CORROSION PREVENTION MANUAL

GENERAL INFORMATION
(VOLUME 1)
SPECIFIC INFORMATION
(VOLUME 2)
MODELS 707 AND 727 THROUGH 777

BOEING DOCUMENT D6-82560
PUBLISHED BY THE BOEING COMPANY, SEATTLE, WASHINGTON, U.S.A.

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CORROSION PREVENTION MANUAL
BOEING DOCUMENT D6-82560
October 1, 2003

To: ALL holders of Corrosion Prevention Manual, Boeing Document D6-82560

Revision five Volumes 1 and 2 dated October 1, 2003 is attached.

The original issue of new Corrosion Prevention Manual, Boeing Document D6-82560 Volume 1, was released June 15, 2000. Volume 1 is applicable to Boeing Airplane Models 707 and 727 through 777.

Volume 1 replaces Part 1 in old Corrosion Prevention Manuals

D6-41910 (Models 707, 727, 737, and 747)
D634T401 (Models 757 and 767).
D634W401 (Model 777)

Volume 2 replaces Parts II and III in old Corrosion Prevention Manuals listed above.

Corrosion Prevention Manual D6-82560 (volumes 1 and 2) revision schedule is April 1 and October 1.

ATTENTION

IF YOU GET PRINTED REVISIONS, PLEASE MAKE SURE YOU HAVE FILED THE PREVIOUS REVISION. BOEING MUST BE NOTIFIED WITHIN 30 DAYS IF YOU DID NOT GET THE PREVIOUS REVISION. REQUESTS FOR REVISIONS OTHER THAN THE PREVIOUS REVISION WILL REQUIRE A COMPLETE MANUAL REPRINT SUBJECT TO REPRINT CHARGES SHOWN IN THE CSMS CATALOG.

FILING INSTRUCTIONS

Refer to the List of Effective Pages (LEP) for the Latest date of issue of all pages within the manual.

NOTE
The Volume 1 LEP is located in the beginning of Volume 1.
The Volume 2 LEPS are located at the beginning of each Airplane Model section.

Pages revised, added or deleted are indicated by an asterisk (*) against the applicable page in the LEP.

File all pages included in this revision in the order indicated in the LEP.

CORROSION PREVENTION MANUAL
BOEING DOCUMENT D6-82560
October 1, 2003

Description of Change

Volume 1

No changes to Volume 1 in this revision.

Volume 2

No changes to Volume 2 in this revision.

REVISION RECORD

All revisions to this manual will be accompanied by a transmittal sheet bearing the revision number. Enter the revision number in numerical order, together with the date filed and the initials of the person filing, in the form below:

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Chapter-Section

CORROSION PREVENTION MANUAL

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CORROSION PREVENTION MANUAL
VOLUMES 1 AND 2 INTRODUCTION

1. General

A. The purpose of this manual is to provide the operators with information to implement corrosion prevention programs for their fleets. Some of this information has already been transmitted to the operator by other means, such as all service letters or service bulletins, but has been included in this manual as a more consolidated means of retaining the data.

B. It is the intention to revise this manual semi annually to update the information. By publishing data in this manual, it is hoped that many operators will be spared corrosion problems by taking preventive action in areas where experience has shown that corrosion may occur. It has been demonstrated that effective corrosion control programs by operators have significantly reduced the magnitude of the corrosion maintenance problem. Consequently, operators are urged to share any new corrosion experiences by forwarding information through the local Boeing Customer Support representative or direct to:

Manager, Maintenance and Maintenance Engineering Technical Services
Boeing Customer Support
P. O. Box 3707
Seattle, Washington 98124-2207

C. The information contained in this manual is of an advisory nature and it is recommended for use in developing a corrosion control program meeting the specific needs of the individual operator. Where allowable damage data are required in the section concerned with corrosion control, reference will normally be made to other documents which have been formally approved, i.e., the applicable Structural Repair Manual.

2. Arrangement of Manual

A. The manual is divided into two volumes. Volume 1 contains general data applicable to all models (707 and 727 through 777). Volume 2 contains data, by specific model, on recommended preventive maintenance practices and how corrosion is to be dealt with, should it occur.

B. Each volume of the manual is divided using the ATA-100 Chapter/Section/Subject numbering system.

C. Volume 1 uses Chapter 20, Standard Practices, Airframe, which is divided, into Sections dealing with various general topics.

D. Volume 2 uses ATA 100 Chapters and Sections to describe corrosion problems. These sections are then subdivided by the use of subject numbers for data on specific problems.

3. Applicability of Data

A. Where data applies only to a limited number of airplanes of one model, effectivity is specified by line number or customer block number. This indicates at which point in the production line changes were introduced. Refer to the Structural Repair Manual for a list of airplanes with their line numbers.

B. Reference is made to applicable Service Bulletins where necessary, but no attempt is made to indicate the modification status of operator's airplanes.

4. Revisions to Manual

A. Semi annual revisions are issued to the manual to update existing data or to introduce new material. Revision bars indicate changed or added data.

B. Where the need arises to disseminate information on a more urgent basis than can be achieved by regular revision, temporary revisions on yellow paper can be issued.

C. A revision record and a temporary revision and Service Bulletin record are supplied at the front of this manual. Operators should update these records when incorporating revised material in the book.

5. Lists of Effective Pages

A. Lists of effective pages showing the latest revision date for each of the pages contained within volume 1 are included in the front matter.

B. List of effective pages showing the latest revision for each of the pages contained within Volume 2 are included at the beginning of each particular airplane model section.

6. List of Acronyms

A. MC - Master Change

B. MPD - Maintenance Planning Document

C. PCR - Publication Change Request

D. PRR - Production Revision Request

E. RR - Rapid Revision

F. SB - Service Bulletin

G. SL - Service Letter

H. SOPM - Standard Operating Procedures Manual

I. SRM - Structural Repair Manual

J. SRP - Service Related Problem

K. TR - Temporary Revision

7. How to Use the Manual

A. The method of using the manual is dependent upon the type of information being sought. If the reader is involved with planning or executing a corrosion prevention program, the logical place to start is in Volume 2. The index at the beginning of each ATA chapter will show the anticipated problem areas, and if they are limited to only part of the fleet, the airplane effectivity. The index will refer to the specific recommended corrosion prevention procedure contained within Volume 2 and will also indicate corrective information as required.

B. Volume 2 will refer to Volume 1 for general procedures. Volume 1 also contains general information on corrosion and how to combat it. Familiarity with Volume 1 will help the reader to understand what initiates corrosion and what should be done to prevent it.

C. Any inspection intervals we give in this manual should be the same as the intervals specified in the Maintenance Planning Document (MPD). If you find any differences, use the intervals given in the MPD.

8. Publications Change Requests

A. Communications concerning this publication should be directed to Boeing Commercial Airplane Group; Attention: Manager, Maintenance Engineering Technical Services. To facilitate uniform handling and to provide direct routing of your questions to the proper Boeing organization, use of the Publications Change Request (PCR) Form is encouraged. Boeing makes this form available through your publication organization.

9. Vendors

A. In the text, we refer to vendors by name and, if available, the Commercial and Government Entity (CAGE) code number. (The CAGE codes are listed in the Federal Cataloging Handbook H4/H8.) In the lists below, we give you the vendor names, codes, and mailing addresses.

B. Vendors with no code:

INTERNATIONAL RESEARCH AND DEVELOPMENT CO.
FOSSWAY
NEWCASTLE-UPON-TYNE NE6 2YD ENGLAND

C. Vendors with Commercial and Government Entity (CAGE) codes. (Refer to the latest issue of the Federal Cataloging Handbook H4/H8 for up-to-date information.)

VH0951	SIKKENS LAKFABRIEKEN BV RIJKSSTRAATWEG 31 P. O. BOX 3 2170 AJ SASSENHEIM THE NETHERLANDS
VS4259	ORION DIAGNOSTICA P.O. BOX 83 02101 ESPOO, FINLAND TELEPHONE 358-9-429 2888
VZ0033	GIBSON CHEMICALS, LTD 350 RESERVE ROAD CHELTENHAM, VICTORIA, AUSTRALIA 3192

VOCDK6 INTERNATIONAL RESEARCH AND DEVELOPMENT, INC.
110 MARTER AVE., SUITE 303
MOORESTOWN, NJ 08057

VOK209 INLAND TECHNOLOGY, INC.
2612 PACIFIC HIGHWAY EAST
NORTH C
TACOMA, WA 98424

VOL040 DINOL INTERNATIONAL
20600 EUREKA ROAD, SUITE 414
TAYLOR, MI 48180-5306

V01139 GENERAL ELECTRIC CO.
SILICONE PRODUCTS BUSINESS DEPT.
HUDSON RIVER ROAD
WATERFORD, NY 12188

V06030 SUNSHINE SCIENTIFIC INSTRUMENTS, INC.
1810 GRANT AVE.
PHILADELPHIA, PA 19115

V07036 NORDSON CORP.
JACKSON STREET
AMHERST, OH 44001

V07334 BINKS MANUFACTURING CO.
9201 W. BELMONT AVE. FRANKLIN PARK,
IL 60131-2807

V1E874 ATLANTIC RICHFIELD CO.
WATSON REFINERY
1801 E. SEPULVEDA BLVD.
CARSON, CA 90745-6121

V1L860 MENASHA CORP.,CONTAINER DIVISION
HIGHWAY 41, P. O. BOX 367
NEENAH, WI 54956

V13091 ROCHESTER MIDLAND CORP.
P. O. BOX 1515
ROCHESTER, NY 14603-1515

V17431	THE DEVILBISS CO DIV. OF CHAMPION SPARK PLUG CO. 300 PHILLIPS AVE., P. O. BOX 913 TOLEDO, OH 43692-0913
V2R369	NORDSON CORP. 555 JACKSON STREET AMHERST, OH 44001-2408
V23373	ARDROX INC. 16961 KNOTT AVE. LA MIRADA, CA 90638-6015
V25980	GRACO INC. 60 ELEVENTH AVE. NE MINNEAPOLIS, MN 55440
V29700	EXXON CO., U.S. A., COMMERCIAL SALES 800 BELL ST., P. O. BOX 2180 HOUSTON, TX 77252-2180
V37636	MAGNAFLUX CORP. 7300 WEST LAWRENCE AVE. CHICAGO, IL 60656-1314
V4H372	CHEVRON USA., INC. 1301 FIFTH AVENUE, ROOM 2900 P. O. BOX 220 SEATTLE, WA 98111
V40161	FUEL QUALITY SERVICE, INC. P. O. BOX 1380 FLOWERY BRANCH, GA 30542
V45738	OXY METAL INDUSTRIES CORP., PARKER COMPANY 32100 STEPHENSON HIGHWAY MADISON HEIGHTS, MI 48071-1003
V47186	HAMMONDS TECHNICAL SERVICES, INC. 1151 KITTYCREST LANE P. O. BOX 38114-373 HOUSTON, TX 77238-8114

V5X376 TRAYCO, INC.
1307 NATIONAL CEMETARY ROAD
P. O. BOX 950
FLORENCE, SC 29503
OR
693 SOUTH COURT STREET
LAPEER, MI 48446

V57573 NILFISK OF AMERICA
300 TECHNOLOGY DRIVE
MALVERN, PA 19355-1311

V66724 HOLT LLOYD CORP.
4647 HUGH HOWELL ROAD
TUCKER, GA 30084-5004

V70829 J. T. BAKER CHEMICAL CO.
222 RED SCHOOL LANE
PHILLIPSBURG, NJ 08865-2219

V72527 VALVOLINE OIL CO.
200 EAST MAIN STREET
P. O. BOX 1400
LEXINGTON, KY 40512

V73138 BECKMAN INDUSTRIAL CORP.
BECKMAN INDUSTRIAL TECHNOLOGIES SUBSIDIARY OF
EMERSON ELECTRIC CO.
4141 PALM STREET
FULLERTON, CA 92635

V73277 E. F. HOUGHTON AND CO.
MADISON AND VAN BUREN AVENUE
VALLEY FORGE, PA 19482

V79003 UNION OIL COMPANY OF CALIFORNIA
76 DIVISION, WESTERN REGION
461 SOUTH BOYLSTON STREET
P. O. BOX 7600
LOS ANGELES, CA 90017-1443

V8E913 ZIP-CHEM PRODUCTS
400 JARVIS DRIVE
MORGAN HILL, CA 95037

V8F610 UNION OIL CO. OF CALIFORNIA
2901 WESTERN AVE.
SEATTLE, WA 98111

V8H761 GETTY OIL CO.
200 EAST CENTRAL
EL DORADO, KS 67042-2130

V8P482 AIR BP
PRIMARY ROAD
HOPKINS INTERNATIONAL AIRPORT
CLEVELAND, OH 44135-3194

V86192 CLEMCO INDUSTRIES
P. O. BOX 7680
SAN FRANCISCO, CA 94120

V86961 SHELL CHEMICAL CO. DIV. OF SHELL OIL CO.
ONE SHELL PLAZA, P. O. BOX 2463
HOUSTON, TX 77001

V9V291 ASHLAND PETROLEUM CO., DIV. OF ASHLAND OIL, INC.
1409 WINCHESTER AVE., P. O. BOX 391
ASHLAND, KY 41114

V98308 CASTROL, INC.
1925 N. MARIANNA AVE.
LOS ANGELES, CA 90032-4007

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IDENTIFICATION TYPES AND CAUSES

1. General

A. The ability to recognize corrosion in its early stages is required to enable corrective action to be taken before costly repairs or replacements become necessary.

2. Identification

A. Aluminum Alloys -- Corrosion of the aluminum surface is usually indicated by whitish powdery deposits with dulling of the surface on unpainted parts. The white powdery deposit also forms at discontinuities in protective coating and may spread beneath paint causing blistering or flaking. As the corrosion attack advances, the surface will appear mottled or etched with pitting. Swelling or bulging of skins or pulled or popped rivets are often visual indications of corrosions.

B. Alloy and Carbon Steels -- Corrosion is indicated by red rust deposits and pitting of the affected surfaces.

C. Corrosion Resistant Steels -- Corrosion is indicated by black pits or a uniform reddish-brown surface.

3. Types

A. The terminology used in describing corrosion is based on either the appearance of the corrosive attack or the mechanism associated with its formation. Frequently, several types of corrosion will occur simultaneously and it becomes difficult to determine the specific cause.

B. The following types of corrosion are those most commonly experienced:

(1) Surface Corrosion -- Visible as uniform etching of the metal surface, and results from direct chemical attack.

(2) Pitting -- Detected as a series of pits on the metal surface, usually in small, well-defined local areas (Fig. 1).

(3) Exfoliation -- Inter granular corrosion characterized by bulging or blistering of the metal surface, resulting from the force created by expanding corrosion products at the grain boundaries (Fig. 2).

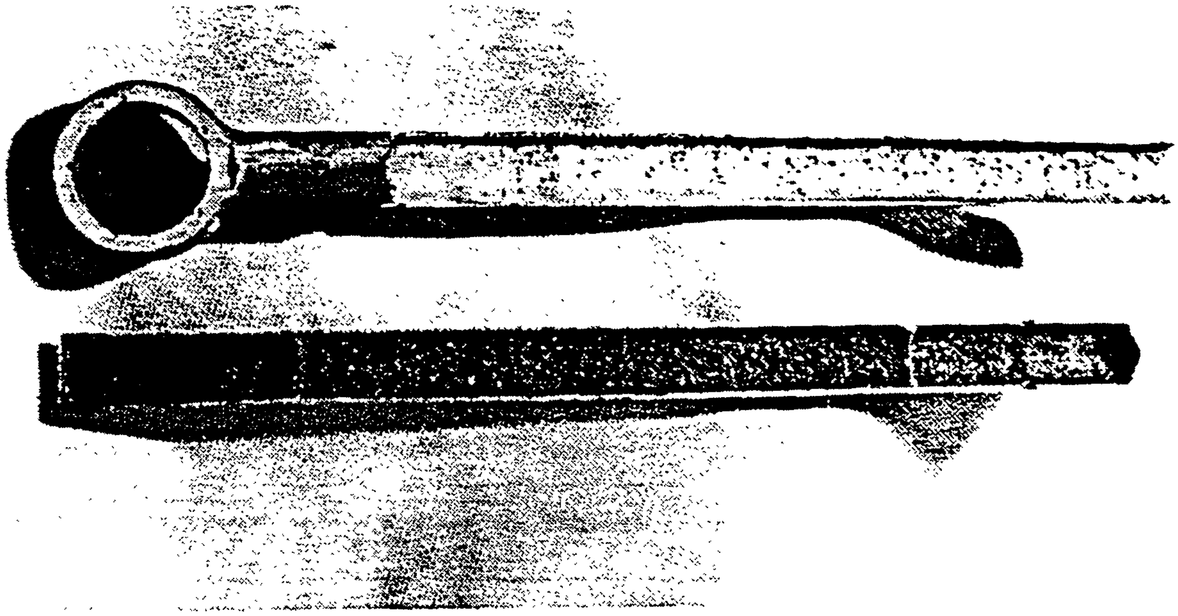
(4) Galvanic -- Usually visible as pitting and is often referred to as dissimilar metal corrosion. However, it is not limited to just dissimilar metal couples. Various types of concentration cells, where electron flow occurs between areas of points of different electrical potential, are also examples of galvanic corrosion. Pitting results when, in the presence of a conducting solution, electron flow occurs between different metals or between different points or areas on a metal surface exhibiting different electrical potential (Fig. 3 and 4).

(5) Filiform -- A thread-like type of corrosion characterized by unpredictable directional growth which develops under protective coatings on certain metals. It is usually found adjacent to fastener head and skins edges (Fig. 5).

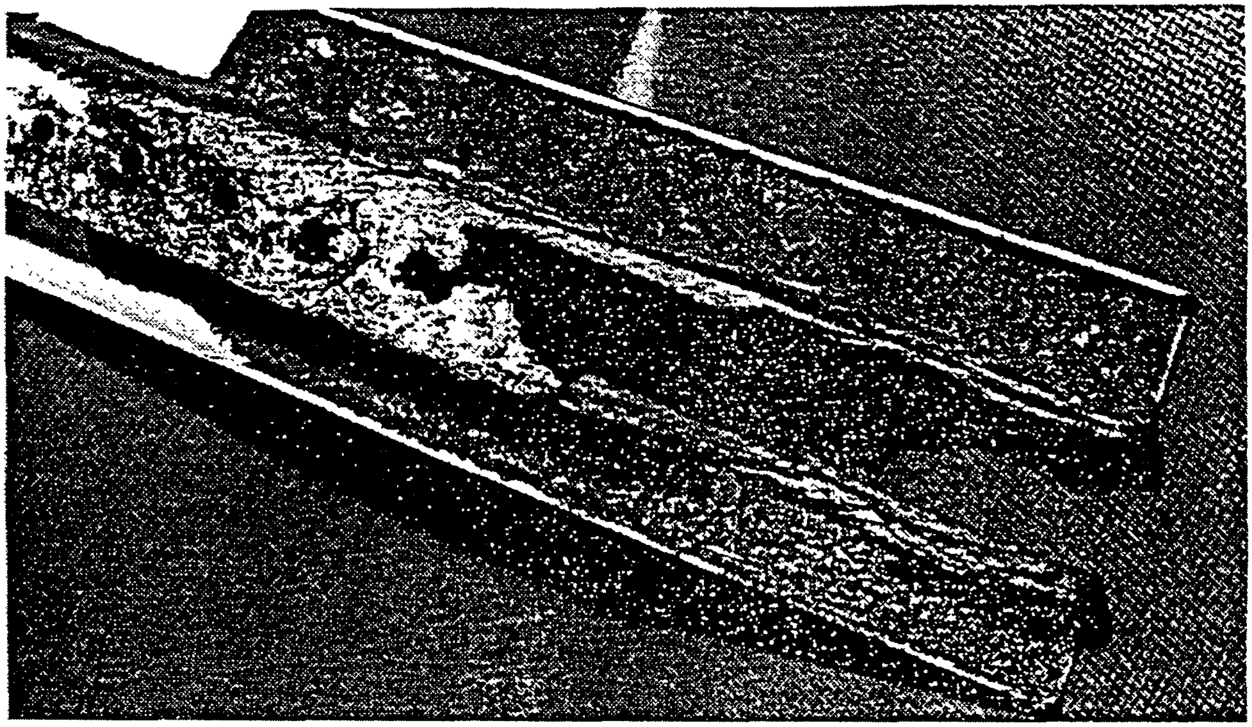
(6) Stress Corrosion -- This type usually manifests itself as fine cracks. It occurs in alloys that are susceptible to cracking when exposed to a corrosive environment while under a tensile stress (Fig. 6).

(7) Fretting Corrosion -- This type of corrosion damage occurs between close fitting parts which rub together. The wear or chafing breaks down the protective surface on either or both parts (Fig. 7).

(8) Microbial -- Occurs in integral fuel tanks and is caused by the presence of bacteria and fungus in jet fuel. The fungus grows at the fuel/water interface, and the metabolic products formed corrode the metallic structure (Fig. 8).



Example of Pitting Corrosion
Figure 1



Example of Exfoliation Corrosion
Figure 2

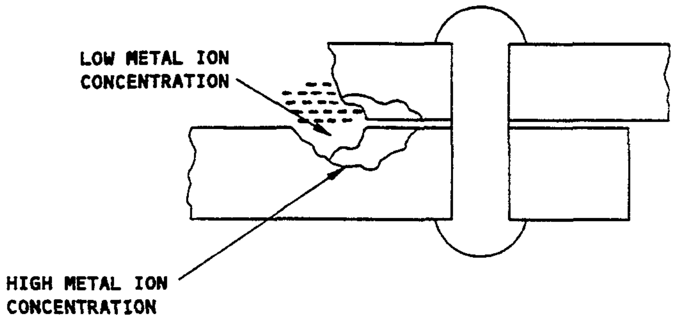
GROUP I	Magnesium and its alloys. Aluminum Alloys 1100,5052,5056,5356, 6061,6063
GROUP II	Cadmium, zinc, aluminum and their alloys (including Group I aluminum alloys)
GROUP III	Iron, lead, tin, and their alloys (except corrosion resistant steel)
GROUP IV	Chromium, nickel, titanium, copper and their alloys. Corrosion resistant steel, silver, graphite, tungsten **[1]**

NOTE

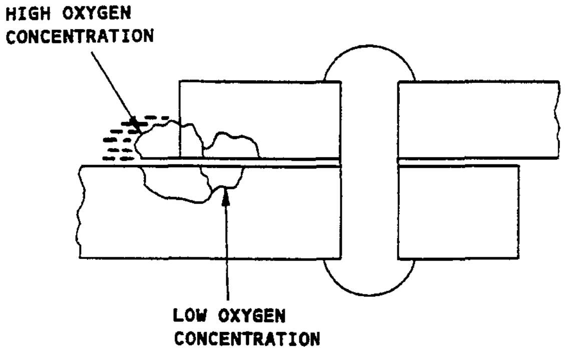
- MEMBERS OF ANY ONE GROUP ARE SIMILAR.
- MEMBERS OF DIFFERENT GROUPS ARE DISSIMILAR.

[1] CORROSION RESISTANT STEELS CONTAIN 14% OR MORE CHROMIUM

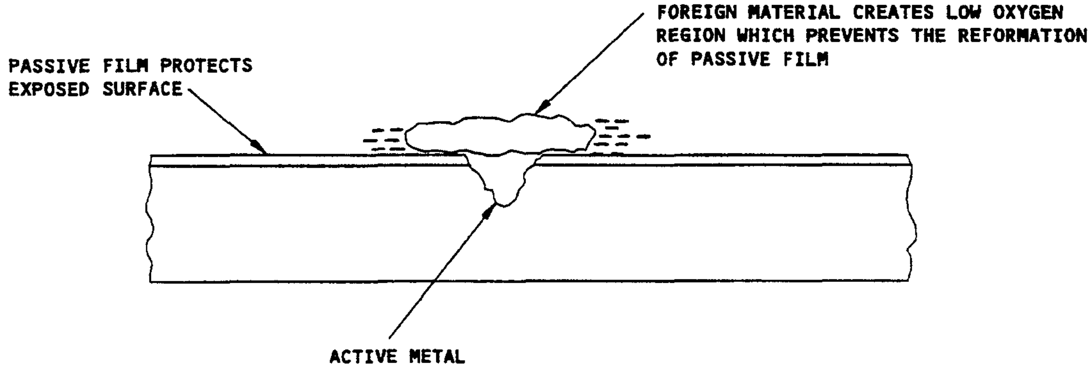
Classification of Dissimilar Metals
Figure 3



