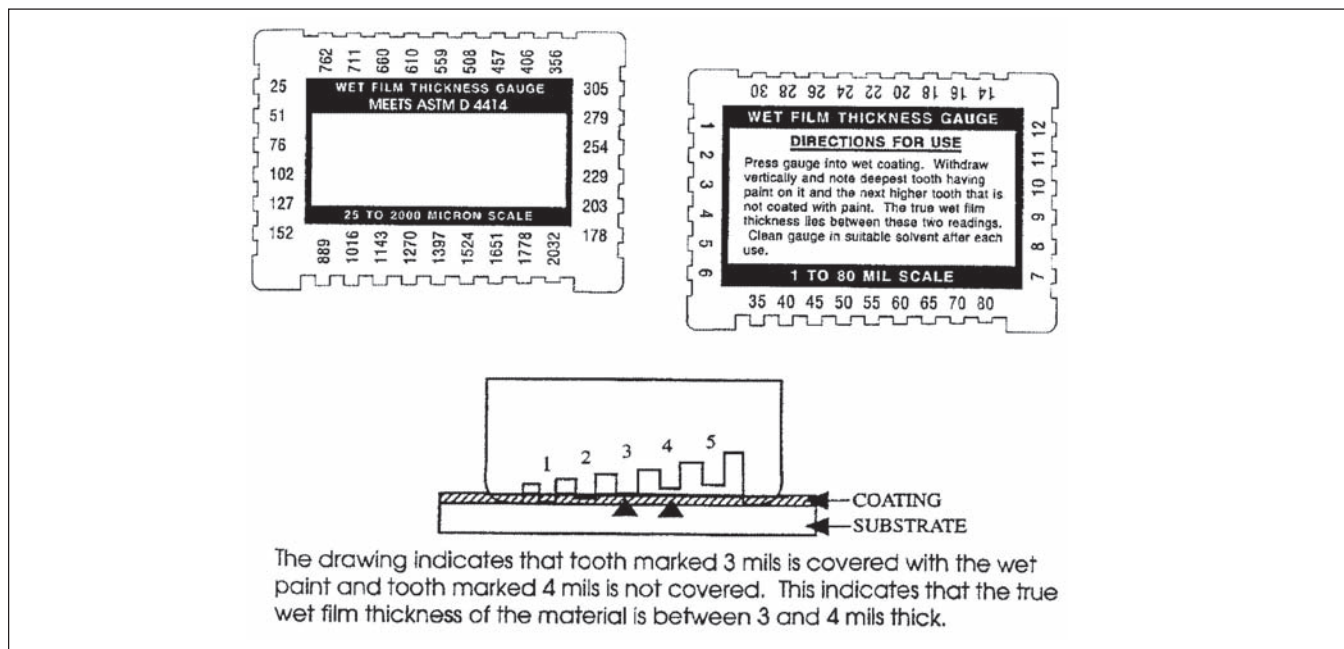


Figure A-5. Wet Film Thickness Gage

A-5.8. DECAL MARKING EQUIPMENT. The Gerber Edge adhesive stencil making system and Avery Techniflex adhesive vinyl are the recommended products for aircraft decal markings; however, any equivalent system may be used.

**A-6. GENERAL MAINTENANCE REQUIREMENTS FOR PAINT SPRAY EQUIPMENT.** Proper maintenance is necessary to preserve the life of the paint spray equipment and ensure high quality results. The spray gun requires little maintenance if kept clean. Two part catalyzed coatings cure or harden by chemical reaction in addition to solvent evaporation. The curing process begins when the two components are mixed. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. If catalyzed materials are allowed to remain in the equipment too long, the equipment will become inoperative. For this reason, paint equipment shall be thoroughly cleaned immediately after use or at least every four hours.

A-6.1. PAINT EQUIPMENT CLEANING. Paint spray equipment cleanup procedures are controlled by EPA regulations. Local and state pollution control districts may also have specific requirements. Consult the local Environmental Affairs Office for specific requirements. Generally approved cleaning solvents and methods are listed below.

A-6.1.1. Paint Cleaning Solvent. To effectively remove residue, paint equipment cleaning solvents must be

compatible with the type of coating material. In general, residue from polyurethane coatings such as MIL-PRF-85285 and TT-P-2760 can be removed using MIL-T-81772 Type I Thinner. Residue from epoxy coatings such as MIL-PRF-22750 and MIL-PRF-23377 can be removed using MIL-T-81772 Type II Thinner. Uncured residue from waterborne coatings such as MIL-PRF-85582 can be removed using a combination of water and TT-I-735 (Isopropyl Alcohol). To prevent corrosion, do not allow water to remain in the paint equipment. Consult specific manufacturer's instructions for guidance on cleaning solvents for each individual coating.

**WARNING**

Eye protection and solvent proof gloves (no latex) must be worn during use and maintenance of the paint gun washer.

Rags and other cleaning materials saturated with waste solvent are a potential fire hazard and therefore shall be deposited in a suitable container immediately after use. The container shall be covered with a tight fitting lid and kept closed except when depositing or removing cleaning materials.

A-6.1.2. Paint Gun Washers. These washers consist of an automated, close-loop spray system that flushes and cleans both interior and exterior of HVLP paint guns





Figure A-6. Paint Gun Washer

and other painting equipment (refer to Volume IV for recommended units). These stainless-steel tank washers (see Figure A-6) provide an alternative to the labor intensive method of manually cleaning paint guns, and minimize worker exposure to potentially harmful solvents. The only exposure is during loading and unloading of paint guns, solvent replenishment, and replacing and disposing of the spent filters. A filtration system allows the cleaning solvent to be reused numerous times before disposal is required, thereby reducing the quantity of spent solvent and rags that must be disposed of as hazardous waste. Solvents selected for use in the unit should be based on the type of coatings to be removed. Operate and service system per manufacturer's instructions. Lid shall be kept closed at all times except for loading and unloading paint spray equipment or servicing system. Do not use this equipment if leaks are present. Spent solvents shall be disposed as necessary to ensure proper equipment operation.

A-6.1.3. Non-Atomized Cleaning. Clean the paint spray gun by placing solvent into the pressure pot or cup and forcing solvent through the spray gun into a suitable waste container. Do not atomize/spray the cleaning solvent. The waste container shall be closed when not in use to prevent solvent evaporation.

A-6.1.4. Manual Gun Cleaning. Clean the disassembled paint spray gun by hand or by soaking the parts in a container filled with solvent. Brushes may be used to assist in cleaning detailed parts. The container shall be closed while parts are soaking and when not in use. Do not immerse the entire paint spray gun.

A-6.2. REMOVAL OF DRIED PAINT. After several months of use or when clogged with dried paint, the

spray gun may be cleaned by completely dismantling and soaking metal components, such as the air nozzle, fluid nozzle, and needle assembly, in MIL-PRF-83936 tank-type paint remover (see Chapter 4). Do not immerse the entire paint spray gun or any plastic components into a paint remover tank.

**A-7. PREPARATION OF SURFACES FOR PAINTING.** Much of the effectiveness of a paint finish depends on careful preparation of the surface prior to applying the coatings. Surface preparation includes scuff sanding of old existing paint, cleaning, and chemical conversion coating of any bare metal.

### WARNING

Some coatings contain chromium compounds, lead compounds, and other heavy metal pigments. Wear eye and respiratory protection and ensure adequate safety precautions are in place to prevent exposure to dust during sanding operations. Contact the local Industrial Hygiene Activity or Occupational Safety and Health Office for guidance on the proper selection of respiratory protection and other personal safety requirements.

### CAUTION

When scuff sanding and feathering paint coatings, avoid damage to metal and composite substrates. Abrasion of substrate materials can damage structural integrity.

### NOTE

Proper surface preparation is essential. Most poorly adherent paint coatings are caused by poor surface preparation. Carefully follow all cleaning, corrosion removal, surface treatment, and solvent wipe-down procedures before applying any coatings.

A-7.1. PREPARATION OF AGED PAINT. Aged paint coatings (those allowed to cure seven days or more) must be scuff sanded prior to repainting to ensure adhesion of additional paint coatings. Scuff sand using 150 grit or finer aluminum oxide cloth (ANSI B74.18), abrasive mat (A-A-58054), or random orbital sander with aluminum oxide paper. Scuff sanding requires a complete roughening of the paint surface; however, avoid aggressive scuff sanding, which can expose the substrate and promote corrosion of metal and degradation of composite materials. Unevenly matched

faying surface joints or fasteners and sharply protruding objects or corners shall be scuff sanded by hand to avoid sanding through the coating. After scuff sanding, remove dry residue using clean cheesecloth (CCC-C-440) dampened with water, followed by wiping with clean cheesecloth dampened with thinner (MIL-T-81772 Type I).

A-7.2. DRYING. All surfaces to be painted shall be thoroughly dry prior to painting. After cleaning, special precautions shall be taken to assure proper drainage of all liquids from between faying surfaces, crevices, and pockets, preferably by permitting the aircraft or component to stand for a sufficient time to permit such drainage. If necessary, isopropyl alcohol (TT-I-735) may be sprayed into seams or fastener patterns after cleaning to ensure displacement of water in these areas. Ensure that areas surrounding the area to be painted, especially crevices and faying surfaces, are also dried prior to painting to prevent drainage onto the work surface.

#### A-7.3. FINAL INSPECTION AND PREPARATION.

a. Inspect surface to be painted to ensure all corrosion has been properly removed. Surfaces must be cleaned and properly treated using chemical conversion coating (see Chapters 2 and 5, respectively). If chemical conversion coating is scratched or damaged, the area must be retreated in accordance with Chapter 5.

b. Replace any seam sealants if necessary, as described in Chapter 7.

c. Mask surrounding areas to protect from paint overspray. Paint masking tape (AMS-T-21595 Type I) and brown masking paper (A-A-203) are suitable for most masking requirements. For touch-up spray applications, it is often desirable to mask to a seam or line to prevent the appearance of a paint edge after masking material is removed.

A-7.4. SOLVENT WIPE. Surfaces must be completely clean prior to painting. Failure to remove all oils, greases, aircraft fluids, fingerprints, or other contaminants will lead to coating adhesion problems and premature corrosion.

A-7.4.1. Clean surfaces immediately prior to painting by solvent wiping with clean cheesecloth (CCC-C-440 Class 2) or cleaning cloth (AMS 3819 Grade A or equivalent) dampened with an approved solvent (MIL-T-81772 Type I, AMS 3166, or equivalent).

A-7.4.2. Environmentally Compliant Solvents. Environmental regulations in most locations prohibit the use of wipe solvents with vapor pressures greater than 45 millimeter of mercury (mmHg). The vapor pressure of MIL-T-81772 Type I and AMS 3166 is approximately 35 mmHg or less.

**A-8. GENERAL PAINT APPLICATION PROCEDURES.** The following procedures are general rules to be followed when applying paint. For more detailed information on the application of paint finishes, refer to MIL-STD-7179 (Finishes, Coatings, and Sealants for the Protection of Aerospace Weapons Systems).

### WARNING

Aircraft shall be electrically grounded during all painting procedures in order to guard against the danger of fire from static electricity.

#### A-8.1. GENERAL SPRAYING TECHNIQUES.

a. Prior to spraying, the gun should be checked to ensure that it produces the proper spray pattern. Figure A-7 shows correct spray patterns and tips on how to achieve them. Table A-3 shows incorrect patterns, causes, and suggested remedies.

b. Always have the spray gun in motion before spraying.

c. Keep the spray gun at a consistent distance from the work during application.

d. Move the spray gun across the work at a consistent speed.

e. For large surfaces, trigger the spray gun after beginning and before ending each stroke.

f. Start the first stroke at the same point on each similar object.

g. Always overlap half of the pattern of the previous stroke.

h. On similar pieces of work, always try to use the same number of strokes or passes.

i. End the last stroke in the same place on similar objects.

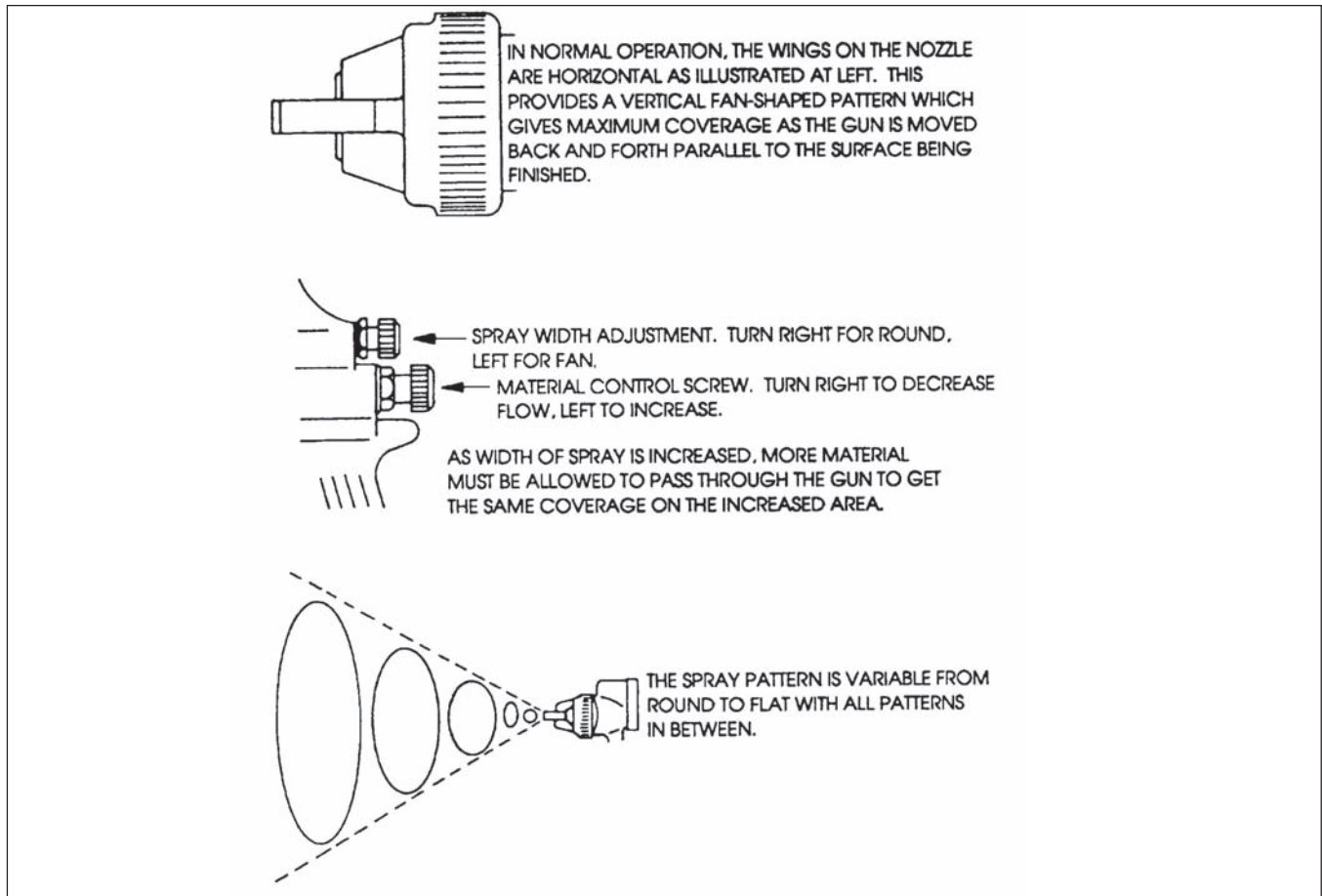


Figure A-7. Obtaining Correct Spray Pattern

### A-8.2. SPRAY GUN DISTANCE.

a. Keep the spray gun at the same distance from the work during application. The proper distance of the spray gun from the work varies with the spray pattern and type of application. When the spray gun is close to the surface being painted, it must be moved more rapidly to prevent runs and sags. For most processes, spray gun distance from the work should be approximately 6-10 inches (see Figure A-8).

b. A full coat of paint through which most materials cannot be seen is called a full wet coat. For a wet, heavy coat, move the spray gun closer to the surface or move the gun more slowly across the surface to increase the volume of paint being applied.

c. A light coat of paint through which most materials can be seen is called a mist coat. For a light film build or for a mist coat, move the spray gun further away or move the gun more quickly across the surface to decrease the volume of paint being applied.

### A-8.3. SPRAY APPLICATION.

a. Hold the paint gun parallel to the work surface so that the spray is always perpendicular to the surface being painted (see Figure A-9).

b. Move the spray gun parallel to the surface to maintain the same distance from the surface. Move both your arm and shoulder, along with the paint gun, to avoid "arcing" and tilting the spray gun (see Figures A-10, A-11, and A-12). Overlap approximately half of the pattern of the previous stroke.

c. Slow gun travel gives a wet, heavy film build; fast gun travel gives a light film build.

d. Trigger the spray gun after the stroke has been started (see Figure A-13). Release the trigger before the end of the stroke. This reduces paint loss, prevents heavy build up of paint on the corners and edges of work, and prevents runs and drips at the beginning and end of the stroke. If the trigger is not completely pulled, only air will flow through the gun.

Table A-3. Troubleshooting Faulty Spray Patterns






Condition	Possible Causes	Correction
<b>Heavy Top or Bottom Pattern</b> 	Horn holes plugged. Obstruction on top or bottom of fluid tip. Cap and/or tip seat dirty.	Clean. Ream with non-metallic point. Clean. Clean.
<b>Heavy Right or Left Side Pattern</b> 	Left or right side horn holes plugged. Dirt on left or right side of fluid tip. Remedies for the top-heavy, bottom-heavy, right-heavy and left-heavy patterns:	Clean. Ream with non-metallic point. Clean. 1. Make a test spray pattern to determine if the obstruction is on the air cap or the fluid tip. Then, rotate the cap one-half turn and spray another pattern. If the defect is inverted, obstruction is on the air cap. Clean the air cap. 2. If the defect is not inverted, it is on the fluid tip. Check for a fine burr on the edge of the fluid tip. Remove with #600 wet or dry sand paper. 3. Check for dried paint just inside the opening. Remove paint by washing with approved solvent.
<b>Heavy Center Pattern</b> 	Fluid pressure too high for atomization air (pressure feed). Material flow exceeds air cap's capacity. Atomizing pressure too low. Material too thick.	Balance air and fluid pressure. Increase spray pattern width with spreader adjustment valve. Thin or lower fluid flow. Increase pressure. Thin to proper consistency.
<b>Split Spray Pattern</b> 	Fluid adjusting knob turned in too far. Atomization air pressure too high. Fluid pressure too low (pressure feed only). Spreader adjusting valve set too high.	Back out counterclockwise to achieve proper pattern. Reduce at air regulator. Increase fluid pressure. Adjust by turning in clockwise.
<b>Jerky or Fluttering Spray</b> 	<b>Suction And Pressure Feed may have:</b> Loose or damaged fluid tip/seat. Material level too low. Container tipped too far. Obstruction in fluid passage. Loose or broken fluid tube or fluid inlet nipple. Dry or loose fluid needle packing nut.	Tighten or replace. Refill. Hold more upright. Backflush with solvent. Tighten or replace. Lubricate or tighten.
	<b>Suction Feed Only may have:</b> Material too heavy. Container tipped too far. Air vent in cup lid clogged. Loose, damaged or dirty lid. Dry or loose fluid needle packing. Fluid tube resting on cup bottom. Damaged gasket behind fluid tip.	Thin or replace. Hold more upright. Clear vent passage. Tighten, replace or clean coupling nut. Lubricate or tighten packing nut. Tighten or shorten. Replace gasket.
<b>Unable to Get Round Spray</b>	Fan adjustment screw not seating properly. Air cap retaining ring loose.	Clean or replace. Tighten.

Table A-3. Troubleshooting Faulty Spray Patterns (Cont.)

Condition	Possible Causes	Correction
<b>Will Not Spray</b>	No air pressure at gun. Internal mix or pressure feed air cap and tip used with suction feed. Fluid pressure too low with internal mix cap and pressure tank. Fluid needle adjusting screw not open enough. Fluid too heavy for suction feed.	Check air supply and air lines. Change to proper suction feed air cap and tip.  Increase fluid pressure at tank.  Open fluid needle adjusting screw. Thin material or change to pressure feed.
<b>Starved Spray Pattern</b>	Inadequate material flow.  Low atomization air pressure (suction feed).	Back fluid adjusting screw out to first thread, or increase fluid pressure at tank.  Increase air pressure and rebalance gun.
<b>Excessive Overspray</b>	Too much atomization air pressure. Gun too far from work surface. Improper stroking (arcing, gun motion too fast).	Reduce pressure. Adjust to proper distance (6 -10 inches). Move at moderate pace, parallel to work surface.
<b>Excessive Fog</b>	Too much, or too fast-drying thinner. Too much atomization air pressure.	Remix properly. Reduce pressure.
<b>Dry Spray</b>	Air pressure too high. Material not properly reduced (suction feed). Gun tip too far from work surface. Gun motion too fast. Gun out of adjustment.	Decrease air pressure. Reduce to proper consistency. Adjust to proper distance (6 -10 inches). Slow down. Adjust.
<b>Fluid Leaking from Packing Nut</b>	Packing nut loose. Packing worn or dry.	Tighten, do not bind needle. Replace or lubricate.
<b>Fluid Leaking or Dripping from Front of Pressure Feed Gun</b>	Packing nut too tight. Dry packing. Fluid tip or needle worn or damaged. Foreign matter in tip. Fluid needle spring missing or broken. Wrong size needle or tip.	Adjust. Lubricate. Replace tip & needle with matched sets. Clean. Replace. Replace.
<b>Thin, Sandy Coarse Finish Drying Before it Flows Out</b>	Gun too far from surface. Too much air pressure. Improper thinner being used.	Check distance: normally 6 - 10 inches from surface. Reduce air pressure and check spray pattern. Follow paint manufacturer's mixing instructions.