METAL ION CONCENTRATION CELL
RIVETED LAP JOINT

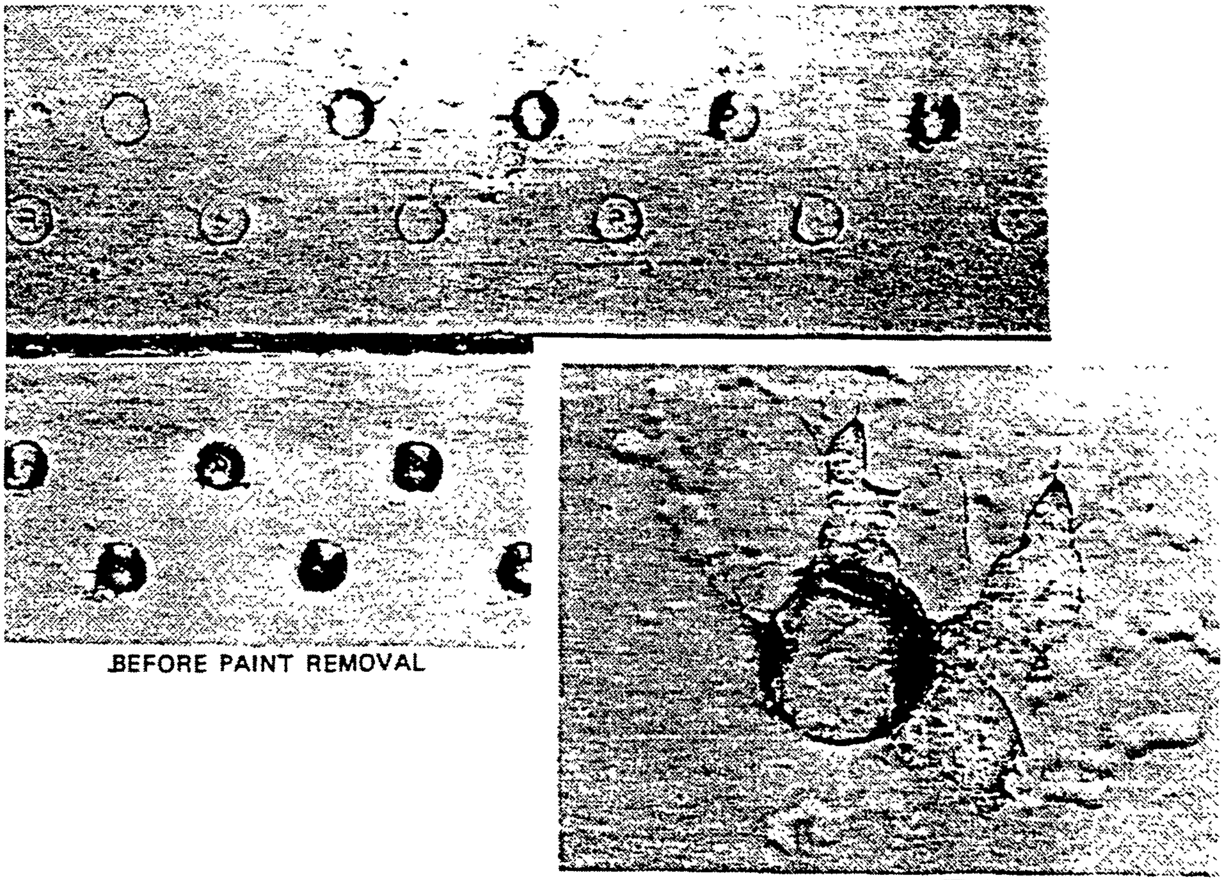


OXYGEN CONCENTRATION CELL



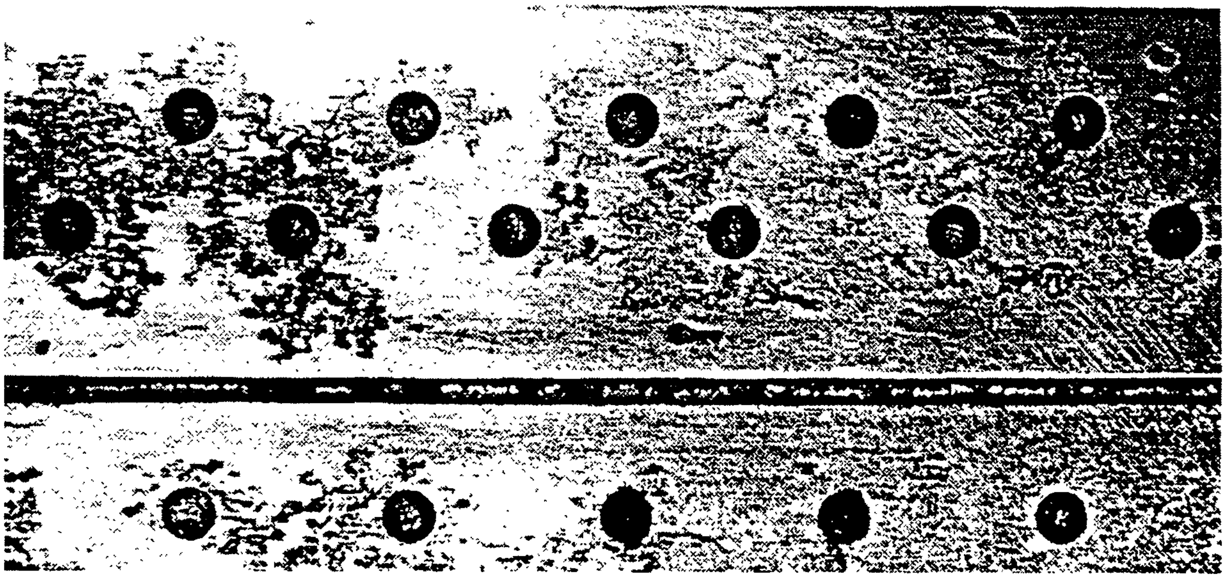
ACTIVE - PASSIVE CELL

Galvanic Corrosion Concentration Cells
Figure 4



BEFORE PAINT REMOVAL

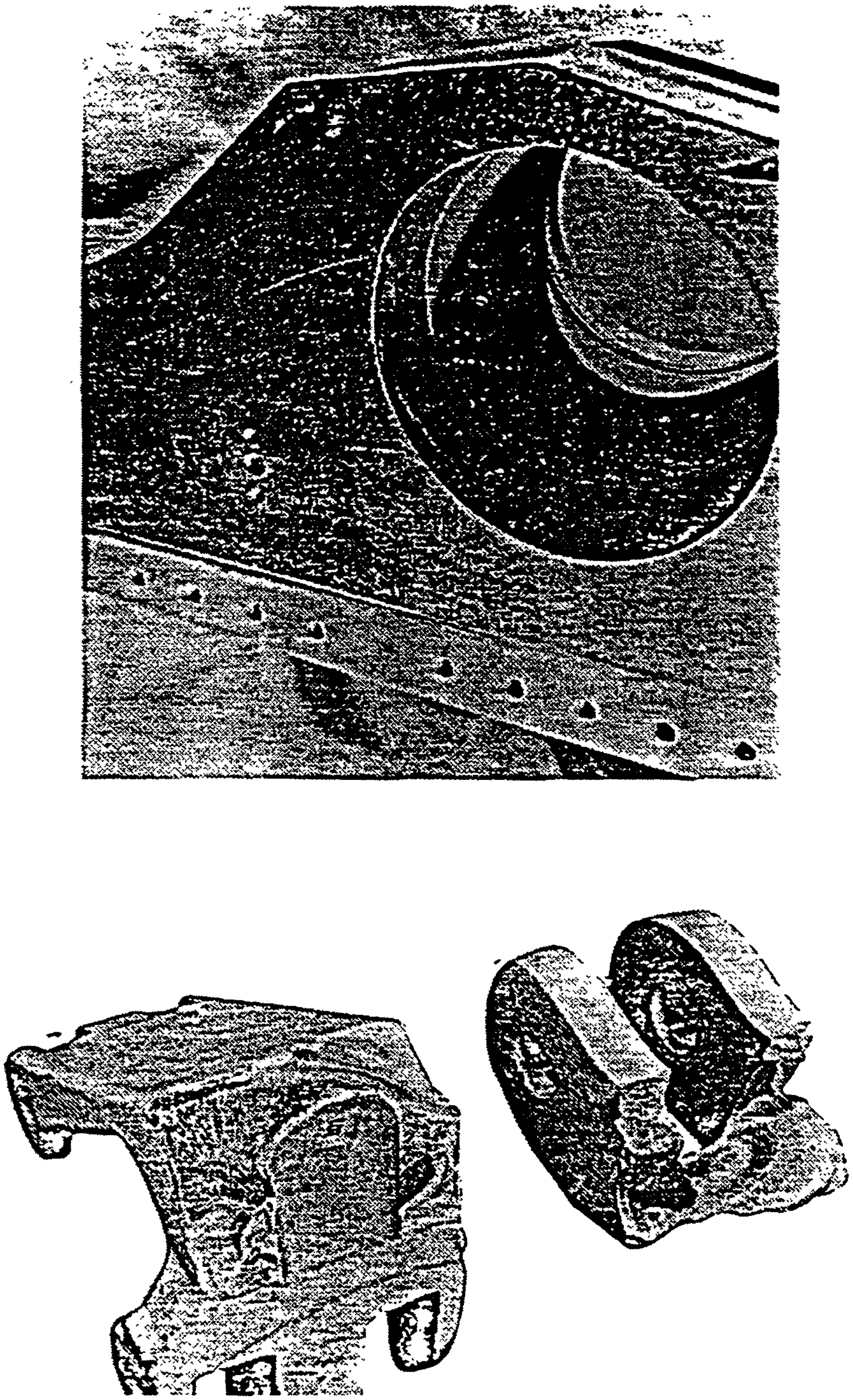
ENLARGED DETAIL



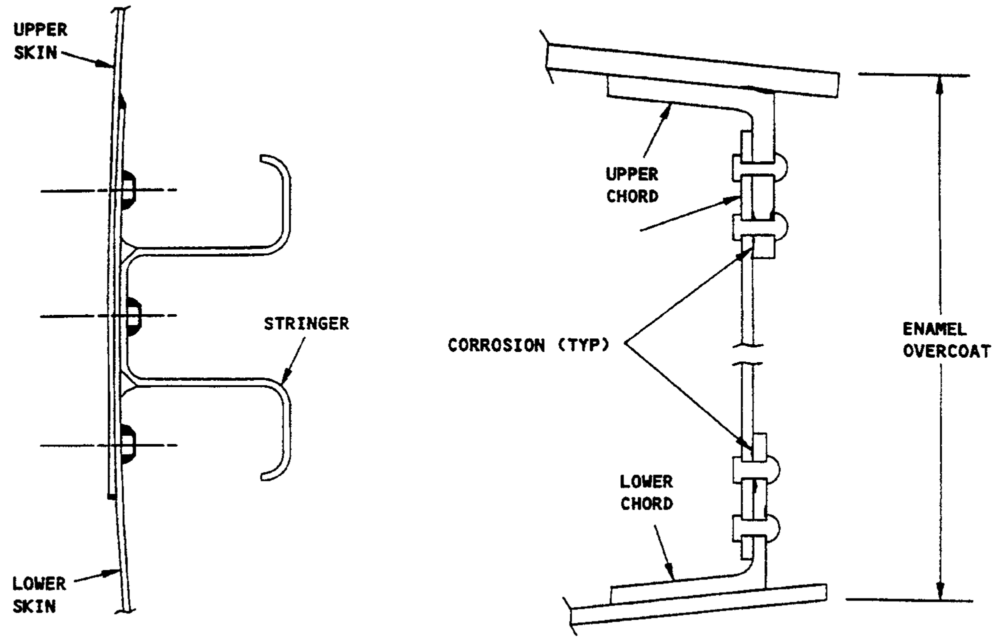
AFTER PAINT REMOVAL

Example of Filiform Corrosion

Figure 5

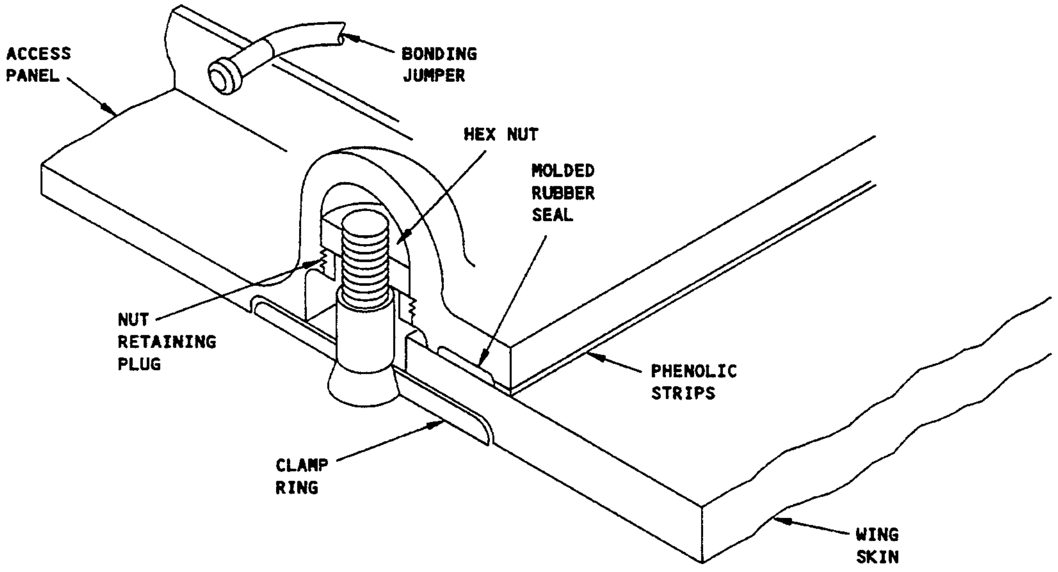


Example of Stress Corrosion Cracking
FIGURE 6



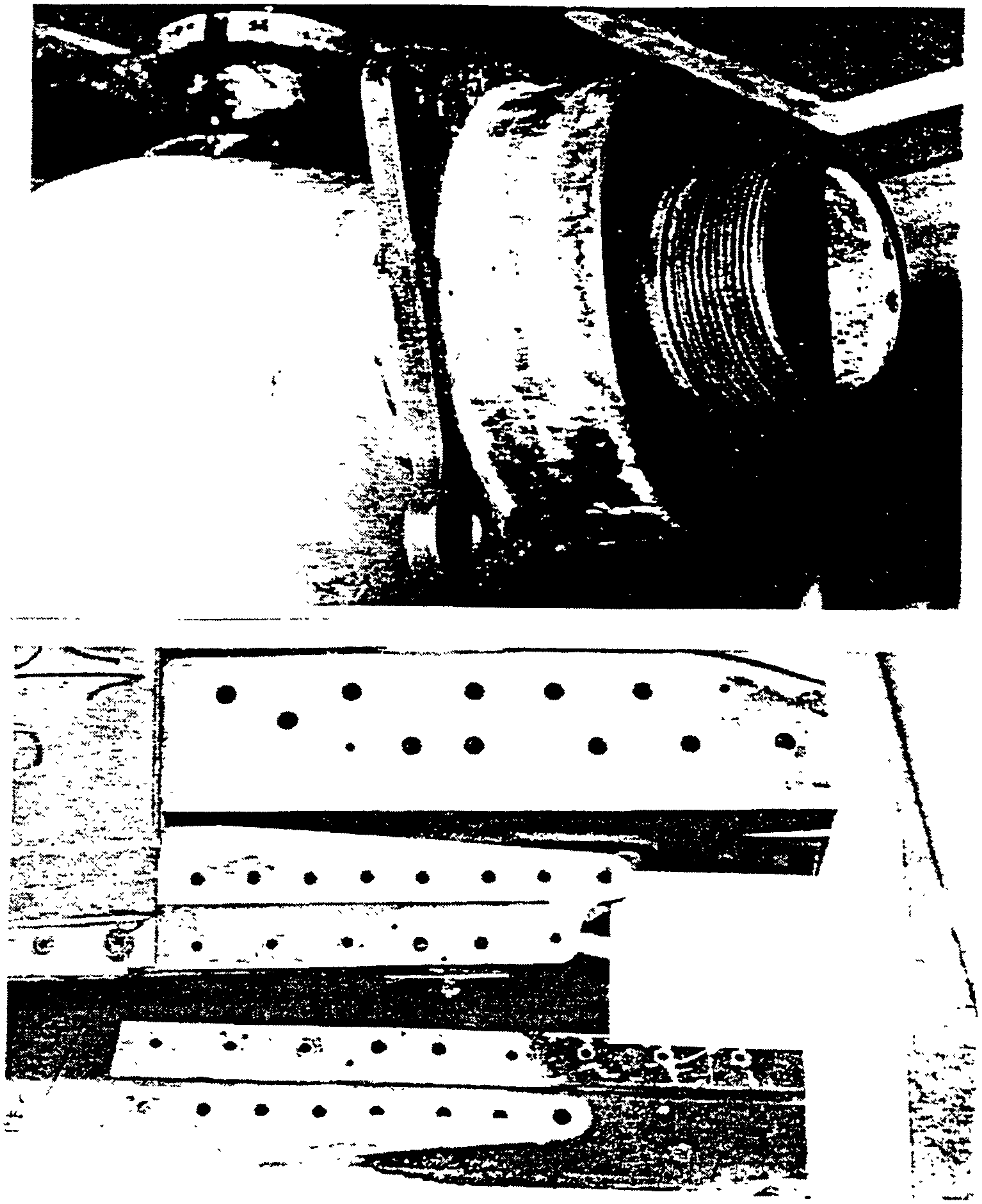
MOVEMENT DUE TO FUSELAGE PRESSURIZING

FRETTING DUE TO WING FLEX



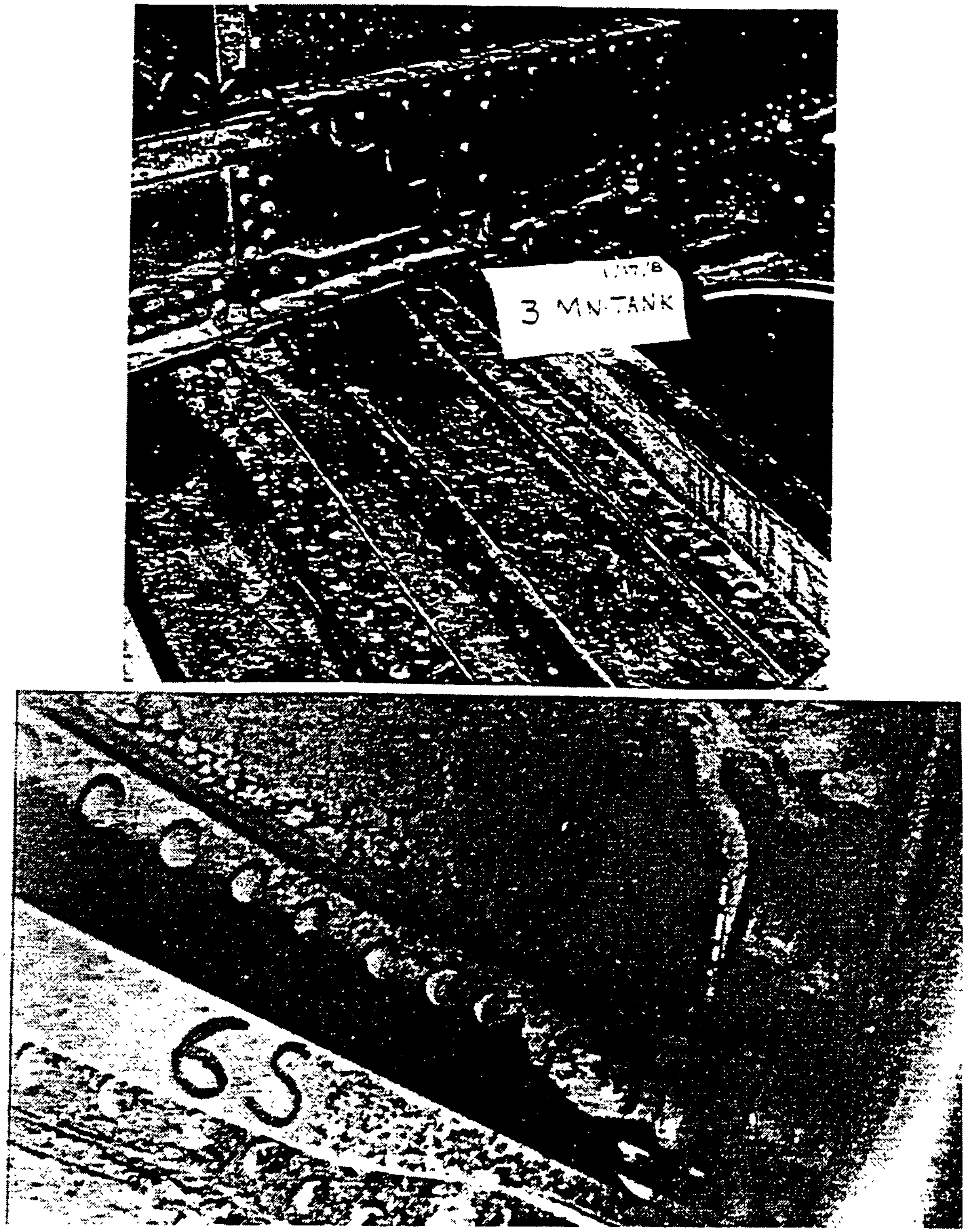
WING FUEL TANK ACCESS PANELS FRETTING WITH WING MOVEMENT

Example of Fretting Corrosion
Figure 7 (Sheet 1)

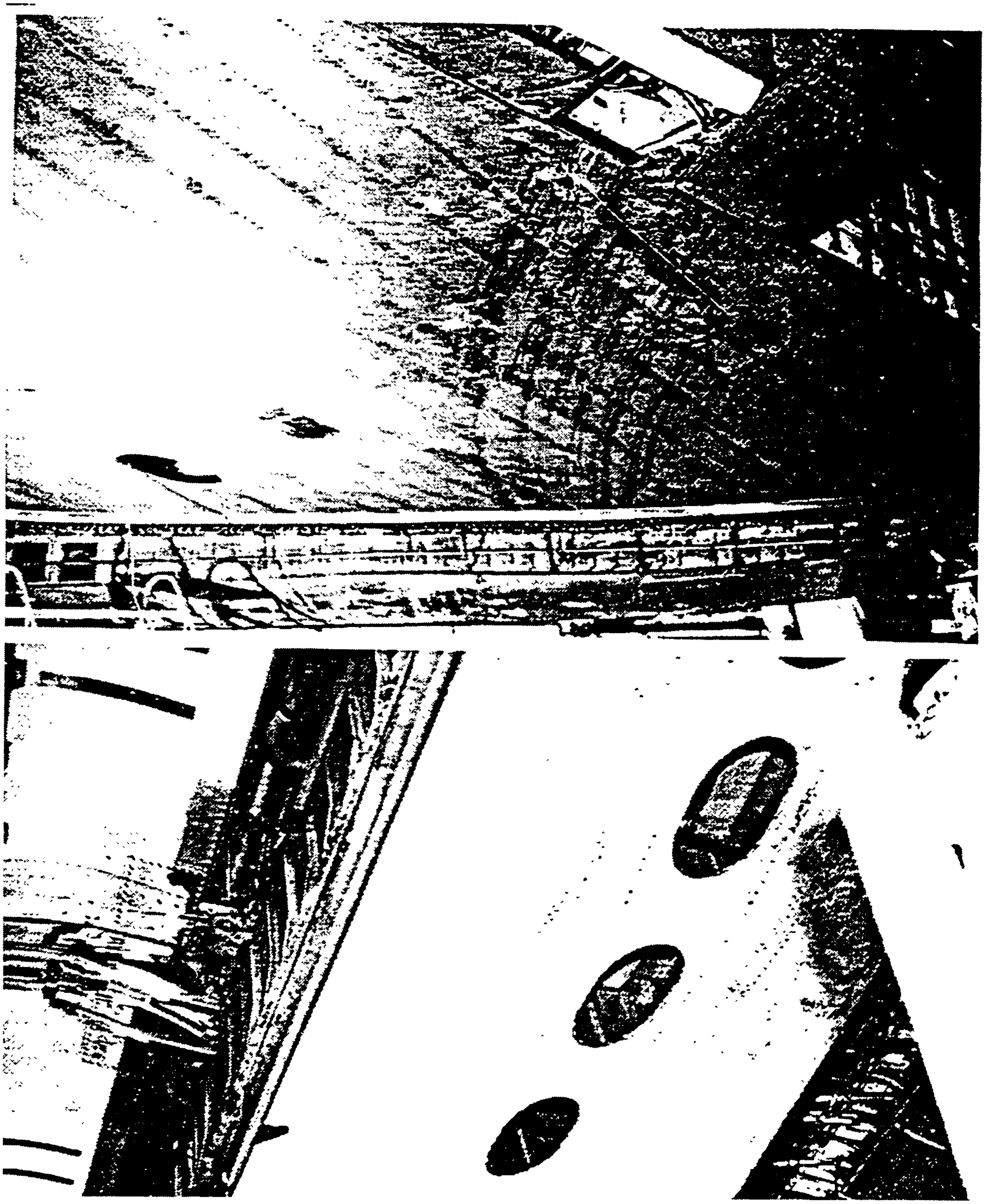


Example of Fretting Corrosion

Figure 7 (Sheet 2)



Example of Microbial Corrosion
Figure 8



Example of Galvanic Corrosion
Figure 9

GENERAL INFORMATION
INSPECTION AND DETECTION

1. Inspection for Corrosion

A. General

The regular maintenance program should include inspection for corrosion followed by correct treatment of affected areas. The areas should be inspected for not only actual corrosion damage but also for conditions that could cause corrosion (such as damaged finishes or blockage of drain holes). Because corrosion is a problem that will not go away, frequent inspection of the problem areas is recommended. Unusual environmental conditions in some geographical locations could make changes necessary to the frequency of inspections. Refer to 20-30-00 for more details.

B. Where to look. Because all parts of the airplane can get corrosion, each of the areas on the airplane must be examined regularly. Refer to Volume 2 for details of possible areas of corrosion and recommended frequencies of inspection and treatment. Here are some examples:

(1) Interior surfaces and lap joints. Be sure to include areas where drain holes could become clogged. Fittings, braces, component parts inside the airplane and structural shapes such as gussets, stiffener webs and material hog-outs can catch unwanted material and moisture to cause corrosion.

(2) Exterior skin areas, painted or not. Carefully examine skin areas on the fuselage, wing and tail. Be sure to include fastener locations and panel edges. If you find corrosion around fastener locations, be sure to remove the fasteners and look for corrosion under the fastener heads and in the holes. Corrosion removal around such fasteners without fastener removal will not stop the corrosion under the fasteners.

(3) Exposed fittings. Fittings and brackets open to wear or damage to surface finish can get corrosion. Such parts are in areas such as:

- (a) Horizontal stabilizer and vertical fin fittings
- (b) Engine mount fittings
- (c) Hydraulic and electrical brackets in the wheel well areas
- (d) Hydraulic and electrical brackets in the open areas of the front and rear spars of the wing.

(4) Floor beams and pressure webs. Traces of spillage under flooring should be investigated to determine if corrosion has occurred on floor beams or pressure webs. Areas around galleys, door entries, lavatories and battery compartments require special attention.

(5) Fairings and surfaces under fairings. Whenever fairings are removed for routine maintenance, the hidden structure under the fairings should be examined for indications of corrosion. The fairing, especially fiberglass fairings, should be examined for coating damage. Fiberglass panels are either aluminum flame sprayed or conductive coated for static bleed off and should be inspected for damaged coatings.

(6) Seat tracks. The slots in the seat track collect dirt and moisture and as a result are particularly susceptible to corrosion.

(7) Bilge area under cargo floor. The stringers and frames under the cargo floor should be inspected for corrosion resulting from accumulation of dirt, moisture and spillage from the cargo.

(8) Plumbing hardware. Exposed tubing B nuts and hydraulic components, tubing identification tapes and braided hoses are to be carefully inspected for signs of corrosion. Interior surfaces of ram air ducts, especially where one wall of the duct is a structural member, should be examined for corrosion damage.

(9) Moisture absorbing materials. In areas where there is little air circulation moisture absorbing materials such as leather, paper, foam rubber, soundproofing and insulation attached to or contacting metal structure can present troublesome corrosion suspect areas. These items should be removed for satisfactory inspection.

(10) Piano and other type hinges. Piano hinge failure generally occurs when the joint corrodes and a lug breaks when the joint is actuated. Inspection should include ease of actuation and evidence of corrosion products at the hinge mating surfaces. other hinges should be inspected for corrosion of bearings, inserts and fasteners.

(11) Integral fuel tanks. Periodic inspections of the integral fuel tanks for corrosions, pitting and blistering of the coating on the interior surfaces of the integral fuel tanks should be made. The interior walls should also be inspected for corrosion. Black areas should be checked for surface corrosion.

(12) Control cables. Examine the cables at scheduled inspections. Cable corrosion can start when the grease used as a corrosion preventive coating is gone.

C. Special Inspections. In instances where loading of nonstandard cargo (i.e. livestock) or cargo spillage of harmful products (i.e., mercury) occur, specific inspection requirements are initiated.

(1) Mercury. After a reported mercury spill in the cargo hold area, maintenance personnel are instructed to remove the spillage as rapidly as possible due to the damaging effect mercury has with aluminum structures. Visual inspections of mercury penetration into aluminum metals should be noted and reported. Detailed procedures for mercury spillage are given in 20-41-00.

(2) Livestock cargo. Subsequent to livestock hauling on an airplane, specific areas should inspected for signs of contaminants that cause corrosion. Detailed procedures are given in 20-61-00.

D. Methods of Inspection. Visual or nondestructive inspection (NDI) procedures are used for identifying the existence of corrosion. For general inspection, the visual means aided by magnifying glasses, borescopes, etc., is used extensively. The NDI techniques have limited capability to locate or detect corrosion because of complexity of instrumentation, complexity of areas being inspected and time consumed to make the inspection. In specific localized areas where inspection by visual means is impossible or where extent of corrosion has to be determined after visual detection, the NDI technique may be used. The following NDI techniques are used to inspect the localized areas; however, the method employed should be at the judgment of the NDI technician.

(1) Eddy current. Eddy current can be used to locate corrosion in skin, doubler and spar areas. The method is also used to determine if corrosion visible by corrosion products, skin bulging or joint dislocation has generated microcracks.

(2) Ultrasonic. Ultrasonic inspection technique is used for flaw detection in honeycomb sandwich constructions or bonded panels. Corrosion can be detected by measurement of panel thickness by ultransonic means.

(3) Radiographic. Radiography (X-ray) is used for flaw detection in areas not accessible for visual inspection without major disassembly. This method is also used for backup method to other NDI techniques (i.e., detect core corrosion in sandwich panels located by the ultransonic method). Severe corrosion can be detected by radiographic means if the depth or metal loss is 20% of the panel thickness or greater.

(4) Penetrant. The penetrant technique can be used on nonmagnetic parts such as thick skins, forgings, etc., after paint stripping and removal to determine the presence of cracks. This technique is also used to detect surface and intergrandular corrosion.

(5) Magnetic particle. This technique may be used on low alloy steel parts. The presence of microcracks, after paint stripping and corrosion removal, can be detected

2. Corrosion Detection

A. General. Painted metals, plated surfaces, or aluminum clad normally will not be susceptible to corrosion as unpainted, unplated or nonclad surfaces. The metals in the corrosion-affected areas are characterized by a scaly or blistered appearance, or at times by discoloration or blistering of the paint. Corrosion on metal surfaces can often be recognized by dulling, darkening, and pitting of the area and sometimes accompanied by whitish, whitish-grey or reddish deposits. Refer to 20-10-00 for identification of corrosion by metals.