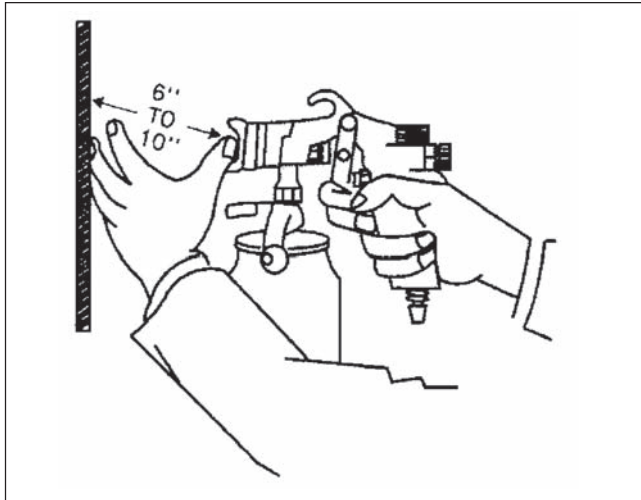


Figure A-8. Estimating Distance to Work Surface

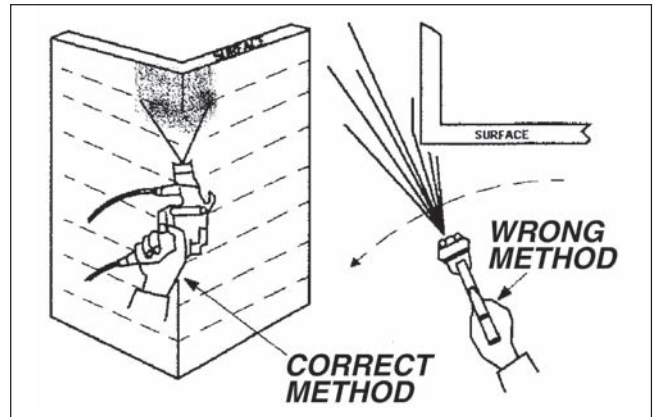


Figure A-11. Spraying Corners

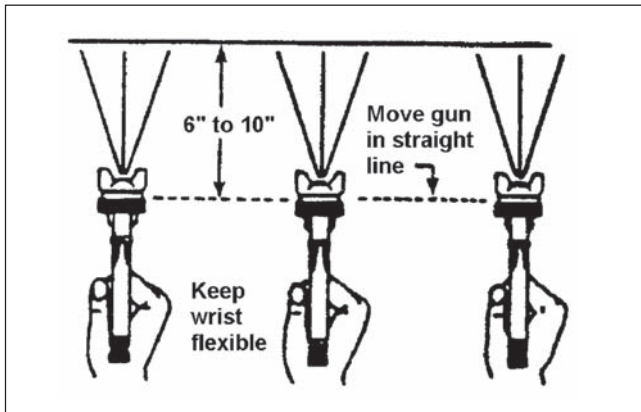


Figure A-9. Parallel Movement of Spray Gun

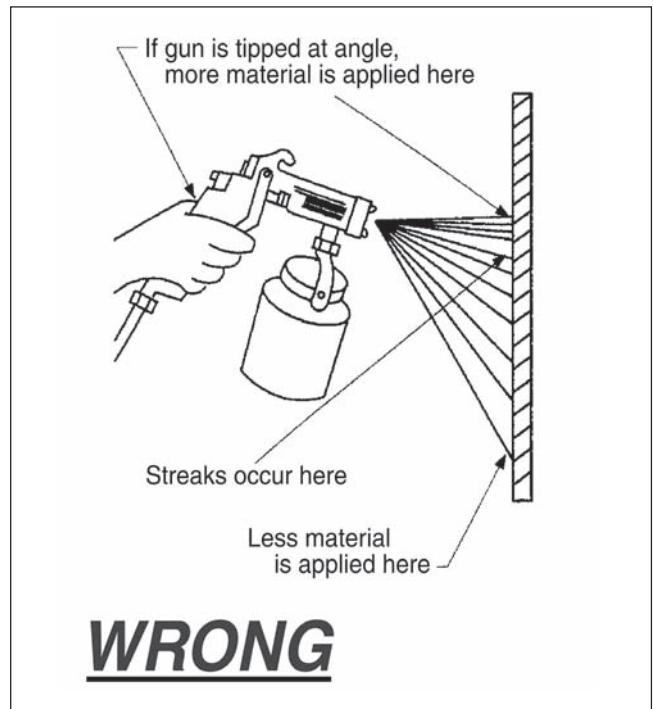


Figure A-12. Improper Spray Angle

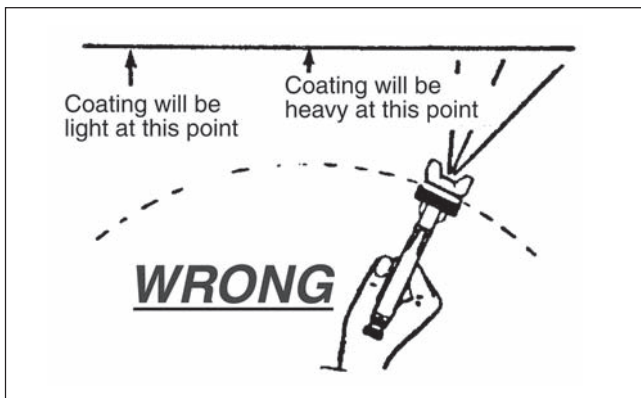


Figure A-10. Avoid Arcing the Spray Gun

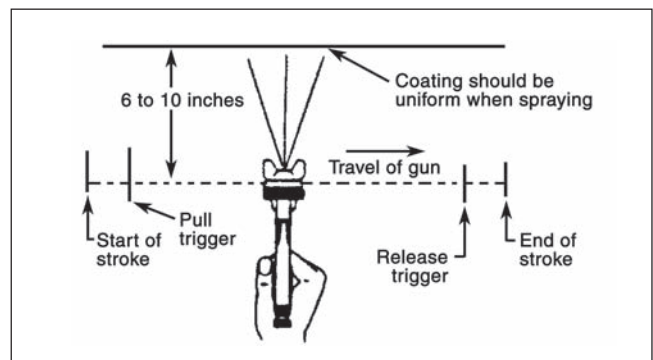


Figure A-13. Triggering the Spray Gun



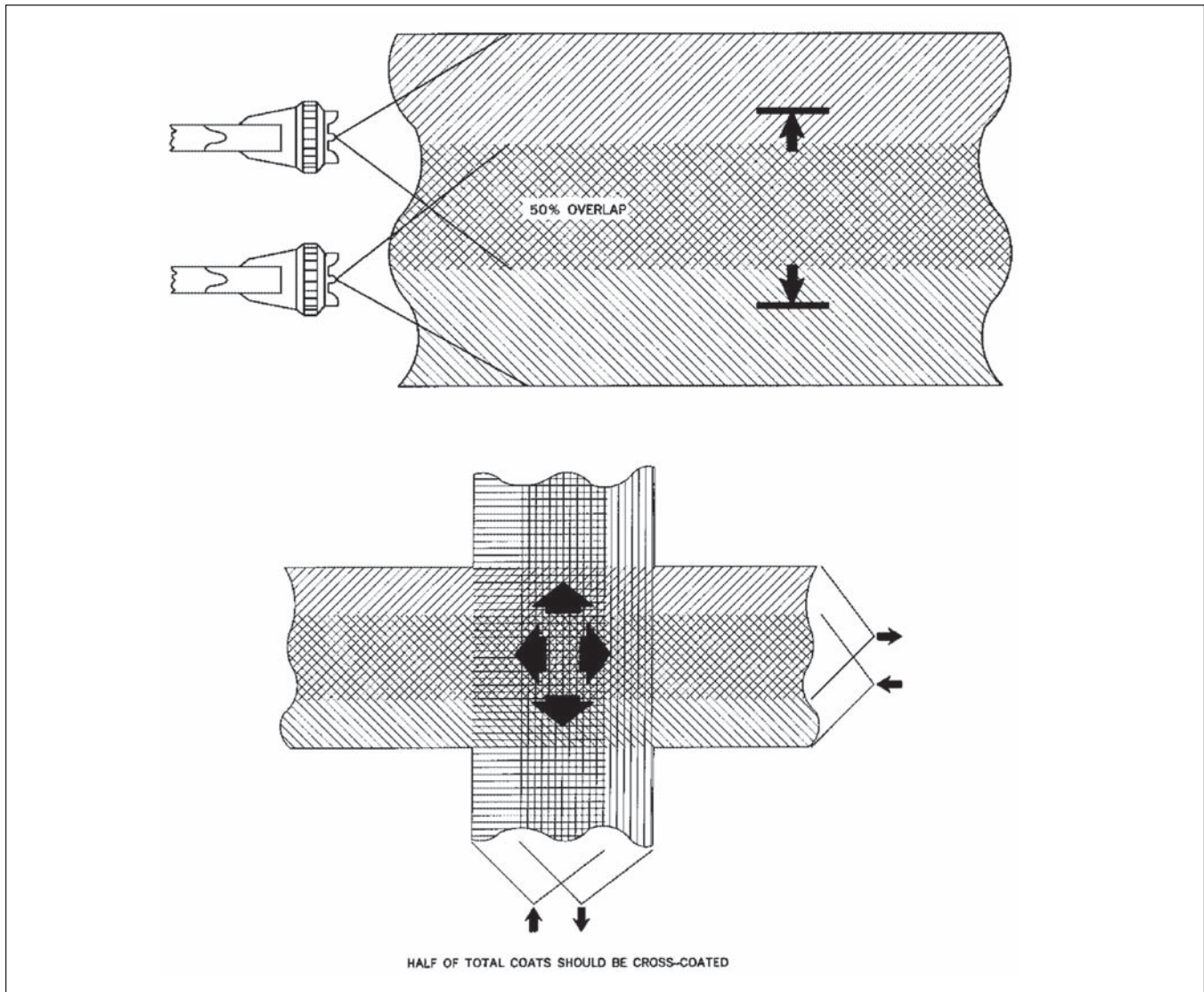


Figure A-14. Proper Spray Pattern Overlap

e. To achieve the desired film thickness, primers can usually be applied in one spray coat; topcoats usually require two coats with specific dry time between coats to allow proper solvent evaporation, film leveling, and curing properties. The second coat should be applied in a cross coat to ensure adequate coverage (see Figure A-14). A paint thickness gauge should be used to check the actual film thickness. Many manufacturers' primer products have different levels of opacity when applied at the proper 0.6-0.9 mils dry film thickness (DFT).

**A-8.4. SPRAY PAINTING DEFECTS.** During spray application of paints, certain defects may appear on the finish due to faulty application methods or poor application conditions. The most common defects, probable causes, and remedies are listed in Table A-4.

For spray touch-up processes, an exact color or gloss match is extremely difficult to obtain and shall not be used as criteria for quality control. Slight orange peel that does not affect operational conditions or aerodynamic smoothness (as defined in MIL-STD-7179) is also acceptable. If unacceptable defects in the paint film are found, repair the defects as follows:

a. For dried defective paint, scuff sand per paragraph A-7 and refinish in accordance with instructions provided in this section for the specific coating being used.

b. For wet, freshly painted surfaces, remove defective paint by wiping with a cloth dampened with an approved solvent. In general, residue from polyurethane coatings such as MIL-PRF-85285 and TT-P-2760 can be removed using MIL-T-81772 Type I Thinner. Residue

Table A-4. Paint Finish Problems

Appearance	Probable Cause	Prevention
<b>Chalking</b> (Loss of gloss; powdery surface)	Weathering of paint films (particularly epoxy topcoats); insufficient paint agitation during mixing	Polyurethane topcoats are not as prone to chalking; use epoxy topcoats only when necessary; ensure coating materials are thoroughly mixed prior to application.
<b>Checking, Crazing, Cracking</b> (crowfoot separation, irregular line separation, mud cracking)	Insufficient drying of films prior to recoating; extreme temperature changes during drying; coats applied too heavily; ingredients not thoroughly mixed; incorrect thinner; solvent softening of lacquer undercoats	Allow sufficient drying time before recoating; avoid extreme temperature changes while applying coating and while coating is drying; avoid heavy coats; mix coatings thoroughly before applying; avoid incompatible additives; do not apply polyurethane or epoxy topcoats over lacquer paint (lacquer is easily softened with MIL-T-81772 Type I thinner).
<b>Blistering</b> (broken edge craters; small, swelled areas similar to blisters on human skin)	Contamination or corrosion under coatings; trapped solvents; exposure of film to constant or repeated high humidity; water in spray gun air line	Ensure surfaces are clean and free of corrosion prior to applying coatings; avoid applying coatings in extremely hot weather; routinely drain water from spray gun air lines; allow sufficient drying time between coats.
<b>Peeling, Lifting</b> (separation of coating from undercoats or substrate)	Improper surface preparation; improper undercoats; inadequate dry time between coats	Ensure surfaces are clean prior to coating; use recommended primers; allow sufficient dry time between primer and topcoat. Ensure that the proper chemical conversion coating is present on the substrate.
<b>Fish Eyes, Poor Wetting</b> (separation of the wet film; undercoat can be seen in spots)	Improper cleaning of surface prior to painting; oil or water in spray gun air line.	Clean surface properly; ensure spray gun air supply has oil and water separator.
<b>Dirt or Particles in Finish</b> (foreign particles dried in the paint film)	Lack of proper cleaning, blowing off, tack ragging; dirt in air supply line or spray gun; dirty working area; defective or dirty air inlet filters; coating not properly strained	Clean surface thoroughly; blow out cracks and seams; clean equipment thoroughly; clean up spray area; replace air inlet filters; strain coatings prior to application; keep containers closed.
<b>Runs, Sags</b> (running of wet paint in rivulets; partial slipping of paint)	Too much thinner; cold surface; gun at improper angle or too close to surface; too much coating applied at one time; improper gun adjustment	Do not add excessive thinner to coatings (refer to specific instructions later in this chapter); ensure surface is at proper temperature; hold gun at proper angle and distance; avoid heavy coats; refer to gun manufacturer's instructions for proper adjustment.
<b>Orange Peel</b> (ball peen hammer dents in coating surface; resembles the skin of an orange)	Inadequate dry time between coats; surface drying too fast; improper gun adjustment	Allow proper dry time between coats; ensure temperatures of material and surface are within the specified range; refer to gun manufacturer's instructions for proper adjustment.
<b>Pin Holes/Hazing</b> , Particularly in Gloss High-solids Polyurethane Paints (tiny bubbles or holes widespread in the dried coating)	Paint applied too thickly; insufficient dry time between coats; ambient temperature too high	Avoid heavy coats; avoid applying paint when ambient temperature exceeds 90° F.

from epoxy coatings such as MIL-PRF-22750 and MIL-PRF-23377 can be removed using MIL-T-81772 Type II Thinner. Residue from waterborne coatings such as MIL-PRF-85582 can be removed using a combination of water and TT-I-735 (Isopropyl Alcohol). Consult the local Environmental Affairs Office for guidance on pertinent regulatory requirements.

**A-8.5. BRUSH AND ROLLER APPLICATION.** Brush or roller application of paint may be used when painting small areas or when spray painting is not convenient or permitted. The advantage of brush and roller application is that the paint does not become atomized and airborne, thus minimizing safety and health concerns.

**A-8.5.1. Brush Application.** Brush application shall be limited to small nicks, chips, or scratches. When brushing, the coating should be applied in one direction, then cross brushed to completely cover the area. Near the end of each stroke, the brush should be gradually lifted to prevent excessive roughness from brush marks. The coating material should be stirred frequently during use to avoid settling. A brush applied coat should be allowed to dry completely before applying subsequent coats.

**A-8.5.2. Roller Application.** In roller application, the coating material should be placed in a paint tray having a sloping bottom. The tray must be sized to accommodate the roller and coating material. The roller is dipped into the tray and rolled back and forth until it is coated. Excess material on the roller is removed by rolling out on the tray grid. The coating is applied by slowly rolling it back and forth across the surface until uniform coverage is obtained. Once a uniform coating is achieved, allow it to dry completely before applying additional coats. During roller application, adjacent strips should be overlapped as in other methods of painting. Since the roller will not fit into corners or other tight areas, these surfaces may be coated using a brush before beginning the roller application. The roller should follow the brushing promptly to avoid lap marks. When applying paint by roller, several coats may be necessary to achieve adequate film thickness.

**A-8.6. ADHESION TESTING.** Adhesion testing may be used for quality control of newly applied coatings when it is directed by aircraft/component specific manual or local directives, or when poor adhesion or poor surface preparation is suspected. Adhesion testing can also be used to evaluate quality characteristics of old/existing coatings. If the primer coat is the only coat applied, then this test applies to the primer. If the primer coat is to be topcoated, then this test applies to the

topcoat only. This test is applicable to primed/painted areas greater than 2 square feet in total area.

**A-8.6.1. Wet Tape Adhesion Test.** Allow the primer/paint to dry at least 48 hours before performing the tape test. Use 4" X 4" square cut cheesecloth (CCC-C-440) layers to equal a pad 1/8" thick. Saturate the pad in water and place it against the surface to be tested. Overlay a larger sheet of polyethylene (A-A-3174 Type I Class 1) over the wet pad and tape the edges down, using AMS-T-21595 Type I masking tape or equivalent. Mark the polyethylene sheet with the date and time. Allow 24 hours dwell time and then remove the cloth and wipe the area dry with clean, dry cheesecloth. Before one minute passes, apply a one inch wide by six inches long piece of ASTM D6123 Type II flatback masking tape (adhesive side down) across the test area. Ensure that four inches of the tape covers the test area and two inches are left unattached for gripping purposes. Press the tape down in the test area with a firm hand pressure (use of tape and decal applicator is also authorized). Grip the two inch loose end of the tape and remove the tape in one abrupt motion.

**A-8.6.2. Pass/Fail Criteria.** If no paint/primer was removed, the adhesion test passed. If more than one square inch (total) of paint/primer was removed, the test failed and the entire surface must be stripped and re-coated in accordance with this manual. If paint/primer was removed but the total area removed was less than one square inch, then a retest must be performed in accordance with the following paragraph.

#### NOTE

It may be more economical to strip and recoat rather than retest.

**A-8.6.3. Retest of Failed Area Less Than One Square Inch.** Perform three additional wet tape tests in adjacent areas to the failed area. All three tests must pass (no coating removed). The coating is considered to have failed adhesion requirements if any coating was removed in the three retests. If this is the case, the surface must be stripped and re-coated in accordance with this manual. If no coating is removed in the retest, touch up the removed coating from the first test and continue processing.

**A-8.6.4. Adhesion Testing for Touch-up Areas.** In order to test for proper adhesion of small areas of touch-up coating (less than two square feet, total), a dry tape test is authorized. Allow the coating (primer/paint) to dry for

48 hours before testing. Apply a 1 inch wide by 6 inches long piece of ASTM D6123 Type II flatback masking tape across the touch-up area and proceed with the test as described in paragraph A-8.6.1. Any coating removal defines a test failure. Strip and re-coat the touch-up area in accordance with this manual.

**A-9. TOUCH-UP OF SMALL AREAS (LESS THAN TWO SQUARE FEET).** The following paragraphs provide instructions and guidelines for touch-up of small areas using touch-up pens, aerosol sprays, and brush applicators.

**A-9.1. TOUCH-UP PEN (SEMPEN™).** MIL-PRF-23377 (Epoxy High Solids Primer), MIL-PRF-85582 (Epoxy Waterborne Primer), and MIL-PRF-85285 Type I (Polyurethane Coating) are available in touch-up pens (see Figure A-15). These self-contained touch-up applicators are available by national stock numbers (refer to Volume IV for ordering information). The applicator is designed for convenient storage, mixing, and application of pre-measured two component coating materials, and is ideal for touch-up of small areas where spraying is impractical or not allowed. Each applicator contains 10 milliliters (1/3 fluid ounce) of material and will cover an area of approximately 1 to 2 square feet. The two components are separated by a barrier (see Figure A-16). The material is mixed and applied as follows:

- a. Before mixing, ensure the applicator is at room temperature. Read and follow manufacturer's information, including MSDS, supplied with the applicator.
- b. Slide the collar all the way to the back of the applicator to displace the barrier between the two components.
- c. With the brush cap in place, shake the applicator vigorously by hand until the two components are thoroughly mixed (approximately one minute).
- d. After mixing, remove the brush cap and press the applicator against a scrap surface to bleed off any internal pressure that may have formed during storage. Make sure the applicator is not pointing toward anyone.
- e. Depress the applicator brush against the work surface. This opens the spring-loaded valve that allows the coating material to flow when the tube is gently squeezed. Use the brush to apply a uniform coating to the surface. See Figure A-17.



Figure A-15. Sempens (Touch-Up Paint Pens)

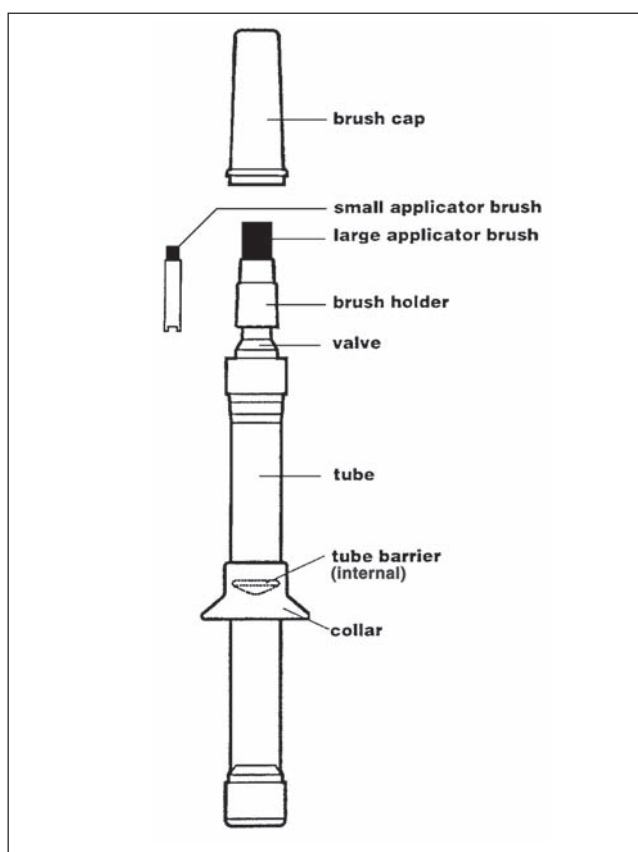


Figure A-16. Sempen Parts Breakdown



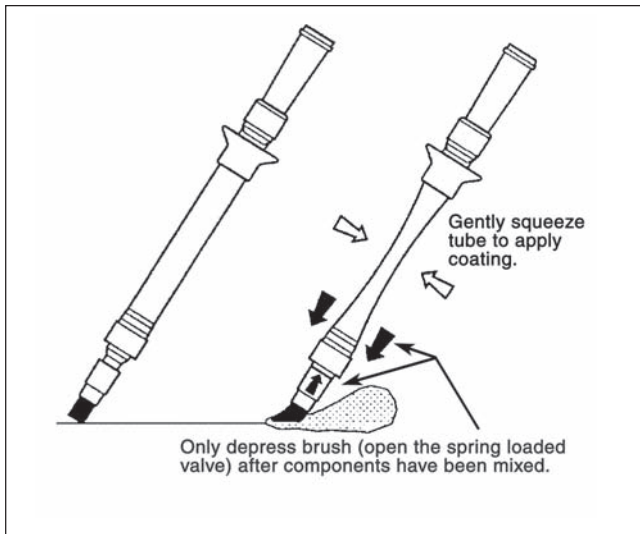


Figure A-17. Sempen Application

f. Replace the brush cap when the applicator is not being used. The useful pot life of the mixed material is approximately 8 hours. Do not store the applicator in a shirt pocket or any other clothing article.

g. If a different size brush is required, follow manufacturer's instructions for changing brushes. Change brushes only after the material in the applicator has been mixed.

### **WARNING**

Prior to application, observe all safety regulations and use proper personal protective equipment (PPE) such as gloves, eye protection, and respirator. Contact the local Industrial Hygiene Activity or Occupational Safety and Health Office for guidance on the proper selection of respiratory protection and other personal safety requirements.

### **NOTE**

Two component aerosols are not authorized for spraying large areas. These sprayers are intended only for small repairs of less than two square feet.

Do not remove red button or cap until product is used. Red button is required to activate the aerosol can.

**A-9.2. TWO COMPONENT AEROSOL.** Two component aerosols provide spray gun performance from a can using approved coatings, such as MIL-PRF-23377 (Epoxy High Solids Primer) and MIL-PRF-85285 Type I (Polyurethane Coating). These aerosol cans are ideal for small touch-up processes as they minimize many of the problems associated with hazardous waste disposal, equipment clean up, and related safety hazards. The aerosol can has a 48 hour pot life once mixed. Refer to Volume IV for the two component aerosol can ordering information. The material is mixed, applied, and cleaned as follows:

a. Remove red button from the cover cap and put it on the plastic pin at the bottom of the aerosol can.

b. Place can upright on a flat surface and push down completely on the red button to break the inner seal. After red button is removed, if done correctly, the plastic pin (at the bottom of the can) should move easily when pushed with finger. Properly dispose of red button to avoid FOD.

c. Invert can and shake contents vigorously for two minutes to mix the catalyst and base materials. Allow 30 minutes to elapse before use. Shake can prior to each use to insure complete mixing.

d. After proper surface preparation (refer to paragraph A-7), apply coating in a manner similar to that used in conventional spray gun painting processes. Standing distance from surface should be 6 to 10 inches. Make full sweeps across and stop spraying at the end of each sweep.

e. Use an overlap stroke pattern for uniform application. Delivery of paint is faster than other aerosols and the fan is larger. Rotate spray tip to select either vertical or horizontal spray fan.

f. After use, invert aerosol can and spray until clear. This will keep the feed tube from clogging during next use.

g. The remainder of the can must be used within 48 hours. After that time, the contents of the can will gel and will no longer be sprayable.

h. Properly dispose of used paint cans in accordance with local environmental regulations.

**NOTE**

PreVal sprayers are not authorized for painting large areas. These sprayers are intended only for small, spot repairs.

**A-9.3. PREVAL AEROSOL TOUCH-UP PAINT SYSTEMS.** PreVal sprayers provide a simple method of applying approved coatings for small, touch-up processes. These sprayers minimize many of the problems associated with hazardous waste disposal, equipment cleanup, and related safety hazards. Many of the commonly used primers and topcoats (MIL-PRF-23377, MIL-PRF-85582, MIL-PRF-85285 Type I, and MIL-PRF-81352 Type III) are available in small 2 ounce bottles that attach directly to the PreVal sprayer. Refer to Volume IV for ordering information.

**NOTE**

Primers and topcoats in 2 ounce bottles may also be applied by brush for small, touch-up applications.

**A-9.3.1. PreVal Aerosol Touch-Up Primers.** Both MIL-PRF-23377 and MIL-PRF-85582 Epoxy Primers are available in small 2 ounce kits that can attach directly to PreVal sprayers. These kits are supplied as two part materials (catalyst and base components) that must be mixed prior to use. Follow manufacturer's instructions printed on the container label for proper mixing procedures. See paragraph A-9.3.3 for additional mixing and application instructions.

**A-9.3.2. PreVal Aerosol Touch-Up Topcoats.** Both MIL-PRF-85285 Type I polyurethane coating and MIL-PRF-81352 Type III one component aircraft touch-up coating are available in small 2 ounce kits that can attach directly to PreVal sprayers.

a. MIL-PRF-85285 Type I topcoat kits are supplied as two part materials (catalyst and base components) that must be mixed prior to use. Follow manufacturer's instructions printed on the container label for proper mixing procedures. See paragraph A-9.3.3 for additional mixing and application instructions.

b. MIL-PRF-81352 Type III is supplied as a single component topcoat that is ready to use. See paragraph A-9.3.4 for additional mixing and application instructions.

**WARNING**

The PreVal sprayer has an air vent on the coupling. To avoid leakage and personal injury, never shake the sprayer once it has been attached to the bottle. Eye protection and proper protective equipment are required when handling, mixing and applying coatings using PreVal sprayers.

**NOTE**

To prevent leaking, do not tilt PreVal sprayers beyond a 45 degree angle. Spray angles of 45 degrees or less will ensure the proper discharge of coatings. During any continuous spray application, PreVal sprayers may "freeze up" and cause irregular spray patterns. To avoid freezing up, limit each spray application to a pattern of 36 square inches (6" X 6"), then pause and continue with spraying. Repeat as necessary until repair area is properly coated.

**A-9.3.3. Two Component Primer and Topcoat Mixing and Application Instructions.**

a. Two component primers and topcoats must be mixed carefully prior to use. Follow manufacturer's instructions printed on the container label for proper mixing procedures for base and catalyst components. Some vendors supply two separate bottles for the two components, others supply the catalyst in a small internal bottle (as a bottle within a bottle) under the cap. Mix entire contents of each kit.

b. Replace cap on larger bottle and shake mixture thoroughly for two minutes. After shaking, allow coating to rest for two minutes to dissipate any air bubbles.

c. Attach pick-up tube to the PreVal sprayer.

d. Remove cap from coating bottle and attach bottle to the PreVal sprayer. To prevent leakage, do not shake the bottle once it is attached to the PreVal sprayer.

e. After proper surface preparation (refer to paragraph A-7), apply coating in a manner similar to conventional spray gun painting processes, making full sweeps and stopping the spray at the end of each sweep.

f. Clean PreVal sprayer after each use. Refer to paragraph A-9.3.5 for cleaning procedures.



g. Properly dispose of empty PreVal sprayers and coating bottles in accordance with local environmental regulations.

#### A-9.3.4. One Component Topcoat Mixing and Application Instructions.

a. With screw cap firmly attached, shake topcoat bottle thoroughly for two minutes. After shaking, allow coating to rest for two minutes to dissipate any air bubbles.

b. Attach pick-up tube to the PreVal sprayer.

c. Remove cap from topcoat bottle and attach bottle to the PreVal sprayer. To prevent leakage, do not shake the bottle once it is attached to the PreVal sprayer.

d. After proper surface preparation (refer to paragraph A-7), apply coating in a manner similar to conventional spray gun painting processes, making full sweeps and stopping the spray at the end of each sweep.

e. Clean PreVal sprayer after each use. Refer to paragraph A-9.3.5 for cleaning procedures.

f. Partially used one component topcoat bottles may be recapped and stored for later use.

g. Properly dispose of empty PreVal sprayers and coating bottles in accordance with local environmental regulations.

A-9.3.5. Cleaning of PreVal Sprayer. The PreVal aerosol sprayer is a small, hand-held canister containing enough propellant to spray two, 2 ounce bottles of primer or topcoat, provided the sprayer is cleaned immediately after each use. Clean as follows:

a. Remove the sprayer head from the coating bottle.

b. Cap and properly store the unused coating. Catalyzed, two part coatings have a limited pot life once mixed. In general, these coatings must be used within 4-8 hours after mixing.

c. Clean the sprayer head by placing the pick-up tube into a small amount of MIL-T-81772 or other approved cleaning solvent. When using a waterborne coating (e.g. MIL-PRF-85582 Epoxy Waterborne Primer), remove residual material with deionized or distilled water first, followed by rinsing with TT-I-735

Isopropyl Alcohol. Spray just enough cleaner through the sprayer to disperse the remaining coating material and produce a clear spray pattern. Alternatively, clean the pick-up tube by hand with cleaning solvent, then invert the sprayer head and depress button to clear the sprayer.

A-9.4. ONE OUNCE PAINT BRUSH TOUCH-UP APPLICATOR. TT-P-1757 (Alkyd Base Primer) and MIL-PRF-81352 Type III (Aircraft Touch-Up Coating) are available in small, one ounce brush-top bottles (similar to "White-Out" bottles). These materials are appropriate for very small touch-up processes that can usually be done concurrently with other maintenance operations. Consult the local Industrial Hygiene Activity or Occupational Safety and Health Office for detailed safety requirements.

### WARNING

Appropriate safety precautions must be taken when working with coating materials. Refer to paragraph A-2 for additional safety information. Consult the local Industrial Hygiene Activity or Occupational Safety and Health Office for detailed safety requirements.

**A-10. SPECIFIC PAINT APPLICATION PROCEDURES.** The following are instructions and guidelines for specific materials, primers, topcoats, and commonly used specialty coatings.

A-10.1. AIRCRAFT PAINT THINNER (MIL-T-81772). This specification covers three types of paint thinners compatible with various coating materials. Due to chemical incompatibility, no single paint thinner is acceptable for all types of coatings. Environmental regulations restrict the amount of thinner that can be added to aircraft coatings. Fortunately, newer coatings and application technologies do not usually require additional thinner. As stated in paragraph A-4.1.1, aircraft coatings must meet strict VOC requirements. Do not add thinner to coatings unless specifically indicated on the container label or on manufacturer's literature supplied with the material. MIL-T-81772 Thinner is available in the following types:

- a. Type I – Polyurethane coating thinner;
- b. Type II – Epoxy coating thinner; and
- c. Type III – Acrylic and alkyd coating thinner.

## A-10.2. EPOXY HIGH SOLIDS PRIMER (MIL-PRF-23377).

A-10.2.1. Description. MIL-PRF-23377 is a VOC compliant (340 g/l maximum) epoxy high solids primer with corrosion inhibitors. This specification covers two types and three classes of materials. Type I, Class C1 or C2, is the standard yellow or light green primer used primarily in high gloss paint systems and on interior components and surfaces. Type II, Class C1 or C2, is the dark green low infrared reflective primer used in tactical paint schemes on exterior surfaces. Each type is available in three classes: Class C1 (barium chromate based corrosion inhibitor), Class C2 (strontium chromate based corrosion inhibitor), and Class N (non-chromate based corrosion inhibitor). Class N materials, especially Type I, may be a variety of colors, such as white, tan, blue, black, or bright green. They will not have the same coloration as Type I, Class C1 or C2 materials. Consult specific maintenance instructions for guidance on the selection of primers for each weapons system. Class C1 shall be selected when no class is specified. Class N shall not be substituted for Class C1 or C2 unless authorization for its use is given by the engineering authority for the system or item to which the primer coating is to be applied. These primers can be applied to properly treated metal surfaces and to cured, scuff sanded primers and topcoats. They dry to durable, chemical resistant films and offer excellent protection against corrosion, particularly when coupled with a compatible topcoat.

A-10.2.2. Temperature Requirements. Ensure the temperature for each primer component is between 60°F and 90°F before mixing and application. Surface temperature of the area to be coated must be between 50°F and 95°F. Do not apply this material if the ambient temperature is below 50°F.

A-10.2.3. Material Preparation. MIL-PRF-23377 primer is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within an epoxy vehicle, while the other component contains the resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of epoxy primer is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix the amount of

material that can be used within two hours. Do not add thinner to attempt to compensate for thickened coatings that are beyond useful pot life. Mix the primer as follows:

a. Mix the pigmented component thoroughly to ensure that the solids are completely dispersed. Use a paint shaker for approximately 10 minutes if possible. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all of the pigment is dispersed.

b. Pour the pigmented component into a clean, empty container. The empty container must be at least two times the capacity of the pigmented component.

### **CAUTION**

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To remain compliant with environmental regulations, do not add thinner to this material unless specifically required by the manufacturer's instructions.

A-10.2.4. Spray Application. After the primer is thoroughly stirred, strain the material through a disposable paint strainer to remove coarse particles. Prior to spraying, allow the mixed primer to stand for approximately 30 minutes. This induction period is necessary to allow components to partially react. Spray the mixed primer in accordance with paragraph A-8.

A-10.2.5. Brush or Roller Application. For brush or roller application, strain the primer and allow it to stand for 30 minutes as per paragraph A-10.2.4. Apply the primer uniformly to the surface in one coat (refer to paragraph A-8.5).

A-10.2.6. Touch-Up Pen Application. For convenient touch-up of small areas, MIL-PRF-23377 Epoxy Primer is available in touch-up pens. Refer to paragraph A-9.1.

A-10.2.7. Aerosol Application. For convenient touch-up of small areas less than two square feet, MIL-PRF-23377 Epoxy Primer is available in aerosol containers. Refer to paragraphs A-9.2 and A-9.3.

A-10.2.8. Film Thickness. The total dry film thickness of primer shall be 0.6 to 0.9 mils (0.0006 to 0.0009 inch) which is slightly more than a mist coat. After the coating has dried, the substrate should be barely visible through the film. Dry film thickness can be estimated using a wet film thickness gage (refer to paragraph A-5.7). Dry film thickness will be approximately 50 percent of the wet film thickness. Primer thickness shall be doubled if no topcoat is to be applied.

A-10.2.9. Drying Time. Tack-free drying time of MIL-PRF-23377 primer depends upon the temperature, but is generally between 30 minutes and 2 hours. Tack-free means that the coating can be touched lightly with the fingertip without noticeable tackiness. Do not apply topcoat until the primer is tack-free. At this stage of drying, the primer is not completely cured and can be easily marred. MIL-PRF-23377 primer will dry hard in approximately 8 hours at 70°F, which means the coating is fairly durable and can be handled. The primer dries more slowly at lower temperatures. Topcoat is generally applied within 24 hours after primer application.

A-10.2.9.1. If the primer has dried for over 24 hours but not longer than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with an approved solvent (see paragraph A-7.4).

b. Apply a thin (mist) coat of MIL-PRF-23377 epoxy primer.

c. Allow primer to dry tack-free and then apply the specified topcoat.

A-10.2.9.2. If the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with paragraph A-10.2.9.1, to ensure proper adhesion.

### A-10.3. EPOXY WATERBORNE PRIMER (MIL-PRF-85582)

A-10.3.1. Description. MIL-PRF-85582 is a VOC compliant (340 g/l maximum) waterborne epoxy primer with corrosion inhibitors. This specification covers two types and three classes of materials. Type I, Class C1 or C2, is the standard yellow or light green primer used primarily in high gloss paint systems and on interior components and surfaces. Type II, Class C1 or C2, is the dark green, low infrared reflective primer used in tactical paint schemes or exterior surfaces. Each type is available in three classes: Class C1 (barium chromate based corrosion inhibitor), Class C2 (strontium chromate

based corrosion inhibitor), and Class N (non-chromate based corrosion inhibitor). Class N materials, especially Type I, may be a variety of colors, such as white, tan, blue, black, or bright green. They will not have the same coloration as Type I, Class C1 or C2 materials. Consult specific maintenance instructions for guidance on the selection of primers for each weapons system. Class C1 shall be selected when no class is specified. Class N shall not be substituted for Class C1 or C2 unless authorization for its use is given by the engineering authority for the system or item to which the primer coating is to be applied. These primers can be applied to properly treated metal surfaces and to cured, scuff sanded primers and topcoats. They dry to durable, chemical resistant films and offer excellent protection against corrosion, particularly when coupled with a compatible topcoat.

A-10.3.2. Material Compatibility. MIL-PRF-85582 epoxy waterborne primer is generally interchangeable with MIL-PRF-23377 epoxy high solids primer for most applications. Since MIL-PRF-85582 primer contains water, to prevent possible corrosion it shall not be used for wet installations (refer to paragraph A-4.8) or for direct application to bare steel (e.g. landing gear components).

A-10.3.3. Temperature Requirements. Ensure the temperature for each primer component is between 60°F and 90°F before mixing and application. Surface temperature of the area to be coated must be between 55°F and 95°F. Do not apply this material if the ambient temperature is below 55°F.

A-10.3.4. Material Preparation. MIL-PRF-85582 primer is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. Distilled or deionized water is also required in most cases as an additional component. One component contains the pigment within an epoxy vehicle, while the other component contains the clear resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of epoxy waterborne primer is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix the amount of material that can be used within two hours. Do not add thinner or water to attempt to compensate for thickened coatings that are beyond useful pot life. Mix the primer as follows:

a. Consult manufacturer's instructions printed on the container label for proper mixing procedures. If distilled or deionized water is specified, do not add tap water. Tap water will have an adverse affect on film properties. Only add the specified amount of water. Do not add excess water.

### **CAUTION**

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

b. Following manufacturer's instructions, mix the components as necessary to ensure that solids are completely dispersed. If using a paint shaker, do not exceed manufacturer's specified agitation time since excessive shaking can cause the coating to gel prematurely. If no shake time is specified, agitate the material for 10 minutes maximum. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all solids are dispersed.

A-10.3.5. Spray Application. After the primer is mixed per manufacturer's instructions, strain the material through a disposable paint strainer to remove coarse particles. No induction time is necessary prior to spraying this primer. Spray the mixed primer in accordance with paragraph A-8.

A-10.3.6. Brush or Roller Application. For brush or roller application, strain the primer and apply it uniformly to the surface in one coat (refer to paragraph A-8.5).

A-10.3.7. Touch-Up Pen Application. For convenient touch-up of small areas, MIL-PRF-85582 Epoxy Waterborne Primer is available in touch-up pens. Refer to paragraph A-9.1.

A-10.3.8. Aerosol Application. For convenient touch-up of small areas, MIL-PRF-85582 Epoxy Waterborne Primer is available in aerosol containers. Refer to paragraph A-9.3.

A-10.3.9. Film Thickness. The total dry film thickness of the sprayed primer shall be 0.6 to 0.9 mils (0.0006 to 0.0009 inch) which is slightly more than a mist coat. After the coating has dried, the substrate should be barely visible through the film. Dry film thickness can be estimated using a wet film thickness gage (refer to paragraph A-5.7). Dry film thickness will be

approximately 50 percent of the wet film thickness. Primer thickness shall be doubled if no topcoat is to be applied.

A-10.3.10. Drying Time. Tack-free drying time of MIL-PRF-85582 primer depends upon temperature and humidity, but is generally 1 to 2 hours. At 70°F and 50% relative humidity, the primer will be tack-free in 1 hour. Tack-free means that the coating can be touched lightly with the fingertip without noticeable tackiness. Do not apply topcoat until the primer is tack-free. At this stage of drying, the primer is not completely cured and can be easily marred. MIL-PRF-85582 primer will dry hard in approximately 6 hours at 70°F, which means the coating is fairly durable and can be handled. The primer dries more slowly at lower temperatures and higher humidity. Topcoat is generally applied within 24 hours after primer application.

A-10.3.10.1. If the primer has dried for over 24 hours but not longer than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with an approved solvent (see paragraph A-7.4).

b. Apply a thin (mist) coat of MIL-PRF-85582 epoxy primer.

c. Allow primer to dry tack-free and then apply the specified topcoat.

A-10.3.10.2. If the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with paragraph A-10.3.10.1, to ensure proper adhesion.

### **A-10.4. POLYURETHANE, ELASTOMERIC, HIGH SOLIDS PRIMER (TT-P-2760)**

A-10.4.1. Description. TT-P-2760 is a VOC compliant (340 g/l maximum) flexible polyurethane primer with corrosion inhibitors. This material is designed for use wherever high flexibility is required. This specification covers two types and two classes of materials. Type I is the standard primer used primarily with high gloss paint systems. Type I primer is the natural color of the corrosion inhibiting pigments used. Type II is the dark green, low infrared reflective primer used with tactical paint schemes. Each type is available in two classes: Class C (strontium chromate based corrosion inhibitor) and Class N (non-chromate based corrosion inhibitor). Consult specific maintenance instructions for guidance on the selection of primers for each weapons system. Class C shall be selected when no class is specified.