B. NDI Procedure. Once visual detection of corrosion has been made, an assessment of the extent of corrosion damage must be made before repairs can be started. Where visual means cannot determine the extent of damage the applicable NDI technique can be used for the assessment. Microcracks must necessarily be checked by one of the NDI techniques.

C. Special. In some cases, operators will be transporting cargo that will require special detection attention or techniques due to the nature of the cargo. Examples of these cargoes are listed below:

(1) Mercury. During the transporting of mercury, containers have been known to break, spilling into cargo hold areas and seeking its way to airplane structure between frames, stringers, skins and under repair patches. Mercury is highly corrosive when in contact with aluminum and its alloy and will compromise the structural integrity of structural member affected. The presence of mercury in an area, after a known spill has been reported, can be identified by a white powder on the surface resulting from the chemical combination of mercury and aluminum particles. Detailed inspection, detection and treatment of mercury corrosion is explained in 20-41-00.

(2) Livestock. Special provisions are made for the transporting of livestock. There are several factors such as humidity, expulsion of salt from the body, waste spillage, etc., that require special corrosion detection techniques. Detailed inspection, detection and treatment for transportation of livestock is given in 20-61-00.

D. Marking. Areas requiring cleaning and stripping for inspection should be clearly marked after detection. The extent of the corroded area should also be clearly identified and reported for repair or treatment.

ENVIRONMENTAL EFFECTS

1. General

A. The probability of encountering corrosion damage to an airplane is dependent on a number of factors such as the degree of protection afforded during manufacture, the maintenance of the protection during service life, and the environment in which the airplane is operated.

B. Some environmental factors are within the control of the manufacturer or the operator such as the Location of battery compartments or the prevention of spillage from galleys and lavatories. In these instances, recommended inspection frequencies or requirements for preventive maintenance can be established which are not dependent on the operator's route structure.

C. Other environmental factors are readily controllable by the operator, such as the salt-laden atmosphere in marine locations or the airborne pollutants of industrial areas. In these circumstances, inspection and corrosion prevention frequencies become a variable.

2. Environment

A. Actual assessments of environmental conditions have to be made Locally by the operator. The environment is a combination of many factors and some of those which should be considered are as follows:

(1) Marine atmosphere - Areas adjacent to salt water normally result in an atmosphere containing salt particles or salt saturated moisture. The degree of salinity of the body of water, temperature and the direction of the prevailing winds create wide variations in the corrosive properties of the atmosphere in coastal regions. It must be remembered that salt water is an excellent medium for the promotion of electrolytic corrosion.

(2) Contaminated atmosphere - In industrial areas the atmosphere usually contains pollutants. There pollutants combine with water to form highly corrosive liquids, for example, sulphur compounds are frequently found, which form sulphur based acids. This can be an even greater hazard when the prevailing winds carry pollutants from a nearby industrial plant to the airplane parking area.

(3) Rainfall - Moderate rainfall in temperate or cold climates does not constitute an environmental problem. Heavy rainfall or hail can result in damage to the finish which will help to initiate corrosion. Tropical rains result in a hot, humid atmosphere which promotes corrosion. Refer to the subparagraphs on relative humidity and heat.

(4) Relative humidity - High relative humidity coupled with high temperature results in a water-saturated atmosphere in the airplane while on the ground. After takeoff, condensation occurs providing the medium for the onset of corrosion. High humidity at lower temperatures is less of a problem, while ideal conditions are those with a Low relative humidity.

(5) Temperature - High temperature and low humidity are the best conditions because any moisture in the airplane is dried out. Similarly, an extremely cold atmosphere is also usually dry. However, combinations of high temperature and high humidity provide the least desirable environment from the corrosion standpoint.

(6) Runway conditions - Airplanes operating from gravel, dirt or grass runways or from runways treated with sodium chloride for ice removal are exposed to adverse conditions due to deterioration of the finish and the deposit of corrosive materials.

(7) Operating altitude - Airplanes operating at relatively low altitudes are obviously exposed to a greater extent to airborne pollutants and a marine atmosphere than airplanes operating at higher levels.

(8) Stage length - Frequent cycling of the airplane, especially in hot, humid zones, will create a greater moisture buildup than can be expected on airplanes used on long stage lengths. This is due to the airplane being exposed to a fresh supply of water-saturated air at every landing, which will condense out in the subsequent flight.

(9) Volcanic gases - Corrosive gases from volcanos are carried in the atmosphere in some regions. There is also a "fallout" zone downwind of active volcanos which could be an undesirable element in some areas.

(10) Airborne abrasives - Blowing sand or coral dust has an erosive effect on the finish and may find its way into the interfacing surfaces of moving parts or into bearings. This abrasion not only creates a wear problem, it exposes unprotected metal to corrosion. The abrasive material itself may also be corrosive, as would be the case with sand from salt water beaches.

B. To establish a corrosion prevention program to meet the operator's individual requirement, it must first be ascertained how severe the operating environment is geographically, and then establish frequencies of inspection and prevention procedures to suit the route structure. Three categories of operating environment have been established as follows:

(1) Severe - Areas in which there is a marine atmosphere or industrial atmosphere containing contaminants. Hot, humid tropical areas also come within the severe category.

(2) Moderate - Temperate regions with other than marine or industrially polluted atmospheres.

(3) Mild - Warm arid zones or areas subject to extremely Low temperatures. However, the use of chemicals on runways and taxiways to prevent ice formation may transfer cold zones to the severe category.

C. Frequencies of inspection or corrosion prevention action throughout this manual will be given for these three categories where the operating environment is a contributing factor. The operating environment is defined as being equivalent to the worst area of operation on the route structure on which the airplane is being used. Thus, an airplane starting in a mild location but flying to a severe area would be considered as operating in a severe environment.

NOTE: Some operators chose to assign only part of their fleet to routes in severe zones to reduce the maintenance cost on the remainder of the fleet.

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CORROSION REMOVAL

1. General

A. When you remove corrosion, complete removal is most important. If all of the corrosion is not removed, the corrosion will continue. For example, if you find corrosion around fastener locations, you must remove the fastener and look for corrosion under the fastener heads and in the holes. Corrosion removal around such fasteners without fastener removal will not stop the corrosion under the fasteners (Fig. 8).

B. Complete removal of corrosion products is also necessary, or the corrosion could come back. Carefully examine all of the area to make sure all corrosion products and other contamination are gone.

C. Dye penetrant inspection will not show if all of the corrosion products were removed from an area. The area must be visually examined to be sure.

D. The area must be clean, without paint, oil or grease, before you can treat it for corrosion.

E. Corrosion can be removed by mechanical procedures or chemical procedures. The details and the selection decision will be different for different amounts of corrosion and different types of metal. Refer to par. 7 for general data about these procedures. Refer to par. 8 and on for details for the different metals.

2. Safety Procedures

NOTE:Refer to par. B. for emergency safety procedures.

A. General Safety Precautions. Obey these safety precautions when you use solvents, special cleaning compounds, paint strippers (strong alkalies or acids), etchants (corrosion removers that contain acids) or conversion coating chemicals.

(1) Do not breathe solvent or acid vapors. Do not use solvents or acids in confined spaces without sufficient ventilation or approved respiratory protection.

(2) Do not add water to acid. Always add acid to water. Water added to acid will boil at an explosively rapid rate.

(3) Do not mix chemicals unless as given in the procedures.

(4) Make sure water for emergencies is available at the work area before work is started.

(5) Do not let your skin touch solvents, cleaners, acid etchants, or conversion coating material. Put on rubber plastic gloves when you use these materials. Put on goggles or plastic face shields and rubber raincoats and rainhats when you clean, strip, etch, or apply conversion coating to overhead surfaces.

(6) When you mix alkalies with water or other agents, use containers which are resistant to the heat that will result.

(7) Wash your skin or clothing immediately after it touches paint stripper, etchant or conversion coating material.

(8) If material gets in the eyes, quickly flush it out with water. Then send the injured person to the medical department for further treatment.

(9) Do not eat or keep food in areas where it could absorb poisons. Always wash your hands before you eat or smoke.

(10) Clean all equipment after work is completed.

B. Emergency Safety Procedures. Know these emergency safety procedures before you use materials which refer to an emergency safety procedure.

WARNING: IMMEDIATE AID IS MOST IMPORTANT IN SKIN, EYE, AND RESPIRATORY TREATMENT.

(1) If touched by the following materials, treat as shown below:

- Methyl alcohol
- Methyl ethyl ketone
- Methyl isobutyl ketone
- Toluene
- Trichloroethylene
- Epoxy resin
- Methylene chloride
- Brush alodine
- Xylene
- Petroleum naphthas
- Chromates
- Dichromates
- Acetates
- Cyclohexanone
- Cellosolve
- Carbon tetrachloride

(a) If splashed into eyes, do not rub. Flush eyes immediately with water for at least 15 minutes. Lift upper and lower lids frequently to ensure complete washing.

(b) If splashed on clothing or large areas, immediately remove contaminated clothing and wash body with plenty of soap and water. Wash clothing before you put it back on.

(c) If splashed onto an easily accessible part of the body, immediately wash with soap and water.

(d) If suffering headache or other obvious symptom resulting from overexposure, move to fresh air immediately.

(e) If vapors are inhaled and breathing has slowed down or stopped, remove person from exposure and start artificial respiration at once. Call ambulance and continue this treatment until ambulance arrives.

(2) If exposed to physical contact with any of the following materials:

Hydrofluoric acid
Nitric acid
Phosphoric acid
Phenol
Cresols
Tricresyl phosphate

Treat as follows:

WARNING: IT CANNOT BE OVEREMPHASIZED THAT IMMEDIATE ATTENTION IS MOST IMPORTANT IN SKIN, EYE AND INHALATION TREATMENT.

(a) Eyes: If splashed into eyes, do not rub, flush immediately with water for at least 15 minutes. Lift upper and lower eyelids frequently to ensure complete washing. Call Medical immediately.

(b) Exposed skin: If splashed on skin, wash affected area with large amounts of water for at least 15 minutes. Report to Medical.

(c) Clothing: If splashed on clothing or large area of body, remove contaminated clothing and wash body under a shower for at least 15 minutes. Wash clothing before reuse. Report to Medical.

(d) Inhalation: If vapors are inhaled, removed worker to fresh air and apply artificial respiration if necessary. Call Medical.

NOTE:Tricresyl phosphate is not considered an inhalation hazard.

(e) Internally: Proceed as follows:

1)Worker unconscious: Do not give any liquid. Begin artificial respiration and have someone call Medical immediately. Worker conscious:

a) Phenols and Cresols: Do not attempt to induce vomiting. Encourage victim to wash out mouth with large qauntities of water. Call Medical immediately.

b) Phosphoric Acid: Do not induce vomiting. Call Medical immediately.

c) HydrofLuoric Acid: Drink water to dilute acid, then cause vomiting by placing finger in the back of throat. Repeat. Wash out mouth repeatedly. Call Medical immediately.

d) Nitric Acid: Do not induce vomiting. Drink large quantities of water, if possible. Call Medical immediately.

e) Tricresyl Phosphate: Cause vomiting by placing finger in the back of throat. If necessary, have victim drink water, then use finger to induce vomiting. Call Medical Immediately.

3. Corrosion Damage and Rework Limits

A. Corrosion evaluation will be required after initial inspection and cleaning to determine nature and extent of repair or rework. It is difficult to establish a distinct and specific dividing line between various conditions, consequently, the first requirement for evaluation is good and sound maintenance judgment. Evaluate corrosion as follows:

(1) Light corrosion - Characterized by discoloration or pitting to a depth of approximately 0.001 inch maximum. This type of damage will normally be removed by light hand sanding or a minimum of chemical treatment.

(2) Moderate Corrosion - Appears similar to light corrosion except there may be some blisters or evidence of scaling and flaking. Pitting depths may be as deep as 0.010 inch. This type of damage will normally be removed by extensive hand or mechanical sanding.

(3) Heavy (severe) Corrosion - General appearance may be similar to moderate corrosion with severe blistering exfoliation and scaling or flaking. Pitting depths will be deeper than 0.010 inch. This type of damage will normally be removed by extensive mechanical sanding or grinding.

B. Degree of Corrosion Damage. A preliminary assessment of corrosion damage is sometimes advisable before cleanup to determine whether there is any chance of reclaiming the part. Where damage is obviously in excess of allowable limits, repair or replacement action should be initiated.

C. Previously Reworked Areas. Allowable damage data is normally based on a loss of material thickness, however, this must also include any loss in thickness due to previous rework. Previous rework can be ignored if the actual thickness remaining after corrosion cleanup is measured. Suitable NDT equipment (such as eddy-current or ultransonic instruments) is recommended both for crack detection and thickness measurement.

D. Depth Measurement Using Straightedge. Depth measurement is often possible using a straightedge and a 10-power magnifying glass as shown in Fig. 1. The straightedge should be placed at various angles to ensure that incorrect measurements are not recorded due to local surface irregularities.

E. Measuring Corrosion Damage with a Dial Depth Gage. The method for taking measurements with a dial depth gage is outlined below:

(1) Remove corroded material and blend out the damage.

NOTE: The base of the depth gage shall be flat against the undamaged surface on each side of the corrosion. When taking measurements on concave or convex surfaces, place the base perpendicular to the radius of curvature of the surface as shown in Fig. 2.

(2) Position the depth gage as illustrated in Fig. 2 and determine the measurement reading.

(3) Take several additional depth readings.

(4) Select the deepest reading as the depth of the corrosion damage.

F. Measuring Corrosion Damage with Impression Materials. In the event the corrosion area is inaccessible for use of the dial depth gage the use of impression materials is recommended.

(1) Clay. Modeling clay or similar materials may be used for making impressions of the corrosion damage. Accurate measurements of the depth of corrosion damage can be made by a comparator or other accurate measurement means.

(2) Silicone flexible mold compound rubber RTV 630A and RTV 630B from General Electric Co. (V01139) may be used to make impressions of corrosion damage and will be more permanent than the clay impressions. Measurements can be made by comparator or other accurate measurement means.

G. Rework Limits. The maximum rework limitations should be determined from the criteria referenced in Volume 2. If no criteria are available and the damage is on primary structure, consult The Boeing Company. To ensure that allowable limits are not exceeded, an accurate measurement of the material removed or material remaining in the reworked area after fairing should be made. If the corrosion damage is in a previously worked area, the material removed must include the thickness remove during previous rework.

4. Corrosion Rework Preparations:

A. Prior to starting any corrosion rework the airplane and the affected corrosion area must be prepared as outlined in the procedures below. Personnel performing these procedures shall observe all safety precautions for handling the materials used.

(1) Position airplane in wash rack or provide apparatus which will permit rapid rinsing of all affected surfaces of the airplane.

(2) Statically ground the airplane (Ref Maintenance Manual Chapter 20).

WARNING: BATTERIES SHOULD BE DISCONNECTED WHEN WORKING IN THE VICINITY OF BATTERY-OPERATED ELECTRICAL EQUIPMENT, ESPECIALLY WHEN FLAMMABLE MATERIALS ARE BEING UTILIZED.

(3) Removed or disconnect airplane batteries as required.

NOTE: Some preventive maintenance procedures also require large quantities of water to be used, such as paint removal and alodizing. In these instances, disconnecting batteries is also prudent if there is electrical equipment in the area.

(4) Protect the pitot-static openings, louvers, airscoops, engine openings, Landing gear, wheels, tires, magnesium skin panels, and airplane interior from moisture and chemical brightening agent.

(5) Protect surfaces, joints and seams adjacent to rework areas from chemical paint strippers, corrosion removers, and surface treatments.

5. Cleaning, General

A. Prior to paint stripping and corrosion removal, if the corroded area or part is soiled by grease, dirt or other foreign material, the area should be cleaned. For general cleaning procedures refer to Chapter 51 of the Maintenance Manual. Special cleaning procedures may be required in some cases and will be outlined in Volume 2. Precautions necessary when working with cleaning chemicals are noted in par. 2.

6. Paint Removal

A. For general procedures, refer to Chapter 51 of the Maintenance Manual. For special removal procedures, refer to the appropriate sections of Volume 2. For safety precautions when you use paint removal chemicals, refer to par. 2. above.

7. Corrosion Removal Procedures

A. General. Corrosion can be removed by mechanical or chemical procedures. Examples of mechanical procedures are hand sanding with abrasive paper or metal wool, power sanding or buffing with abrasive mats, grinding wheels or rubber mats, and abrasive blasting, which includes abrasive blasting with glass beads. The selections decision is different for different metals, different amounts of corrosion or the access to the area or part. In most corrosion removal operations, the mechanical procedures are recommended. The chemicals used in the chemical removal procedure can also cause corrosion and must not be permitted to flow into joints or seams or on highly stressed steel parts.

B. If the area of corrosion includes or is near fasteners, remove the fasteners before you start to remove the corrosion. There could be corrosion under the fastener heads or in the holes. Corrosion removal around such fasteners without fastener removal will not stop the corrosion under the fasteners (Fig. 8). Also, metal from the fastener heads will be rubbed into the adjacent metal surface during the corrosion removal procedure, and can cause subsequent galvanic corrosion.

C. Blending Repaired Areas. After corrosion removal, blend all depressions with the adjacent surface to keep stress concentrations to a minimum.

(1) Remove rough edges and all corrosion from the damaged area. Make selection of the applicable abrasive from Fig. 3.

(2) Repair depressions to make smooth, elliptical blend-outs as shown in Fig. 4. In areas with multiple pits close together, remove the material in between to keep surface irregularities or waviness to a minimum (Fig. 5).

(3) In areas where sufficient clearance does not permit the elliptical shape as specified in Fig. 4 and 5, blend as nearly as possible to these dimensions and make the remaining area smoothly continuous, with no sharp or sudden changes (Fig. 6).

(4) Remove all surface defects. Use the correct abrasive to get the necessary surface finish.

D. Repair Depth Measurement. After you remove the corrosion and blend out the area., make depth measurements to be sure that the blend is not deeper than the repair limit. A dial depth gage (Fig.2) or impression materials can be used to find the depth (Fig. 2).

E. Corrosion Removal - Mechanical. The mechanical corrosion removal procedure is recommended for most cases of corrosion damage. Some examples of this procedure are: hand sanding with abrasive paper or metal wool, power sanding with abrasive mats, grinding wheels, wire brushes or rubber mats, carbide tipped scrapers and abrasive blasting. For general procedures, refer to the steps below. For details for the different metals, refer to par. 8 and on.

(1) Wire Brushing. Wire brushing is a mechanical abrasive operation unusually done with a hand wire brush or a wire brush mounted on a motor-driven wheel. By using brushes of various lengths and gages of wire, a wide range of abrasive action is possible. Wire brushing is used to remove heavy corrosion and paint or dirt, especially where chemical treatment is impractical. A typical wire brushing procedure follows:

(a) Protect adjacent components from scale, chips, corrosion products and chemical agents.

(b) If you find grease or dirt, clean the area per par. 5.

(c) Remove any loose corrosion with a hand scraper.

WARNING: THE USE OF GOGGLES OR FACE SHIELD IS MANDATORY WHEN USING MOTOR-DRIVEN WIRE BRUSHES.

(d) Wire brush area to a firm metal substrate.

(2) Grinding. Grinding is a method of removing heavy corrosion by means of motorized grinding wheels or abrasive belts. Part of the base metal is ground away with the corrosion. A typical grinding procedure follows:

(a) Protect adjacent components from scale, chips, corrosion products and chemical agents.

(b) If you find grease or dirt, clean the area per par. 5.

WARNING: THE USE OF GOGGLES OR FACE SHIELD IS MANDATORY WHEN USING MOTOR-DRIVEN GRINDERS.

CAUTION: MOTORIZED GRINDING, IF NOT CAREFULLY MONITORED, CAN REMOVE MORE MATERIAL THAN NECESSARY. THE USE OF OTHER REWORK METHODS IS PREFERRED.

(c) Remove paint and corrosion by grinding until a firm corrosion free surface is reached. Continue grinding to remove coarse irregularities. Use find abrasive paper to polish the surface to the desired finish.

(3) Glass Bead Abrasive Blasting. Abrasive blasting is used to clean or finish metals and other materials. It hits the surface with a stream of abrasive particles. For corrosion removal, use galss bead abrasive blasting to remove only filiform corrosion. Do not use it to remove other types of corrosion that extend below the surface. Use standard blasting procedures and these special details.

WARNING: AVOID EXCESSIVE INHALATION OF ABRASIVE DUST. PROVIDE VENTILATION AS REQUIRED.

(a) In-cabinet Blasting. In-cabinet blasting is preferred. External gun blasting may be used if adequate confinement and recovery are provided for the abrasives.

1) For the abrasive, use glass beads (150 mesh or finer).

2) If possible, remove the part from the component. If this is not possible, give areas adjacent to the part protection from scale, chips, corrosion products and the abrasive blast.

3) If you find grease or dirt, clean the area per par. 5.

4) Give protection from the blast to such close tolerance surfaces as bushings, bearings, close tolerance shafts and threads.

5) Remove only the corrosion products by abrasive blasting with glass beads.

(b) External Gun Blasting. The frequency of occurrence of filiform corrosion has led to the development of portable abrasive blasters. A typical external gun blasting procedure for removing filiform corrosion on aluminum skin follows:

1) Remove any heavy soils with alkaline emulsion cleaner.

2) Strip the protective finish (both enamel and primer).

3) Mechanically remove the filiform corrosion by blasting with glass beads (approximately 150 mesh).

4) After blasting, remove any enamel or primer that may remain in the corrosion cleanup area. Flush with water and clean the surface in preparation for surface treatment.

(c) Portable Abrasive Blaster. Filiform corrosion can be quickly removed by use of a portable abrasive blaster. An example is the Model E-10A Clemco Eductomatic Portable Blast Cleaner (Clemco Industries, V86192) (Fig. 7).

1) The unit weighs 7 pounds and includes an abrasive reservoir (which holds up to 4 pounds of glass beads)., suction abrasive pickup, swivel blast nozzle and vacuum abrasive return.

2) The blast head has a concentric arrangement. The inner tube blasts the glass beads against the airplane surface, and the outer passage retrieves the beads and dust and separates them. A double-acting control valve regulates both the blast and the suction. The blast head is connected by a swivel joint to the body of the unit. This feature lets you turn the blast in any direction and keep the main body of the machine vertical.

3) During operation, control the air source to 80 pounds pressure maximum. Hold the blast nozzle on the surface to remove corrosion in an approximate one-inch diameter path. Try the equipment on a test panel to get to know the procedure.

4) The glass beads quickly remove corrosion (about 36 linear inches a minute) but almost none of the cladding on the aluminum surface.

F. Corrosion Removal - Chemical. The chemical corrosion removal procedure can be used on the airplane where chemical flow can be controlled and the area can be fully washed with water. Because the chemicals used for corrosion removal can also cause corrosion, you must not let the chemicals become caught in such locations as lap joints, faying surfaces, or splices. on parts removed from the airplane, the chemical removal procedure could be better. The chemical agents used in corrosion removal are of the acid type. Because the chemicals are different for each metal details of the procedures are given in the applicable paragraphs that follow.

G. Special Corrosion Removal Procedures. Special procedures are applicable when corrosion damage was caused by other than usual airline service. Spilled mercury will cause corrosion very quickly. Refer to 20-41-00 for details. A fire in the airplane can cause corrosion because of ashes and fire extinguisher chemicals. Refer to 20-42-00 for details. Also, spilled alkaline or acid agents cause corrosion. Refer to 20-43-00 and 20-44-01 for details. Livestock and fish as cargo can cause much corrosion of the airplane structure and make necessary special procedures. Refer to 20-61-00 and 20-62-00 for more data.

8. Corrosion Removal Procedures for Aluminum and Aluminum Alloys

WARNING: OBEY THE SAFETY PRECAUTIONS AND PROCEDURES OF PAR. 2. ABOVE.

A. General. Aluminum and its alloys are the most frequently used materials in commercial airplanes. The metal is not toxic, not magnetic and because it can absorb large amounts of energy, it will not spark when hit by other metals. Although aluminum is high in the electrochemical series, it makes a tightly bonded anodic oxide film on the surface that gives more resistance to mild corrosive conditions. One sign of corrosion is a whitish deposit of corrosion products. General etching, pitting or roughness of the surface gives an indication of the start of corrosion damage.

B. Corrosion Removal - Mechanical

(1) Make sure the metal is aluminum.

(2) Give adjacent areas protection to prevent more damage from corrosion products removed during mechanical removal.

(3) If you find grease or dirt, clean the area per par. 5.

(4) Remove paint per par. 6, if applicable.

(5) Measure the amount of damage per par. 3.

(6) Remove corrosion by one of the following:

CAUTION: DO NOT USE A CARBON STEEL BRUSH OR STEEL WOOL ON ALUMINUM SURFACES, OR THE STEEL PARTICLES WILL BE RUBBED INTO THE ALUMINUM AND CAUSE MORE CORROSION DAMAGE. STEEL FASTENERS MUST BE REMOVED BEFORE CORROSION REMOVAL TO MAKE SURE THAT CORROSION IS COMPLETELY REMOVED AND ALUMINUM SKINS DO NOT BECOME CONTAMINATED WITH STEEL PARTICLES. CONTAMINATION OCCURS WHEN FASTENER HEADS ARE GROUND DOWN DURING CORROSION REMOVAL FROM THE ADJACENT SKIN SURFACES.

(a) Remove light corrosion by light hand sanding with abrasive paper (Fig. 3).

(b) As an alternative, remove light corrosion and stains with pumice paste. Mix pumice powder with water to make a slurry paste. Apply with a clean, soft cloth and rub gently. When paste is dried to a white powder, wipe off with a clean, dry, soft cloth. Remove remaining corrosion and corrosion products with No. 600 grit wet or dry abrasive paper and water.

(c) Remove heavy corrosion products by hand with any of the following items:

1) Carbide-tipped scraper

2) Fine fluted rotary file

3) 400 grit aluminum oxide (alumina) abrasive paper

4) Stainless steel brush (with bristles no larger than 0.010 inch in diameter)

After you use the stainless steel brush or file, polish the surface with 400 grit alumina abrasive paper, and then with 600 grit alumina abrasive paper.

CAUTION: HEAVY, CONTINUOUS RUBBING (SUCH AS WITH POWER-DRIVEN WIRE BRUSHES) CAN MAKE ENOUGH HEAT TO CAUSE METALLURGICAL CHANGES.

(d) Mechanically remove moderate or bad corrosion by stainless steel wire brush (with bristles no larger than 0.010 inch in diameter), grinding, or, only for filiform corrosion, abrasive blasting with glass beads. Do not use glass bead abrasive blasting to remove other types of corrosion that extend below the surface. Refer to par. 7.E. for procedures. On nonclad anodized surfaces, be careful not to damage the anodized surface adjacent to the corrosion area.

(e) Dry abrasive blasting with glass beads (par. 7.E.(3)) is approved to remove only filiform corrosion from aluminum alloys. Do not use glass bead abrasive blasting to remove other types of corrosion that extend below the surface. Use air pressures of 40 to 80 psi. The higher pressure removes corrosion more quickly.

(7) After you remove all corrosion that can be seen through a 10-power magnifying glass, remove 0.002-inch more material to be sure you removed all the corrosion products.

(8) Blend repaired areas per par. 7.C.

(9) Clean the repaired area.

(10) Measure the depth of the blends per par. 7.D., to be sure that they are within repair limits.

(11) Treat the repaired area per 20-50-00.

C. Corrosion Removal - Chemical.

CAUTION: AVOID CHEMICAL REMOVAL AT TEMPERATURES ABOVE 100°F OR BELOW 40°F.

DO NOT USE ALKALINE TYPE CORROSION REMOVERS TO REMOVE CORROSION FROM ALUMINUM ALLOYS.

WHEN APPLYING CORROSION REMOVAL SOLUTION, PARTICULAR CARE SHOULD BE TAKEN TO KEEP ACID OUT OF FAYING SURFACES, BUTT JOINTS, SEAMS, CREVICES, ETC.

(1) Mask adjacent areas to prevent brighteners from contacting magnesium, anodized aluminum, glass, plexiglass, fabric surfaces and steel.

WARNING: WEAR ACID-RESISTANT GLOVES, PROTECTIVE MASK, AND PROTECTIVE CLOTHING WHEN WORKING WITH ACID COMPOUNDS. IF THE ACID ACCIDENTLY CONTACTS THE SKIN OR EYES, FLUSH OFF IMMEDIATELY WITH A CONSIDERABLE AMOUNT OF CLEAN WATER. CONSULT A PHYSICIAN IF EYES ARE AFFECTED OR IF SKIN IS BURNED.

(2) Dilute the phosphoric acid base corrosion removing compound according to manufacturer's instructions. Mix the compound in wood, plastic or plastic lined containers. Do not add water to acid; always add acid to water.

(3) Apply diluted solution to corroded areas by spraying or with a sponge or brush. Apply with a circular motion, starting from lower surfaces and working upward to minimize runs and streaks.

(4) Leave the solution on from 5 to 30 minutes, depending on the temperature and the amount of corrosion present. Agitate occasionally with shortfibered acid resistant brush. Do not allow solution to dry on the surface, as streaking will result.

(5) Rinse with a stream of water or wipe off with clean, moist cloth frequently rinsing the cloth in clear water.

(6) Dry area with clean, dry cloth and inspect area for corrosion.

CAUTION: DO NOT REPEAT OPERATION MORE THAN ONCE. IF CORROSION STILL REMAINS AFTER SECOND ATTEMPT, PROCEED TO MECHANICAL REMOVAL METHODS.

(7) Repeat steps 3 thru 6 if any corrosion remains.

(8) Fair depressions resulting from rework per par. 7.C., and surface finish with 400 or 600 grit abrasive paper. Select proper abrasive per Fig. 3.]

(9) Clean reworked area.

(10) Determine depth of faired depression per par. 7.D., to ensure that rework depth limits have not been exceeded.

(11) Treat reworked surface as indicated in 20-50-00.

9. Corrosion Removal Procedures for Magnesium Alloys

A. General. Magnesium is lightweight, but is the most chemically active metal. It is highly susceptible to corrosion when failure of the protective coating has occurred. To preclude serious structural damage, early detection and prompt corrective action must be taken. The beginning of corrosion is indicated by a lifting of the paint film and white spots on the surface, which rapidly develop into snow-like mounds or whiskers. Procedures for corrosion removal by either mechanical or chemical methods are provided in the following paragraphs.

WARNING: PERSONNEL USING THESE PROCEDURES SHALL OBSERVE THE SAFETY PRECAUTIONS AND PROCEDURES PER PAR. 2.

SMALL PARTICLES AND FINE SHAVINGS OF MAGNESIUM IGNITE EASILY AND PRESENT AN EXTREME FIRE HAZARD. MAGNESIUM DUST IS HIGHLY FLAMMABLE AND, IN PROPER CONCENTRATION, MAY CAUSE AN EXPLOSION. WATER IN CONTACT WITH MOLTEN MAGNESIUM PRESENTS A STEAM EXPLOSION HAZARD. EXTINGUISH FIRES OF MAGNESIUM WITH ABSOLUTELY DRY TALC, CALCIUM CARBONATE, SAND, OR GRAPHITE BY APPLYING THE POWDER TO A DEPTH OF 1/2 INCH OR MORE OVER THE BURNING METAL. DO NOT USE FOAM, WATER, CARBON TETRACHLORIDE, OR CARBON DIOXIDE.

B. Corrosion Removal - Mechanical

(1) Positively identify the metal as magnesium.

(2) Protect adjacent area to prevent additional corrosion damage from corrosion products removed during mechanical removal.

(3) If grease or soil is present, clean the rework area per par. 5.

(4) Strip paint per par. 6, if applicable.

(5) Determine extent of damage per par. 3.

(6) Remove loose corrosion products with aluminum wool.

(7) Remove corrosion by one of the following:

CAUTION: DO NOT USE CARBON STEEL BRUSH OR STEEL WOOL ON MAGNESIUM SURFACES. TINY METAL PRATICALS WILL BECOME IMBEDDED IN THE MAGNESIUM CAUSING FURTHER CORROSION AND SUBSEQUENT DAMAGE TO PART.

DO NOT USE SILICONE CARBIDE ABRASIVES ON MAGNESIUM SURFACES.

(a) Light corrosion shall be removed by light hand sanding, selecting abrasive paper indicated in Fig. 3 or:

(b) Light corrosion and stains may be removed with pumice paste. Prepare pumice paste by mixing pumice powder with water to form a slurry paste. Apply to stain, using a clean, soft cloth and rub gently. When paste has dried to a white powder, wipe off with a clean, dry, soft cloth. If corrosion products still exist, use No. 600 grit wet or dry abrasive paper and water to remove the remaining corrosion.

(c) Remove heavy corrosion products by hand scraping with any of the following items:

1) Carbide-tipped scraper

2) Fine fluted rotary file

3) 400 grit alumina abrasive paper

4) Stainless steel brush (bristles of the brush not to exceed 0.10 inch in diameter)

After use of the stainless steel brush or file, surface shall be polished with 400 grit alumina abrasive paper, then with 600 grit alumina abrasive paper.

CAUTION: VIGOROUS, HEAVY, CONTINUOUS RUBBING (SUCH AS WITH POWER DRIVEN WIRE BRUSHES) CAN GENERATE ENOUGH HEAT TO CAUSE METALLURGICAL CHANGE.

(d) Mechanically remove moderate or severe corrosion by stainless steel wire brush or abrasive blasting. Refer to par. 7.E., for procedures. Select appropriate abrasives from Fig. 3.

NOTE: Bristles of stainless steel wire brush should not exceed 0.010 inch in diameter.

(e) Dry abrasive blasting is an approved method for corrosion removal from magnesium alloys. Refer to par. 7.E. Air pressures of 10 to 35 psi shall be used on magnesium alloy surfaces.

(8) After removing all corrosion visible through a 10-power magnifying glass, apply corrosion treating solution, refer to par. 9.C.(4), and wash thoroughly with clean water.

(9) Fair depressions resulting from rework per par. 7.C., and surface finish with 400 or 600 grit abrasive paper. Select appropriate abrasive material per Fig. 3.

(10) Clean reworked area.

(11) Determine depth of faired depression per par. 7.D., to ensure that depth rework Limits have not been exceeded.

(12) Treat reworked area per 20-50-00.

C. Corrosion Removal - Chemical. Chromic acid solution may be used to remove surface oxidation and light corrosion products from magnesium surfaces. This method is not adequate where deep pitting or heavy corrosion have occurred which require mechanical methods of removal If properly used, the chemical method causes less reduction in section thickness. Parts containing copper-based inserts shall not be treated with this method unless properly masked off. Excessive amounts of fluorides, sulfates, or chlorides must not be allowed to build up in the solution as these compounds tend to coat and etch the metal rather than clean the surface.

CAUTION: THE FOLLOWING PROCEDURES ARE NOT APPLICABLE TO ADHESIVE BONDED PARTS OR ASSEMBLIES, AREAS WHERE THE CHEMICAL AGENTS MIGHT BECOME LODGED., OR LOCAL AREAS BARED SPECIFICALLY FOR GROUNDING OR ELECTRICAL BONDING PURPOSES.

(1) Positively identify the metal as magnesium.

(2) Remove loose corrosion products with aluminum wool.

(3) Mask off other materials and parts, especially rubber parts, bearings, cast or pressed inserts, and plated steel to prevent contact with the treating solution or its fumes.

(4) Prepare corrosion treating solution. Two chemical preparations are available. To prepare the solutions, proceed as follows:

(a) Chromium trioxide preparation

WARNING: ADD CHROMIUM TRIOXIDE TO WATER; DO NOT ADD WATER TO THE CHROMIUM TRIOXIDE.

1) To make 1 U.S. gallon of solution, add 24 ounces of chromium trioxide to water in a mixing container of lead lined steel, stainless steel or 1100 aluminum. Reaction time is 1 to 15 minutes when heated to 190 to 202°F. Longer reaction time Is required when mixed at room temperature.

(b) Sodium Dichromate/Nitric Acid Preparation. Prepare solution in the following portions: 1-1/2 pounds of sodium dichromate, 1-1/2 U.S. pints of concentrated nitric acid per U.S. gallon of water. Mix as follows:

NOTE: The solution shall be prepared and stored in clean polyethylene or glass containers.

1) Fill a suitable container with a volume of water equal to approximately 1/4 the desired total quantity of solution.

2) Add full quantity of sodium dichromate in proportions indicated above and agitate until the chemical is dissolved.

3) Add another volume of water until quantity of solution is equal to 2/3 the total desired quantity.

4) Slowly add total volume of nitric acid to solution and mix thoroughly.

5) Add water until total desired quantity of solution is reached and stir until entire solution concentration is equal.

6) Remove corrosion by carefully applying the chromic acid solution to the corroded area with acid resistant brush.

7) Allow the solution to remain on the surface approximately 15 minutes; agitate surface with brush. Wipe dry.

8) Rinse thoroughly with water while scrubbing the brush and wipe dry.

9) Repeat the preceding sequence as necessary until all corrosion products have been removed and a bright metallic color of the metal appears.

10) Fair depressions resulting from the rework per par. 7.C.

11) Surface treatment after corrosion removal per 20-50-00.

10. Corrosion Removal Procedures for Carbon Steel

A. General. Carbon steel in its heat-treated form is used in areas where high structural or aerodynamic loads occur on the airplane. Landing gear, flap tracks, structural splices, terminal fittings and miscellaneous brackets are some of the typical parts made from heat-treated carbon steel. Red iron rust is one of the most familiar kinds of corrosion on carbon steel and generally caused from formation of ferrous oxides due to atmospheric exposure. Some surface metal oxides are purposely used to protect the underlying base metal. Red iron rust is not one of these and actually attracts moisture from the air and promotes additional corrosion. The red rust first shows on unprotected airplane hardware such as bolts, nuts and exposed fittings. Slight corrosion damage on highly stressed steel parts becomes potentially dangerous and the rust shall be removed and controlled. Corroded steel parts should be removed from the airplane for treatment if possible. The general procedures for corrosion removal are provided in the following paragraphs.

WARNING: PERSONNEL USING THESE PROCEDURES SHALL OBSERVE THE SAFETY PRECAUTIONS AND PROCEDURES OUTLINED IN PAR. 2.

B. Corrosion Removal - Mechanical

(1) Positively identify the metal as steel and determine its heat-treat value.

(2) Protect adjacent area to prevent additional corrosion damage from corrosion products removed during mechanical removal.

(3) If grease or soil is present, clean the rework area per par. 5.

(4) Strip paint per par. 6, if applicable.

CAUTION: HAND-HELD POWER TOOLS MUST NOT BE USED ON HIGH-STRENGTH STEELS HEAT-TREATED TO 220,000 PSI AND ABOVE. EXERCISE EXTREME CARE WHEN USING TOOLS ON HIGH-STRENGTH STEEL NOT TO OVERHEAT THE STEEL SURFACE.

(5) Corrosion removal on steels heat-treated to 220,000 psi and above shall be accomplished by dry abrasive blasting as outlined in par. 7.E., with blasting pressure ranging from 40 to 70 psi or hand tools described in par. 7.E.

(6) Mechanically remove all corrosion from steel parts heat-treated below 220,000 psi as follows:

(a) Remove heavy corrosion products using stainless steel hand brush. Use dry abrasive blasting per 7.E., as an alternate method with blasting pressures ranging from 40 to 70 psi.

(b) Remove residual corrosion by hand sanding or with approved hand-operated power tool as outlined in par. 7.E. Select appropriate abrasives from Fig. 3.

(7) Make visual check through a 10-power magnifying glass to ensure that all corrosion is removed.

(8) Fair depressions resulting from reworked per par. 7.C., and surface finish with 400 grit abrasive paper selected from Fig. 3.

(9) Clean reworked area.

(10) Determine depth of faired depression per par. 7.D., to ensure that rework depth limits have not been exceeded.

(11) Treat reworked area as indicated in 20-50-00 immediately upon finish of rework.

C. Corrosion Removal - Chemical. Chemical rust removers are of either the acid or alkaline type. The acid type is intended for use in removing the rust or black oxide formations by either immersion or brush application of the chemical. The alkaline type is intended for use in removing red rust by immersion treatment. Procedures for the use of both types of rust removers are provided below.

CAUTION: STEEL PARTS HEAT-TREATED ABOVE 220,000 PSI ARE SUBJECT TO HYDROGEN EMBRITTLEMENT, AND THE USE OF ACID IS PROHIBITED.

(1) Inhibited Phosphoric Acid Base Rust Remover - Brush-on Method

(a) Positively identify the metal as steel.

(b) Protect adjacent area to prevent additional damage from the chemical agents.

(c) If grease or soil is present, clean the corrosion area per par. 5.

(d) Remove heavy rust by chipping an/or wire brushing with stainless steel bristle brush.

(e) Dilute the concentrated acid according to manufacturer's instructions in acid resistant mixing container. Do not add water to acid; always add acid to water.

(f) Apply the acid mixture to corroded area with acid-resistant brush. Allow to remain long enough to loosen rust (2 to 10 minutes) and rinse completely with clean water.

(g) Examine corroded area visually with 10-power magnifying glass.

(h) If corrosion is still evident, repeat application and rinse thoroughly.

(i) After removal is complete, blend or fair area affected per par. 7.C.

(j) Determine depth of faired depressions per par. 7.D., to ensure that rework limits have not been exceeded.

(k) Treat surface of reworked area per 20-50-00 immediately upon finish of rework.

(2) Inhibited Phosphoric Acid Base Acid Rust Remover - Immersion Method

NOTE: This method is to be used for removing heavy rust from parts removed from the airplane and where the corroded area can be completely immersed.

(a) Positively identify the metal as steel.

(b) If grease or soil is present, clean the corrosion area per par. 5.

(c) Remove heavy rust by chipping an/or wire brushing with stainless steel wire brush.

(d) Prepare the acid mixture per step (1)(e).

(e) Immerse the parts in acid solution only long enough to loosen the rust. The solution may be heated to a maximum of 104^{0}F to increase the removal rate. Agitation will also help.

(f) Rinse in continuously flowing cold water rinse tank or flood with clean water.

(g) Visually examine the corrosion area with 10-power magnifying glass.

(h) If corrosion still exists, repeat immersion steps.

(i) After removal is complete, fair or blend the reworked area per par. 7.C.

(j) Determine depth of faired depression per par. 7.D., to ensure that rework depth limits have not been exceeded.

1) Treat surface of reworked area per 20-50-00 immediately upon finish of rework.

(3) Alkali Type Rust Remover

WARNING: THE ALKALI RUST REMOVER, SODIUM HYDROXIDE BASE, IS HIGHLY ALKALINE AND, THEREFORE, HARMFUL TO SKIN AND EYES. PERSONNEL SHOULD WEAR RUBBER GLOVES, APRONS AND GOGGLES WHEN WORKING WITH THIS MATERIAL. USE WITH ADEQUATE VENTILATION.

(a) Positively identify the metal as steel.

(b) Protect adjacent components to prevent damage from the chemical agents, chips, scales, or corrosion products.

(c) Remove grease and soil from corrosion damage area per par. 5.

(d) Remove heavy rust by chipping and/or wire brushing with stainless steel bristle brush.

(e) Prepare alkali base rust remover solution per manufacturer's instruction. Carbon steel or corrosion resistant steel tanks may be used.

(f) Immerse parts in rust remover solution. Temperature up to the boiling point of the solution may be used to increase the rate of removal.

(g) Rinse thoroughly in clean water.

(h) Visually examine for complete corrosion removal with a 10-power magnifying glass.

(i) If corrosion still exists, repeat immersion procedure above.

(j) Dry thoroughly and fair or blend depressions from corrosion removal per par. 7.C.

(k) Determine depth of faired depression per par. 7.D., to ensure that rework depth limits have not been exceeded.

(l) Treat surface of reworked area per 20-50-00 immediately upon finish of rework.

11.Corrosion Removal Procedure for Stainless Steel and Nickel-Chromium Alloys

A. General. Stainless steel and nickel-chromium alloys are used where corrosion resistance is one of the major considerations in the design of the component or system. In most applications, these steels will have no other surface protection except for matching color schemes of the surrounding structure or dissimilar metal organic coatings. Stainless steel and nickel-chromium steels, however, are not free from corrosion attack. Corrosion usually appears as pits usually black in color. The existence of corrosion products prevents a passivated environment at the stainless steel surfaces and creates an active/passive corrosion cell (Ref 20-10-00). It is, therefore, necessary that the corrosion removal is complete.

CAUTION: ABRASIVE BLASTING OR GRINDING SHALL NOT BE USED ON THIN WALL TUBES OR THIN WEBS LESS THAN 0.0625 INCH THICK.

B. Corrosion Removal - Mechanical. Use the same general procedures as for carbon steel.

C. Corrosion Removal - Chemical. In severely corroded areas and where chemical agents will not be trapped in cracks, crevices, lap joints, etc., the chemical removal methods described for carbon steel are applicable.

12.Corrosion Removal Procedure for Titanium Alloys

A. General. Titanium alloys are used in several locations in the airplane, particularly in high-temperature areas and in areas where high-strength members are exposed to corrosive environment. Exposure of the titanium surface to fire resistant hydraulic fluids such as BMS 3-11 causes hydrogen embrittlement subsequently leading to pitting of the surface. The alloy is generally corrosion resistant. Corrosion, however, does appear as white or black color oxides. Corrosion removal shall be accomplished per the following procedures:

WARNING: SMALL CHIPS OR SILVERS OF A TITANIUM ALLOY, WHICH ARE THE RESULT OF A MACHINING PROCESS OR PROCEDURE, CAN EASILY IGNITE. AN EXTREME FIRE HAZARD MAY DEVELOP. EXTINGUISH SUCH FIRES WITH ABSOLUTELY DRY TALC, CALCIUM CARBONATE, SAND OR GRAPHITE. DO NOT USE WATER, CARBON DIOXIDE, CARBON TETRACHLORIDE OR THE ORDINARY DRY CHEMICAL FIRE EXTINGUISHER.

B. Corrosion Removal - Mechanical.

(1) If grease or soil is present, clean the area per par. 5.

(2) Hand polish with aluminum polish with a soft cloth until all traces of corrosion or surface deposits are removed.

(3) Remove the polish with soft cloth.

(4) Treat reworked area per 20-50-00.

C. Corrosion Removal - Chemical. Because titanium is susceptible to hydrogen embrittlement when exposed to acid solutions, chemical corrosion removers are not permitted.

13.Corrosion Removal Procedures for Plated or Phosphated Surfaces

A. General. Metal parts are plated either to provide a smooth surface for wear resistance or to provide a sacrificial metal to protect the base metal. Phosphate treatments on metal surfaces provides a good adhesion surface for organic finishes and provides good wear and corrosion resistance when used with oil or corrosion preventive compounds. Cadmium plating corrosion will appear as a dull gray product. Phosphate treated surfaces will appear as a red-black part darker than common rust when corroded.

B. Corrosion Removal from Cadmium Plated Surfaces

(1) Protect adjacent areas from contaminants during corrosion removal.

(2) If grease or soil is present, clean area per par. 5.

(3) If corrosion appears only on the plated surfaces, rework as follows:

(a) Remove corrosion products by rubbing lightly with stainless steel wool. Limit rework area to a minimum so that plating material in adjacent area is preserved.

(b) Apply chromic acid solution to the corroded area and allow to remain on surface for 30 to 60 seconds. The solution strength shall be 4 ounces of chromium trioxide to 1 U.S. gallon of water.

(c) Rinse with clean water and air dry.

(4) If corrosion has penetrated to the base metal, rework as follows:

(a) Determine from SRM if part shall be reworked or replaced.

(b) If part can be reworked, identify the base metal and remove corrosion per applicable procedures.

(5) Treat rework surface per 20-50-00.

C. Corrosion Removal from Plated Surfaces (Except Cadmium Plated Surfaces)

(1) Protect adjacent areas from contaminants during corrosion removal.

(2) If grease or soil is present, clean area per par. 5.

(3) Remove heavy corrosion by mechanical method per par. 7.E.

(4) Remove remaining corrosion using phosphoric acid base rust remover (mixed on a 1:1 ratio). Allow acid solution to remain only long enough to remove the corrosion.

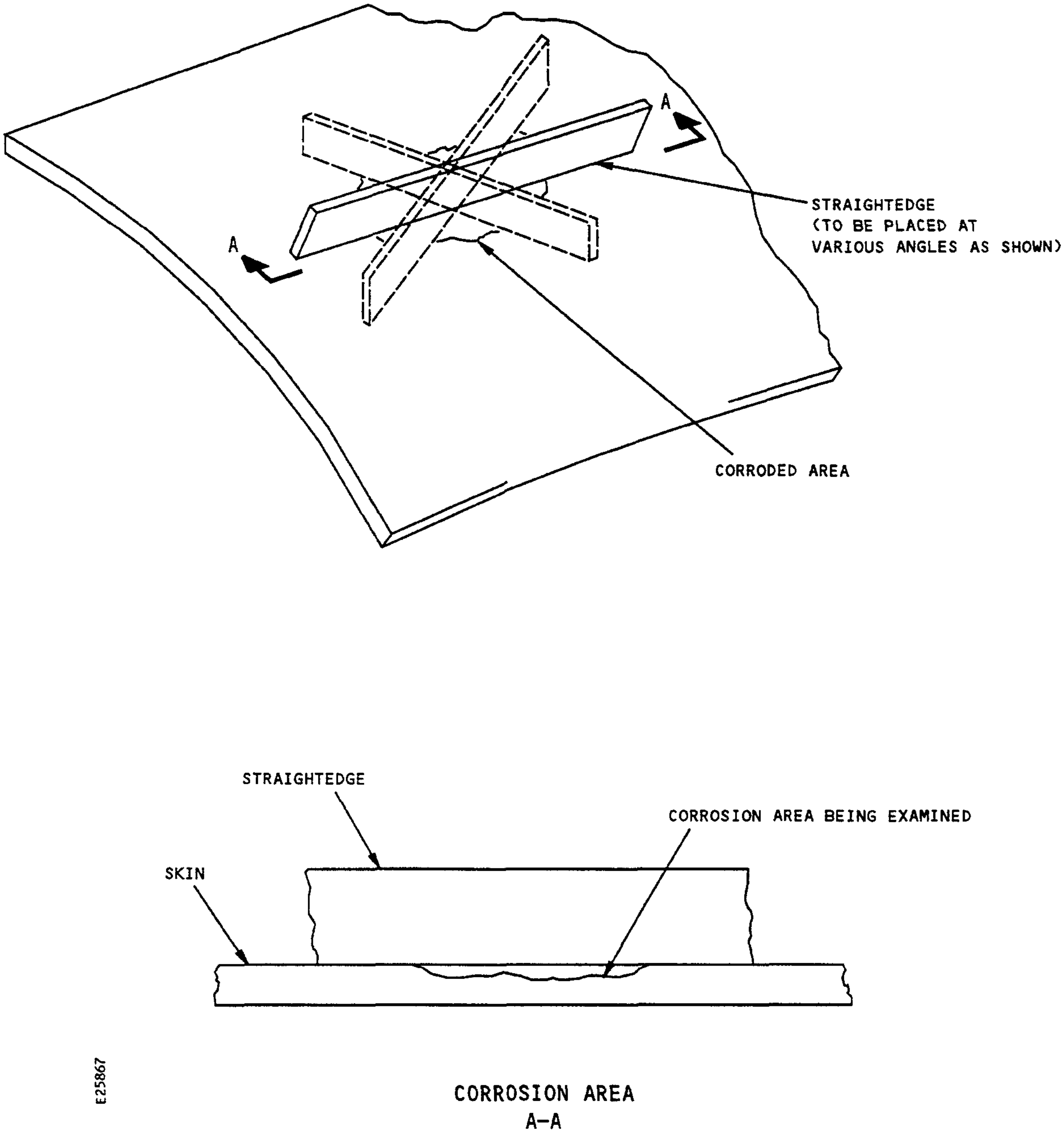
(5) Thoroughly rinse the acid from the surface with clean water.

(6) Air dry and treat the reworked surface per 20-50-00.

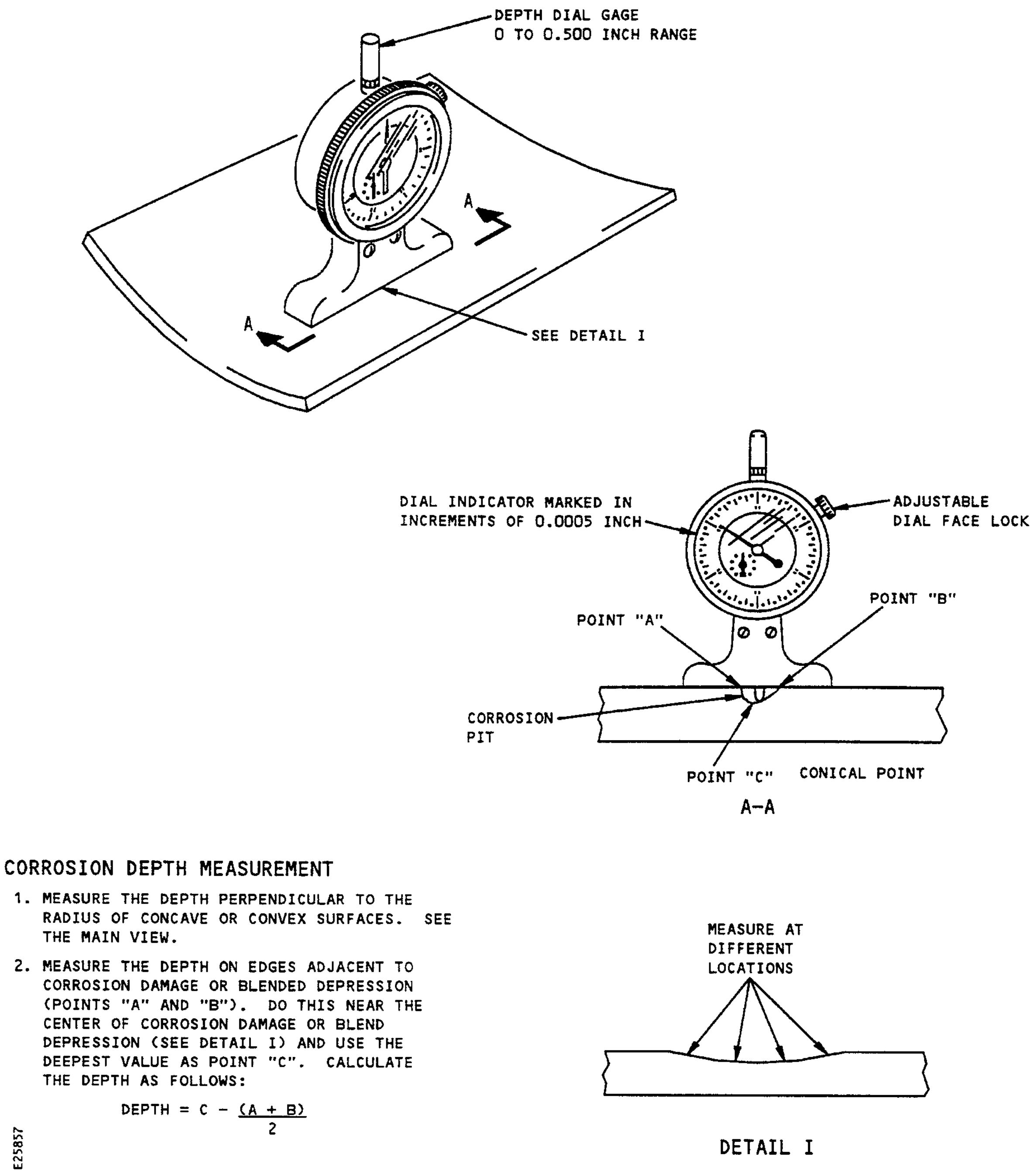
D. Corrosion Removal from Phosphated Surfaces

(1) Phosphated cadmium surfaces shall be treated per procedures for cadmium plated surfaces.