Class N shall not be substituted for Class C unless authorization for its use is given by the engineering authority for the system or item to which the primer coating is to be applied. These primers can be applied to properly treated metal surfaces and to cured, scuff sanded primers and topcoats. They dry to flexible, chemical resistant films and are usually coupled with MIL-PRF-85285 Polyurethane Topcoat.

A-10.4.2. Temperature Requirements. Ensure the temperature for each primer component is between 60°F and 90°F before mixing and application. Surface temperature of the area to be coated must be between 60°F and 90°F. Do not apply this material if the ambient temperature is below 60°F.

A-10.4.3. Material Preparation. TT-P-2760 primer is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within a vehicle, while the other component contains the clear resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of this primer is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix the amount of material that can be used within two hours. Do not add thinner to attempt to compensate for thickened coatings that are beyond useful pot life. Mix the primer as follows:

a. Following manufacturer's instructions, mix the pigmented component as necessary to ensure that solids are completely dispersed. If using a paint shaker, agitate the material for approximately 10 minutes. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all solids are dispersed.

b. Pour the pigmented component into a clean, empty container. The empty container must be at least two times the capacity of the pigmented component.

### **CAUTION**

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of clear resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To remain compliant with environmental regulations, do not add thinner to this material unless specifically required per manufacturer's instructions.

A-10.4.4. Spray Application. After the primer is mixed per manufacturer's instructions, strain the material through a disposable paint strainer to remove coarse particles. No induction time is necessary prior to spraying this primer. Spray the mixed primer in one wet cross coat in accordance with paragraph A-8.

A-10.4.5. Brush or Roller Application. For brush or roller application, strain the primer and apply it uniformly to the surface in one coat (refer to paragraph A-8.5).

A-10.4.6. Film Thickness. The total dry film thickness of primer shall be 1.5 to 2.0 mils (0.0015 to 0.0020 inch). After the coating has dried, the substrate will not be visible through the film. Dry film thickness can be estimated using a wet film thickness gage (refer to paragraph A-5.7). Dry film thickness will be approximately 50 percent of the wet film thickness.

A-10.4.7. Drying Time. Tack-free drying time of TT-P-2760 primer depends upon temperature and humidity, but will generally be within 5 hours. Tack-free means that the coating can be touched lightly with the fingertip without noticeable tackiness. Do not apply topcoat until the primer is tack-free. TT-P-2760 primer will be dry hard in approximately 8 hours at 70°F, which means the coating is fairly durable and can be handled. The primer dries more slowly at lower temperatures. Topcoat is generally applied between primer tack-free time and 24 hours after primer application.



A-10.4.7.1. If the primer has dried for over 24 hours but not longer than 7 days, proceed as follows:

- a. Clean the surface by wiping with clean cheesecloth dampened with an approved solvent (see paragraph A-7.4).
- b. Apply a thin (mist) coat of TT-P-2760 primer.
- c. Allow primer to dry tack-free and then apply the specified topcoat.

A-10.4.7.2. If the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with paragraph A-10.4.7.1, to ensure proper adhesion.

#### A-10.5. POLYURETHANE AIRCRAFT COATING (MIL-PRF-85285).

##### A-10.5.1. Description.

A-10.5.1.1. MIL-PRF-85285 Type I, Polyurethane Coating is a VOC compliant (420 g/l maximum) topcoat. This specification covers three types of materials. Type I is intended for aircraft use. Type II is intended for use on ground support equipment (GSE) and is not for use on aircraft surfaces. Type III is a low VOC (50 g/l) coating intended for use on both aircraft and GSE. Type III shall not be substituted for Type I or Type II without authorization from the aircraft engineering authority. Type I material is available in gloss, semigloss, and flat (lusterless) colors. It is intended for use over properly applied primers conforming to MIL-PRF-23377, MIL-PRF-85582, or TT-P-2760. The resulting paint system is durable, flexible, weather resistant, corrosion resistant, and chemical resistant.

A-10.5.1.2. Self-Priming Topcoat, TT-P-2756, is no longer approved for use on Navy aircraft or equipment.

A-10.5.2. Safety Requirements for Polyurethane Coatings Containing Free Isocyanates. Some polyurethane coatings used on Navy and Marine Corps aircraft, such as MIL-PRF-85285, require special handling during mixing, application, and curing to avoid exposure to free isocyanate vapors. Adequate ventilation and approved respiratory protection are mandatory. Polyurethane coatings generally present no special health hazards when cured (dried), however, isocyanates are an integral part of the polyurethane reaction and can be released while the coating is still wet. Isocyanate vapors, even in very small concentrations, can produce significant irritation of the skin, eyes, and respiratory tract and may also induce

allergic sensitization of personnel. Specific details are provided in OPNAVINST 5100.23.

A-10.5.2.1. Sensitization. Isocyanate sensitization is characterized by bronchial constriction, causing difficulty in breathing, dry cough, and shortness of breath. Individual susceptibility appears to be a controlling factor. Once sensitized, many personnel cannot tolerate even minimal subsequent exposure to isocyanates, and must thereafter avoid work areas where such exposure could occur. In addition, solvents employed with polyurethane coatings tend to increase the rate of absorption and severity of the physiological effect.

A-10.5.2.2. Medical Examinations. All personnel assigned duties involving the mixing and application of polyurethane coatings that contain free isocyanates shall receive a baseline medical examination following the guidance of the current edition of the NAVENVIRHLTHCEN Medical Surveillance Procedures Manual to include the protocols for mixed solvents and isocyanates. Periodic medical examinations are required if the results of the industrial hygiene survey recommend them.

A-10.5.2.3. Protective Clothing. Protective clothing listed shall not be substituted without specific approval by the local industrial hygienist. Personnel applying polyurethane coating that contains free isocyanates shall wear gloves (MIL-G-12223 or meeting OSHA requirements), chemical or splash-proof goggles, coveralls (A-A-55196 or MIL-C-2202) and respiratory protection as specified by the local Industrial Hygiene activity. When this polyurethane coating is applied in confined spaces (i.e., intake ducts), contact the local Industrial Hygiene activity for guidance on proper respiratory protection. Consult OPNAVINST 5100.23 for further information.

#### **NOTE**

Personnel wearing respirators are required to receive initial and annual fit testing.

A-10.5.2.4. Unprotected Personnel. The hangar area shall be cordoned off during paint application to prevent exposure to unprotected personnel. Safe distances for unprotected personnel, as determined by the local Industrial Hygiene activity, must be maintained at all times.

A-10.5.2.5. Facility Requirements. Polyurethane painting operations employing free isocyanates shall be conducted in an area which has received a workplace



evaluation by the local Industrial Hygiene activity. This area shall be sufficiently isolated to prevent exposure to unprotected personnel, as described above. Intermediate maintenance activity production-type spray painting operations or squadron paint touch-up operations employing paint spray equipment shall be conducted only in well ventilated areas approved by the local Industrial Hygiene activity and in accordance with pertinent environmental regulations. Routine Industrial Hygiene evaluations must be obtained by contacting the Occupational Health Office or Medical Clinic. Each facility will maintain a hard copy of the initial and periodic industrial hygiene evaluation. Refer to OPNAVINST 5100.23 for frequency of Industrial Hygiene Evaluations/Surveys.

#### A-10.5.3. Temperature and Humidity Requirements.

Extreme temperature and humidity conditions will adversely affect film-forming properties of polyurethane topcoats. Ensure the temperature for each coating component is between 60°F and 90°F before mixing and application. Surface temperature of the area to be coated must be between 60°F and 90°F. For best results, apply this material only when the ambient temperature is between 60°F and 90°F, and relative humidity is between 30 and 75 percent. Temperature and relative humidity can be obtained using a sling psychrometer (Volume IV). If applied when temperature or humidity is low, the coating will not properly cure. If applied when temperature or humidity is high, the coating will dry too fast and exhibit pinholes, microblisters, or hazing in gloss films, and gloss variation (streaking) in lusterless films.

A-10.5.4. Material Preparation. MIL-PRF-85285 topcoat is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within a polyurethane vehicle, while the other component contains the clear resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of polyurethane topcoat is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix the amount of material that can be used within two hours. Do not add thinner to attempt to compensate for thickened coatings that are beyond useful pot life. Mix the topcoat as follows:

a. Mix the pigmented component thoroughly to ensure that the solids are completely dispersed. Use a paint shaker for approximately 10 minutes if possible. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all of the pigment is dispersed.

b. Pour the pigmented component into a clean, empty container. The empty container must be at least two times the capacity of the pigmented component.

#### **CAUTION**

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of clear resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To remain compliant with environmental regulations, do not add thinner to this material unless specifically required per manufacturer's instructions.

A-10.5.5. Spray Application. After the topcoat is thoroughly stirred, strain the material through a disposable paint strainer to remove coarse particles. After mixing and straining, the material is ready for application. No induction time is required. Spray the mixed topcoat in accordance with paragraph A-8. Two coats are necessary to achieve adequate film thickness. The first coat shall be a light (mist) coat. Allow the first coat to set for 30 to 60 minutes before applying the second coat to permit solvent evaporation. The second coat shall be a full wet coat to achieve the desired film thickness (refer to paragraph A-10.5.9). Apply MIL-PRF-85285 topcoat within 24 hours of primer application.

A-10.5.5.1. If the primer has been allowed to dry longer than 24 hours but not more than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with an approved solvent (see paragraph A-7.4).

b. Apply a thin (mist) coat of MIL-PRF-23377 or MIL-PRF-85582 epoxy primer.

c. Allow primer to dry tack-free and then apply the specified topcoat.

A-10.5.5.2. If the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with paragraph A-10.5.5.1, to ensure proper adhesion.

A-10.5.6. Brush or Roller Application. For brush or roller application, strain the topcoat per paragraph A-10.5.5. Apply one uniform coat to the surface (refer to paragraph A-8.5) and allow it to dry tack-free before applying an additional coat (if needed) to achieve the desired thickness.

A-10.5.7. Touch-Up Pen Application. For convenient touch-up of small areas, MIL-PRF-85285 Polyurethane Coating is available in touch-up pens. Refer to paragraph A-9.1.

A-10.5.8. Aerosol Application. For convenient touch-up of small areas less than two square feet, MIL-PRF-85285 Polyurethane Coating is available in aerosol containers. Refer to paragraphs A-9.2 and A-9.3.

A-10.5.9. Film Thickness. The total dry film thickness of MIL-PRF-85285 topcoat shall be 1.7 to 2.3 mils (0.0017 to 0.0023 inches). Dry film thickness can be estimated using a wet film thickness gage (refer to paragraph A-5.7). Dry film thickness will be approximately 50 percent of the wet film thickness.

A-10.5.10. Drying Time. Tack-free drying time of MIL-PRF-85285 topcoat depends upon the temperature, but is approximately 4 hours at 70°F. Tack-free means that the coating can be touched lightly with the fingertip without noticeable tackiness. At this stage of drying, the coating is not completely cured and can be easily marred. The topcoat will dry hard in approximately 12 hours at 70°F, which means the coating is fairly durable and can be handled. The coating dries more slowly at lower temperatures. Complete coating system cure requires approximately 7 days. In general, the aircraft shall be handled and taxied as little as possible during the first week after painting of exterior surfaces.

#### A-10.6. EPOXY HIGH SOLIDS COATING (MIL-PRF-22750).

A-10.6.1. Description. MIL-PRF-22750 epoxy topcoat is a VOC compliant (340 g/l maximum) high solids coating suitable as an alternate touch-up material when polyurethane topcoats are not available or cannot be used. This topcoat has excellent chemical resistance, however, it is not as flexible as polyurethane topcoat and will chalk when exposed to sunlight. Exact color matching of epoxy topcoat to polyurethane topcoat is usually poor and is aggravated by the tendency of

epoxy topcoat to chalk. MIL-PRF-22750 epoxy topcoat can be applied over primers conforming to MIL-PRF-23377, MIL-PRF-85582, and TT-P-2760.

A-10.6.2. Temperature Requirements. Ensure the temperature for each coating component is between 60°F and 90°F before mixing and application. Surface temperature of the area to be coated must be between 50°F and 95°F. Do not apply this material if the ambient temperature is below 50°F.

A-10.6.3. Material Preparation. MIL-PRF-22750 topcoat is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within an epoxy vehicle, while the other component contains the clear resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of epoxy topcoat is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix the amount of material that can be used within two hours. Do not add thinner to attempt to compensate for thickened coatings that are beyond useful pot life. Mix the topcoat as follows:

a. Mix the pigmented component thoroughly to ensure that the solids are completely dispersed. Use a paint shaker for approximately 10 minutes if possible. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all of the pigment is dispersed.

b. Pour the pigmented component into a clean, empty container. The empty container must be at least two times the capacity of the pigmented component.

#### **CAUTION**

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of clear resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To

remain compliant with environmental regulations, do not add thinner to this material unless specifically required per manufacturer's instructions.

A-10.6.4. Spray Application. After the epoxy topcoat is thoroughly stirred, strain the material through a disposable paint strainer to remove coarse particles. Prior to spraying, allow the mixed topcoat to stand for approximately 30 minutes. This induction period is necessary to allow components to partially react. Spray the mixed topcoat in accordance with paragraph A-8. To achieve the desired film thickness, two coats are usually required. The first coat shall be a light (mist) coat. Allow the first coat to set for 30 to 60 minutes before applying the second coat to permit solvent evaporation. The second coat shall be a full wet coat to achieve the desired film thickness. Refer to paragraph A-10.6.6. Apply the epoxy topcoat within 24 hours of primer application.

A-10.6.4.1. If the primer has been allowed to dry longer than 24 hours but not more than 7 days, proceed as follows:

- a. Clean the surface by wiping with clean cheesecloth dampened with an approved solvent (see paragraph A-7.4).
- b. Apply a thin (mist) coat of MIL-PRF-23377 or MIL-PRF-85582 epoxy primer.
- c. Allow primer to dry tack-free and then apply the epoxy topcoat.

A-10.6.4.2. If the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with paragraph A-10.6.4.1, to ensure proper adhesion.

A-10.6.5. Brush or Roller Application. For brush or roller application, strain the epoxy topcoat and allow it to stand for 30 minutes as per paragraph A-10.6.4. Apply one uniform coat to the surface (refer to paragraph A-8.5) and allow it to dry tack-free before applying an additional coat to achieve the desired film thickness.

A-10.6.6. Film Thickness. The total dry film thickness of epoxy topcoat shall be 1.7 to 2.3 mils (0.0017 to 0.0023 inch). Dry film thickness can be estimated using a wet film thickness gage (refer to paragraph A-5.7). Dry film thickness will be approximately 50 percent of the wet film thickness.

A-10.6.7. Drying Time. Tack-free drying time of MIL-PRF-22750 topcoat depends upon the temperature,

but is generally between 2 and 6 hours. At 70°F, the material will be tack-free in less than 5 hours. Tack-free means that the coating can be touched lightly with the fingertip without noticeable tackiness. At this stage of drying, the coating is not completely cured and can be easily marred. MIL-PRF-22750 Epoxy Topcoat will dry hard in approximately 8 hours at 70°F, which means the coating is fairly durable and can be handled. Epoxy topcoat dries more slowly at lower temperatures.

#### A-10.7. AIRCRAFT TOUCH-UP COATING (MIL-PRF-81352 TYPE I).

A-10.7.1. Description. MIL-PRF-81352 Type I is a VOC compliant (340 g/l maximum) acrylic lacquer coating that can be used for application of temporary markings/MODEX. Lacquer coatings dry by solvent evaporation. These coatings are easily applied; however, they are not very durable and are not resistant to operational fluids and some cleaning compounds. For application of markings, lacquer is generally applied over clean, lightly scuff sanded topcoats. In areas where lacquer is not permitted, use MIL-PRF-85285 Type I polyurethane topcoat or MIL-PRF-22750 epoxy topcoat. Lacquer coatings do not provide sufficient durability for use as a touch-up material for conventional coatings.

A-10.7.2. Material Preparation. MIL-PRF-81352 Type I acrylic lacquer is available in quart, gallon, and aerosol (pint) containers. Quarts and gallons should be thoroughly mixed, using a paint shaker if possible, to completely disperse the solids. Refer to manufacturer's instructions for obtaining the appropriate spray viscosity.

A-10.7.3. Spray Application. Dry film thickness of lacquer shall be 1.5 to 2.0 mils (0.0015 to 0.0020 inches), which can be obtained by applying two wet coats. Allow approximately 15 minutes dry time between coats. The underlying paint coating should not be visible through the dried film. These coatings will dry hard within two hours.

A-10.7.4. Brush and Roller Application. Application of lacquer by brush or roller is not recommended but can be used when spray application is not permitted.

A-10.8. SPECIALTY COATINGS. Many aircraft require the use of specialty coatings for operational or functional requirements beyond the scope of standard primer/topcoat paint systems. Specialty coatings include Rain Erosion Resistant Coating, Teflon Filled Anti-chafe Coating, Electrically Conductive Coating, Non-slip Walkway Coating, and Heat Resistant Coating. Refer to specific maintenance instructions for coating

requirements applicable to individual weapons systems. Some of the more common specialty coatings are described below.

A-10.8.1. Rain Erosion Resistant Coatings (AMS-C-83231 and MIL-PRF-85322). Antistatic rain erosion resistant coatings are two component, room temperature curing polyurethane elastomer coatings. They are designed to protect fiber-reinforced plastic surfaces (e.g. radomes, antennas, and leading edges) from rain impact at high speed while preventing static charge buildup. Many of these materials consist of polyurethane resins and, therefore, may pose health risks due to isocyanates. As stated in paragraph A-10.5.2, free isocyanate vapors, even in very small concentrations, can produce significant irritation of the skin, eyes, and respiratory tract and may also induce allergic sensitization of personnel. Personnel using these materials shall consult OPNAVINST 5100.23 for specific details. Refer to specific maintenance instructions for information concerning the selection and use of rain erosion resistant coatings. Consult manufacturer's data supplied with the material for safety, mixing, and application instructions.

A-10.8.2. Anti-Chafe Coatings. Anti-chafe polyurethane topcoats are primarily used on surfaces where low friction and abrasion, impact, and chemical resistance are required to reduce chafing and wear. Examples of these areas are slats, flap tracks, interference areas, and exit door areas. They are generally proprietary materials that often contain additives such as polytetrafluoroethylene (PTFE or Teflon). These coatings are available in several colors, including common gray colors used with tactical paint schemes. They are usually supplied as two component kits that must be mixed together in the proper proportions prior to use. Also, anti-chafe topcoats are designed to be applied over a primer to provide maximum performance. Refer to specific maintenance instructions for information concerning the selection and use of anti-chafe coatings. Consult manufacturer's data supplied with the material for safety, mixing, and application instructions.

A-10.8.3. Black Conductive Coating (P/N: 8-B-6). This material is used as a protective coating on fiber-reinforced plastic parts, such as radomes and helicopter rotor blades, to provide erosion protection and dissipate static electricity. Refer to specific

maintenance instructions for information concerning the selection and use of black conductive coatings. Consult manufacturer's data supplied with the material for safety, mixing, and application instructions.

A-10.8.4. Non-Slip Walkway Coating (A-A-59166). Walkway coatings contain grit (e.g. pumice, aluminum oxide) to provide a nonskid surface for improved footing on specific aircraft surfaces. Examples of these areas are leading edge extensions (LEX) and upper walkway surfaces. This polyurethane topcoat is supplied as a single component material and is available in two types: Type I has a smooth texture; Type II has a rough, gritty texture. Both types are usually applied by brush or roller and are available in a variety of colors, including many of the common gray colors used with tactical paint schemes. Refer to specific maintenance instruction manuals for information concerning the selection and use of non-slip walkway coatings. Consult manufacturer's data supplied with the material for safety, mixing, and application instructions.

A-10.8.5. Heat Resistant Coating (TT-P-28 Type I). This is a VOC compliant (250 g/l maximum) aluminum pigmented coating resistant to temperatures up to 1200°F. It is generally used on steel surfaces exposed to temperatures in excess of the tolerance of standard paint systems. It is supplied as a single component and can be applied by brush or spray. After application, allow the coating to air dry for 30 minutes followed by baking at 400°F (204°C) for one hour. If baking is not possible after air drying, the coating may be cured during component use at elevated temperature. Refer to specific maintenance instructions for information concerning the use of heat resistant coating. Consult manufacturer's data supplied with the material for safety and application instructions.

A-10.8.6. Decals. Traditional painted stencils tend to wear off due to weather and flight wear. The use of vinyl decals instead of painted stencils has several advantages: elimination of hazardous air pollutants (HAPS) and hazardous waste, less frequent application, and reduced labor requirements. Decals should not be used in areas regularly exposed to temperatures above 150°F. Comply with MIL-STD-2161 requirements for color and location of decals. Consult manufacturer's data supplied with the material for safety and application instructions.



## APPENDIX A SUPPLEMENTAL REQUIREMENTS FOR NAVY AIRCRAFT

### SECTION II. AIRCRAFT AND ENGINE CLEANING



Figure A-18. Jet Engine Corrosion Control Cart

**A-11. SCOPE.** This section discusses aircraft and engine cleaning. For corrosion charts of the specific aircraft, refer to the applicable maintenance instruction manual (MIMs), or contact the Fleet Support Team (FST) for the aircraft.

**A-12. AIRCRAFT CLEANING.** Cleaning compounds and materials which appear only in Appendix B (Supplemental Requirements for Army Aircraft) are not authorized for cleaning Navy aircraft. See Chapter 2 for detailed information on aircraft cleaning procedures and authorized materials and equipment.