(2) Phosphated ferrous alloys shall be treated per procedures for carbon steel.



Typical Usage of Straight Edge in Determining Depth of Corrosion
Figure 1



CORROSION DEPTH MEASUREMENT

1. MEASURE THE DEPTH PERPENDICULAR TO THE RADIUS OF CONCAVE OR CONVEX SURFACES. SEE THE MAIN VIEW.
2. MEASURE THE DEPTH ON EDGES ADJACENT TO CORROSION DAMAGE OR BLENDED DEPRESSION (POINTS "A" AND "B"). DO THIS NEAR THE CENTER OF CORROSION DAMAGE OR BLEND DEPRESSION (SEE DETAIL I) AND USE THE DEEPEST VALUE AS POINT "C". CALCULATE THE DEPTH AS FOLLOWS:

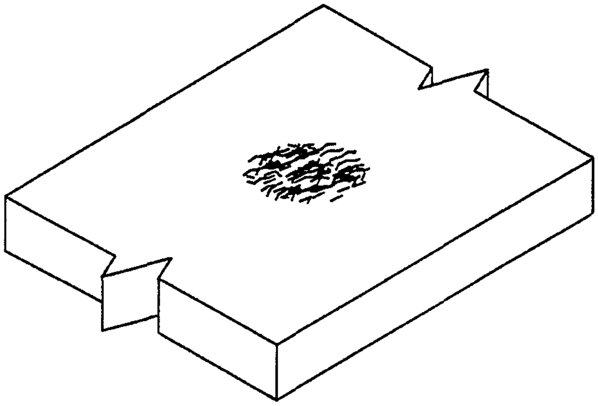
$$\text{DEPTH} = C - \frac{(A + B)}{2}$$

Corrosion Damage and Repair Depth Measurement with a Depth Dial Gage
Figure 2

E25872

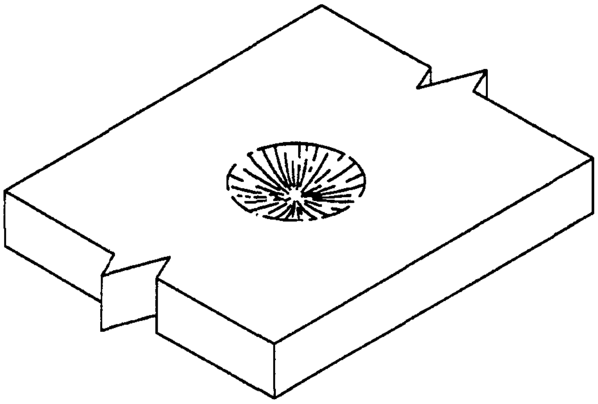
METALS OR MATERIALS TO BE PROCESSED	RESTRICTIONS	OPERATION	ABRASIVE PAPER OR CLOTH			ABRASIVE FABRIC OR PAD	WOOL		PUMICE 350 MESH OR FINER	ABRASIVE WHEEL
			ALUMINUM OXIDE	SILICON CARBIDE	GARNET		ALU-MINUM	STAIN-LESS STEEL		
FERROUS ALLOYS HEAT TREATED 220 KSI OR HIGHER	DO NOT USE ACID BASE RUST REMOVERS. DO MOT USE HAND-HELD POWER TOOLS	CORROSION REMOVAL AND BLENDS	150-FINER	150-FINER		FINE TO ULTRA-FINE	X	X	X	
		FINISHING	400				X	X	X	
FERROUS ALLOYS	DOES NOT APPLY TO STEEL HEAT TREATED 220 KSI OR HIGHER	CORROSION REMOVAL AND BLENDS	150-FINER	180-FINER		FINE TO ULTRA-FINE	X	X	X	X
		FINISHING	400				X	X	X	
ALUMINUM ALLOYS EXCEPT CLAD ALUMINUM	DO NOT USE SILICON CARBIDE ABRASIVE	CORROSION REMOVAL AND BLENDS	150-FINER		7/0-FINER	VERY FINE AND ULTRA-FINE	X		X	X
		FINISHING	400				X		X	
CLAD ALUMINUM	SANDING LIMITED TO THE REMOVAL OF MINOR SCRATCHES	CORROSION REMOVAL AND BLENDS	240-FINER		7/0-FINER	VERY FINE AND ULTRAFINE			X	X
		FINISHING	400						X	
MAGNESIUM ALLOYS		CORROSION REMOVAL AND BLENDS	240-FINER			VERY FINE AND ULTRAFINE	X		X	
		FINISHING	400				X		X	
TITANIUM		CLEANING AND FINISHING	150-FINER	180-FINER				X	X	X
PLATED OR PHOSPHATED SURFACES		REFER TO THE APPLICABLE BASE METAL FOR CORROSION REMOVAL						X		

Abrasives for Corrosion Removal
Figure 3



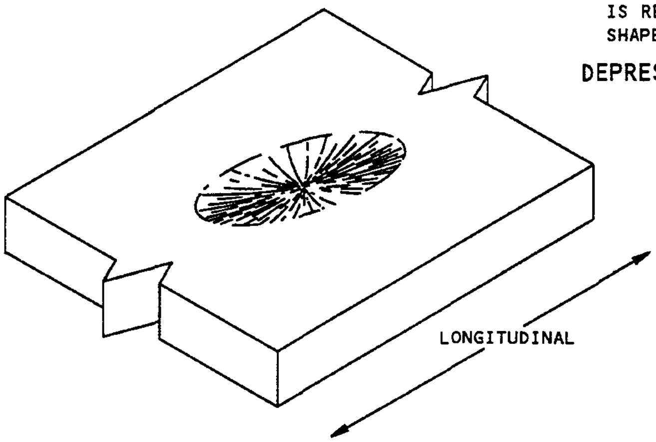
NOTE: ALL LOOSE CORROSION PRODUCTS ARE REMOVED FROM THE PIT.

CORROSION DAMAGE BEFORE REPAIR



NOTE: ROUGH EDGES ARE SMOOTH AND ALL CORROSION IS REMOVED. BUT DEPRESSION IS NOT CORRECTLY SHAPED.

DEPRESSION AFTER CORROSION REMOVAL



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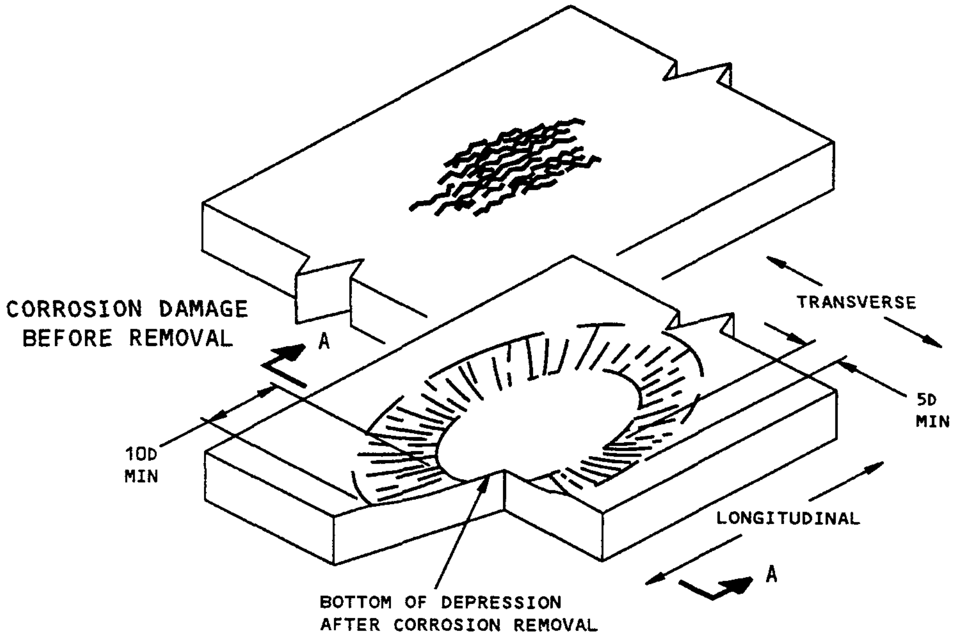
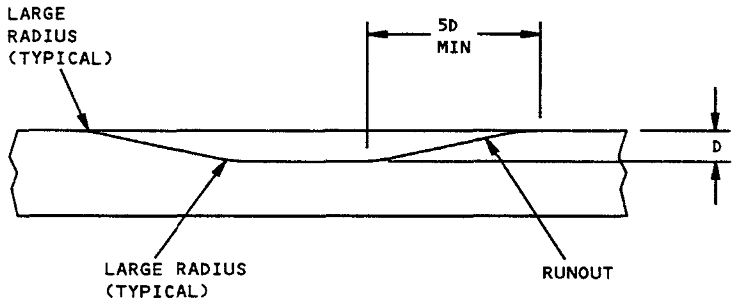
NOTE: THE BLEND NOW HAS THE RATIO AND DIRECTION SHOWN IN FIG. 5.

Single Depression Blends
Figure 4



DAMAGE REMOVED AND SURFACE IS SMOOTH
WITH SHALLOW ELLIPTICAL BLENDOUT



EXAMPLE OF 1:5 BLEND RATIO
A-A

NOTE

D = DEPTH OF DEPRESSION

1. SEE SPECIFIC REPAIR FOR MAXIMUM DEPTH
2. BECAUSE THE MAXIMUM DEPTH IS DIFFERENT AT DIFFERENT LOCATIONS, MAXIMUM SIZE OF BLENDOUT WILL ALSO BE DIFFERENT
3. USE THE SAME BLEND RATIO AT ALL TIMES UNLESS THE REPAIR INSTRUCTIONS ARE DIFFERENT

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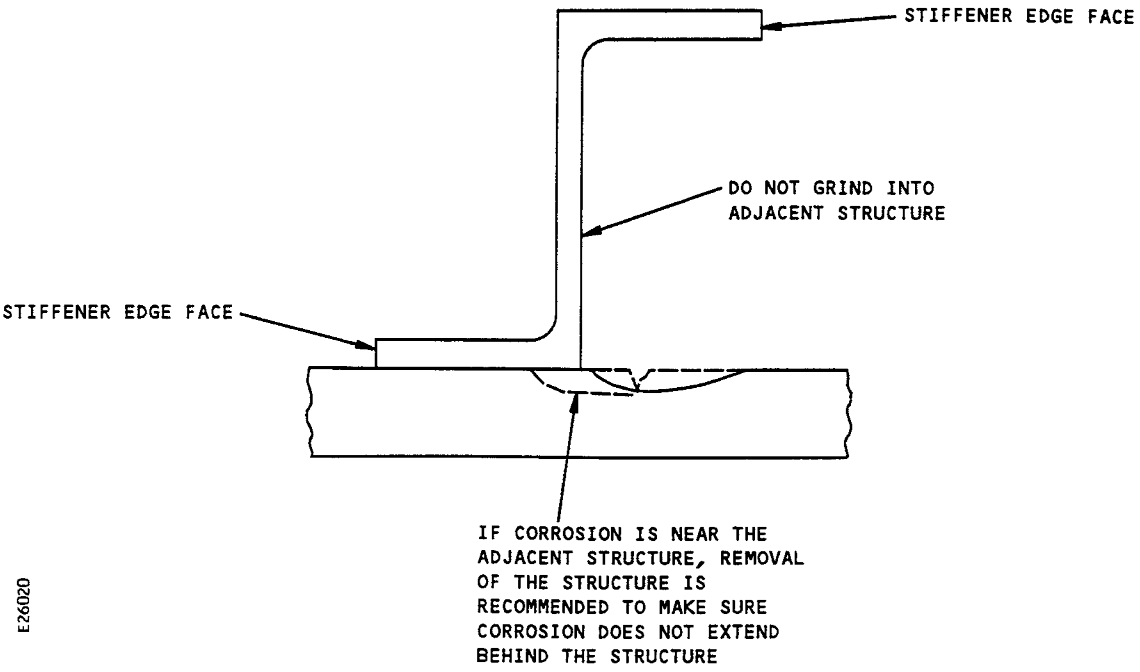
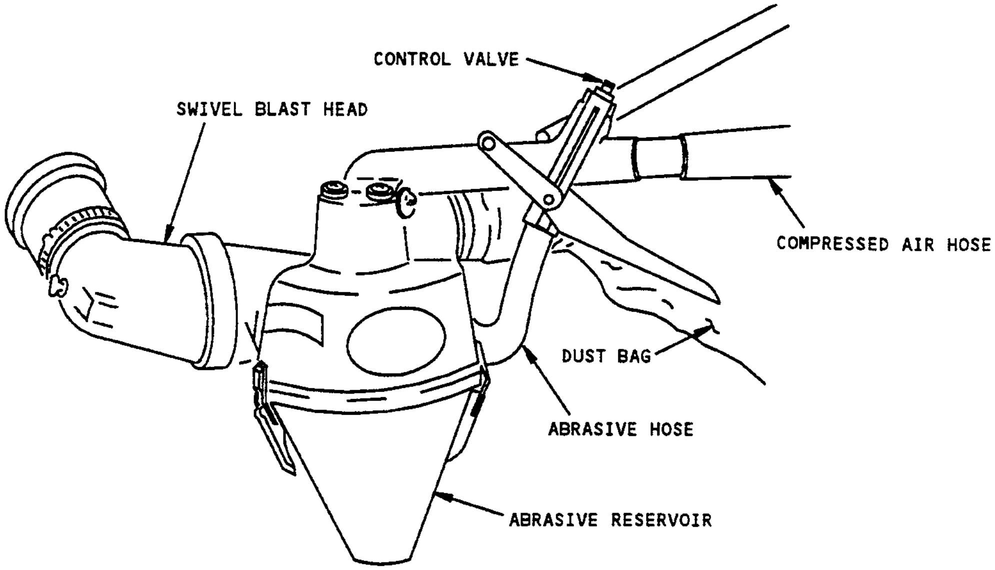
Multiple Depression Blends
Figure 5



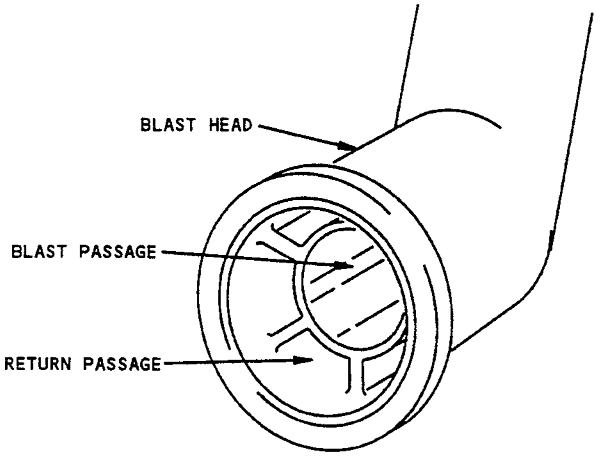
Corrosion in Limited Clearance Areas
Figure 6



PORTABLE ABRASIVE BLASTER COMPONENTS
(CLEMCO MODEL E-10A UNIT SHOWN)

NOTE: FOR BEST RESULTS, THE BLAST NOZZLE SHOULD BE HELD ON THE SURFACE SO THAT IT REMOVES CORROSION IN AN APPROXIMATE 1-INCH DIAMETER PATH.

BLAST NOZZLE ON WORK SURFACE

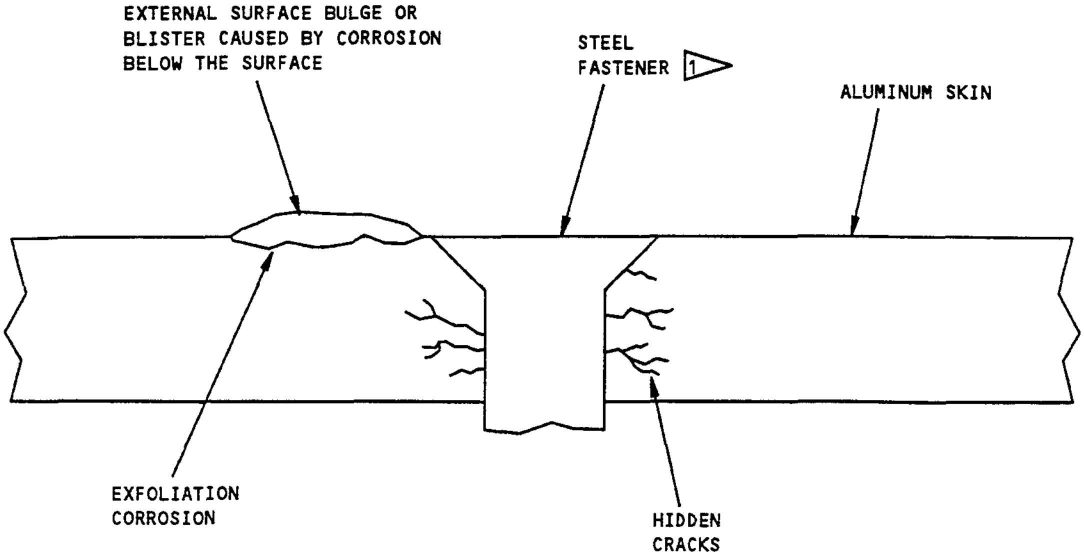


NOTE: THE BLAST HEAD OF THE CLEMCO PORTABLE BLAST CLEANER HAS A CONCENTRIC ARRANGEMENT. THE INNER TUBE BLASTS THE GLASS HEADS AGAINST THE CORRODED SURFACE AND THE OUTER PASSAGE RETRIEVES BEADS AND DUST.

BLAST HEAD

E26045

Portable Abrasive Blaster
Figure 7



1 FASTENERS NEAR OR IN THE AREA OF CORROSION MUST BE REMOVED. CORROSION REMOVAL ON THE EXTERNAL SURFACE WITHOUT FASTENER REMOVAL WILL NOT STOP CORROSION UNDER THE FASTENER HEAD OR IN THE HOLE.

E26051

Corrosion at Fasteners
Figure 8

CORROSION REMOVAL TECHNIQUES
PROCEDURE AFTER MERCURY SPILLAGE

1. General

A. The corrosive action of mercury is very rapid; consequently, immediate action must be taken when mercury spillage has been discovered.

B. Mercury amalgamates readily with aluminum alloys at room temperature if the oxide film on the aluminum has been scratched or damaged. Once a small area of aluminum has been amalgamated, corrosion occurs. This process is accelerated by moisture and particularly by salt water.

C. The amalgamation of stressed aluminum structure may also result in rapid cracking similar to stress corrosion cracking.

D. Mercury is not consumed in the amalgamation process. As the aluminum oxidizes, it separates from the amalgam and the mercury continues to attack fresh aluminum.

E. The presence of organic finishes, greases or a thick continuous oxide layer retards the amalgamation process.

2. Detection

A. A grayish-white powder or fuzzy coating on aluminum surfaces indicates the presence of corrosion caused by spilled mercury.

B. The presence of even small amounts of mercury can be detected by a sniffer. This is an electronic device that is sensitive to mercury vapor.

C. X-ray that will show up on the film as small white spots can best detect Mercury. Corrosion may show up as tree-like forms penetrating a structural component.

3. Personnel Precautions

WARNING: ALWAYS PROVIDE AMPLE VENTILATION WHILE CLEANING AREAS CONTAMINATED BY MERCURY.

DO NOT EAT, SMOKE OR BLOW NOSE AFTER CONTACTING MERCURY WITHOUT FIRST WASHING HANDS THOROUGHLY.

A. Appreciable amounts of mercury will vaporize at normal temperatures to the extent that a stagnant air mass can become dangerous to personal health.

B. Free mercury or amalgam must not be picked up by hand.

C. Clean tools with soap and hot water or steam bath. Discard drill bits after use on structure contaminated by mercury.

4. Isolation of Contaminated Areas

A. On discovery of spilled mercury steps should be taken to avoid enlargement of the contaminated area. The following precautions are advised:

(1) Do not remove access/inspection plates or even fasteners that could result in the spread of the mercury, until such times as the area has been thoroughly cleaned up.

(2) If hands become contaminated, do not touch any exposed metal in the surrounding area in case it becomes contaminated.

(3) Mercury spreads easily from one surface to another by adhering to hands, shoes, clothes, tools, etc. Keep traffic to a minimum in the contaminated area.

(4) Wear foot covers (wing socks) to prevent damage to finish. Failure to wear foot covers may result in exposing bare metal to attack.

(5) Consider protecting uncontaminated areas by taping down protective material such as plastic sheets or toweling. Plastic sheeting or toweling can also be taped over a contaminated area to isolate it while equipment is being collected for the removal of mercury.

5. Mercury Removal

A. The first action to be taken is to remove all visible mercury without delay. The following methods of removal are suggested, the more primitive methods are less effective than those requiring special equipment, but any possible method should be attempted whereby speed is essential.

(1) Use paper or cardboard troughs to scoop up the mercury.

(2) Use adhesive tape to pick up small droplets.

(3) Use a medicine dropper for globules.

(4) Use a high-powered vacuum cleaner with a trap. See Fig. 1 for a suggested method of making a trap.

(5) Use one of the special mercury pickup brushes that attract the mercury. Foam pads are also commercially available that will pick up mercury. Refer to par. 6 for details of a suitable brush.

(6) Use the special Hg vacuum cleaner, if available.

WARNING:ALL DETECTABLE MERCURY MUST BE REMOVED FROM THE AIRPLANE.

B. After removal of any visible mercury more sophisticated means must be employed to ensure that hidden mercury is located and removed. A sensing device known as a mercury sniffer can be used, or even more effectively, X-ray pictures can be taken.

C. Where there is evidence of the presence of mercury in joints, between faying surfaces, or trapped in any way between structural members, they must be disassembled as necessary to permit complete removal of the mercury.

6. Removal of Mercury Using Brushes

A. A special brush is available made from nickel plated carbon fibers that will pick up mercury. Refer to par. 7 for the source of supply.

B. A brush made from fine copper wire can also be used to pick up mercury. It is suggested that a suitable brush could be manufactured locally by using the fine wires used in domestic flexible electrical cable. The procedure for using the copper brush is as follows:

(1) Dip the brush in nitric acid (HN03) to clean the wires.

(2) Dip the brush into water to remove the acid.

(3) Dip the brush into alcohol to remove the water.

(4) Pick up the mercury with the brush. Mercury adheres to the copper wires by forming an amalgam. After the brush has collected a quantity of mercury it can be shaken off into a suitable container, and the picking up process continued.

7. Special Equipment

A. Because of the urgency involved in removing mercury from the airplane, most of these procedures utilize materials that are readily available locally. However, the use of some special equipment is beneficial in ensuring that all traces of mercury are removed, and the sources of supply for these items are as follows:

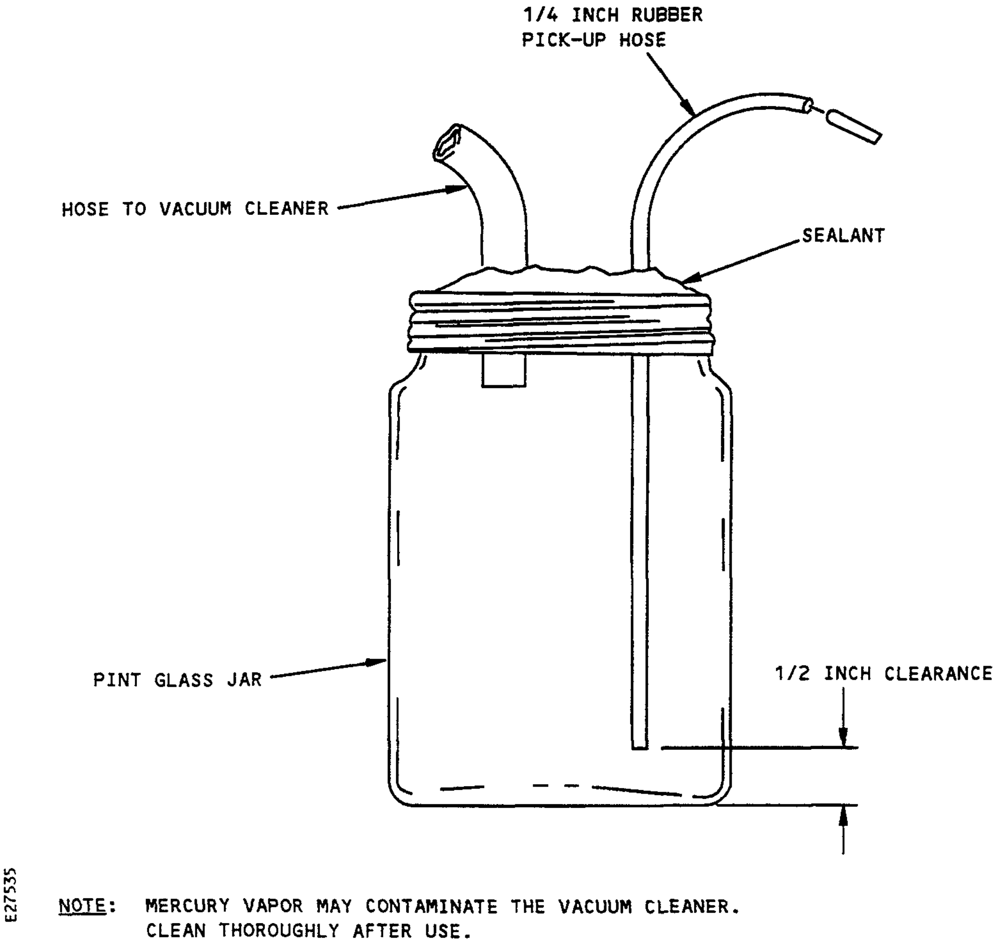
(1) Hg vacuum cleaner: Nilfisk of America Inc. (V57573).

(2) Sensing device (mercury sniffer): Beckman Industrial Corp. (V73138), or Sunshine Scientific Instruments Inc. (V06030).

(3) Nickel-plated carbon-fiber brushes: International Research and Development Co.

(4) Mercury sponge: J.T. Baker Chemical Co. (V70829).

CORROSION REMOVAL TECHNIQUES
PROCEDURE AFTER MERCURY SPILLAGE



NOTE: MERCURY VAPOR MAY CONTAMINATE THE VACUUM CLEANER. CLEAN THOROUGHLY AFTER USE.

Vacuum Cleaner Mercury Trap
Figure 1

GENERAL INFORMATION CORROSION REMOVAL TECHNIQUES
PROCEDURE AFTER FIRE DAMAGE

1. +General

A. Service experience has indicated that corrosion problems can occur if fire damaged areas are not immediately cleaned. The sooty deposits resulting from burning organic materials and the residue from the use of dry powder type fire extinguishers are the sources of contaminants that may initiate corrosion in metal systems and structure.

B. The dry powder type fire extinguishers are considered very effective in combatting airplane fires. The powder from extinguishers of this type is decomposed by heat to form carbon dioxide. The residual deposit, however, is hygroscopic and forms sodium hydroxide when moisture is absorbed from the air or mixed with water from airplane flushing. Sodium hydroxide is alkaline and can cause corrosion damage to aluminum structure, electrical components, etc. Use large quantities of water for flushing in every compartment, crevice and corner, and behind electrical panels to eliminate all traces of this rather insoluble white powder.

C. BCF and similar halogen type fire extinguishers normally leave no chemical residue to corrode parts or surfaces. However, when subjected to flame or hot surfaces, halogenated agents can decompose to produce small amounts of halogen acids.

2. Preventive Maintenance

A. Remove fire damaged interiors to expose structure. This includes interior trim, seats, passenger service units, linings, insulations, galleys, etc. Removal of tubing, cables, electrical wiring, etc., is not necessary if they are unaffected.

B. Screen or mask off areas not affected.

C. Open all drains, hatches and doors for drainage and ventilation. Use compressed air to blow dry all hidden recesses.

D. Inspect structure for heat damage, soot, fire extinguishing material residue and corrosion. Paint discoloration indicates temperature had exceeded 350°F (180°C)and requires structural analysis. Check for acid contamination of structure, control cables and wire bundles using litmus paper. Products of combustion or decomposed fire extinguishants may combine with moisture to form corrosive chemicals. Flush structure with water as necessary to remove contaminants and replace control cables, etc., as necessary.

E. Remove and replace structure damaged beyond repair.

NOTE: Use eddy current technique outlined in Nondestructive Test Manual to determine any change in heat-treat of any suspect structure.

GENERAL INFORMATION CORROSION REMOVAL TECHNIQUES
PROCEDURE AFTER FIRE DAMAGE

WARNING: SOLVENTS CAN CAUSE SKIN IRRITATION. THE VAPOR MAY IRRITATE EYES AND RESPIRATORY SYSTEM OR CAUSE HEADACHES, SLEEPINESS, OR FAINTING. USE WITH ADEQUATE VENTILATION, FACE SHIELDS AND PROTECTIVE CLOTHING. AVOID PROLONGED BREATHING OF VAPORS OR REPEATED CONTACT WITH SKIN.

F. Remove soot by washing affected areas with 1,1,1 - Trichloroethane, Aerofluor 343, or Shopmaster RTU, nonflammable solvent-type cleaner. Pressure gun application is suggested for flushing fay surface joints, such as stringers to body skins. An absorbent cloth held beneath the area will catch the contaminated solvent.

WARNING: SODIUM DICHROMATE IS TOXIC IF TAKEN INTERNALLY. USE PROTECTIVE CLOTHING, FACE MASK AND RESPIRATOR WHEN SPRAYING. CONTACT LOCAL AUTHORITIES FOR WASTE DISPOSAL REQUIREMENTS.

G. Inhibit corrosion that could be caused by residue from the dry powder fire extinguisher by washing affected areas with a 10-percent-by-weight solution of sodium dichromate. The dichromate solution acts as a mild corrosion inhibitor. Thoroughly dry all treated surfaces before continuing with any other treatment. Repeat rinse and inhibition treatment if any white residue shows.

NOTE: Any remaining liquid dichromate solution will weep through seams and fastener holes during cabin pressurization and could subsequently discolor the exterior paint finish. Forced hot air used to dry the area may be necessary before further flight if humidity is high.

H. Inspect for remaining residue contaminants. Contaminants that remain behind clips, brackets, nutplates, etc., may require removal of the item before cleanup can be complete.

I. Remove corrosion using one of the methods described in 20-40-00.

J. Treat reworked surfaces per 20-50-00 and paint same as surrounding area (Ref 20-60-00).

K. Apply clear (Type I) BMS 3-23 corrosion inhibiting compound to cleaned-up affected areas especially skin-to-stringer joints. Allow to air dry thoroughly before reinstalling insulation blankets. It is important that the affected area be covered with a continuous film. Use a rag or brush to spread puddles. A thin, even application is all that is required to provide corrosion protection and to prevent moisture placing the sodium dichromate into solution again, with the possible resultant staining of exterior surfaces.

L. Replace all interior items and restore airplane to serviceable condition.

CORROSION REMOVAL TECHNIQUES
PROCEDURE AFTER ALKALINE SPILLS

1. General

A. Alkaline spills are caustic and can cause corrosive damage to airplane structure unless neutralized.

B. The primary source of alkaline spillage is in the battery compartments where alkaline electrolytes may overflow during charging or spill during battery servicing.

C. Alkali-based corrosion removal compounds and airplane cleaners are used quite extensively during routine maintenance operations. Without thorough neutralizing and/or rinsing, a spilled alkaline compound can produce corrosion damage.

D. Containers of alkaline compounds may be part of a cargo and may be broken during loading or unloading. Spillage from such sources are usually larger in scale than battery electrolyte spills. It is therefore recommended that the neutralization of the alkaline be accomplished as soon as possible.

2. Detection

A. Alkalines are clear and are not color detectable. However, spillage is usually spread by personnel working in the immediate spillage area. Such known spills should be neutralized as soon as possible.

B. In the cases where spillage has gone undetected and has penetrated the protective finishes, a white powdery deposit (aluminum oxide) would indicate corrosion on aluminum structure.

C. In other instances, particularly around the top of nickel-cadmium battery cells, the alkaline electrolyte that has overflowed the vent caps reacts with the carbon dioxide in the air and produce a white powdery deposit. This white deposit is not corrosive and otherwise harmless but is an indication that electrolyte has spilled or otherwise escaped.

3. Personnel Protection

WARNING: ALKALINES ACCIDENTLY SPILLED ON SKIN, CLOTHING OR OTHER MATERIAL SHOULD BE FLOODED IMMEDIATELY WITH CLEAN WATER. IF EYES ARE INVOLVED, FLOOD WITH CLEAN WATER OR BORIC ACID SOLUTION AND CONSULT A PHYSICIAN IMMEDIATELY.

A. Adequate protective clothing (rubber or plastic gloves, goggles, face shields, aprons, boots, head gear, etc.) should be worn when handling or working in alkaline contaminated areas.

B. Wash hands after using alkaline neutralizing treatment solutions and/or materials before eating or smoking.

C. Waste materials, solvents, chemical solutions, wiping rags, masking materials, etc., shall be collected and safely disposed of.

4. Isolation of Contaminated Area

A. On discovery of alkaline spills, steps should be taken to contain the contaminated area. The following precautions are advised:

(1) Do not allow alkaline spills to spread to adjacent areas that will not be cleaned.

(2) In battery areas, protection of equipment beneath using plastic sheets is advised. If equipment is operating, venting should be maintained.

(3) Consider protecting uncontaminated areas by taping down protective material such as plastic sheets.

5. Alkaline Spillage Cleanup

A. If equipment is adjacent to the treatment area, use plastic sheets to cover the equipment to prevent splashing of alkalines or treatment fluids.

B. Wipe up excess fluids with cloth and discard cloth into plastic container for disposal.

C. Neutralize the treatment area with a 5% acetic acid solution or full strength household vinegar applied with a brush or cloth swab.

D. Continue to apply the solution until all chemical reaction ceases. Then allow the solution to remain on the surface for an additional 5 minutes. Particular attention should be given to faying surface joints. Pressure application may be necessary to flush the joint thoroughly.

E. Remove the neutalized mixture with a mop or sponge.

F. Rinse the affected area with generous quantities of clean water. occasionally agitate the surface with a soft brush.

G. Neutralization of the alkaline fluid should be determined with litmus paper.

H. Wipe dry with clean cloths.

I. After thoroughly drying, repair or replace damaged finishes if at all possible. Refer to 20-50-00 and 20-60-00 for protective finish systems.

J. Apply BMS 3-23 water displacing corrosion inhibiting compound over the entire area.

NOTE:For details of application of BMS 3-23, refer to 20-60-00.

GENERAL INFORMATION CORROSION REMOVAL TECHNIQUES
PROCEDURE AFTER ACID SPILLS

1. General

A. Acid spills, unless neutralized, can rapidly corrode metallic structure.

B. The primary source of alkaline spillage is in the battery compartments where acid electrolytes may overflow during charging or spill during battery servicing.

C. Acid-based corrosion removal compounds and airplane cleaners are used quite extensively during routine maintenance and repair. Spills do occur at times and thorough neutralizing and/or rinsing is necessary to preclude corrosion damage.

D. Containers of acid concentrates or acid based chemicals may be part of a cargo and may be broken during loading or unloading. Spillage from such sources are usually larger in scale than battery electrolyte or maintenance servicing chemical spills mentioned in par. B and C. It is, therefore, advisable that the acid spillage be neutralized as soon as possible.

E. Operators should also be aware of the fact that acids may deteriorate nonmetallic materials such as fabrics, wood, leather, etc.

F. The FAA has required the removal of all lithium sulfur dioxide batteries from all U.S. civil aircraft. This is due to the fact that many incidents have been reported in which lithium sulfur dioxide batteries have burned or vented violently. Some batteries have also leaked sulfur dioxide gas, which combines with moisture to form extremely corrosive sulfurous acid.

2. Detection

A. Any discoloration on the surface should be suspected and investigated. Black, white, yellow and brown are predominant chemical reaction precipitate colors. Precipitate colors depend on the acid and the material on which the acid is spilled.

3. Personnel Protection

WARNING: ACIDS ACCIDENTLY SPILLED ON SKIN, CLOTHING OR OTHER MATERIAL SHOULD BE FLOODED IMMEDIATELY WITH CLEAN WATER. IF EYES ARE INVOLVED, FLOOD WITH LARGE AMOUNTS OF CLEAN WATER AND CONSULT A PHYSICIAN IMMEDIATELY.

A. Adequate protective clothing (rubber or plastic gloves, goggles, face shields, aprons, boots, head gear, etc.) should be worn when handling or working in acid contaminated areas.

B. Wash hands after using acid neutralizing treatment solutions and/or materials before eating or smoking.

C. Waste materials, solvents, chemical solutions, wiping rags, masking materials, etc., shall be collected and safely disposed of.

4. Isolation of Contaminated Area

A. On discovery of acid spills, steps should be taken to contain the contaminated area. The following precautions are advised:

(1) Do not allow acid spills to spread to adjacent areas that will not be cleaned.

(2) In battery areas, protection of equipment beneath using plastic sheets is advised. If equipment is operating, venting should be maintained.

(3) Consider protecting uncontaminated areas by taping down protective material such as plastic sheets.

5. Acid Spillage Cleanup

A. If equipment is adjacent to the treatment area, use plastic sheets to cover the equipment to prevent inadvertent splashing of acids or treatment fluids.

B. Wipe up excess fluids with cloth and discard cloth into plastic container for disposal.

C. Neutralize the treatment area with a 20% sodium bicarbonate solution applied with a brush or cloth swab. Particular attention should be given to faying surface joints. Pressure application may be required to flush the joint thoroughly.

NOTE: One pound of sodium bicarbonate in 1 gallon of water will give the desired mixture.

D. Continue to apply the solution until bubbles cease. Then allow the solution to remain on the surface for an additional 5 minutes.

E. Remove the neutralized mixture with a mop or sponge.

F. Rinse the affected area with generous quantities of clean water. Occasionally agitate the surface with a soft brush.

G. Neutralization of the alkaline fluid should be determined with litmus paper.

H. Wipe dry with clean cloths.

I. After thoroughly drying, repair or replace damaged finishes if at all possible. Refer to 20-50-00 and 20-60-00 for protective finish systems.

J. Apply BMS 3-23 water displacing corrosion inhibiting compound over the entire area.

GENERAL INFORMATION STANDARD TREATMENT METHODS

1. General

A. In order to preclude the occurrence or recurrence of corrosion after corrosion removal or corrosion damage repair, the exposed surfaces of most metals must be immediately treated after rework. These treatments include conversion coating, plating or the application of thin protective film, i.e., oil or primer, over the base metal. The conversion coatings and primer application also enhance the surface adhesion qualities for painting, if required. Some metals, such as stainless steel and titanium, which are basically corrosion resistant do not require surface protection except for painting to match the surrounding structure, or in dissimilar metal applications when plating, painting or sealing becomes necessary.

B. Corrosion Prevention. Although the surface finish has been restored by the treatment methods in this section to minimize the recurrence of corrosion, service experience indicates it would be advantageous to apply a corrosion inhibiting compound over the surface finish in the more susceptible areas. Refer to the applicable sections of Volume 2.

2. Surface Treatment for Aluminum and Aluminum Alloys

A. General. Aluminum and its alloys quickly forms an invisible protective oxide film on the surface when exposed to atmosphere. The oxide will provide corrosion protection in mild environment, but since the reworked area is in a corrosion prone area further protection is required.

B. Surface Treatment. All aluminum surfaces that have been reworked per 20-40-00 or applicable methods in Volume 2 should be cleaned and have a conversion coating applied. The coating materials chemically convert the aluminum surface into a very thin (0.00001 to 0.0005 inch) non-metallic chromated film as an integral part of the metal. This film is resistant to corrosion and an excellent adherent for subsequent priming. The conversion coating can be applied by alodizing or by Iridite treatment. Solutions used in both treatments are proprietary but are readily available through most sources handling chemicals. There are several alodizing chemicals and the treatment procedure for each is presented below. The treatment procedure for Iridite is also included.

C. Alodizing. The alodizing chemicals used for treatment are:

Alodine 1200 or 1200S (colored film)
Alodine 1000, 1000L or 1500 (clear film)
Nitric Acid

The colored film of parts treated with Alodine 1200 or 1200S will vary from light golden iridescent to goLd-brown. Parts treated with Alodine 1000, 1000L or 1500 will have no color. For most applications Alodine 1200 or 1200S is recommended. (If the parts have BMS 10-20 primer, use only Alodine 600 because other coating materials, such as Alodine 1200 or 1200S, can cause a powdery coating if applied on cured BMS 10-20 primer. Refer to 20-43-03 of the Standard Overhaul Practices Manual for procedure details.) Treatment of reworked areas may be accomplished either by immersion where parts are removed from the airplane or by manual coating methods.

WARNING: MATERIALS USED ARE FLAMMABLE AND TOXIC. SPONGES, CLOTH AND TOOLS IN CONTACT WITH ALODINE SOLUTION SHOULD NOT BE ALLOWED TO DRY WITHOUT THOROUGHLY RINSING IN WATER BEFORE DISCARDING.

ALODINE POWDER CONTACTING ORGANIC COMPOUNDS MAY CAUSE COMBUSTION. IF ALODINE SOLUTION IS SPLASHED INTO EYES OR SKIN, FLUSH IMMEDIATELY WITH A CONSIDERABLE AMOUNT OF CLEAN WATER.IF SOLUTION IS SPILLED ON CLOTHING, IMMEDIATELY REMOVE CONTAMINATED CLOTHING AND WASH CLOTHING AND BODY WITH A CONSIDERABLE AMOUNT OF CLEAN WATER.

(1) Solution Preparation.

(a) All solutions except Alodine 1000 or 1000L shall be made up in and contained in stainless steel tanks or in tanks lined with acid-resistant plastic or rubber. Alodine 1000 and 1000L solutions may be made up in and contained in mild steel tanks.

(b) The cleaned tank shall be half filled with make-up water. Sprinkle the powder chemicals uniformly over the surface or pour the liquid chemicals along the length of the tank, stir the solution until chemicals are completely dissolved or liquids are completely mixed, then add water to volume.

(c) For large, long tanks, longitudinal agitation is recommended to keep solution concentrations uniform.

(d) Prepare Alodine 1200 and 1200S solutions for immersion application in accordance with proportions and control shown in Fig. 1, Sheet 1.

(e) Prepare Alodine 1000, 1000L and 1500 solutions for immersion applications in accordance with proportions and control shown in Fig. 1, Sheet 2.

(f) Prepare Alodine solutions for manual application in accordance with instructions in Fig. 2.

(2) Alodine Surface Treatment

(a) Wipe with dry clean cheesecloth to remove base particles and residue from the treatment area.

(b) Wipe with cheesecloth dampened (not saturated) with solvent, series 88 (Ref. SOPM 20-30-88). Repeat using clean cheesecloth until no visible residue transfers to the cheesecloth.

(c) Allow to dry for a minimum of 15 minutes.

NOTE: Water break test may be used to determine cleanliness. In this method a mist of distilled water is atomized on the surface to be coated. If the water gathers and forms into droplets within 25 seconds the surface shall be considered as failing the test. If the water forms a continuous film by flashing out suddenly over a large area the surface shall also be considered as having failed the cleanliness test because of impurities on the surface. If the water drops coalesce into a continuous film of water without a sudden flash and forms a lens, then the surface shall be considered as having satisfactorily passed the water break test.

(d) Mask off dissimilar metal inserts, except chromium, nickel, corrosion resistant steel, or titanium.

(e) Immersion Application. Immerse part in alodine-solution for 2 to 6 minutes. Use a test sample to find the correct immersion time.

CAUTION: EXERCISE CARE WHEN WIPING FRESHLY TREATED SURFACE TO AVOID SCRATCHING OR TEARING COATING.

(f) Manual Application

1) Apply the alodine solution to the cleaned metal surface by brush, swab, swatches of saturated blotting paper, or a clean cellulose sponge.

2) Allow solution to act on surface 1 to 5 minutes until coating is formed. Coating time will depend on temperature of the part. Maintain a continuous wet film on surface of work area.

3) Where difficulty is experienced in the formation of the coating, lightly abrading with a fine or very fine aluminum oxide nylon mat soaked with the solution will help.

4) Dirty surfaces may not take coating and will require rinsing off the solution, cleaning and reapplication.

5) Areas with powdery coating shall be recoated with fresh solution.

(g) Remove excess alodine by thoroughly flushing with clean water, then allow to dry at ambient temperature. Force air dry if possible.

(h) Apply original finish.

(i) Remove masking and protective covering.

D. Iridite Treatment. The chemicals used in the Iridite treatment are:

- Iridite 14
- Iridite 14-2
- Nitric Acid.

Iridite treating can be controlled by length of time solution is applied to give a yellow or a clear coating. Treatment of reworked areas may be accomplished either by immersion or by manual coating methods.

WARNING: MATERIALS USED ARE FLAMMABLE AND TOXIC. SPONGES, CLOTH AND TOOLS IN CONTACT WITH IRIDITE SOLUTION SHOULD NOT BE ALLOWED TO DRY WITHOUT THOROUGHLY RINSING IN WATER BEFORE DISCARDING.

IRIDITE POWDER CONTACTING ORGANIC COMPOUNDS MAY CAUSE COMBUSTION. IF IRIDITE SOLUTION IS SPLASHED INTO EYES OR SKIN, FLUSH IMMEDIATELY WITH A CONSIDERABLE AMOUNT OF CLEAN WATER. IF SOLUTION IS SPILLED ON CLOTHING, IMMEDIATELY REMOVE CONTAMINATED CLOTHING AND WASH CLOTHING AND BODY WITH A CONSIDERABLE AMOUNT OF CLEAN WATER.

(1) Solution Preparation

(a) All compressed air used for solution agitation or for drying parts shall be filtered to remove oils and solid particles.

(b) All containers for Iridite solution shall be fabricated from or lined with stainless steel or plastic. Some suitable plastic materials are polyethylene, Koroseal, Tygon, Lucoflex and Lucite.

(c) Slowly add the Iridite powder to room temperature water by required concentration. Agitate the solution (clean filtered air is satisfactory) until all soluble material is dissolved.

(d) Prepare Iridite 14 and Iridite 14-2 solutions for immersion or manual applications in accordance with proportions and control shown in Fig. 3.

(2) Iridite Surface Treatment

(a) Wipe with dry clean cheesecloth to remove loose particles and residue from the treatment area.

(b) Wipe with cheescloth dampened (not saturated) with solvent, series 88 (Ref. SOPM 20-30-88). Repeat using clean cheesecloth until no visible residue transfers to the cheesecloth.

(c) Allow to dry for a minimum of 15 minutes.

NOTE: The water break test may be used to determine cleanliness. In this method a mist of distilled water is atomized on the surface to be coated. If the water gathers and forms into droplets within 25 seconds the surface shall be considered as failing the test. If the water forms a continuous film by flashing out suddenly over a large area the surface shall also be considered as having failed the cleanliness test because of impurities on the surface. If the water drops coalesce into a continuous film of water without a sudden flash and forms a lens, then the surface shall be considered as having satisfactorily passed the water break test.

(d) Mask off dissimilar metal inserts, except chromium, nickel, corrosion resistant steel, or titanium.

(e) Immersion Application. Immerse part in Iridite solution for 1 to 6 minutes until the desired coating is obtained. The use of test sample is recommended to ascertain the correct immersion time.

NOTE: The Iridite solution will accumulate sludge. In no case shall the depth of the sludge be allowed to reach a point where it touches the work.

CAUTION: DO NOT ATTEMPT TO BRUSH OUT THE SOLUTION LIKE PAINT AS SOFT COATING WILL SCRATCH OR TEAR WHILE STILL FRESH.

(f) Manual Application. Apply the Iridite solution liberally and evenly with a nylon brush, cotton swab, cellulose sponge or white blotting paper. Maintain a continuos wet film for 3 to 6 minutes if a yellow coating is required and from 30 seconds to 3 minutes if a clear coating is required.

(g) Remove excess Iridite by thoroughly flushing with clean water, then allow to dry at ambient temperature. Force air dry if possible.

(h) All powder visible on parts after treatment shall be wiped off the dry parts with clean dry rags.

(i) Apply original finish.

(j) Remove masking and protective covering.

3. Surface Treatment for Magnesium Alloys

A. General. Magnesium alloys are highly susceptible to corrosion when the metal surface is exposed without a protective finish. An oxide-carbonate film will normally form on an exposed magnesium alloy surface but this surface provides very little protection against corrosion. A proper protective finish is therefore required.

B. Surface Treatment. All magnesium alloy surfaces that have been reworked per 20-40-00 or applicable methods in Part 3 shall be cleaned and treated with a conversion coating. The coating materials convert the magnesium alloy surface into an inhibitive passive layer on the base metal that resists corrosion. This coating is applied using the brush-on technique.

(1) Solution Preparation

(a) The chemicals used for the solution are:

Chromic Acid (Cr03)
Calsium Solfate (CaS04.2H20)

(b) The solution shall be prepared and stored in polyethylene or glass containers.

(c) Prepare the solution using the following proportions and control. The chemicals shall be added to the water in the order given below.

Chromic Acid	1.3 oz/gal
Calcium Sulfate	1 oz/gal
Distilled Water	to make 1 gal
pH	1.2-1.6

NOTE: Adjust pH with additions of sodium hydroxide or sulfuric acid as required.

(d) Vigorously stir for 15 minutes to ensure that the solution is saturated with calcium sulfate.

(e) Let solution stand for 15 minutes to allow undissolved calcium sulfate to settle on the bottom of the container.

(f) Decant into another container without transferring undissolved calcium sulfate.

(2) Conversion Coating Application

CAUTION: THE FOLLOWING PROCEDURE IS NOT APPLICABLE TO ADHESIVE BONDED PARTS OR ASSEMBLIES OR AREAS WHERE THE BRUSH-ON SOLUTION MIGHT BECOME LODGED OR ON LOCAL AREAS BARED SPECIFICALLY FOR GROUNDING OR ELECTRICAL BONDING PURPOSES.

(a) Wipe treatment area with dry clean cheesecloth to remove loose paticles and residue.

(b) Wipe with cheesecloth dampened (not saturated) with solvent, series 88 (Ref. SOPM 20-30-88). Repeat using clean cheesecloth until no visible residue transfers to the cheesecloth.

(c) Allow to dry for a minimum of 15 minutes. Refer to para.2.C.(2)(c) for water break test to determine cleanliness.

(d) Mask off dissimilar metal inserts, except chromium, nickel, corrosion resistant steel, or titanium.

CAUTION: SEVERE RUBBING OF WET SURFACE CAN CAUSE COATING DAMAGE.

(e) Apply solution by swabbing with brush, swab, swatches, cellulose sponge or white blotting paper. Maintain a continuous wet film until metal surface becomes dull golden to dark brown in color.

(f) Rinse with clean cold water.

CAUTION: DO NOT DIRECT HIGH PRESSURE AIR TO SURFACE WHILE DRYING AS COATING IS STILL SOFT.

(g) Allow to dry at ambient temperature. Force air dry if possible.

(h) Apply original finish.

(i) Remove masking and protective covering.

4. Surface Treatment for Carbon Steels

A. General. Bare surfaces of carbon (alloy) steels are highly reactive when exposed to the environment. Carbon steel is either cadmium or cadmiumtitanium plated after machining and heat treatment. Steel parts absorb hydrogen during processing operations and in service when hydrogen may be produced and diffused into the metal. Hydrogen absorption, can cause crack initiation and propagation and result in delayed brittle fracture when the part is under sustained tensile strength. The susceptibility of steel parts to hydrogen embrittlement increases as hardness and strength increases.

B. Surface Treatment. Steel parts heat-treated to 180 ksi and below are not considered susceptible to hydrogen embrittlement while steel parts heat-treated to 220 ksi and above are highly susceptible to hydrogen embrittlement and must be plated by Low embrittlement processes. In order to preclude the use of conventional plating process, reworked surfaces of all carbon steel parts shall be cadmium plated by low hydrogen embrittlement cadmium plating processes. Refer to 20-42-01, 20-42-02 and 20-42-10 of the Boeing Standard Overhaul Practices Manual for plating procedures. Apply original finish after plating.

5. Surface Treatment for Stainless Steels and Nickel-Chromium Alloys

A. No surface treatment is required after rework on stainless steel and nickel-chromium alloys. Refer to par. 7 for plated alloys. Stainless steel requires passivation after rework.

6. Surface Treatment for Titanium Alloys

A. No surface treatment is required after rework on titanium alloys. Apply original finish. Refer to par. 7 for plated alloys.

7. Surface Treatment for Cadmium Plated or Phosphated Metals

CAUTION: STEEL PARTS HEAT-TREATED ABOVE 180 KSI ARE SUBJECT TO HYDROGEN EMBRITTLEMENT. LOW HYDROGEN EMBRITTLEMENT PLATING MUST BE USED. REFER TO 20-42-01,20-42-02 AND 20-42-10 OF THE BOEING STANDARD OVERHAUL PRACTICES MANUAL FOR PLATING PROCEDURES.

A. Rework of cadmium plated surfaces indicates a break in the plated surface and exposure of the base metal. Surface treatment should therefore be replating of the base metal. Use low hydrogen embrittlement stylus cadmium plating (20-42-10 of the Boeing Standard Overhaul Practices Manual). Major rework requires stripping and replating.

B. Phosphate coating is applied to the cadmium plating on alloy steels heat-treated to 180 ksi and above that are partially cadmium plated. Surface treatment involves use of phosphoric acid to the cadmium plating. Refer to par. 10.C.(1) of 20-40-00 for treatment procedure. If cadmium plating is broken, plate per par. A. before coating.

C. Phosphate coating of alloy steels heat-treated to 180 ksi and below is applied instead of plating to inaccessible areas such as inside of tubings, sharp beads, etc. Coating procedure of the base metal is the same as described in par. 10.C.(1) of 20-40-00.

Material	Variable	Make-Up **[1]**	Control
Alodine 1200	Concentration pH Temperature	1.2 oz/gal - - - - - -	1.0 to 3.0 oz/gal 1.5 to 2.1 **[2]** 60 to 100F
Alodine 1200S	Concentration pH Temperature	1.2 oz/gal - - - - - -	1.0 to 3.0 oz/gal 1.3 to 1.8 **[2]** 60 to 100F

[1] After make-up, allow the solution to set undisturbed for 24 hours before using. The small amount of precipitate which forms will not bother the coating process.

[2] Higher concentrations will tend to have lower pH values, which will rise with age or use, generally leveling off with the ranges stated. The pH may be lowered by additions of Alodine powder, nitric acid, or both. Where hard water is used, small additions of Alodine toner may be used.

Alodine Solution Preparation for Immersion Method
Figure 1 (Sheet 1)

Material	Variable	Make-Up [1]	Control
Alodine 1000 powder	Concentration pH Temperature	0.15 oz/gal - - - - - -	0.14 to 0.18 oz/gal below 4.5 [3] 140 to 150F
Alodine 1000 liquid [2]	Concentration pH Temperature	19.20 oz/gal as Alodine 1000L - - - - - -	17.9 to 23.0 fl oz/gal as Alodine 1000L below 4.5 [3] 140 to 150F
Alodine 1500	Concentration pH Temperature	1.28 oz/gal - - - - - -	1.10 to 1.46 fl oz/gal below 4.0 [3] 150 to 160F

[1] Where powder is used, allow solution to set undisturbed 24 hours before use. The small amount of precipitation which forms will not bother the coating process.

[2] Alodine 1000L is a liquid concentrate. One gallon of concentrate is equivalent to 1 ounce of Alodine 1000 powder.

[3] The pH may be lowered by additions of the Alodine until the top of the concentration range is reached. Discard the solution when the pH reaches the maximum value. Do not attempt control by adding acid.

NOTE: All gallons are U.S. gallons.