#### **A-13. EQUIPMENT FOR ENGINE CLEANING.**

**A-13.1. JET ENGINE CORROSION CONTROL CART.** The corrosion control cart, P/N 65A102-J1-1, is designed for cleaning and rinsing the compressor section of turbine engines. It is a trailer mounted, self contained mobile unit designed for shipboard use and shore based operations (see Figure A-18). The cart consists of a 33 gallon capacity solution tank and a work platform area on top of the solution tank. There is a water supply

hose and applicator storage area on the right hand side. Two air cylinders are mounted on the left hand side to supply the air pressure needed to discharge the water solution from the solution tank. The instruction plate and schematic diagram are mounted on the left hand side to provide information about operating the unit. The 33 gallon capacity solution tank is divided into two separate compartments: a 7 gallon preservative compartment at the front end of the unit and the 26 gallon water compartment at the rear end of the unit. On top of each compartment is a filler opening and at the bottom of each compartment is a plug for drainage purposes. The operational instructions of the cart are listed in NAVAIR 19-20D-1 (Jet Engine Corrosion Control Cart). Washing with MIL-PRF-85704 (Gas Path Cleaner) shall be performed as follows:

- a. Fill the 7 gallon forward tank with 1 gallon of MIL-PRF-85704 Type II and 4 gallons of fresh water, or with 5 gallons of MIL-PRF-85704 Type II RTU (ready to use). Then fill the 26 gallon aft tank with fresh water.
- b. Prepare the aircraft for turbine engine washing in accordance with the applicable maintenance requirements.
- c. Spray the cleaning solution or fresh water as required (see Table 2-1 for additional information).

**A-13.2. CORROSION CONTROL SPRAY UNIT, TRAILER MOUNTED.** The spray unit, P/N 76E04000-30A, stores and controls the delivery of water, preservative oil, and cleaning solutions to the compressor section of turbofan, turbojet, and turboshaft engines. It is a self contained sprayer mounted on a towable trailer (see Figure A-19). The spray unit consists of a 200 gallon water tank and a 10 gallon oil/cleaning solution tank. Compressed air from the compressor assembly pressurizes the tanks for delivery of fluids. The solution tank is a reservoir for storage of preservative or cleaning solutions. Fresh water from the water tank is usually used during corrosion control for rinsing. The 4:1 mixer assembly mixes four parts water to one part chemical in the solution tank. The unit can also supply compressed air directly to the aircraft being serviced. The unit is secured to an aluminum chassis mounted on a four wheel running gear. Operating instructions for the unit are listed in NAVAIR 19-20D-2 (Corrosion Control Spray Unit).



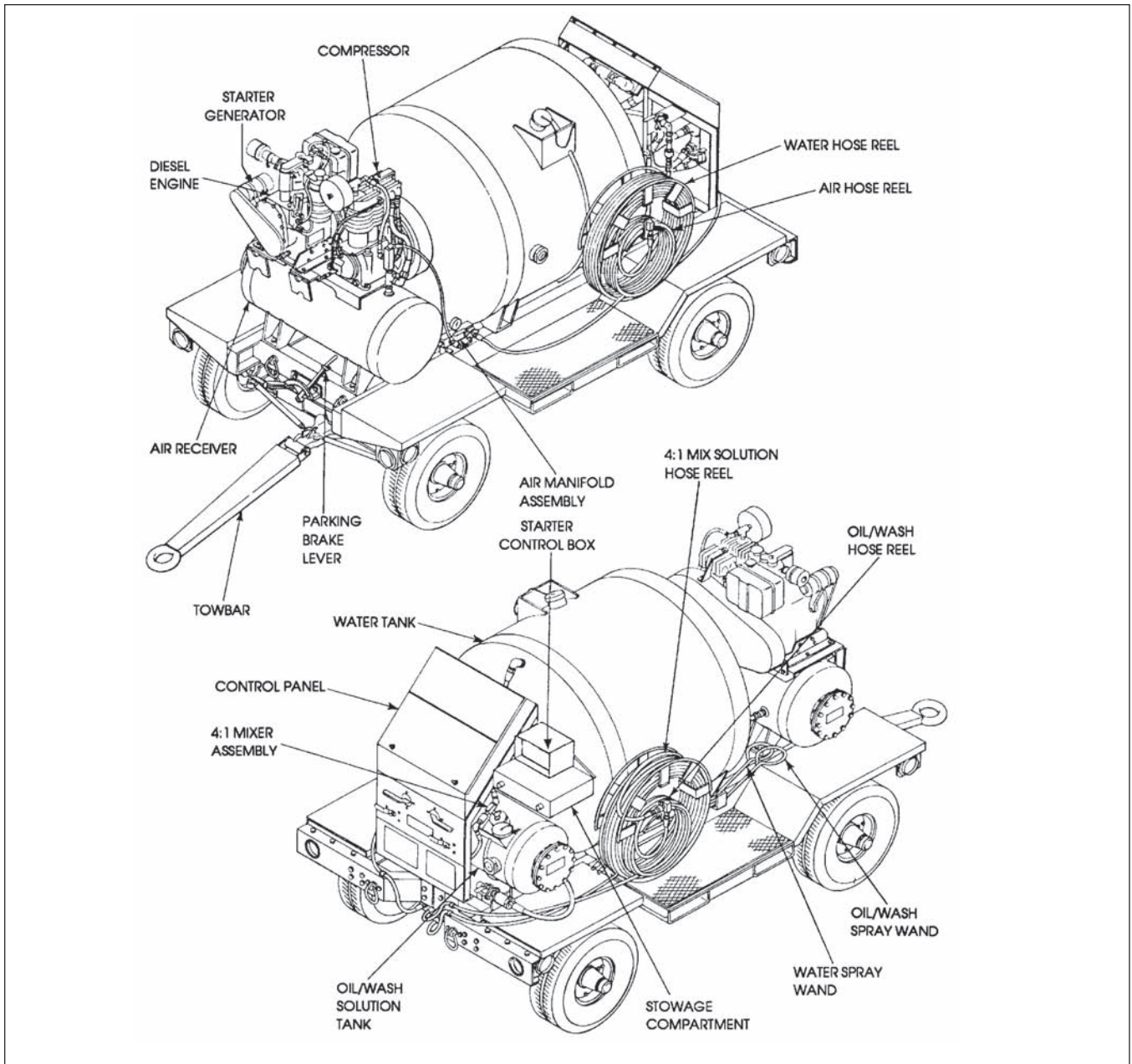


Figure A-19. Corrosion Control Spray Unit

**APPENDIX B**  
**SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT**

**B-1. SCOPE.** This appendix consists of eight sections. Section I deals with aircraft finish coating. Section II describes frequency of cleaning. Section III covers chemical corrosion removal and pre-paint treatment of aluminum alloys. Section IV encompasses the treatment of specific areas. Section V contains decontamination

procedures for salt water and microbiological growth contamination. Section VI details the identification of metals. Section VII contains procedures for plastic media blasting. Section VIII lists a table of consumable materials.

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**APPENDIX B  
SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT**

**SECTION I. AIRCRAFT FINISH COATING**

**B-2. PAINTING AND TOUCH-UP OF ARMY AIRCRAFT, CHEMICAL AGENT RESISTANT COATING FINISH.**

B-2.1. U.S. Army personnel will adhere to the Detail Specification, MIL-DTL-53072, Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection when performing painting or finish touch-up tasks on aircraft having CARC finish.

B-2.2. This document covers the general requirements for application and inspection of the chemical agent resistant coating (CARC) system used on tactical military equipment. It is intended for use as a guide in selection of the appropriate materials and procedures, and as a supplement to information available in cleaning, pre-treating, and coating specifications. The document also includes information on touch-up/repair, health and safety guidelines, environmental restrictions, national stock numbers (NSN) for CARC and CARC-related materials, and application equipment and techniques.

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**APPENDIX B**  
**SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT**

**SECTION II. CLEANING**

**B-3. FREQUENCY OF CLEANING.** The frequency of cleaning of army aircraft shall be 30 days, with the following exceptions, unless aircraft are stationed within two miles of salt water. Extended or low level operations over salt water require daily fresh water rinsing. Cleaning procedures and materials shall be in accordance with Chapter 2 of this manual with the addition of the following Army approved exterior aircraft cleaners for helicopters: Hurrifsafe 8015 and Hurrifsafe 8065. Hurrifsafe 8015 is approved as substitute for MIL-PRF-85570 Type II

cleaner for cleaning exterior surfaces that are painted. Dilute Hurrifsafe 8015 with water in the same equivalent parts ratio as the MIL-PRF-85570 Type II cleaner is diluted per Chapter 2, Table 2-2, Exterior Surfaces, Painted Surfaces, for light to heavy soils. Hurrifsafe 8065 is to be used for moderate to heavy soils as defined by Chapter 2, Table 2-2, Exterior Surfaces, Painted, and requires no dilution. See Section VIII for ordering information.

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## APPENDIX B SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT

### SECTION III. CORROSION REMOVAL AND SURFACE TREATMENT

#### B-4. CHEMICAL CORROSION REMOVAL AND PREPAINT TREATMENT OF ALUMINUM ALLOYS.

##### WARNING

Wear acid-resistant gloves, chemical or splash proof goggles, protective mask, and protective clothing when working with acidic compounds. If acid accidentally contacts the skin or eyes, flush off immediately with clean water. Report to the medical facility if eyes are affected or if skin is burned.

Magnesium surfaces should be protected and subsequently treated as prescribed in Chapter 5 of this manual.

##### CAUTION

Corrosion removal compound (SAE AMS 1640) is for use on aluminum alloys only and shall not be used on or rinsed over magnesium. It shall be used on aircraft only when required to remove corrosion as a pre-paint treatment and shall not be used solely for the purpose of enhancing the appearance of the aircraft or equipment. The use of this compound under the premise of general corrosion removal is also prohibited. When this compound is accidentally splashed or spilled, remove immediately by rinsing with water or wiping with a wet rag. Keep a wet rag on hand at all times for the removal of spills or splashes.

When working with any acidic solution for corrosion removal, keep the solution confined to the area being treated. The acidic solution shall be kept away from operating mechanisms, magnesium alloys, and steel parts, especially steel screws and fasteners in stressed panels (e.g. wing).

B-4.1. MASKING. All parts and assemblies, especially cadmium plate items and hinges susceptible to damage by the acidic compound, shall be masked and/or protected. Mask all openings leading to the primary structure and any other openings which might allow the solution (uncontrolled) to get into the aircraft or equipment interior. Specific examples of extremely critical areas on most aircraft are the landing gears, engines, main

framing and support members of the landing gears, engines, elevons, elevators, rudder, and wings and wing stubs. Masking can be accomplished by using waterproof barrier paper (MIL-PRF-131 Class 1) and masking tape (AMS-T-21595 Type I).

B-4.2. CLEANING. Surfaces should be thoroughly clean before application of the corrosion removal compound (see Chapter 2). For pitted or heavily corroded areas the compound will be more effective if applied warm (140°F (60°C) maximum) followed by vigorous agitation with a nonmetallic acid-resistant brush (H-B-643) or an aluminum oxide abrasive nylon mat (A-A-58054). The application of the remover on the heavily corroded areas may have to be repeated several times to completely remove the corrosion. When using the acid remover, be sure to allow a sufficient dwell time (12 to 15 minutes) before rinsing.

B-4.3. INSPECTION. After each application, examine the pits and/or corroded area with a 10 power magnifying glass to determine if another application is required. Corrosion still on the area will appear as a powdery crust slightly different in color from the uncorroded base metal. Darkening of the area due to shadows and reaction from the acid remover should not be considered.

#### B-4.4. CORROSION REMOVAL COMPOUND (SAE AMS 1640).

##### CAUTION

When using corrosion removal compound on aluminum alloy surfaces, take particular care to keep acid out of faying surfaces, butt joints, seams, and crevices.

When using the flap brush to remove corrosion, take action to control the particles or abrasives that break away and prevent them from contaminating systems or components. Prior to accomplishing corrosion removal from severely pitted areas, check the component or item against the applicable aircraft or overhaul manual for authorized or allowable metal removal limits.

B-4.4.1. The corrosion removal compound (SAE AMS 1640) material is basically intended for use

as a pretreatment prior to the application of a protective coating. However, it also can be used to remove corrosion products from aluminum alloy materials or items (e.g., skins, stringer, ribs in wings, tubing, or ducts). The wipe-off technique is recommended for ducting, tubing, stringer, and similar parts, followed by a thorough rinsing of the treated area with clean water. In cases of severe pitting, the chemical method of removal may be aided by hand agitating (lightly) the pits with a corrosion resistant steel wire (0.005 to 0.006 inch maximum diameter of filament wire) brush (MIL-B-15319) or by agitating with a power driven nylon flap brush, Density 5, Type A, grade fine or very fine (3M Corp. or equal).

#### B-4.4.2. General Application Procedure.

a. Pre-clean surfaces in accordance with Chapter 2.

b. Survey or inspect equipment and determine area(s) that should be treated with the corrosion removal compound, using criteria cited in Chapter 3. Pitted surfaces and/or aluminum surfaces with a powdery metallic residue which was not removed by cleaning should be treated. If the aircraft is being prepared for complete painting or repainting, prepare all cleaned bare aluminum surfaces for treatment.

#### B-4.4.3. Mask Applicable Areas (see B-4.1.).

c. Set up application equipment, put on protective clothing, and prepare corrosion removal and prepaint solution by diluting Type I material with an equal volume of water before using. Mix the compound in wood, plastic, or plastic lined containers only. Follow the manufacturers mixing instructions.

#### **NOTE**

SAE AMS 1640 Type I corrosion removal solution has a one year shelf life; therefore, it shall not be used after one year from the date of manufacture. SAE AMS 1640 Type II material should be used within 90 days after dissolution.

d. Apply the corrosion removal solution by spray, mop, sponge, or brush. When applying the solution on large surface areas, begin application on lower surface and work upward, with a circular motion, brushing enough to loosen the surface film. Allow the solution to remain on the surface for approximately 12 minutes, then rinse away with clean tap water. Chromate conversion coating (MIL-DTL-81706) shall be applied immediately thereafter. Refer to Chapter 5 for prepaint treatment application instructions.

#### **NOTE**

The final protective paint system or primer shall be applied only on a completely dry surface within 48 hours after applying the conversion coating. A second conversion coating shall be applied over the previous application if more than 48 hours has elapsed since the first conversion coating was applied.

### **B-5. CHEMICAL CORROSION REMOVAL AND TREATMENT OF MAGNESIUM ALLOYS.**

#### **WARNING**

When preparing the chromic acid pickle solution, add chromium trioxide to water; do not add water to chromium trioxide.

B-5.1. The chromic acid pickle solution described herein may be used to remove surface oxidation and light corrosion products from magnesium surfaces. It is not considered adequate where deep pitting or heavy corrosion has occurred, which require mechanical methods, nor is it satisfactory for removing sand or the effects of blasting. The chemical method causes less reduction in section thickness. This method shall not be used for parts containing copper based inserts unless the inserts are masked off. Excessive amounts of anions, such as chlorides, sulfates, and fluorides, must not be allowed to build up in the solution, as these anions tend to coat or etch the metal rather than clean the surface.

B-5.2. CHROMIC ACID PICKLE SOLUTION. Mix 24 ounces of chromic acid and enough water to make one gallon in a container constructed from lead lined steel, stainless steel, or 1100 aluminum.

#### B-5.3. APPLICATION PROCEDURE.

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

b. Heat the solution to 190° to 202°F (88° to 94°C). The solution can be applied at room temperature for a longer reaction time, if desired.

c. Carefully apply the chromic acid solution to the corroded area with an acid resistant brush (H-B-643). Allow the solution to remain on the surface for approximately 15 minutes.

d. Thoroughly rinse the solution from the surface with plenty of clean water.

e. Repeat the preceding sequence as necessary until all corrosion products have been removed and the metal has a bright appearance.

f. Apply the chemical pretreatment and final protective finish recommended for the area.

**B-5.4. PRE-TREATMENT PROCESSES (BRUSH APPLICATION).** Chemical pre-treatment, such as the chromic acid brush-on solution, provides a passive surface layer with an inhibitive characteristic that resists corrosive attack and also provides a bond for subsequent coatings. Properly applied magnesium pre-treatment tend to neutralize corrosion media in contact with the surface. Numerous type treatments are available; however, for the purpose of this manual, the following brush-on treatment corresponding to Type VI of Specification AMS-M-3171 is given. The pre-treatment shall be applied immediately after paint removal and washing in order to prevent corrosion and surface deterioration.

**B-5.4.1. Chromic Acid Brush-On Pretreatment.** The chromic acid brush-on pretreatment may be applied to all magnesium parts that require touchup. This treatment is generally used in refinishing procedures or when parts and assemblies are too large to be immersed. This treatment is less critical to apply than the other brush-on treatments, is relatively inexpensive, not as harmful when trapped in faying surfaces and does not present the toxicity hazards of the other brush-on treatments. Ensure that all contaminants, grease, and oil are removed prior to the treatment process.

B-5.4.1.1. Preparation.

#### **WARNING**

When preparing the chromic acid brush-on pretreatment, add the chemicals to the water in the order shown below, stirring the solution vigorously, either mechanically or by agitation, for at least 15 minutes. Avoid skin contact or inhalation of acid fumes.

B-5.4.1.2. Add 1-1/3 ounces (37.8 grams) of technical grade chromic acid (A-A-55827) and one ounce (28.3 grams) of calcium sulfate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) to enough

water to make one gallon in a container constructed from stainless steel, aluminum, vinyl, polyethylene, or rubber. The operating temperature range is 70° to 90°F (21° to 32°C). After mixing, the pH of the solution should be between 1.1 and 1.6. Adjust with acid if the pH is greater than 1.6 and with water if the pH is less than 1.1.

B-5.4.1.3. Application Procedure.

a. Clean the surfaces to be treated (see B-4.2). A water break test is recommended if the cleanliness of the surface is in doubt.

b. Apply the coating solution by brush, swab, or a low pressure, non-atomizing spray. Keep the receiving surfaces wet throughout the treatment operation until the required or specified coating film is produced. Under optimum conditions (i.e., at temperatures of 70°F (21°C) or above, and using fresh materials), the time required is usually one to five minutes; up to one to two minutes of treatment should produce a brassy film, and three to five minutes should produce a dark brown coating. Under adverse conditions, and if the desired or specified finish color is not produced in the specified time, the treatment may have to be prolonged (up to 20 to 30 minutes in some instances) until the proper finish is obtained. For good paint adhesion, a dark brown color free of powder is considered best. The color may vary in using different manufacturers materials.

#### **NOTE**

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

c. The coating should be closely observed during the treatment for color changes, rinsed with cold running water when the desired condition or color is reached, and air dried. The preparation and use of test panels, made of the same material and under the same conditions, prior to starting the actual treating operation may be used as an aid in determining the application time required to produce the necessary coating. A good coating is uniform in color and density, adheres well, and is free of loose powder.

d. Apply wash primer (MIL-C-8514) to the treated surface as soon as practical after thorough drying.

e. Apply recommended final protective finish.

B-5.5. PAINT SYSTEMS. Use paint systems which are recommended for aluminum (see TM 55-1500-345-23). Treat touch-up of broken conversion films or magnesium as described in paragraph B-5.6. prior to the application of any paint system.

#### **NOTE**

The final protective paint system or primer shall be applied on a completely dry surface and shall be applied within 48 hours after application of the AMS-M-3171 or chromic acid brush-on pretreatment. A second pretreatment coating shall be applied over the previous if more than 48 hours have elapsed since the previous application.

B-5.6. REPAIR OF MIL-M-45202 COATINGS. Some magnesium parts in current aircraft have been originally protected by proprietary electrolytic processes. The HAE process can be identified by the brown to mottled gray appearance of the unpainted surface. DOW 17 coatings have a green to grayish-green color. Coatings of the electrolytic type are thicker than those applied by immersion or brushing. Electrolytic finishes cannot be restored in the field. When failure occurs, remove corrosion products, touch-up bare magnesium with chemical treatment solution (AMS-M-3171), and repaint the part. Take care to minimize the removal of these coatings.

### **B-6. CHEMICAL CORROSION REMOVAL AND TREATMENT OF FERROUS METALS OTHER THAN STAINLESS STEEL.**

#### **WARNING**

The phosphoric acid-type corrosion remover (MIL-C-10578 Type III) contains a strong acid. Protect hands, face, and eyes, wear protective clothing, and avoid prolonged inhalation of vapors. Corrosion removing compound, sodium hydroxide base (A-A-59261) is highly alkaline, and, therefore, harmful to the skin and eyes. Operators should wear rubber gloves, aprons, and chemical or splash proof goggles and use adequate ventilation when working with this material.

#### **CAUTION**

Do not use the phosphoric acid-type corrosion remover (MIL-C-10578 Type III) if the danger of trapping the material in crevices or recesses exists. Steel parts heat-treated above Rockwell C40 (180,000 psi) tensile strength are subject to hydrogen embrittlement; therefore, the use of the phosphoric acid-type corrosion remover (MIL-C-10578 Type III) is prohibited.

Do not use the sodium hydroxide base corrosion removing compound (A-A-59261) to remove corrosion from aluminum alloys. Do not process dissimilar metals in the solution.

B-6.1. Chemical corrosion removal is recommended for use where there is no danger of the chemicals becoming, trapped in crevices or recesses. Chemical rust remover is either acid or alkaline. The acid type (MIL-C-10578 Type III) is intended for removal of red rust and black oxide formations by either immersion or brush application of the chemical. The alkali type (A-A-59261) is intended for removing red rust by immersion treatment.

#### **B-6.2. APPLICATION PROCEDURES.**

B-6.2.1. Brush-On Method. Phosphoric acid-type corrosion remover (MIL-C-10578 Type III) is used to remove rust and condition the metal surface prior to painting. Type III material should always be rinsed off with water after application.

- a. Protect adjacent components to prevent damage by scale, chips, corrosion products, or chemicals.
- b. Remove any grease or soil by method outlines in Chapter 2 of this manual.
- c. Remove heavy rust by chipping and/or wire brushing.
- d. Add one part of the concentrated material as received to one part of water by volume, adding the acid to the water. Use acid resistant mixing tanks.
- e. After proper dilution, apply the material to the corroded area with brush or swab. Allow the material to remain long enough to loosen the rust (usually two to 10 minutes, depending on the degree of rusting).
- f. Remove the by with hot water. The material must be completely rinsed from the part.



g. If corrosion is still evident, repeat paragraphs e. and f.

h. Dry the part and immediately apply the protective paint or other corrosion preventive finish.

**B-6.2.2. Immersion Method (Acid Type).** Use inhibited phosphoric acid-type rust remover (MIL-C-10578 Type III) for small parts. Corrosion resistant steel tanks are preferred for the immersion treatment.

a. Remove grease and oil as outlined in Chapter 2 of this manual.

b. Remove heavy rust by chipping and/or wire brushing.

c. Mix the rust remover as described above.

d. Immerse the parts in the solution only long enough to loosen the rust. For removal of heavy rust, the solution can be heated to 140°F (60°C) maximum. Agitate the parts in the solution to further increase the rate of rust removal.

e. Rinse in a continuously overflowing cold water rinse tank, if water rinse tank is available, or spray with clean, preferably hot, water.

f. Dry the parts and immediately apply the final protective paint or other corrosion preventive finish.

**B-6.2.3. Immersion Method (Alkali Type).** Use an alkali type corrosion remover for removing corrosion from small parts with or without attendant paint, grease, or other surface coating. Corrosion removing compound, sodium hydroxide base (MIL-C-14460) is suitable for rust removal by simple immersion of the parts. The compound will also remove grease, paint, and rust from the parts, and may be used to clean copper and brass and strip phosphate coatings. In addition, rust can be removed from critical or machined surfaces with the compound without causing dimensional change of the part.

g. Prepare alkaline rust remover in accordance with manufacturers instructions as printed on the container. The usual concentration employed for Type I material is five pounds per gallon of water. Carbon steel or corrosion resistant steel tanks may be used.

h. Immerse parts in the rust remover solution. Rust removal time varies with the extent of the rust. Temperatures up to the boiling point of the solution may be used to increase the rate of rust removal.

i. Rinse thoroughly in clean (preferably hot) water.

j. Dry thoroughly and immediately apply final protective finish or other corrosion preventive compound.

**B-6.3. PAINT SYSTEMS.** See TM 55-1500-345-23 for paint systems applicable to aircraft in general. In addition, see the aircraft maintenance manuals overhaul manuals, or parts drawings for specific paint systems.

## **B-7. CHEMICAL CORROSION REMOVAL AND TREATMENT OF STAINLESS STEEL AND NICKEL BASE ALLOYS.**

### **CAUTION**

Take care to protect surrounding unaffected areas next to area being treated by avoiding leakage of chemicals into recesses or inaccessible area in order to prevent additional damage from corrosion attack.

The heat-treatable straight-chromium alloys, such as AISI Types 403, 410, and 420 are susceptible to cracking when placed in pickling solutions; therefore, corrosion removal by brushing or grinding is recommended.

**B-7.1.** Chemical removal of corrosion is recommended for severely corroded areas where there is no danger of the chemicals becoming entrapped in recesses or structural complexities or the possibility of damaging surrounding metals and plating.

**B-7.2.** Corrosion removal procedure for installed components which are not readily removable.

a. Protect adjacent unaffected areas not being treated to prevent additional corrosive attack. When internal corrosion is evident, the components shall be removed and processed through an overhaul facility in accordance with the specific directives.

b. Protect nearby non-corrosion-resistant steel alloys, plated areas, copper-bronze alloys, aluminum alloys, braided flexible lines, and operating mechanisms to prevent the chemical treating solution from coming in contact with those areas.

c. Remove all loose corrosion by brushing with stainless steel wool or No. 400 carborundum paper. Remove loose particles by wiping with a clean cloth dampened with approved compliant cleaning solvents.

Table B-1. Control of the Dissolving Action of Nitric-Hydrofluoric Acid Solution

Dissolving or Pickling Action is MORE Severe	Dissolving or Pickling Action is LESS Severe
When the nitric acid content is decreased. When the hydrofluoric acid content is increased.	When the nitric acid content is increased. When the hydrofluoric acid content is decreased.
When the temperature is increased.	When the temperature is decreased.
When immersion time is increased.	When immersion time is decreased.

d. In areas where there is no danger of liquid oxygen spillage, corrosion may be removed with phosphoric acid base rust remover (MIL-C-10578).

e. Thoroughly rinse all chemical corrosion remover from the area.

f. Allow the area to dry, then apply final protective finish or other corrosion preventive if required.

coils to heat the solution. The heating coils should be installed so that they are easily replaced since they will be corroded by the solution.

c. Optimum pickling conditions (temperature, time, and acid concentration) shall be determined by exposure of test panels to all conditions of the cleaning cycle. Excessive etching or intergranular attack of the base metal shall be avoided.

**B-7.3. PICKLING FOR CORROSION REMOVAL.**

**WARNING**

The scale loosening solution, the pickling solution, and the passivating solution all contain strong acids. Observe the standard safety precautions for handling acids. Wear protective clothing, avoid inhaling fumes, provide adequate ventilation, and always add acid to water. Hydrofluoric acid is exceptionally hazardous.

a. Mixtures of nitric acid (O-N-350) and hydrofluoric acid (MIL-A-24641) in water are recommended. The correct percentage content of the two acids for a given corrosion removal job shall be determined by testing. (See B-7.2.c). The nitric acid content may vary from 5 to 50% and the hydrofluoric acid from 0.5 to 5%, both by volume. Normally, an aqueous mixture containing 12 to 15% nitric acid and 1% hydrofluoric acid is used to remove light scale or corrosion. The percentage of hydrofluoric acid may be increased to remove heavier scale or corrosion. The more nitric acid present with respect to hydrofluoric acid, the less rapid the corrosion or scale removal. Nitric acid acts to inhibit the action of hydrofluoric acid. Rubber lined or Koroseal tanks may be used to hold the solutions.

b. The pickling temperature may be adjusted from room temperature to 140°F (60°C). Higher temperatures shall be avoided to reduce evaporation loss of hydrofluoric acid. Temperatures below 120°F (49°C) should be used if intergranular attack is experienced in localized areas, such as weld zones. Type 300 series stainless steels may be used to manufacture steam

(1) Make test panels, 1 x 4 inches, of the same material as that of the compound being cleaned. Process the test panels through the complete cleaning and pickling cycle.

(2) If etching, intergranular attack, or metal loss is excessive (i.e., would cause component to be condemned), or if cleaning is not complete, adjust the acid concentration, immersion time, or solution temperature until the desired result is obtained. **Table B-1** shows the effect of the variables (acid concentration, immersion time, and solution temperature) on the pickling action of the solution.

d. The following procedures are merely guidelines for acid pickling. Competent operators must establish specific procedures by test as outlined in paragraph c. above. A scale loosening procedure is included for use only if severe scale is encountered and it is desired to loosen the scale by chemical means. Normally, heavy scale may be removed by mechanical means prior to acid pickling. A passivating procedure is also included and may be used following pickling. Solvent or vapor degreasing shall precede the following procedure:

(1) If necessary, remove severe scale by a mechanical method.

(2) If necessary, loosen severe scale by immersing parts in an 8-10% (by weight) solution of sulfuric acid (A-A-55828) in water at 150° to 160°F (66° to 71°C) for approximately five minutes. Observe results and repeat if required. Scrub as required to remove sludge.

(3) Rinse parts quickly and thoroughly in clean, hot water.

(4) Transfer parts to the nitric-hydrofluoric acid pickling bath. A typical bath consists of 15% nitric acid (O-N-350), 2 to 3% hydrofluoric acid (MIL-A-24641), and 82 to 83% clean water, all by volume.

(5) Immerse parts for five to 15 minutes at a temperature of 60° to 140°F (16° to 60°C). Scrub or agitate as required.

#### NOTE

The required acid concentration, temperature, and time shall be determined by test prior to starting pickling operations (see B-7.2.c). New welds should be mechanically vibrated during the pickling operations.

(6) Immediately rinse thoroughly in clean, hot water.

(7) Transfer the parts to a passivating solution for treatment as follows:

(a) Immerse parts in an aqueous solution containing 20 percent by volume nitric acid (O-N-350) at ordinary room temperature for 30 minutes.

(b) Rinse in clean, hot water.

(c) Immerse parts for one hour in a hot aqueous solution (140° to 160°F (70° to 71°C)) containing 5% sodium dichromate.

(d) Rinse thoroughly.

**B-7.4. PAINT SYSTEMS.** Stainless steel parts normally are not painted. However, where extreme corrosive conditions are encountered or where organic finishes are required for decorative purposes, finishing systems may be found in TM 55-1500-345-23, the overhaul manuals, or on the parts drawings.

**B-8. CHEMICAL CORROSION REMOVAL AND TREATMENT OF COPPER AND COPPER BASE ALLOYS.** Copper and copper alloys are relatively corrosion resistant, and attack on such components will usually be limited to staining and tarnish. Generally such changes in surface conditions are not dangerous

and should ordinarily have no effect on the function of the part. Copper corrosion is evidenced by the accumulation of colored products. Corrosion can be removed from copper with phosphoric acid base rust remover (MIL-C-10578), provided that there is no danger of trapping the acid in the crevices or recesses.

#### B-8.1. CORROSION REMOVAL FROM IMMOVABLE AREAS.

a. Protect adjacent components to prevent damage by chemical agents.

b. Remove grease or soil from the area to be treated with cleaner and/or solvent (see Chapter 2).

c. Remove corrosion with phosphoric acid base rust remover (MIL-C-10578).

d. Rinse the area thoroughly, dry, and apply final protective paint or other finish if required.

#### B-8.2. CORROSION REMOVAL FROM REMOVABLE COMPONENTS.

a. Components which can be disassembled can be treated in immersion tanks. The tanks should be manufactured from or lined with stainless steel, lead, ceramic, glass, or acid resistant rubber. Immersion racks should be manufactured from stainless steel or Monel. The proper conditions (time, temperature, and acid concentration) for the process should be determined by test, using panels of the same material which is to be treated.

b. Disassemble the component as necessary. Do not simultaneously process dissimilar metals in the acid bath.

c. Degrease parts by immersion, spray, or vapor cleaning.

d. Immerse parts in a solution containing 5 to 10% sulfuric acid (A-A-55828), by volume, in water; add the acid to the water, not the water to the acid. Maintain solution between 60° and 120°F (15° and 49°C). The required temperature, immersion time, and acid concentration shall be determined by test.

e. Rinse thoroughly.

f. If a red stain appears on the parts following the above treatment, remove the stain by immersing parts in a solution containing sulfuric acid (A-A-55828), 4-10% by volume, sodium dichromate, 4 -8 ounces per gallon of solution, and water, remainder.

g. Maintain the above solution at 60° to 120°F (15° to 49°C). The required temperature, immersion time, and acid concentration shall be determined by test.

h. Rinse thoroughly. This will remove any residual acid, which could cause staining of the metal surface.

i. Dry rapidly, preferably with hot air. Rapid drying will prevent water stains on the metal surface.

**B-8.3. PAINT SYSTEMS.** Normally copper and copper alloys are not painted. However, if paint is required for decorative or other purposes the finishing systems are listed in TM 55-1500-345-23, the aircraft maintenance manuals, overhaul manuals, or parts drawings.

### **B-9. CHEMICAL CORROSION REMOVAL AND TREATMENT OF TITANIUM AND TITANIUM-BASE ALLOYS.**

#### **CAUTION**

Titanium is susceptible to hydrogen embrittlement in acid solutions; therefore, the acid pickle should be used only when other corrosion removal methods are not adequate. Assign competent operators to monitor the process.

**B-9.1.** An acid pickle will remove most oxide coatings from titanium, provided that the scale was formed at temperatures below 1000°F (540°C). Gray or black oxides should be removed by a mechanical method, such as abrasive blasting, prior to the acid pickle to prevent pitting of the titanium.

a. If present, remove gray or black oxide by mechanical means.

b. Remove soil as outlined in Chapter 2.

#### **WARNING**

Hydrofluoric acid is extremely hazardous. Follow all MSDS safety precautions and ensure use of all required PPE.

#### **NOTE**

The required acid concentration and immersion time shall be determined by test prior to the pickling operation.

c. Immerse parts in a solution normally containing 20% nitric acid (O-N-350) and 3% hydrofluoric acid (MIL-A-24641) in water, by volume. Maintain the solution at the normal room temperature. Allow the parts to remain in the solution only long enough to remove the oxide coats. Intermittent wiping with a brush or cloth during the pickling operation will facilitate oxide removal with a minimum of pitting.

d. Rinse thoroughly in cold running water, air dry, or dry in air oven at 180° to 240°F (82° to 116°C).

e. Apply final protective finish, if required.

**B-9.2. PAINT SYSTEMS.** Titanium does not require a paint system for corrosion protection. Where organic finishes are required for decorative or other purposes, finishing systems may be found in TM 55-1500-345-23, aircraft maintenance manuals, overhaul manuals, or parts drawings.

**B-10. CHEMICAL CORROSION REMOVAL AND TREATMENT OF PLATED AND PHOSPHATED SURFACES.** Chemical corrosion removal is recommended for use where there is no danger of the chemicals becoming trapped in crevices or recesses. Acid-type chemical rust removers are recommended. The acid type is intended for removing red rust and other types of corrosion from the base metal by brush application of the chemical. The acid rust remover is intended for use following removal of heavy corrosion by mechanical means. The acid will remove any remaining corrosion and condition the metal surface to improve paint adhesion.

**B-10.1. TOUCH-UP OF CORRODED AREAS ON CADMIUM OR ZINC PLATED SURFACES.**

Cadmium and zinc plate provide cathodic protection to the underlying base metal. If, during normal use, the plated surface is broken, the cadmium or zinc plate will be anodic to the base metal (usually steel or copper alloy): therefore, the plate will corrode and sacrificially protect the base metal. Removal of corrosion from cadmium or zinc plated surfaces shall be limited to the removal of the corrosion products from the underlying base metal. Mechanical corrosion removal methods shall be used.

- a. Protect adjacent components for scale, corrosion products, and chemical agents.
- b. Clean the area with dry cleaning solvent (MIL-PRF-680 Type II) or other approved materials to remove grease or other soils (see Chapter 2).
- c. Remove corrosion products from the base metal with abrasive paper or abrasive nylon pad. Avoid removing undamaged cadmium or zinc plate adjacent to the corroded area. Corrosion removal shall be limited to the immediate area of the corrosion on the base metal.
- d. Remove any remaining corrosion and condition the metal surface with phosphoric acid base rust remover (MIL-C-10578). Allow the acid to contact the surface only long enough to remove the corrosion.
- e. Allow the area to dry, and immediately apply final protective paint or other corrosion preventive finish.

**NOTE**

The above procedures are intended only for touchup of corroded areas on cadmium or zinc plated surfaces. Where service temperatures preclude the use of organic finishes or the thickness of the organic finish will impair operation of the part, severely corroded parts must be replaced. Where facilities are available, severely corroded cadmium plated parts may be replated.

- f. Small corroded areas can be brush plated in accordance with instructions in Depot Maintenance Work Requirements (DMWRs).

**B-10.2. TOUCH-UP OF CORRODED AREAS ON PLATED PARTS (EXCEPT THOSE PLATED WITH CADMIUM OR ZINC).**

When a break occurs in the surface of plates such as chromium, nickel, tin, or copper, corrosion of the base metal will follow. The corrosion will normally be accelerated because the above plates are cathodic to most base metals.

- a. Protect adjacent components from scale, corrosion products, and chemical agents.
- b. Clean the area to remove grease or other soil.
- c. Remove heavy corrosion by mechanical means, such as wire brushing.
- d. Remove any remaining corrosion and condition the metal surface with phosphoric acid base rust remover (MIL-G-10578). Allow the acid to contact the surface only long enough to remove the corrosion.
- e. Thoroughly rinse the acid from the surface with clean water.
- f. Allow the area to dry and immediately apply final protective paint or other corrosion preventive finish.

**B-10.3. PAINT SYSTEMS.**

Paint may be used to prevent further corrosion on plated or phosphated surfaces, provided that the part does not operate at temperatures which preclude the use of organic finishes and that the finish will not prevent the part from performing its intended function. Organic finishes shall not be used on: bearings or wearing surfaces of gears, cams, or slides; where an electrical conducting surface is required; where the reflective properties of the plates are essential, and, other areas where the finish will prevent the part from performing its intended function. Finishes consistent with the requirements for corrosion protection of the base metal should be used. Refer to TM 55 1500-345-23, the aircraft maintenance manuals, overhaul manuals, or parts drawings for specific paint systems.

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## APPENDIX B SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT

### SECTION IV. TREATMENT OF SPECIFIC AREAS

**B-11. PURPOSE.** This section covers preventive and corrective procedures and materials for specific aircraft parts or areas.

#### **B-12. CORROSION TREATMENT OF SPECIFIC TYPE TUBING.**

##### **WARNING**

Do not use Specification MIL-PRF-16173 material on any oxygen line fittings. This material contains petroleum solvents which are not oxygen compatible. Explosion may occur if oxygen contacts this material and the resulting mixture is subjected to sudden pressure or impact. After installation, apply the exterior paint system to the exposed tubing, sleeve, and back portion of the B nut of these fittings.

B-12.1. No paint coating shall be applied to the interior surface of airspeed indicator tubing, oxygen tubing, or other plumbing lines. Interior and exterior surfaces of other aluminum alloy tubing shall be treated with MIL-DTL-81706, except oxygen lines which shall be treated on external surfaces only. Tubing in methylbromide or trifluorobromoethane fire extinguishing systems shall be finished with baked resin coating conforming to MIL-PRF-3043. The process shall be in accordance with MIL-C-5056.

B-12.2. If possible, the interior surfaces of structural aluminum alloy tubing shall be protected in accordance with the general schedule for aircraft interior surfaces. The interior surfaces of structural aluminum alloy tubing sealed by welding need not be painted on land planes. On amphibian aircraft, however, the interior of such members shall be coated with epoxy polyamide primer (MIL-PRF-23377) or corrosion preventive compound (MIL-C-11796 Class 3), applied through appropriately drilled holes when permitted by aircraft maintenance manuals.

B-12.3. The interior surfaces of structural magnesium alloy tubing shall be painted in accordance with the general schedule for aircraft interior magnesium surfaces. Interior surfaces of sealed structural magnesium tubing shall be coated with epoxy polyamide

primer (MIL-PRF-23377) or corrosion preventive compound (MIL-C-11796 Class 3), applied through appropriately drilled holes when permitted by aircraft maintenance manuals.

B-12.4. The interior and exterior surfaces of copper alloy, corrosion resistant alloy (stainless steel), and heat resistant alloy tubing need not be painted except as required for protection against dissimilar metal contact.

B-12.5. The interior of structural carbon steel tubular assemblies not closed by welding shall be finished in the same manner as exterior surfaces as possible. Assemblies completely closed by welding or to which application of primer is not practicable or not effective, such as crimped-end tubing not closed by welding or tubing heat treated after assembly, shall be treated after assembly, (and heat treatment, if performed) with hot linseed oil (ASTM D260) in lieu of the zinc chromate primer coats. The liquid shall be applied by forcing it into the hollow member under pressure through holes drilled therein or by immersing the part in a bath of the liquid. For a large structure, interconnecting holes may be drilled between various members in order that the liquid will circulate. The presence of the hot material in each member may be checked by noting the increase in temperature of the member. Parts that are immersed shall be manipulated to ensure that no airpockets are formed, and the parts shall remain in the bath until all bubbling has ceased. The members shall be thoroughly drained after treatment, and all exterior surfaces shall be wiped free of oil. All access holes drilled in the members shall be closed with cadmium plated self-tapping screws or equivalent. Solder shall not be used to close the holes.

B-12.6. Aluminum tubing which is normally exposed to the combined direct action of climatic elements either during flight or on the ground shall be protected with the complete exterior paint system. Climatic elements include humidity extremes, rain, hail, snow, sleet, salt-laden air, industrial atmospheres, windblown sand, and dust. Tubing in areas such as wheel wells and their fairings, speed-brakes, wing flaps, and unsheltered tubing at missile sites is categorized as exposed tubing.

a. Clean tubing in accordance with paragraph B-4.4.1.

b. Condition surface by the method outlined in B-4.4.1.

c. Apply chromate conversion coating (MIL-DTL-81706) to the interior and exterior surfaces; treat only the exterior surfaces of oxygen lines.

#### NOTE

Apply only the conversion coating if tolerances will not allow the application of the primer coat. Take precautions to exclude primer from internal tubing areas.

d. For permanent installations, apply two coats of epoxy polyamide primer (MIL-PRF-23377) and two coats of paint. (See TM 55-1500-345-23 for typical paint systems). The chromate conversion coating and primer shall be applied over the entire external surface of the tubing including under the sleeve. After fabrication and prior to installation, the complete exterior paint system shall be applied to all lines and fittings. Coating damaged during installation shall be retouched. Fittings that are inaccessible for inspection and refinishing as may be required in service or are so oriented that fluid can collect on or behind the fittings shall have exposed surfaces between parts sealed with a corrosion inhibitive sealing and coating compound (MIL-PRF-81733). After sealing, the seals and the surfaces adjacent to them shall receive the prescribed paint finish.

#### NOTE

Where double flares are used, such as in oxygen systems, the ends must be capped, and paint must be applied after the flaring operation to prevent coating the inside face of the flare (sealing surface) which mates with the seat of the fitting. To prevent contamination, end fittings shall not be painted until after installation on the aircraft.

e. Paint coating shall be omitted for a distance of one inch from each fitting of lines which are known to require periodic removal in service. After installation, apply MIL-PRF-81309 Type II water displacing corrosion preventive compound with a small brush to the unpainted portion of the tubing, the exposed part of the sleeve, and the back portion of the B nut. Do not apply to fitting threads. Allow to dry for a period of at least one hour and then coat the same area with MIL-PRF-16173 Grade 4 corrosion preventive compound.