Alodine Solution Preparation for Immersion Method
Figure 1 (Sheet 2)

Material	Preparation Instructions
1200	Add 3 ounces of powder to water for each gallon of final solution. Stir well until the powder is dissolved. Disregard any small amount of settled-out insoluble material. Allow to stand at least one hour before use. A pH range of 1.50 to 1.90 is required and adjusted by addition of nitric acid.
1200S	Add 2 ounces of powder to water for each gallon of final solution. Stir well until the powder is dissolved. Disregard any small amount of settled-out insoluble material. Allow to stand at least one hour before use.
1000	Add 0.4 ounce of powder to water for each gallon of final solution. Stir well untilthe powder is dissolved. Disregard any small amount of settle-out insoluble material. Allow to stand at least one hour before use.
1000L	Dilute 4 volumes of the Alodine 1000L with 6 volumes of water and stir well to produce a final concentration of 0.4 ounce of Alodine 1000 per gallon of solution.
1500	Add 8 fluid ounces of Alodine 1500 to water for each gallon of final solution. Stir to get a uniform mixture.

NOTE: All gallons are U.S. gallons.

When a water-break free surface cannot be obtained, Ridosol 501 wetting agent (same source as Alodine) may be added to the solution. Add 0.10 to 0.50% by volume, i.e. 0.128 to 0.64 fluid ounces per gallon.

Alodine Solution Preparation for Manual Application
Figure 2

Material	Variable	Make-Up **[1]**	Control
Iridite 14	Concentration pH Temperature	2.8 oz/gal - - - - - -	2.7 to 3.3 oz/gal 1.0 to 1.7 **[2]** Room temp to 95^{0}F
Iridite 14-2	Concentration pH Temperature	1.45 oz/gal - - - - - -	1.25 to 2.25 oz/gal 1.1 to 16 **[2]** Room temp to 95^{0}F

[1] After make-up, allow the solution to set undisturbed for 24 hours before using. The small amount of precipitate which forms will not bother the coating process.

[2] Adjust the pH with nitric acid until a distinctly yellow adherent film is obtained within the 5 minute immersion time on bare 2024 aluminum alloy.

Iridite Solution Preparation
Figure 3

8. Treatment of Fasteners and Fastener Holes in Composites for Repairs

A. Graphite panel installed on graphite structural component.

(1) Remove fasteners, if loose.

(2) On countersinks and in holes, apply primer BMS 10-11 type 1 or BMS 10-79 type 2.

(3) Install removable steel or titanium fasteners dry.

(4) Install permanent fasteners with wet primer or BMS 5-95 sealant.

B. Graphite panel installed on aluminum structure, or aluminum repair plates on graphite panels.

(1) Remove fasteners, if loose.

(2) On countersinks and in holes, apply primer BMS 10-11 type 1 or BMS 10-79 type 2.

(3) Apply BMS 5-95 fay surface sealant on mating surfaces.

(4) Install fasteners with wet BMS 5-95 sealant.

(5) Fillet seal protruding fastener heads and nuts/washers.

C. Armada or fiberglass or graphite panels, installed in any combination.

(1) Remove fasteners, if loose.

(2) On countersinks and in holes, apply primer BMS 10-11 type 1 or BMS 10-79 type 2.

(3) Install removable fasteners with wet BMS 10-11 type 1 or BMS 10-79 type 2 primer.

(4) Install permanent fasteners with wet primer or BMS 5-95 sealant.

GENERAL INFORMATION
STANDARD PREVENTIVE MAINTENANCE PROCEDURES

1. General

A. The data contained in this subject is general. For system and model specific preventive maintenance procedures, refer to Volume 2.

2. Airplane Washing

A. Washing helps decrease corrosion as well as maintain the appearance of the airplane. Procedures for airplane washing are in Chapter 12 of the Maintenance Manual.

B. Washing removes corrosive deposits that collect on airplane surfaces. Dirt collects moisture that then causes corrosion. But other factors are important in a washing program:

   (1) Washing and in particular high-pressure water or steam can get moisture into areas not usually contaminated.

   (2) The detergents used for washing can cause corrosion if they are not fully rinsed off. Rinsing can be a problem if high-pressure hoses pushed the washing solution into small cavities.

   (3) Any washing solution that removes unwanted grease and oil will also remove the grease and oil that must stay for lubrication. Lubrication again after airplane washing will then be necessary.

   (4) Frequent washing will in time remove corrosion inhibiting compounds, such as BMS 3-23,3-26,3-29 or 3-35. The time is a function of the frequency of washing and the strength of the detergent.

   (5) Too much polishing of unpainted aluminum surfaces can wear away the clad surfaces.

C. The washing frequency must agree with the operating environment and external appearance of the airplane. As a guide these frequencies are recommended:

   (1) Mild Zones--90 days

   (2) Moderate Zones--45 days

   (3) Severe Zones--15 days

D. Polishes can be used on unpainted surfaces but possibly only once every 18 months or 2 years.

3. Protective Finish

A. Maintenance of the surface finish is important to prevent corrosion problems. Damage to paint or other surface coatings should be repaired at the earliest convenient opportunity. Until you can repair the finish, use a corrosion inhibitor to minimize the risk of corrosion.

B. Where damage to the finish is not confined to the paint, and on surfaces without paint, treat the metal per SOPM 20-50-00 before you apply the paint.

C. Examples of finish systems are shown in Fig. 1. Refer to Chapter 51 of the Maintenance Manual for details of how to remove and apply finishes.

4. Corrosion Inhibitors

A. Corrosion inhibitors are used with finish systems and to prevent or stop corrosion when the finish system is damaged. Many can get into small cavities to push out water. Thus, they can go in between faying surfaces or between fasteners and holes, where the finish is broken.

NOTE:Make an analysis of your airplane's environment, the inhibitor used, and the application schedule to be sure of sufficient corrosion protection. Other water displacing corrosion inhibiting compounds could be satisfactory. BMS 3-29 is being introduced into Boeing production lines as shown.

Model	Line No. Ref.	Service Letter
757	493	757-SL-20-21
767	480	767-SL-20-21

For standardization, operators are encouraged to evaluate using BMS 3-29 as a replacement for both BMS 3-23 and the "dual coat" consisting of BMS 3-23 and BMS 3-26. However, BMS 3-23 and BMS 3-26 are still acceptable. Also, refer to the discussion of a new heavy duty CIC BMS 3-35 (paragraph 4.E.).

B. BMS 3-23 Water Displacing Corrosion Inhibiting Compound

(1) General

(a) This is an organic compound of nonvolatile base materials in solvents to make a fluid. It does not contain silicones. Dipping, brushing, or spraying can apply this compound. The liquid carrier evaporates quickly to put a thin layer of wax-like material on the surface. The coating is not easily rubbed or worn off, but must be applied again if the surface is washed frequently.

(b) BMS 3-23 compound stays tacky and thus will collect unwanted material. The areas where it is applied must be regularly cleaned and then more of the corrosion inhibitor must be applied. The time between applications of the compound will change with the location in the airplane. Refer to the Maintenance Planning Document for details.2) Types of BMS 3-23 are listed below.

1) Type I - A transparent colorless film which is detectable only with ultraviolet light.

2) Type II - A colored film which is readily detected by the unaided eye.

(2) Materials qualified under BMS 3-23:

Type	Material	Vendor
I	Boeshield T-9 (colorless)	Gibson Chemicals, Ltd.,VZ0033
	Boeshield T-9HF (colorless)	Oxy Metal Industries, V45738
II	Boeshield T-9 (colored)	Gibson Chemicals, Ltd.,VZ0033
	Boeshield T-9HF colored)	Oxy Metal Industries, V45738
	LPS-3	Holt Lloyd Corp., V66724
	Dinitrol AV8 (Replaces AV5B-2)	Dinol International, VOL040

(3) Precautions for Use of BMS 3-23

WARNING: THESE COMPOUNDS ARE APPROXIMATELY EQUAL TO KEROSENE OR ALIPHATIC NAPHTHA IN TOXICITY. TO PROTECT SKIN, USE SAME PRECAUTIONS AS FOR KEROSENE. WHEN YOU SPRAY THEM IN AN ENCLOSED AREA, SUCH AS LOWER FUSELAGE, A VAPOR CONCENTRATION OF 500 PARTS PER MILLION IS THE MAXIMUM COMFORTABLE WORKING LIMIT. AT THIS CONCENTRATION A MAN CAN WORK AN 8-HOUR SHIFT. VAPOR LEVELS EXCEEDING 500 PPM ARE NOT DIRECTLY TOXIC, BUT FORCED VENTILATION MAY BE NECESSARY TO MAINTAIN A COMFORTABLE LEVEL. PERCHLOROETHYLENE IS THE PREFERRED SOLVENT AS IT IS NONFLAMMABLE. BUT PERCHLOROETHYLENE IS TOXIC. IF USED IN EXTREMELY CONFINED AREAS, MECHANICAL VENTILATION IS MANDATORY RESPIRATORY AND SKIN PROTECTION MAY BE NECESSARY.

WHEN MIXED, WATER-DISPLACING CORROSION-INHIBITING COMPOUNDS AND OXYGEN CAN BE EXPLOSIVE. KEEP THE COMPOUND AWAY FROM OXYGEN SYSTEM COMPONENTS.

(a) As these are hydrocarbons, these compounds can be dangerous when mixed with oxygen. Oxygen system components must be shielded to protect them from direct or indirect contamination.

WARNING: AS A FIRE SAFETY PRECAUTION, THE MATERIAL SHOULD BE KEPT AWAY FROM SURFACES THAT WILL GET HOTTER THAN 300^0F IN SERVICE. THE DRY FILM FLASH POINT IS 500^0F.

CORROSION INHIBITOR CONTAINS FLAMMABLE COMPONENTS. DO NOT EXPOSE THESE MATERIALS TO OPEN FLAME, ACTIVE CIRCUITS, OR OTHER COMPONENTS WHERE A POTENTIAL FIRE HAZARD WOULD EXIST. THE VOLATILE CARRIER IS ALSO FLAMMABLE. MAINTAIN SAFETY PRECAUTIONS UNTIL THE CARRIER HAS FULLY EVAPORATED.

(b) Precautions must be taken when using these materials which can constitute a fire hazard when subjected to high temperature.

(c) Mask electrical connectors where there is a possibility of contamination of electrical contacts. Refer to Volume 2, 32-10-37, 2.F.8 for exceptions to 737-600, -700, -700C, -800 and -900 use of CICs on main landing gear electrical connection.

CAUTION: REMOVE EXCESS CORROSION INHIBITING COMPOUNDS FROM MECHANISMS AND MOVING PARTS WITH A CLEAN, DRY RAG. THE RESULTANT THIN FILM IS ADEQUATE FOR CORROSION PROTECTION. EXCESSIVE BUILDUP COULD HARDEN AT LOW TEMPERATURES AND CAUSE OPERATING DIFFICULTIES.

(d) The use of corrosion inhibiting compounds on control cables is not considered a suitable substitute for the cleaning and corrosion protective procedures in the airplane maintenance manual. Direct application of these compounds on control cables, pulleys, teflon-lined bearings, and lubricated surfaces should be avoided.

CAUTION: THE COMPOUND CAN CAUSE SILICONE RUBBER AND BMS 3-11 RESISTANT SEALS TO SWELL.

(e) Be careful when you apply corrosion-inhibiting compound near door or emergency hatch seals, grease seals in bearing assemblies or rubber-lined clamps for tubing or wiring. Hydraulic seals may also be affected, so these corrosion inhibitors are not suitable for use on actuator rods.

(f) Do not apply corrosion inhibiting compounds on grease joints or sealed bearings. These compounds dissolve greases and other lubricants. They are penetrating compounds and can get around the seals and into the bearings.

(g) Do not apply or let corrosion inhibiting compounds get on insulation blankets. These compounds decrease the water-repellent quality and increase flammable quality of the blankets. If corrosion inhibiting compounds get on blankets, refer to SOPM 20-41-05 for instructions.

(h) Do not apply these compounds on interior materials such as cargo liners. The compounds change the flammable quality of these materials.

(i) Do not apply these compounds near engines, cowling, or related areas of high temperature or where firewall sealant is used. The high temperature can cause deterioration of the compounds. Corrosion inhibiting compounds can cause damage to the sealant.

(j) Some corrosion inhibiting compounds dry tack-free and may cause increased friction or sluggish operation between moving parts. Do not spray these compounds on areas, such as exposed actuator rods, that will come in contact with other surfaces.

(4) Compatibility of BMS 3-23

(a) As these materials are all usually hydrocarbons, you can apply a different compound over existent corrosion inhibitors without bad effects.

(b) The compound can be used on fiberglass fairings and ducts if the temperature of the duct is not hotter than 220'F.

(c) The compound can be used on bladder fuel tanks and fuel vapor barriers.

(5) Cleaning before application of BMS 3-23

(a) The surface does not have to be extremely clear before you apply these compounds. But you will get better joint penetration if you clean the area first before application. Vacuum or wipe away loose dirt or other unwanted matter. Then you can clean the surfaces where necessary, with the usual airplane cleaning agents or solvents.

(6) Application of BMS 3-23

(a) Obey the precautions given in step (4) above and use masks or shields to give protection to components. Do not apply corrosion inhibiting compounds to areas which will subsequently be painted or sealed.

(b) Statically ground the airplane per Chapter 20 of the Maintenance Manual.

(c) Before you apply corrosion inhibitor near batteries, electrical contacts, electrical connectors, or other components where there could be a fire hazard, remove external power and put the battery switch in the off position.

(d) Let all primers or enamels cure for a minimum of 8 hours.

(e) Apply a continuous wet coat to permit joint penetration by capillary action. An application rate by spraying of 1 gallon per hour at a coverage rate of 15 to 20 square feet per minute will produce a film thickness of 0.0003 inch. Or these materials may be brushed. Refer to step (8) for details of spraying equipment and procedures. The use of pressure equipment that applies these compounds under pressure directly to a joint or lap will improve the penetration. A soak period of 60 minutes is required before excess compound is removed to ensure maximum penetration.

(f) Wipe up puddles with clean gauze or rags after the 60-minute minimum soak time.

(g) Give the area a good flow of air until the volatile solvents are gone. Then remove the masks or shields from the area treated.

(h) Do not use corrosion inhibiting compounds near oxygen system components. If you find corrosion near oxygen system components:

1) Clean away corrosion products and repair per the Structural Repair Manual.

2) Chemical treat all bare aluminum surfaces.

3) Apply one coat BMS 10-11, type 1 green primer.

4) Apply one coat BMS 10-11, type 1 yellow primer.

5) Apply BMS 10-11, type 2 epoxy or BMS 10-60 polyurethane enamel.

(7) Methods of Application of BMS 3-23

(a) Spray Application

1) Aerosol cans can be used with plastic nozzle extensions but they are not generally recommended due to cost and the amount of overspray generated.

2) The preferred application method is with standard pressure pot equipment using an airless spray gun operated at low pressure (45 psi). Suitable spray equipment is available from the following suppliers:

Nordson Corporation, V07036 or V2R369
The DeVilbiss Company, V17431
Binks Manufacturing Company, V07334
Graco Incorporated, V25980

3) Greater accessibility will be provided with the use of accessories such as spray gun extension kits and swivel adapters for variable nozzle positioning.

4) Standard air atomizing equipment (siphon or pressure pot) may be used when access is sufficient to allow application of a wet coat. A spray nozzle-to-surface distance of no more than 12 inches is required for wet application. When spray is operated with a pressure pot, a suitable extension may be made as follows:

a) Remove and retain air cap.

b) Remove fluid tip, and solder or braze 1/8-inch annealed copper tubing of desired length on end of tip.

c) Make nozzle at the end of the tubing by clamping tube around a 0.010-inch diameter wire.

d) Do not connect air hose to spray gun.

e) Use 20 to 30-psi pot pressure for spraying.

(b) Brush Application

1) Brush application may be accomplished using an ordinary paintbrush or a clean cloth. This method is most appropriate for small confined areas or where caution is necessary to prevent corrosion inhibiting compound from getting on surrounding equipment.

2) For large areas or where confinement is not a problem, spray application is the effective method to use.

(8) Removal of Water-Displacing Corrosion Inhibiting Compounds

(a) Complete removal of corrosion inhibiting compounds is required before repainting is attempted. Solvent cleaning is also required before penetrant inspection. The following solvents have been successfully used to remove these compounds:

1) Perchloroethylene

2) Trichloroethylene

3) Trichloroethane

4) Naphtha

5) Magnaflux Corp. solvent (V37636)

6) Dry cleaning solvent, P-D-680 (Not recommended for use in lower lobe cargo compartment)

WARNING: P-D-680 IS HIGHLY FLAMMABLE IN THE PRESENCE OF OPEN FLAMES AND SPARKS.

NOTE: Use of methyl ethyl ketone (MEK) or acetone is not recommended.

7) Biogenic SE377C cleaner (V13092)(Preferred for removal of BMS 3-23 compound from areas with faying surfaces)

8) Citra Safe (VOK209)

(b) When you use solvents to remove water-displacing corrosion inhibiting compounds, give the area a good flow of air until the solvents evaporate.

(9) Exterior Discoloration by BMS-23

(a) Liberal use of water displacing corrosion inhibiting compounds on the internal surfaces of the airplane can lead to discoloration of the external surface. Because of the excellent penetrating properties of these materials, a bleed-through can be expected at fasteners that are not fluid-tight. This is normal and does not indicate a requirement to replace or redrive the fasteners. The tiny passages should seal themselves within a short time.

(b) You can remove these compounds from the exterior surface with one of the solvents listed. These solvents will not stain or damage the exterior of the airplane or decorative finish. A noticeable difference in oxidation of the exterior surfaces can occur between those areas, which have been coated with the compound, and areas that have not. If you see this difference in color, you can buff it out with the materials listed in Chapter 20 of the Maintenance Manual.

C. BMS 3-26 Corrosion Inhibiting Compound

(1) General

(a) This is an organic compound of nonvolatile base materials in solvents to make a fluid. It does not contain silicones. This compound can be dipped, brushed, or sprayed. After it dries, it makes a transparent but visible protective layer.

(b) Coated surfaces become dry to the touch after 24 hours. The layer is not easily rubbed or worn off, but must be applied again if the surface is washed frequently.

(2) Types of BMS 3-26

(a) Type I -- Makes a continuous layer of medium thickness with a drop melting point of 140°F minimum.

(b) Type II -- Makes a continuous thick layer with a drop melting point of 200°F minimum.

(3) Materials qualified under BMS 3-26

Type	Material	Vendor
I	Ardrox 3321	Ardrox Inc., V23373
	Dinitrol AV25B	Dinol International, VOL040
	Dinitrol AV25B-2	Dinol International, VOL040
	LPS Formula B997	Holt Lloyd Corp., V66724
II	Ardrox 3322	Ardrox Inc., V23373
	Dinitrol AV100D (Replaces AV100B)	Dinol International, VOL040
	LPS Formula B1007	Holt Lloyd Corp., V66724

(4) Precautions for Use of BMS 3-26

(a) Use the same precautions for BMS 3-26 that we list for BMS 3-23 water displacing compound (Ref par. 4.B(3)).

(5) Compatibility of BMS 3-26

(a) As these materials are usually hydrocarbons, you can apply a different compound over existent corrosion inhibitors without bad effects.

(6) Cleaning before Application of BMS 3-26

(a) The surface does not need to be extremely clean before you apply these compounds. Vacuum or wipe away loose dirt or other unwanted matter. Then you can clean the surfaces, where necessary, with the usual airplane cleaning agents or solvents.

(7) Methods of Application of BMS 3-26

(a) You can use the same application procedures for BMS 3-26 that we list for BMS 3-23 water displacing compound (Ref par. 4.B.(7),(8)), with the differences noted in steps (b) and (c) below.

(b) Let the BMS 3-26 compound dry. Do not wipe up puddles after 60 minutes.

(c) If the coated surface will touch another surface (such as insulation blankets), let the coating dry tack-free.

(8) Removal BMS 3-26

(a) You can use the same solvents for BMS 3-26 that we list for BMS 3-23 water displacing compound (Ref par. 4.B.(8)). Also, you can use these solvents:

Use on BMS 3-26 Type	Material	Vendor
I	Varsol No. 1	Exxon Company, USA, V29700
	Shell-Sol 345	Shell Petrochemical, V86961
	Skellysolve-S	Getty Oil Co., V8H761
	Chevron 325	Chevron USA, Inc., V4H372
	Union No. 5 Thinner	Union Oil Company of California, V79003 or V8F610
	S-76 Cleaning Solvent	Union Oil Company of California, V79003 or V8F610
	Klenzine	Atlantic Richfield Company, V1E874
	Sikkens 96.126	Sikkens, VH0951
II	Skellysolve V	Getty Oil Co., V8H761
	Standard 265 Thinner	Chevron USA, Inc., V4H372
	Sikkens 96.131	Sikkens, VH0951

(9) Exterior Discoloration by BMS 3-26

(a) Liberal use of these corrosion-inhibiting compounds on the internal surface of the airplane can lead to discoloration of the external surface. Because of the excellent penetrant properties of these materials, a "bleed through" can be expected at fasteners that are not fluid-tight. This is normal and does not indicate a requirement to replace or redrive the fasteners. The tiny passages should seal themselves within a short time.

(b) You can remove these compounds from the exterior surface with one of the solvents listed. These solvents will not stain or damage the exterior of the airplane or decorative finish. But a noticeable difference in oxidation of the exterior surfaces can occur between those areas, which have been coated with the compound, and areas that have not. If you see this difference in color, you can buff it out with the materials listed in Chapter 20 of the Maintenance Manual.

D. BMS 3-29 Corrosion Inhibiting Compound

(1) General

(a) This is an organic compound of nonvolatile base materials in solvents to make a fluid. It does not contain silicones. This compound can be dipped, brushed or sprayed. After it dries, it makes a transparent but visible protective layer. Coated surfaces become dry to the touch after 24 hours. The layer is not easily rubbed or worn off, but must be applied again if the surface is washed frequently.

(b) BMS 3-29 specifies an advanced corrosion-inhibiting compound that has the penetration characteristics of BMS 3-23 and the durability of BMS 3-26. BMS 3-29 may be used in lieu of a single coat of BMS 3-23 or the two-coat system (dualcoat) of BMS 3-23 and BMS 3-26.

NOTE: Dinol AV-30 (BMS 3-29) weighs over 3 times as much as Dinol AV-8 (BMS 3-23) and could produce a significant weight increase when used on all areas where a single coat of corrosion inhibiting compound is recommended. This is based on the dry film weights of AV-30 compared to AV-8 when applied at the recommended thickness. Once the coating has cured, a weight increase of approximately 500 grams per liter of AV-30 used or 80 gram per square meter of surface area covered will be realized. The weight increase from AV-8 is approximately 330 grams per liter and 25 grams per square meter. A decrease in coating weight of approximately 40% would be realized if AV-30 is used in lieu of the BMS 3-23/BMS 3-26 dualcoat (140 grams per square meter). All weights are approximations and will vary depending on actual dry film thickness.

(2) Materials qualified under BMS 3-29

Material	Vendor
Dinitrol AV-30	Dinol International., VOL040

(3) Precautions for Use of BMS 3-29

(a) Use the same precautions for BMS 3-29 that we list for BMS 3-23 water displacing compound (Ref par. 4.B.(3)).

(4) Compatibility of BMS 3-29

(a) As these materials are usually hydrocarbons, you can apply a different compound over existent corrosion inhibitors without bad effects.

(5) Cleaning before application of BMS 3-29

(a) The surface does not need to be extremely clean before you apply these compounds. But you will get better joint penetration if you clean the area first. Vacuum or wipe away loose dirt or other unwanted matter. Then you can clean the surfaces, where necessary, with usual airplane cleaning agents or solvents.

(6) Methods of Application of BMS 3-29

(a) You can use the same application procedures for BMS 3-29 that we list for BMS 3-23 water displacing compound (Ref par. 4.B.(7),(8)), with the differences noted in steps (b) and (c) below.

(b) Let the BMS 3-29 compound dry. Do not wipe up puddles after 60 minutes.

(c) If the coated surface will touch another surface (such as insulation blankets), let the coating dry tack-free.

(7) Removal of BMS 3-29

(a) You can use the same solvents for BMS 3-29 that we list for BMS 3-23 water displacing compound (Ref par. 4.B.(8)). Also, use these solvents:

Material	Vendor
Varsol No. 1	Exxon Company, USA, V29700
Shell-Sol 345	Shell Petrochemical, V86961
Skellysolve-S	Getty Oil Co., V8H761
Chevron 325	Chevron USA, Inc., V4H372
Union No. 5 Thinner	Union Oil Company of California, V79003 or V8F610
S-76 Cleaning Solvent	Union Oil Company of California, V79003 or V8F610
Klenzine	Atlantic Richfield Company, V1E874
Sikkens 96.126	Sikkens, VH0951
Skellysolve V	Getty Oil Co., V8H761
Standard 265 Thinner	Chevron USA, Inc., V4H372
Sikkens 96.131	Sikkens, VH0951

(8) Exterior Discoloration by BMS 3-29

(a) Liberal use of these corrosion-inhibiting compounds on the internal surface of the airplane can Lead to discoloration of the external surface. Because of the excellent penetrant properties of these materials, a "bleed through" can be expected at fasteners that are not fluid-tight. This is normal and does not indicate a requirement to replace or redrive the fasteners.

(b) You can remove these compounds from the exterior surface with one of the solvents listed. These solvents will not stain or damage the exterior of the airplane or decorative finish. But a noticeable difference in oxidation of the exterior surfaces can occur between those areas which have been coated with the compound and areas that have not.

E. BMS 3-35 Corrosion Inhibiting Compound

(1) General

(a) A new heavy duty CIC, BMS 3-35 has been developed. Although BMS 3-35 provides crevice penetration close to that achieved with BMS 3-23, it meets the same 1500 hour salt spray corrosion protection requirement as BMS 3-29. BMS 3-35 is approved for use on all Boeing commercial model airplanes including those no longer in production.

(2) Materials qualified under BMS 3-35

(a) Cor-Ban 3-35 (Zip-Chem Products., V8E913)

(b) Dinitrol AV-15 (Dinol International., V0L040)

(3) Precautions or use of BMS 3-35.

(a) Use the same precautions of BMS 3-35 as we list for BMS 3-23 (Ref par. 4.B.(3)).

(4) Compatibility of BMS 3-35

(a) BMS 3-35 are compatible with all Boeing approved CIC's.

(5) Cleaning before application of BMS 3-35

(a) The surface does not need to be extremely clean before you apply BMS 3-35 but better joint penetration will be obtained if you clean the area first.

(6) Methods of Application of BMS 3-35

(a) The application hardware and processes for BMS 3-35 are the same as applying other heavy duty CIC products. Refer to SOPM for additional CIC application details.

(7) Production Incorporation

(a) Refer to Airplane Configuration Bulletin 9914598 dtd Jan. 17,00 for models 737, 747, 757, 767 and ACB 9912596 for the 777 model; and Airplane Configuration Bulletin dtd Oct. 11,99 for further information including production airplane models Line Number incorporation.

F. MIL-C-16173 Corrosion Preventive Compound

(1) Although the water-displacing corrosion inhibiting compounds are the primary corrosion inhibitors used in airplane manufacture, in certain applications where a more durable surface protection is required, solvent-dispersed corrosion inhibiting compounds per MIL-C-16173, Grade 1 are used. These materials are volatile liquids which may be sprayed or brushed on the surfaces to be treated. The liquid carrier evaporates and leaves a residue (hard grease in appearance) which will become sufficiently dry to permit handling after approximately 4 hours. The Grade 1 compound provides a hard film, but does not have the penetrating or water displacing qualities of the BMS 3-23 or similar corrosion inhibiting compounds. Applications should be limited to areas where a specific callout of this inhibitor is made.

(2) Types of MIL-C-16173

(a) Grade 1 compounds form a hard film like a hard grease. This coating is dry enough to touch in 4 hours. But it does not penetrate crevices or displace water.

(b) Grade 2 compounds form a film which stays soft after it dries. This coating does not displace water.

(c) Grade 3 compounds form a film which stays soft after it dries. This compound will displace water.

(d) Grade 4 compounds form a transparent film. This coating is dry enough to touch in 4 hours, and is non-tacky after 24 hours.