#### NOTE

Use dry cleaning solvent (MIL-PRF-680) to remove the preservative coatings from fittings installed on painted tubing.

B-12.7. Often corrosion occurs on or near sleeves used under fittings on tubing. When corrosion is encountered and/or tubing is replaced, determine what type sleeve (type metal and/or plate) is installed.

B-12.8. Stainless steel tubing which is normally exposed to the direct action of climatic elements may also require an organic finish for corrosion protection. Austenitic stainless steels are particularly susceptible to pitting and/or stress corrosion cracking when exposed to combinations of salt-laden air and dust particles (metallic or nonmetallic) or other materials which can cause concentration cells to form on the stainless steel surface. Where severe deteriorating conditions cause frequent replacement of stainless steel tubing, the tubing shall be protected as follows:

a. Remove all foreign soils, oils, and grease by hand cleaning.

b. Remove corrosion products (see Chapter 4 and paragraph B-7.).

c. Wipe down immediately before painting with an approved solvent cleaner.

d. Apply wash (DOD-P-15328).

e. Apply two coats of epoxy polyamide primer (MIL-PRF-23377).

f. Where appearance is a consideration as an alternate to paragraph e., apply one coat of primer followed by a topcoat of the exterior coating being used in the surrounding area. Ensure that primer and topcoat are compatible (see TM 55-1500-345-23).

B-12.9. Cadmium plate may deteriorate under exposure to certain chemicals, abrasion, or environmental conditions. Until such time as the tubing can be replaced or replated, the following method of touchup will be used:

a. Clean the tubing thoroughly.

b. Mechanically remove the deteriorated cadmium and/or corrosion.

- c. Wipe thoroughly with an approved solvent cleaner.
- d. Apply wash (DOD-P-15328).
- e. Apply two coats of epoxy MIL-DTL-53022 (corrosion inhibitor, lead and chromate free).
- f. As an alternate to paragraph e., apply one coat of primer followed by a topcoat to match surrounding area. Ensure that the primer and topcoat are compatible (see TM 55-1500 345-23).

**B-13. CORROSION REMOVAL FROM THIN METAL.**

When corrosion and stains are to be removed from airframe structure skins thinner than 0.0625 inch and an abrasive method of removal is required, the following procedure applies:

- a. Prepare pumice paste by mixing pumice powder (SS-P-821) and water to form a slurry. Use a clean, soft cloth such as cheesecloth to apply the paste to the stain and rub gently.

**CAUTION**

Do not allow metallic or corrosion particles to build up on the polishing area or polishing tool (cloth or grit paper) during polishing. Damage to the metal may result.

- b. When pumice has dried to a white powder, wipe off with clean, dry, soft cloth. If corrosion products still exist (stubborn stains), use number 600 grit, wet or dry, abrasive paper and water to remove the remaining corrosion. Wipe clean with clean, dry, soft cloth.

**B-14. CORROSION AND PAINT REMOVAL FROM METAL COMPONENTS REMOVED FROM AIRCRAFT.**

Metal components removed from aircraft (except control surfaces, precision components, and close tolerance fittings) and taken to repair shops for routine rework may be cleaned free of paint and corrosion by abrasive blasting. See Chapter 4 and the specific alloy sections for detailed information.

**B-15. AIR INTAKE DUCTS-JET AIRCRAFT.**

Air intake ducts are fabricated from materials (usually 5000 series aluminum) which have high corrosion resistance. Certain components of these ducts may be cast aluminum or magnesium. Coating of these castings and frequent cleaning of the duct is usually sufficient to preclude attack by corrosion. Aircraft performing low level missions

or take-off and landings over salt water or in highly saline atmospheres may need the ducts painted to reduce corrosion attack. Such a requirement must be determined by the operating activity. A polyurethane paint system as outlined in TM 55-1500-345-23 is recommended.

**NOTE**

When the history of an aircraft reveals duct cracking and rivet shear, a coating is not desirable. Painting of such ducts will make detection of failures difficult, and often impossible, without removal of the paint.

**B-16. CLOSELY COILED SPRINGS.** Springs that are closely coiled, preventing the application of plating to internal surfaces, shall receive two coats of MIL-DTL-53022 (corrosion inhibitor, lead and chromate free) or MIL-PRF-23377.

**NOTE**

These requirements do not apply to springs made of corrosion resistant steel or beryllium copper, or to springs in oil or hydraulic fluids.

**B-17. CORROSION TREATMENT OF STEEL CABLES.**

- a. Inspect cable for damage in accordance with TM 1-1500-204-23-1, paragraph 9-12e, and appropriate aircraft manuals.

b. Move surface controls of the particular cable to the extremities to reveal the cable in the pulley contact, fairlead area, or drum. If the surface of the cable is corroded, relieve cable tension and carefully force the cable open by reverse twisting and visually inspect the interior.

c. Corrosion on the interior strands of the cable constitutes failure, and the cable must be replaced. If no internal corrosion is detected, remove loose external rust and corrosion with a clean, dry, coarse-weave rag or fiber brush.

d. After thorough cleaning, apply MIL-PRF-16173 Grade 1 corrosion preventive compound sparingly. Do not apply the material so thick that it will interfere with the operation of cables at fairleads, pulleys or grooved bellcrank areas.

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**APPENDIX B**  
**SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT**

**SECTION V. DECONTAMINATION PROCEDURES FOR SALT WATER AND  
MICROBIOLOGICAL GROWTH CONTAMINATION**

**B-18. GENERAL.** This section describes decontamination procedures to be followed after it has been determined that a fuel system is contaminated with salt water or microbiological growth. It is extremely important that fuel system decontamination procedures be initiated as soon as possible following evidence of contamination, particularly if salt water contaminated, because serious corrosion damage to metallic components can begin within a few hours. Defueling, depuddling and purging are required as part of decontamination of the fuel system. Defueling shall be done in accordance with instructions contained in the applicable aircraft maintenance manual.

**B-18.1. COMPONENTS REQUIRING SPECIAL TREATMENT.** Components such as cork floats, wiring bundles, braided hose covering and capacitance type fuel quantity indicators may require special treatments which include removal and soaking in a hot cleaning solution followed by scrubbing to remove residual salt deposits and/or microbiological growth. When ultrasonic cleaning equipment is available, cleaning time can be shortened considerably.

**B-18.2. WATER EMULSION CLEANING COMPOUNDS.** Water emulsion cleaning compounds are specified to assist in cleaning grossly contaminated systems. Since residues from these cleaning compounds provide food for microorganisms leading to microbiological growth, it is essential that thorough fresh water rinsing follow their use.

**B-19. SALT WATER CONTAMINATION.** Salt water contamination of the aircraft fuel system does not necessarily result in immediate engine fuel system contamination. Therefore, fuel samples shall be obtained from the engine fuel system beginning with main filters and working downstream until the extent of salt water penetration into the fuel system can be established. If there is no evidence of salt water in the engine fuel system, the system shall be disconnected and/or blanked off to prevent possible contamination during fuel cell and aircraft plumbing system decontamination.

**B-19.1. DECONTAMINATION PROCEDURES.**

**WARNING**

Sodium dichromate crystals (A-A-59123) are toxic to the skin and eyes. Chemical or splash proof goggles, rubber gloves (MIL-G-12223), coveralls (MIL-C-2202), and a respirator (GGGM-125/1) shall be worn when handling these crystals.

**CAUTION**

To prevent possible damage to fuel system nonmetallic components, the solution temperature shall not exceed 120°F (49°C).

Do not allow sodium dichromate solution to dry out on any metallic surface during treatment.

Ensure that cellulose sponges are in good condition (i.e., not coming apart or shredding) when used inside a fuel cell or tank. Also, to prevent a fire hazard, cellulose sponges and cheesecloth used for cleaning fuel cells or tanks shall be disposed of in accordance with local safety instructions.

**B-19.2.** To decontaminate the fuel system, proceed as follows:

a. While the fuel system is still assembled, defuel aircraft and drain remaining fuel using low point drains. Include draining the engine fuel systems, if contaminated.

b. Prepare an inhibitor solution by adding 35 to 40 pounds of sodium dichromate crystals (A-A-59123) to each 50 gallons of fresh water. To improve flushing ability, use warm water (100° to 120°F (38° to 49°C)), if available. The inhibitor solution will dissolve and remove most of the residual salts, thus providing temporary corrosion protection for metallic components.

c. To treat systems by flushing, remove tank or cell access plates and removable components, as necessary, to provide maximum access to contaminated areas. Using a pump (5100-254B) and rubber hose, pump and circulate the sodium dichromate solution throughout the tanks and cells, keeping all surfaces wet for at least 30 minutes. Allow tanks and cells to drain into receptacles during this operation.

d. As soon as treatment by flushing is completed, drain all inhibitor solution from system. Immediately begin rinsing with fresh water and continue rinsing until rinse water is clear or has only a slight orange tint.

#### **NOTE**

Fuel system components contaminated with salt water that cannot be thoroughly inspected "in place" for corrosion damage shall be removed and disassembled sufficiently to establish internal conditions and for damage correction. For metering devices and other items, remove and flush with fresh water, drain, dry, and preserve internally with water displacing, corrosion preventive compound (MIL-PRF-81309 Type II Class 1), tag with the notation "CONTAMINATED INTERNALLY WITH SEA WATER", and forward to the designated maintenance facility for rework.

e. As soon as possible after flushing and inhibiting treatment, open all cells and tanks by removing access plates, probes, pumps, fittings, etc., for maximum visual inspection of interior areas.

f. Remove residual fuel and sodium dichromate solution using an explosion-proof vacuum cleaner or cellulose sponges (A-A-2073) and cheesecloth (CCC-C-440). For cells which are impossible to enter, use an explosion-proof vacuum cleaner or attach the cellulose sponge or cheesecloth to a wooden handle for reaching remote areas.

g. Inspect fuel cells for corrosion and evidence of microbiological growth. Treat corrosion in accordance with Chapter 6. If microbiological growth is found proceed to and comply with paragraph 2-4c of TM 1-1500-204-23-3.

h. Test fuel system for leaks as outlined in paragraph 2-5g of TM 1-1500-204-23-3.

## **B-20. MICROBIOLOGICAL GROWTH CONTAMINATION OF FUEL CELLS.**

### **WARNING**

Solutions containing isopropyl alcohol (TT-I-735) are flammable and shall be drained into safety containers and disposed of in accordance with local safety instructions.

### **CAUTION**

To prevent possible damage to fuel system nonmetallic components, the solution temperature shall not exceed 120°F (49°C).

a. Defuel aircraft in accordance with instructions contained in the applicable maintenance manual.

b. Remove capacitance type fuel quantity indicator probes, internal plumbing, valves, electrical wiring, float switches, etc., as necessary to gain access to all areas where salt water or microbiological growth may have collected, or where hidden corrosive attack may have occurred. Except for fuel quantity indicator probes (which shall always be removed and cleaned), the extent of further component removal shall be determined by the evidenced need for a more in-depth inspection of a component.

c. Make up a water emulsion cleaning solution by adding one part by volume of MIL-PRF-85704 Type I cleaning compound to nine parts of fresh water.

d. For electrical wiring, fuel quantity indicator probes, fittings, plumbing lines, and any intricate components that cannot be effectively cleaned with the water emulsion cleaning solution and scrubbing with a hog bristle brush (H-B-420), immerse in water emulsion cleaning solution for approximately one to three hours. If possible, the solution should be heated and maintained at approximately 120°F (49°C).

e. When all residues have been loosened, rinse thoroughly with water until items are clean. Drain as well as possible, rotating items to get complete draining. Place items in drying ovens maintained at 120°F (49°C) maximum for 12 hours. If ovens are not available dry by immersing items in undiluted isopropyl alcohol (TT-I-735) for approximately one minute and blow dry with clean compressed air at a pressure of no more than 10 psi. Install new fuel quantity probes if these cleaning



procedures prove to be ineffective when processed probes are tested electrically in accordance with applicable maintenance instruction manuals.

#### NOTE

When cleaning bladder and self-sealing cells, look for evidence of cell liner porosity, deterioration, punctures, tears, etc., which may allow salt water, sodium dichromate solution or fuel to leak from the fuel cell into the airframe cavity and cavity liners. If leaks are suspected, inspect airframe cavity liners and cavities when the cell is removed for repair or replacement. If authorized repair does not require removal, disassemble and loosen cell sufficiently to examine for liquid entrapment and corrosion damage. If cavity liner or cavity is wet, remove residual fuel/water using an explosion-proof vacuum cleaner, cellulose sponges (A-A-2073), and cheesecloth (CCC-C-440). Treat corrosion in accordance with Chapter 6.

f. Clean fuel cells or tanks by scrubbing contaminated areas with water emulsion cleaning solution (see paragraph B-20.c.). Efficient scrub brushes may be prepared by trimming bristles of paint brushes (H-B-420) to approximately one half the normal length. Brushes may be attached to wooden handles for reaching remote areas. Thoroughly scrub all interior areas until all residues have been loosened.

g. Ensuring that lower sections of fuel cells and tanks are open to permit free drainage, thoroughly flush and rinse interior of fuel cells with fresh (warm water, if available) to remove all foreign matter and cleaning compound residues. Continue rinsing until all evidence of cleaning compound is removed or until discharge water is clear.

h. To assist in cleaning, flush fuel cells with a mixture of one part isopropyl alcohol (TT-I-735) and one part tap water. A pump (5100-254B) and extension hose may be used to apply the water/alcohol solution.

i. Flush the hidden area with the 50% water/alcohol solution. Remove residual water/alcohol solution with an explosion-proof vacuum cleaner, cellulose sponges (A-A-2073) and cheesecloth (CCC-C-440). To facilitate drainage of hidden or inaccessible areas formed by bulkheads, baffles, stiffeners, etc., alter attitude of aircraft by inflating and deflating gear struts or by using jacks in accordance with applicable maintenance instructions manuals.

j. Remove all visible traces of water: alcohol solution by passing warm (120°F (49°C) maximum), dry air through fuel cells for approximately eight to 12 hours. This can be accomplished by closing a cell except for two openings: one for entry and one for exit of hot air. The entry and exit openings should be as far apart as possible. The exit opening should be large enough to allow water and alcohol vapors to readily escape and prevent pressure buildup in fuel cells. When possible, during the last part of the drying operation, close off the exit opening and direct the drying air through the installed fuel boost and transfer pump ports to ensure adequate drying of these parts.

k. After drying, inspect fuel cells and tanks for evidence of salt crystals or remaining sodium dichromate. Remove any such residues by swabbing with sponges dampened with the 50% water: alcohol solution. Unless the deposits are so extensive that reflusing with water is needed, it will not be necessary to perform additional forced air drying.

l. Inspect for corrosion and treat all corroded areas in accordance with Chapter 6.

m. For integral type fuel cells, inspect the condition of sealants. Repair or replace, as necessary, all sealant coatings in accordance with paragraph 2-5f of TM 1-1500-204-23-3.

n. Functionally check all electrical equipment in accordance with applicable maintenance instructions manuals before installation.

o. As soon as possible after cleaning, drying, and any replacing of sealant, reassemble fuel system and change all fuel filters and fuel aircraft to normal operating capacity in accordance with applicable maintenance instructions manuals. After fueling wait a minimum of four hours and then take fuel samples from the low point drains.

p. Test fuel system for leaks in accordance with paragraph 2-5g of TM 1-1500-204-23-3.

q. A test flight or maintenance operational check in accordance with applicable aircraft maintenance manuals shall be performed following the performed maintenance.

r. Inspect fuel storage tanks and trucks for possible sources of fungus and/or water contamination.

s. To avoid future fungus contamination, use only military specification turbine fuel, which contains a biocidal agent (MIL-DTL-85470), or add this agent according to accepted commercial methods noted on the biocidal container when refueling with non-military fuel.

## **B-21. REMOVAL OF MICROBIOLOGICAL GROWTHS.**

### **WARNING**

Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to application of isopropyl alcohol (TT-I-735). Do not use synthetic wiping cloths with flammable solvents such as isopropyl alcohol. Observe personal precautionary and protective measures. Use chemical or splash proof goggles and rubber gloves when working with tri-basic sodium phosphate (O-S-642). When solution is splashed into eyes, immediately flush thoroughly with water and report to dispensary.

### **CAUTION**

The use of strong tri-basic sodium phosphate (O-S-642) is not recommended for removing paint from wood surfaces, since the solution will attack the fibers, causing swelling and discoloration.

B-21.1. Fungus growth such as mildew and mold occur on organic materials (plastic and oil), and on organic coatings (paints) or deposits on the surface of inorganic (metal and concrete) materials, particularly in damp, warm climates.

**B-21.2. MICROBIOLOGICAL GROWTH ON PLASTICS.** Since the term plastics includes compounds of different chemical compositions varying widely in chemical and physical properties, one type of plastic may be cleaned by a method which may be destructive to another type of plastic. In general, organic solvents, including petroleum solvents such as dry cleaning solvent and mineral spirits paint thinner, should not be used to clean plastics or allowed to come in contact with plastics. Plastics are cleaned by wiping with a lint-free cloth or sponge moistened with clean water or a solution of two

ounces by weight of detergent (P-D-410) per gallon of water. Plastics are polished by rubbing with ground abrasive technical pumice (SS-P-821). Other cleaning methods can be used for certain types of plastics.

**B-21.2.1. Acrylate and Methacrylate Resin Plastics (Plexiglas).** These plastics are cleaned by washing with a solution containing one ounce of general purpose detergent (MIL-D-16791) in one gallon of water. Wipe area with a flannel cloth.

**B-21.2.2. Plastic Electrical Insulation.** Clean plastic electrical insulation by wiping with a lint-free cloth or sponge moistened with isopropyl alcohol TT-I-735).

### **B-21.3. PAINTED AND UNPAINTED METAL SURFACES.**

**B-21.3.1. Fungus Growth.** Fungus growth is removed from painted and unpainted metal surfaces by scrubbing with a solution of two ounces by weight of detergent (P-D-410) per gallon of water. When fungus cannot be removed from unpainted surfaces by scrubbing with detergent, mechanical removal is recommended in accordance with Chapter 4 of this manual.

**B-21.3.2. Mildew.** Mildew may be produced by fungus growing on organic matter adhering to a soft paint film or on the paint oil itself. Remove mildew by scrubbing with a water solution of tribasic sodium phosphate (O-S-642).

a. A strong phosphate solution (three pounds per 10 gallons of water) is most effective, but the solution should be applied to small areas of the surface at a time, rinsed off immediately with clean water, and dried with a wiping cloth. When allowed to remain on the painted surface for several minutes, the solution will loosen the paint and may attack the wood fibers.

b. Scrubbing the surface with a mild phosphate solution (2½ ounces by weight per 10 gallons of water) will not loosen the paint and is less effective in removing the mildew. Rinse the surface thoroughly to remove residue.

c. To prevent recurrence of mildew, the old paint system should be removed in accordance with TM 55-1500-345-23.

## APPENDIX B SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT

### SECTION VI. IDENTIFICATION OF METALS

**B-22. GENERAL.** The metal identification kit (FSN 6630-831-5932) shall be used to determine the types of metal(s) used in the construction of aircraft. The use of this kit employs two methods of identification: (a) primary classification of metals; and (b) chemical spot analysis. See **Table B-2**.

#### NOTE

Before proceeding with test, remove paint (if present) from a one inch square area with cloth soaked in an approved compliant solvent cleaner.

#### **B-23. PRIMARY CLASSIFICATION.**

a. For a preliminary identification, compare metal strips in the kit with unknown metal on aircraft.

b. Place a magnet on the metal surface. Magnetic attraction classifies the base metal as a ferrous magnetic material (i.e., iron or steel).

**B-24. CHEMICAL SPOT ANALYSIS.** Chemical tests are used to identify a base metal and/or plating. If the base metal is plated and its identification is desired, the plating must be mechanically removed by abrasion before tests are made. Surrounding surface treatments of the metal will not interfere with these tests.

#### **B-25. TESTING PROCEDURES FOR TYPES OF SURFACE TREATMENT.**

**B-25.1. PHOSPHATE TREATMENT.** To confirm the presence of a phosphate treatment on steel, zinc, cadmium, or aluminum, place a drop of 20% nitric acid solution on the surface and follow this with two drops of ammonium molybdate solution. If the metal surface has had a phosphate treatment, a yellow precipitate will form.

**B-25.2. CHROMATE TREATMENT.** Surface chromate treatments on zinc, cadmium, aluminum, or magnesium are highly colored and are indicative of the application of these treatments. A bleached chromate treatment may have been applied, however, and then coated with lacquer to mask any residual iridescence for the sake of appearance. If so, visual detection of the chromate is

impossible. To test for this lacquer, proceed as directed in the following paragraph.

**B-25.2.1. Test for Lacquer.** Place a drop of concentrated sulfuric acid on the surface. If lacquer is present, the spot will rapidly turn brown with no effervescence. If lacquer is not present, the spot will not turn brown. If the metal is zinc, there will be a rapid effervescence; if cadmium, there will be no reaction.

**B-25.2.2. Test for Chromate Film on Zinc Chromium.** Place a drop of 5% aqueous solution of lead acetate on the surface. If the metal has been treated, the surface will show no discoloration for 10 seconds. If there is no surface treatment, an immediate dark spot will appear.

#### NOTE

A bleached chromate treatment is not approved because the bleaching process lowers corrosion resistance of metal.

#### **B-26. CONTENTS OF METAL IDENTIFICATION KIT.**

This kit consists of metal strips (1.0 x 6.0 x 0.063 cubic inches) to be used for visual comparison and practice, and reagents to be used for performing a chemical spot analysis. Conduct the following test procedures:

#### NOTE

Where tests have been conducted, it will be necessary to remove the test chemical, neutralize the surface, and apply the original paint coating. Where plating has been removed, recoat with two coats of epoxy primer (MIL-PRF-23377).

**B-26.1. IRON AND STEEL.** Place a drop of 10% hydrochloric acid on the metal surface. The acid will not noticeably react on iron or steel. Place a drop of sodium sulfide over the drop of hydrochloric acid. This will cause a black ring to form around a white precipitate. To confirm this test, a drop of 20% nitric acid on iron or steel will cause a black spot, and a drop of sodium sulfide over the nitric acid will cause a black precipitate. If the steel or iron has been bonderized, the spot will appear as a black ring around a white spot in both tests. This is not a test for bonderizing process.

Table B-2. Metal Identification Kit

Material (1)	Specification
Aluminum (7075)	QQ-A-250/12
Aluminum (7075, anodized)	QQ-A-250/12 anodized IAW MIL-A-8625 Type I
Aluminum (7076, conversion-coated)	QQ-A-250/12 conversion coated IAW MIL-DTL-81706 and MIL-C-5541
Aluminum (2024)	QQ-A-250/1
Copper	ASTM B 152
Copper (chromium-plated)	QQ-C-576 chromium plated IAW QQ-C-320
Copper (nickel-plated)	QQ-C-576 nickel plated IAW QQ-N-290
Copper (silver-plated)	QQ-C-576 silver plated IAW QQ-S-365
Magnesium (AZ31 B) (chromated)	AMS 4375, 4377 or 4376
Steel (AISI 1025)	MIL-S-7952
Steel (AISI 1025, phosphatized)	MIL-S-7952 phosphated IAW TT-C-490 Type I
Steel (AISI 1025, zinc-plated)	ASTM B 633
Steel (18-8) (stainless)	AMS 5901, 5517, 5518, 5902, 5519 for CRES 301 annealed, 1/4H, 1/2H, 3/4H and Full Hard, respectively AMS 5516, 5903, 5904, 5905, 5906 for CRES 302 annealed, 1/4H, 1/2H, 3/4H and Full Hard respectively AMS 5513, 5910, 5911, 5912, 5913 for CRES 304 annealed, 1/4H, 1/2H, 3/4H and Full Hard respectively AMS 5524 or 5907 for CRES 316 annealed and 1/4H, respectively
Reagents (2)	Volume
Acetone: Technical	16 ounces
Acid, Hydrochloric: ACS 10% aqueous solution	16 ounces
Acid, Nitric: ACS 20% aqueous solution	4 ounces
Acid, Sulfuric: Technical purity	2 ounces
Ammonium Hydroxide: ACS	2 ounces
Ammonium Molybdate: ACS, saturated	2 ounces
Cadmium Chloride: 10% aqueous solution	2 ounces
Cupric Chloride: 10 grams to 100cc HCL	8 ounces
Dimethylglyoxime: ACS, saturated solution in 98% alcohol (2)	4 ounces
Lead Acetate: ACS 5% aqueous solution	4 ounces
Sodium Sulfide: ACS, saturated solution	16 ounces
Sodium Hydroxide: 10% aqueous solution	8 ounces
Miscellaneous Items	Quantity
Cheesecloth (CCC-C-440)	1 yard
Dropper, Medicine	6
Labels, Gummed	1
Magnet Permanent, 2 x 1/2 x 1/2 cubic inches	1 box
<p>(1) Metal strips will be individually packaged in polyethylene envelopes large enough for the strips to be repackaged and isolated from each other after each use. The strips will be marked by stencil showing the alloy and coating system used.</p> <p>(2) Will deteriorate with age. Keep tightly closed and away from light. Reagents will be packaged in polyethylene bottles and marked appropriately.</p>	

B-26.2. CHROMIUM. Place a drop of 10% hydrochloric acid on the metal surface, followed by a drop of concentrated sulfuric acid. If the plating is chromium, the solution will turn green within one to two minutes.

B-26.3. ZINC. Place a drop of 10% hydrochloric acid on the metal. If the metal is zinc, reaction will be rapid. A drop of sodium sulfide over the hydrochloric acid will cause a white precipitate. To confirm this test, a drop of 20% nitric acid also will cause a rapid reaction, and the addition of sodium sulfide will form a white precipitate.

B-26.4. CADMIUM. Place a drop of 10% hydrochloric acid on the metal. If the plating is cadmium, there will be no noticeable reaction. The addition of a drop of sodium sulfide over the drop of acid; however, will cause a yellow ring to form around a white precipitate. To confirm this test a drop of 20% nitric acid will react with the metal but there will be no color change. A drop of sodium sulfide over the drop of acid will cause a yellow precipitate.

B-26.5. TIN. The hydrochloric acid-sodium sulfide test will have the same reaction on tin as on cadmium. If the metal is tin, a drop of 20% nitric acid on the surface will cause a rapid reaction and a black spot to form. When a drop of sodium sulfide is added to the acid, the result is a black precipitate.

B-26.6. SILVER. Place a drop of 20% nitric acid on the surface and let it react for 10 seconds. Then add a drop of 10% hydrochloric acid. If the metal is silver, there will be an immediate formation of a white precipitate.

B-26.7. NICKEL. Place a drop of dimethylglyoxime solution on the metal and follow it with a drop of ammonium hydroxide. The result will be pink-red coloration. Both the 10% hydrochloric acid-sodium sulfide and the 20% nitric acid-sodium sulfide tests will cause a black ring around a white precipitate.

B-26.8. MAGNESIUM. A drop of 10% hydrochloric acid on magnesium will cause a violent reaction and a black spot to form. To confirm that the metal is magnesium, place a drop of 10% sodium hydroxide on the surface. There should be no reaction.

B-26.9. ALUMINUM. Unlike its reaction on magnesium, 10% hydrochloric acid will have no noticeable reaction on aluminum. A spot of 10% solution of sodium hydroxide (caustic soda) on the surface, however, will cause a rapid reaction.

B-26.10. HEAT-TREATABLE AND NONHEAT-TREATABLE ALUMINUM ALLOYS. Place a drop of 10% solution of sodium hydroxide (caustic soda) on the metal. Pure or nonheat-treatable aluminum will not discolor, but heat-treatable aluminum alloys will turn black.

B-26.11. CLAD ALUMINUM ALLOYS. Clad alloys must be tested on the unclad edge. A drop of 10% cadmium chloride solution on a clean unclad surface of the metal will produce a dark discoloration on 7076 and 7178 aluminum alloys within two minutes. No discoloration will appear on 2024 aluminum alloy within two minutes.

B-26.12. COPPER AND BRASS. If plating is present, remove it by abrasion with sandpaper. Determine whether the metal is copper or brass by noting the typical brass or copper color. Similarly determine copper plating by its typical color.

B-26.13. STAINLESS STEEL (18-8). Mix 10 grams of cupric chloride in 100 milliliters of hydrochloric acid and place one drop of the mixture on the metal. After two minutes, follow this with three or four drops of water, then dry the surface. If a brown spot appears, the metal is 18-8 stainless steel.

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## APPENDIX B SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT

### SECTION VII. PLASTIC MEDIA BLASTING (PMB) FOR ARMY AIRCRAFT COMPONENTS

#### **B-27. PLASTIC MEDIA BLASTING (PMB) FOR ARMY AIRCRAFT COMPONENTS.**

B-27.1. SCOPE. The purpose of this section is to establish the requirements and controls for the PMB process for use at intermediate and depot level maintenance of Army aircraft components of rotary wing aircraft.

##### B-27.1.1. Application.

a. This section provides the requirements and procedures for removing organic coatings (paints, primers, or lacquers); surface cleaning and removal of light surface corrosion and carbon deposits; removal of sealants and adhesives; and assist in removal of any of these after chemical soaking, from parts and components of aircraft using PMB techniques.

b. PMB is authorized only for parts and components where PMB is specified by the applicable aircraft component Depot Maintenance Work Requirement (DMWR) or Technical Manual (TM). Comply with any additional processing instructions required by these authorizing documents. The applicable technical data shall be used when additional processing, such as etching to remove metal flow, flushing, solvent cleaning, stripping, etc., is used in conjunction with the PMB processing.

c. Request for processing Flight Safety Parts (FSP) with internal oil, grease, air, or other fluid passages, will be coordinated and approved via official written correspondence by the AMCOM Aviation and Missile Research Development Engineering Center (AMRDEC) before authorizing PMB.

d. For purposes of this section, PMB shall be used on metal surfaces and the following composite surfaces only: fiberglass, carbon fiber, boron and graphite/epoxy, and Kevlar. Proper masking shall be in place where other types of surfaces are present.

B-27.1.2. Limitations. The PMB shall not be authorized for the following surfaces:

a. Engineering plastics and glass that must remain clear.

b. Elastomeric rubber surfaces.

c. Cadmium plated parts and other plated or contaminated parts where the PMB may generate airborne hazards controlled by safety, health, or environmental regulations.

d. Parts made of Beryllium Copper.

e. Bearings and assemblies with exposed seals and gaskets unless these can be properly masked and post examination reveals zero intrusion of media in active or lube wetted surfaces.

f. Teflon lined surfaces and small threaded holes and inserts.

##### B-27.1.3. Classification.

B-27.1.3.1. Critical Parts. Parts with Internal air or fluid flow passages, or FSP where any portion of the PMB is considered a Critical Inspection Point.

B-27.1.3.2. Soft Metal Parts. Parts made of Aluminum or Magnesium Alloy.

B-27.1.3.3. Ferrous Parts. Parts made of Ferrous Alloy.

B-27.1.3.4. Titanium Parts. Parts made of Titanium Alloy.

B-27.1.3.5. Non-metal Parts. Non-metal parts or surfaces approved for PMB.

B-27.2. DOCUMENT CONFLICTS. In event of conflict between the requirements of this section and the applicable aircraft component DMWR or TM, the aircraft component DMWR or TM shall take precedence. The requirements of this section shall take precedence over any other specifications or standards referenced herein.

##### B-27.3. MATERIAL REQUIREMENTS.

B-27.3.1. The plastic media type used for the PMB process shall be in accordance with MIL-P-85891 Type V, 20-40 particle size. Optional media and particle size is not authorized unless approved by the aircraft component DMWR or TM.

B-27.3.2. Media used on ferrous alloys shall not be used on parts made of aluminum, magnesium, or titanium.

B-27.3.3. Media having a high density level of 200 parts per million (ppm) or more of any type of contamination can cause mechanical damage. Purge and dispose of contaminated media.

### **CAUTION**

PMB with heavily contaminated media may permanently damage substrate surfaces.

#### **B-27.4. EQUIPMENT REQUIREMENTS.**

##### **B-27.4.1. General.**

a. PMB equipment used to remove organic coatings from aircraft components shall be a direct pressure feed abrasive blasting unit capable of propelling a controlled and continuous stream of plastic media from 15-40 psi and 0-500 pound per hour media flow. The equipment shall be equipped with setting indicators and regulation devices. A blast cabinet (glove box) or walk-in type facility may be used.

b. Siphon fed abrasive blasting equipment shall not be used for plastic media blasting.

c. PMB equipment shall have a recovery system, consisting of a cyclone separator, a rotary airlock, a magnetic particle separator, and a screen separator. The recovery system shall be capable of producing media cleanliness levels as described in B-27.4.1.f. Alternate recovery system configurations require engineering approval prior to use.

d. The blast cabinet or walk-in facility shall have lighting capable of producing a minimum of 55 foot candles illumination at the work surface. Portable lighting may be used to eliminate shadows at the work surface. All lighting shall meet the requirements of the National Electric Code for Class II Division 1 locations (dust ignition proof). Reference Army Regulation 11-27.

e. Nozzles shall be venturi type,  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in diameter, constructed of a material with an abrasive resistant characteristic of tungsten carbide or better.

f. PMB equipment shall be capable of maintaining acceptable levels of media size per MIL-P-85891 and cleanliness of 200 parts per million or less of heavy particle contamination.

g. Compressed air supply to the PMB equipment shall be dry and filtered, 60% maximum relative humidity. Dedicated source is recommended.

h. Preventative maintenance shall be in accordance with the manufacturer's recommendations, including allowable nozzle ID wear. Annual PM program for the PMB equipment shall include replacing worn nozzles, lines, and valves; recalibrating pressure and flow gages on the equipment; and re-certification for full capability for the intended PMB operation.

i. Equipment certification shall include calibration of air pressure gages, verification of pressure at nozzle exit, and flow rate.

j. Re-certification shall be required of any equipment that was repaired or is deemed responsible for failure to produce consistent results, including supply air, operator, or media deficiencies, prior to returning to production.

k. There shall be sufficient PMB units to support the PMB operations so that processing Ferrous Alloys, Titanium, Magnesium, Thorium, etc., are each done in their own dedicated separate units (designed for that purpose), different from the units used for all other work. If this is not feasible, the media shall be completely purged when switching between these different processes.

B-27.4.2. Glove Box Cabinet Type Equipment. Glove Box Cabinets shall be specifically designed for use with plastic media meeting the general requirements above. All aircraft component parts shall be processed using the Glove Box Cabinets unless the equipment is not capable or the part will not properly fit inside the cabinet.

B-27.4.3. Walk-In Facility. This processing is authorized when the part or component exceeds the size limitations of the Glove Box Cabinet. The Walk-In Facility (open blasting), in addition to the general requirements, shall meet the requirements of OSHA 29CFR1910.9:

a. Ventilation. A minimum cross-draft ventilation rate of 75 cubic feet/minute per square foot of open face area shall be provided.

b. Dust Collector. The dust collector system shall be capable of removing 99.97% of the particles 0.3 (three tenths) micron or greater in size from re-circulation systems.

c. Dust Monitor. The dust monitor equipment shall be capable of continuously monitoring explosive conditions of air in the facility.

d. Safety. Walk-in room operator safety equipment shall include a carbon monoxide monitor, respiratory equipment, blast hood and hearing protection. Safety equipment shall be as specified by the cognizant Safety and Industrial Hygiene Department.

e. Maintenance. The Walk-In Facility shall be operated and maintained in accordance with the equipment manufacturer's instruction manual.

#### B-27.5. PMB PROCESS.

##### B-27.5.1. General Requirements.

B-27.5.1.1. The PMB blast shall be kept moving in an even sweeping motion and not allowed to dwell over one spot while maintaining stand off distance and nozzle angle.

B-27.5.1.2. The PMB operator shall stop the process immediately when any abnormality in the process is observed or damage to the substrate is noticed. Sometimes the coating scheme may be different than expected, media characteristics may change, air pressure may fluctuate, etc. The anomaly shall be corrected or appropriate changes made before proceeding.

B-27.5.1.3. An operating procedure or processing sheet shall be developed for each part and shall include the following:

- a. P/N, substrate (including plating), and identification of film to be removed (indicate limitations).
- b. Part preparation, including cleaning and masking.
- c. Media type, specification.
- d. Air pressure.
- e. Flow rate.
- f. Stand off distance.
- g. Angle of impingement.
- h. Maximum dwell time.

i. Post processing cleaning, inspection, flow.

j. Special instructions.

#### **NOTE**

The aircraft component DMWR or TM may exclude certain parameters as stated above, as required.

B-27.5.1.4. The air pressure selected for removal of organic coatings shall be within 25-40 psig, unless otherwise specified in the aircraft component DMWR or TM.

B-27.5.1.5. The air pressures selected for general cleaning and removal of oxides and carbon deposits shall be within 15-25 psig, unless otherwise specified in aircraft component DMWR or TM.

B-27.5.1.6. The angle of impingement shall be within 45-90 degrees, unless otherwise specified in aircraft component DMWR or TM.

B-27.5.1.7. The minimum stand off distance of nozzle to workplace shall be 2 inches unless otherwise specified in aircraft component DMWR or TM.

B-27.5.1.8. Metal parts with wall thickness less than 0.032 inch shall not be PMB processed.

B-27.5.1.9. Parts and components must be free of oil, grease, dirt, or other contamination, and shall be air dried prior to PMB blasting.

B-27.5.1.10. Masking of aircraft component parts shall be as required in order to protect sensitive areas, areas that do not require PMB, or that require a different PMB process, and to avoid media intrusion in internal passages or bearing surfaces. The following masking methods are acceptable as required.

- a. Tape, impact resistant, 3M 500, BT 100, or equivalent.
- b. Plugs, oversize, tapered, made from Neoprene rubber are recommended.
- c. Bags.
- d. Fixtures and covers.
- e. BER mating parts.
- f. Molds.

B-27.5.1.11. Masking used shall be made to adequately withstand the blasting force, prevent media intrusion, and protect from mechanical damage. The effectiveness of the masking shall be verified by visual and fiber optic inspection before approving initial production.

B-27.5.2. Critical Parts.

B-27.5.2.1. All parts with internal air or fluid passages or areas that may entrap PMB media that could remain entrapped until assembly and/or cause cross contamination of other subsequent processing of the end item, will be masked to prevent media intrusion.

B-27.5.2.2. Thoroughly clean excess PMB media from the parts by vacuuming or blowing with dry/filtered compressed air before removing the masking. Then vacuum or blow air through the internal passages to remove any entrapped media.

B-27.5.2.3. Flush with solvent or detergent as required by the applicable aircraft component DMWR or TM to clear internal passages.

B-27.5.2.4. FSP with Critical Inspection Points shall be Fiber Optic inspected after PMB, cleaning, and flushing, and evidence of the inspection shall be maintained on file.

B-27.5.3. Soft Metal Parts.

B-27.5.3.1. Unless otherwise specified in the aircraft component DMWR or TM, aluminum and magnesium parts shall only be stripped to the primer layer applied to the anodized or chemical surface treatment. They may exhibit a haze of primer after stripping.

B-27.5.3.2. Magnesium parts coated with Rock Hard® resin coating or MIL-R-3043 resin coatings shall be stripped only to the resin coatings if subsequent penetrant inspection is required.

B-27.5.3.3. If the chemical conversion coating, anodize, or resin coating has been completely removed exposing the bare metal substrate, etching to remove flowed metal shall be required after PMB and before NDI. Refer to applicable aircraft component DMWR or TM for etching chemicals and process. The chemical

conversion coating, anodize, or resin coating shall be re-applied before re-painting.

B-27.5.4. Titanium Parts. Titanium parts may be stripped to bare metal. Any chemical conversion coatings or soft metal platings removed shall be re-applied.

B-27.5.5. Ferrous Parts. Ferrous alloy parts may be stripped to bare metal if these are not cadmium plated. Any chemical conversion coatings or soft metal platings removed shall be re-applied.

B-27.5.6. Non-Metal Parts.

B-27.5.6.1. Non-metal surfaces may be stripped to the primer layer. The lowest effective air pressure setting should be used to avoid damaging the surface.

B-27.5.6.2. A rough haze or exposed fibers is unacceptable.

B-27.5.7. Post Processing.

B-27.5.7.1. All parts blasted by PMB shall be thoroughly cleaned by blowing with dry/filtered air or vacuuming. If masking was applied, masking shall not be removed prior to blowing with air. Other media cleaning methods, such as ultrasonic cleaning or solvent flushing, may be used as per the applicable aircraft component DMWR or TM.

B-27.5.7.2. After removing the masking, clean the part per the applicable aircraft component DMWR or TM to remove lingering PMB media and masking residue.

B-27.5.7.3. Parts susceptible to corrosion that have been stripped to bare metal shall be coated with a corrosion preventive compound if subsequent processing is delayed.

B-27.6. TRAINING AND CERTIFICATION REQUIREMENTS.

Personnel performing and supervising media blasting of organic coatings from aircraft component surfaces shall complete a training program leading to certification. An AMCOM authorized source shall be used for the initial training and certification. Operators shall be re-certified every two years.

**APPENDIX B  
SUPPLEMENTAL REQUIREMENTS FOR ARMY AIRCRAFT**

**SECTION VIII. CONSUMABLE MATERIALS**

Table B-3. Consumable Materials

Item	Nomenclature	Specification	NSN	QTY
1	Coating Compound Metal Pre-treatment	MIL-C-8514	8030-00-082-2425	KT
2	Primer, Wash	DOD-P-15328	8030-00-535-2726	KT (1 OZ)
3	Corrosion Removing and Metal Conditioning	MIL-C-10578	6850-00-854-7952	DR (5 GL)
4	Corrosion Removing Compound	A-A-59261	6850-00-935-5853	DR (425 LB)
5	Sulfuric Acid	A-A-55828	6810-00-227-1845	BT (5 PT)
6	Hydrofluoric Acid	MIL-A-24641	6810-00-543-4012	GL
7	Sodium Dichromate	A-A-59123	6810-00-262-8566	BT (5 LB)
8	Resin Coating	MIL-PRF-3043	8030-00-200-6946	CN (75 LB)
9	Corrosion Removal Compound	SAE AMS 1640	6850-00-527-2426	CN (5 GL)
10	Brush Platers. Hard Swab (1.5" wide)	H-B-178/1-2	7920-00-244-7431	EA
11	Chromium Trioxide, Technical Grade	A-A-55827	6810-00-264-6517	CN (5 LB)
12	Epoxy Primer, Lead and Chromate Free	MIL-DTL-53022	8010-01-193-0517	KT (1 GL)
13	Washing Compound	P-D-410	7930-00-880-4454	BX (6 - 1 GL)
14	Tribasic Sodium Phosphate	O-S-642	6810-00-141-6078	LB
15	Inhibitor, Icing, Fuel	MIL-DTL-85470	6850-01-057-6427 6850-01-377-5074 6850-01-089-5514	GL CN (5 GL) DR (55 GL)
16	Aqueous Cleaning Solutions	HURRISAFE 8015 HURRISAFE 8065	6850-01-426-6682 6850-01-434-6556 6850-01-434-6557	5 GL 6 - 1 GL 12 - 32 OZ Trig Sprayers

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Official:



JOYCE E. MORROW  
*Administrative Assistant to the  
Secretary of the Army*

1023004

GEORGE W. CASEY, JR.  
*General, United States Army  
Chief of Staff*

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