(e) Grade 5 compounds form a film which stays soft after it dries. The coating can be removed with low pressure steam. This compound will displace water.

(3) Grade 1 is the most common type of MIL-C-16173 compound used for corrosion prevention. Cosmoline 1058 (V73277), referred to as Cosmoline in this manual, is the MIL-C-16173 Grade 1 material that we use in production. Refer to the Qualified Products List of MIL-C-16173 for a complete listing of approved material part numbers and vendors, for all grades.

(4) Precautions for Use of MIL-C-16173

(a) Use the same precautions for MIL-C-16173 that we list for waterdisplacing corrosion inhibiting compounds (Ref par. 4.B.(3)).

(5) Compatability of MIL-C-16173

(a) As these materials are aLl usually hydrocarbons, you can apply new applications of a different compound over existing corrosion inhibitors without bad effects.

(6) Cleaning Before Application of MIL-C-16173

(a) The surface does not need to be extremely clean before you apply these compounds. But you will get a better continuous film if you clean the area first. Vacuum or wipe away loose dirt or other unwanted matter. Then you can clean the surfaces, where necessary, with the usual airplane cleaning agents or solvents.

(7) Application of MIL-C-16173

(a) You can use the same application procedures for MIL-C-16173 that we list for BMS 3-23 water displacing compound (Ref par. 4.B.(7), (8)), with the differences noted in steps (b)(c) below.

(b) Let the MIL-C-16173 compound dry. Do not wipe up puddles after 60 minutes.

(c) If the coated surface will touch another surface (such as insulation blankets), let the coating dry tack-free. (Use only grades 1, 4, or 5. Grades 2 and 3 form soft films which would be damaged by such contact.)

(8) Removal of MIL-C-16173

(a) You need to remove all of the compound before you try to paint the surface. Solvent cleaning is also required before penetrant inspection.

(b) Naptha can remove these compounds. Methyl Ethyl Ketone (MEK) or acetone is not recommended.

(c) When you use solvents to remove corrosion inhibitors, give the area a good flow of air until the solvents evaporate.

G. MIL-C-11796 Corrosion-Preventive compound

(1) This is a petrolatum-base compound, which is applied as a hot liquid. The compound can be applied with a brush or a swab. Small parts can be dipped in the liquid. The internal surfaces of tubes or other hollow parts can be coated by a fill and drain method.

(2) Types of MIL-C-11796

(a) Grade 1 compounds form a hard film. They can penetrate 3-8 mm and have a melting point of 155^{0}F or higher.

(b) Grade 1A compounds are similar to Class 1 compounds, but will not cause an oil slick on water.

(c) Class 2 compounds form a medium film, and can penetrate 9-15 mm and have a melting point of 150^{0}F.

(d) Class 3 compounds form a soft film that can be applied and easily removed at room temperature. They can penetrate 20-25 mm and have a melting point of 135°F. These compounds can mix with lubricating oil.

(3) Refer to the Qualified Products List of MIL-C-11796 for a complete listing of approved material part numbers and vendors for all grades.

(4) Precautions for Use MIL-C-11796

(a) Use the same precautions for MIL-C-11796 that we list for waterdisplacing corrosion inhibiting compounds (Ref par. 4.B.(3)).

(5) Compatibility of MIL-C-11796

(a) As these materials are all usually hydrocarbons, you can apply new applications of a different compound over existent corrosion inhibitors without bad effects.

(6) Compatibility of MIL-C-11796

(a) The surface does not need to be extremely clean before you apply these compounds. But you will get better continuous film if you clean the area first. Vacuum or wipe away loose dirt or other unwanted matter. Then you can clean the surfaces, where necessary, with the usual airplane cleaning agents or solvents.

(7) Application of MIL-C-11796

(a) These compounds are applied as hot liquids. During application, keep the compounds in the following temperature ranges:

MIL-C-11796 Class 1 or 1A	170-200°F
MIL-C-11796 Class 2	160-190°F
MIL-C-11796 Class 3	150-180°F

(b) Apply the compound to the surface with a brush or swab.

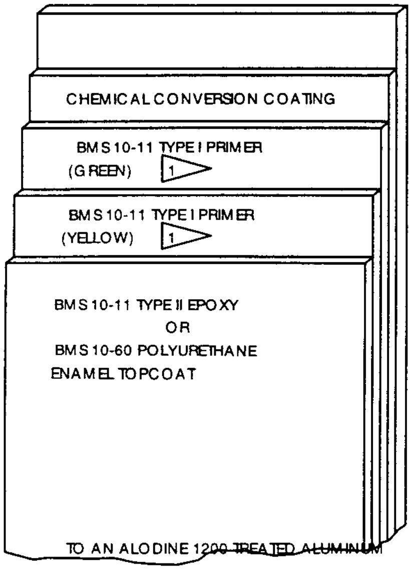
(c) To apply the compound to the internal surfaces of hollow parts, refer to 20-41-03 of the Boeing Standard Overhaul Practices Manual.

(8) Removal of MIL-C-11796

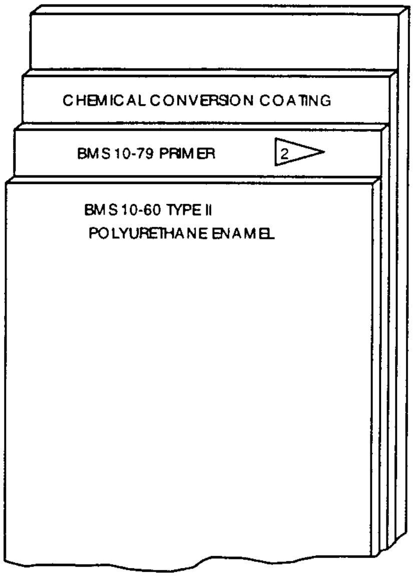
(a) You need to remove the entire compound before you try to paint the surface. Solvent cleaning is also required before penetrant inspection.

(b) Dry cleaning solvent P-D-680 can remove these compounds. Methyl Ethyl Ketone (MEK) or acetone is not recommended.

(c) When you use solvents to remove the compound, give the area a good flow of air until the solvents evaporate.



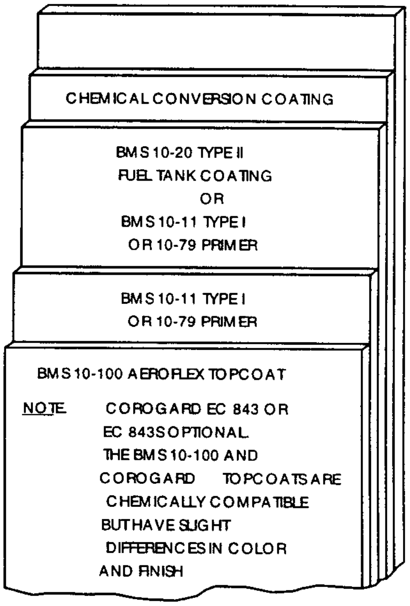
INTERIOR AND EXTERIOR PROTECTIVE
(NONAERODYNAMIC)



EXTERIOR PROTECTIVE
(FILIFORM RESISTANT)

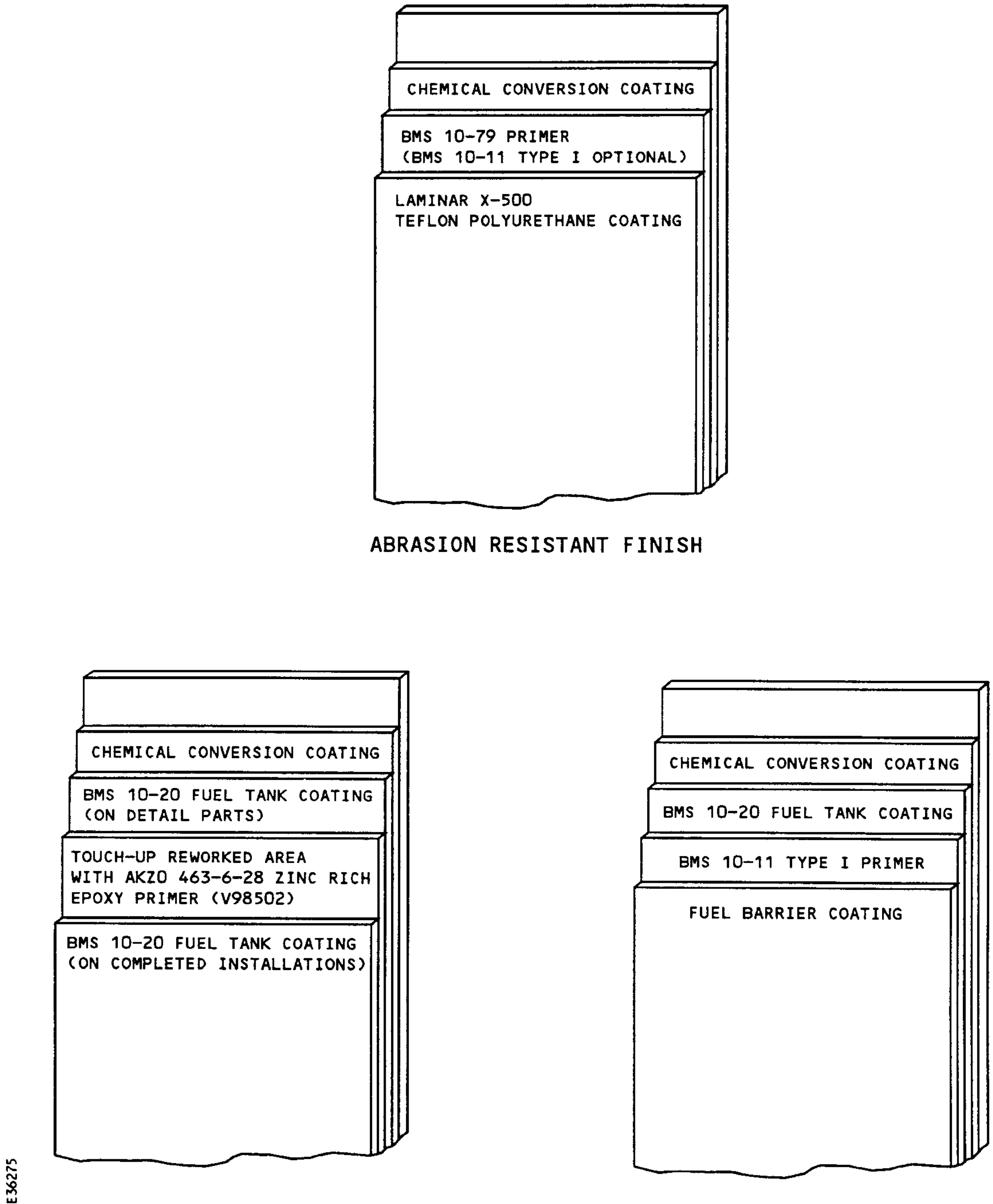
1 GREEN PRIMER USED ON DETAILS BEFORE INSTALLATION, YELLOW PRIMER ADDED AFTER INSTALLATION DUAL COLORS USED FOR INSPECTION PURPOSES ONLY.

2 OPERATORS ENCOUNTERING DELAMINATION PROBLEMS WITH THE FINISH SHOULD USE BMS 10-79 TYPE II PRIMER IN LIEU OF TYPE I. THE PRIMER SHOULD BE APPLIED SUBSTRATE.



BMS 10-11 (AEROFLEX OR COROGARD) PAINT SYSTEM

Finish Systems
Figure 1 (Sheet 1)

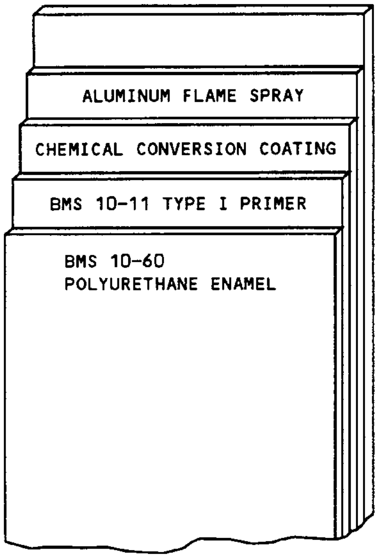


ABRASION RESISTANT FINISH

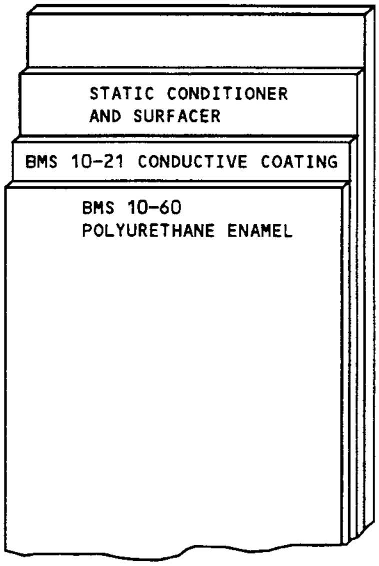
INTEGRAL FUEL TANK

SECONDARY FUEL BARRIER

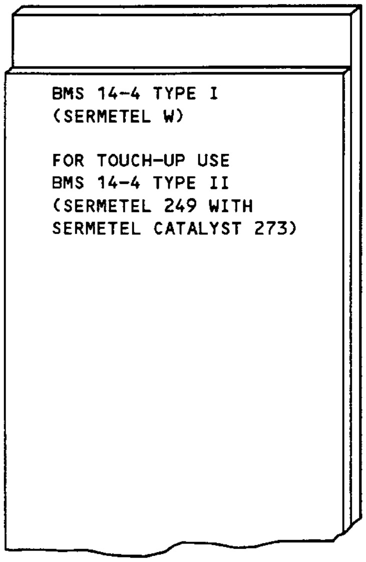
Finish Systems
Figure 1 (Sheet 2)



FIBERGLASS REINFORCED PLASTIC EXTERIOR
(ALUMINUM FLAME SPRAYED)



FIBERGLASS REINFORCED PLASTIC EXTERIOR
(CONDUCTIVE COATED)



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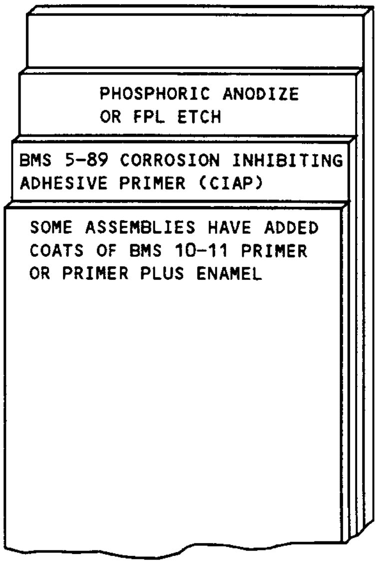
HEAT-, WEATHER-, AND OIL-
RESISTANT COATING



BONDED STRUCTURE

Finish Systems
Figure 1 (Sheet 3)

CORROSION PREVENTION MANUAL

STANDARD PREVENTATIVE MAINTENANCE METHODS
TRANSPORTATION OF LIVE ANIMALS

1. General

A. Corrosion problems arising from the transportation of live animals occur from two main sources. One is derived from animal wastes which are corrosive. Because the effects of waste products are so well known, adequate steps are usually taken to ensure that the airplane does not become contaminated. The second problem source is the increase in humidity inside the airplane.

B. Problems associated with the occasional transportation of small animals in cargo compartment are negligible, but the bulk transportation of large animals makes it advisable to ensure that adequate precautionary measures against corrosion are taken.

2. Animal Wastes

A. It is the usual practice to dehydrate animals before transportation to minimize the amount of waste products generated.

B. The bulk transportation of animals necessitates the use of absorbent floor coverings to contain the waste. Solids are removed after every flight and replaced with clean wood shavings. After two-round trips the floor covering is replaced.

3. Humidity

A. Animals generate more heat than humans consequently there is a greater possibility of moisture buildup in the airplane.

B. To permit the maximum possible circulation of air from the cabin air conditioning system the use of pens with open areas in the sidewalls is recommended.

C. To reduce the effect of high ground temperatures it is recommended that fans be used to circulate air through the cabin while the airplane is on the ground.

4. Preventive Maintenance

A. The use of airplanes for bulk shipment of live animals necessitates periodic cleaning and deodorizing of the airplane. As this requires removal of cabin lining and insulation blankets it also provides an excellent opportunity to perform preventive maintenance.

B. At each available opportunity inspect the inner skin surface and fuselage structure for signs of corrosion. Ensure that all drains are unobstructed, and that there are no trapped liquids.

CAUTION: DISINFECTANTS MAY CONTAIN CHEMICALS WHICH ARE HARMFUL TO AIRPLANE STRUCTURES. SODIUM HYDROXIDE SOLUTION, SODIUM CARBONATE SOLUTION (PLAIN OR WITH 0.1 PERCENT SODIUM SILICATE) AND CHLORINATED LIME SOLUTION WILL ALL CORRODE ALUMINUM. CRESYLIC AND LIQUIFIED PHENOL SOLUTIONS WILL SEVERLY ATTACK ORGANIC FINISHES, SEALANTS AND PLASTICS, INCLUDING THE ACRYLIC WINDOWS OF THE AIRPLANE INTERIOR.

C. After the airplane has been cleaned and deodorized and before reinstallation of the insulation blankets and cabin lining, treat the inner skin surface and structure with water displacing corrosion inhibiting compounds as described in 20-60-00.

NOTE: In the fuselage crown area, airplanes used for livestock transportation will require and receive more frequent preventive maintenance than recommended in Volume 2.

D. Dry all insulation blankets before reinstallation.

E. No additional preventive maintenance is proposed for occasional transportation of small animals, except that where there is obvious contamination from animal wastes, local cleaning should be performed followed by treatment with water displacing corrosion inhibiting compounds.

STANDARD PREVENTIVE MAINTENANCE METHODS

MICROBIAL GROWTH IN INTEGRAL FUEL TANKS

1. General

A. Corrosion of integral fuel tanks has been encountered due to microbial growth. Micro-organisms enter the tank with the fuel. Airplane fuel tanks also frequently contain some water which either enters the tank with the fuel or is the result of condensation within the tank. The microbes thrive at the water/fuel interface and multiply rapidly forming a slime or matted growth within the tank. This matted growth traps water so that it cannot be removed by normal slumping procedures. Corrosion is produced when the protective finishes on the lower surfaces of the fuel tank eventually break down under continuous exposure to water soaked microbial growth mats and the by-products of microbial growth.

B. The incidence of microbial contamination of fuel is higher in hot humid climates, therefore the possibility of fuel tank corrosion increases where the airplanes operate in these regions (Fig. 1).

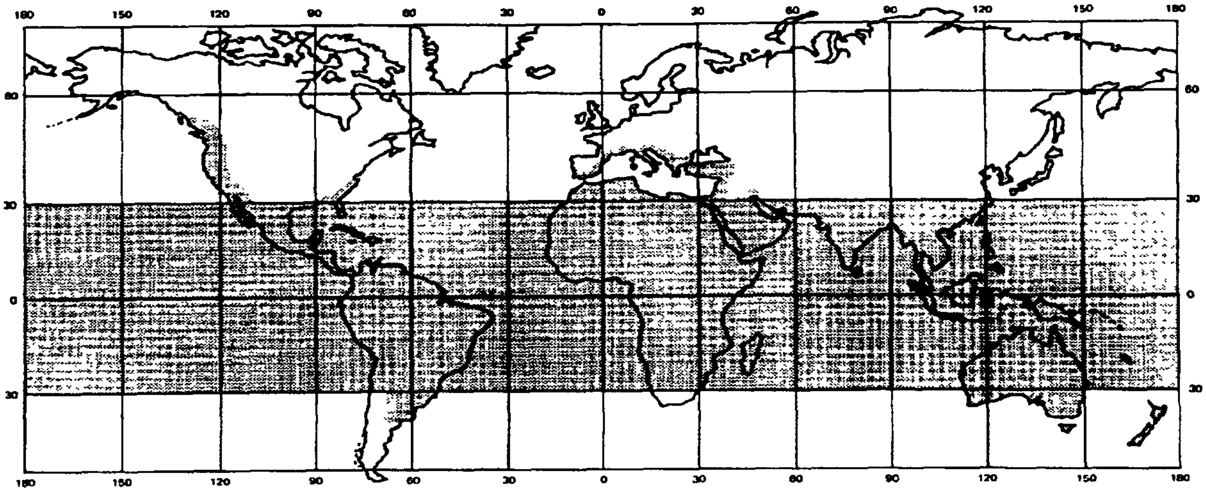


Figure 1 Areas which are at high risk of developing microbiological containination

CAUTION: ALTHOUGH THE SHADED AREAS ARE CONSIDERED AS HIGH RISK AREAS, PROBLEMS HAVE BEEN ENCOUNTERED IN MOST PARTS OF THE WORLD. IT IS VERY IMPORTANT THAT PROPER FUEL SYSTEM MAINTENANCE IS PRACTICED AT ALL TIMES.

2. Detection of Microbial Contamination

A. Personnel involved in slumping fuel tanks should be advised to report any evidence of slime in the water and fuel removed from the airplane.

B. You can check fuel for micro-organisms with the Microbe-Monitor Test Kit from Air BP, V8P482. This kit contains two bottles. You put a fuel sample in each bottle with a hypodermic syringe. One bottle contains liquid to sustain the microbes, while the other contains a similar liquid with biocide added. A dye in the sample bottles will change color to tell you within 48 hours if the fuel sample is contaminated. An alternate test kit, the Hum-Bug Detector Kit from Humanoids Technical Services Inc. V47186 is acceptable. Another alternate test kit, the Escalate Combo Microbial Test Kit from Orion Diagnostic VS4259 catalogue number 67987 has been approved and detects fungal growth after 3.5 to 4 days and will even detect contamination after a few hours. As with all kits, this method will not quantify the exact amount of contamination, it only provides a qualitative estimate of the relative amount of contamination.

C. If you find microbial contamination when you do a check of the fuel-water interface following tank slumping, you should make a tank entry as soon as possible. If you wait too long to remove microbial growth, you expose the tank structure and components to a higher probability of corrosion.

D. Entry into contaminated tanks will reveal a colored deposit on the horizontal tank surfaces and top surfaces of plumbing. This deposit is usually brown or black although other colors have been noted. There may also be evidence of corrosion products where the effects of microbial contamination are becoming apparent.

E. Any time the tanks are entered they should be inspected for microbial growth. Also ensure that limber holes and drains are not blocked. See Volume 2 for location of drains.

3. Removal of Microbial Deposits

CAUTION: DO NOT USE DETERGENTS AS THEY SPREAD MICROBIAL GROWTH.

A. Microbial deposits can usually be removed by scrubbing with a soft to firm brush or sponge and clean warm water.

NOTE: Efficiency of removal is dependent upon how long the tanks are "aired" prior to removal. The longer they are allowed to dry, the more difficult the removal.

(1) Ventilate tanks using air movers. Continue ventilation during tank cleaning to aid in drying tank.

(2) Open or remove sump drain valves.

(3) Starting at the outside edge of the tank, work toward access door openings and fuel sump drain.

(4) Check that tank is free of all loosened fungus.

(5) Ensure that all drain holes, slots, and tubes are clear of loosened fungus or other foreign material which could block drainage of water or fuel.

B. Mop up residual matter.

C. Thoroughly vacuum clean and flush to remove all remaining foreign material with the tank following the above cleaning operations.

D. After cleanup of fungus, reworked area may be touched up with Bostik 463-6-28, zinc-rich epoxy primer and topcoated with BMS 10-20.

E. Corrosion removal and restoration of damaged finish is required after removal of microbial deposits per 20-50-00 and 20-60-00.

4. Removal of Corrosion

A. Corrosion should be removed by one of the methods described in 20-60-00.

B. Restore damaged finish after corrosion removal in accordance with 20-60-00.

5. Biocide Treatment

A. If you put a biocide into the fuel storage tanks, to the tanker supplying the airplane, or directly into the airplane tanks, you will reduce the incidence of microbial growth. We recommend two options, Biobor JF (Hammond Technical Services, Inc., V47186) or Kathon FP 1.5 (Fuel Quality Service, Inc., V40161).

NOTE: Specific recommended instructions for the use of Kathon FP 1.5 will be added as required; however, suggested application time periods in step C. and residual water drainage described in step E. should be adhered to in addition to restrictions shown in the following table:

KATHON FP 1.5 BIOCIDE		
ENGINE MANUFACTURER	CONTINUOUS USAGE Parts per Million (by weight)	INTERMITTENT USAGE Parts per Million (by weight)
General Electric	100 P.P.M.	100 P.P.M.
Rolls-Royce	50 P.P.M.	100 P.P.M.
CFM	100 P.P.M.	100 P.P.M.
Pratt-Whitney	100 P.P.M.	100 P.P.M.

B. The quantity of Biobor JF approved by engine manufacturers to treat aviation fuel is 270 parts per million (ppm) for intermittent applications. This concentration can be used for initial treatment. Follow-up treatment of 135-150 ppm with application time periods made in conjuction with service checks that will allow the biocide to remain in the tanks for the period of time noted in par. F are recommended. Intermittent applications should be made if fuel analysis indicates fuel contamination with fungus. To calculate the quantity of biocide required (in fluid ounces) to treat the fuel, multiply the quantity of fuel in pounds by 0.004. This gives 270 ppm concentration. (Use half of this for a 135 ppm concentration). This is equivalent to 25.37 fluid ounces of biocide per 1000 gallons of JP4 or 25.86 fluid ounces of biocide per 1000 gallons of kerosene calculated on a fuel density at 15^{0}C. Interpolations may be made for other concentrations.

C. The application time periods will vary for each operator and will depend on the operating environment (including fuel storage tanks). Operating environment will determine the amount of moisture and subsequent microbial infestation present in the fuel tanks. It is recommended that operators in severe environment make the first follow-up treatment one month after the initial control treatment. Subsequent biocide concentrations and application time periods may be adjusted after fuel sample analysis of fuel drained from the airplane tank indicate the degree of fuel contamination.

D. The addition of Biobor JF must be accomplished with extreme care to prevent localized concentration resulting in borax salt deposits.

E. These deposits will not go back into solution and can eventually be picked up in engine filters. The preferred method of adding Biobor JF is by metered injection directly into the flowing stream of fuel.

Method 1. Mix the required amount of Biobor JF in a fuel tanker, making sure of good mixture. Make sure no water is present in the airplane tank and fuel the airplane.

Method 2. Fill the airplane tank to at least one-half full of fuel. Mix the required amount of Biobor JF in from 10 to 20 gallons of fuel. Add this to the tank through the overwing fueling port and immediately finish fueling the tank through the same filler port. Circulate the fuel in the tank to assure that the Biobor JF is well mixed with the fuel.

CAUTION: BEFORE ADDING UNDILUTED BIOBOR JF TO THE FUEL TANK, MAKE SURE NO WATER IS TRAPPED IN THE TANK UNDER OR NEAR THE OVERWING FILL PORT.

Method 3. Fill the airplane tank to a least 60% full and add the required amount of Biobor JF directly to the tank. Immediately finish filling the tank through the overwing port and then mix by starting the boost pumps and circulating the fuel to assure that the Biobor JF is mixed thoroughly. Before adding Biobor JF to the tank make sure no water is trapped in the tank.

NOTE: When the 757 main tanks are 45% full there is no fuel under the overwing filler ports.

When the 767 main tanks are 80% full there is no fuel under the overwing filler ports.

When using Method 2 or 3 fill one main tank and thoroughly mix; then fill the center auxiliary tank and then opposite main tank through the crossfeed and fueling manifold systems. Refill the main tank as before.

F. Before performing the treatment of airplane fuel tanks with biocide, drain any residual water from the tank as described in Chapter 12 of the Maintenance Manual.

G. For effective control the suppliers of Biobor JF recommend that it remain in the tank for 72 hours before further untreated fuel is added. Under normal airplane operations this is frequently impracticable, but it is advisable to plan to add the biocide at a service check which will allow the treated fuel to remain in the tank for at least 72 hours.

6. Frequency of Preventive Maintenance

A. As water is necessary for microbial growth, fuel tanks should be sumped frequently where the fuel supplies are known to contain water or where high humidity and the resultant condensation within the tank is a known factor. Successful water drainage requires that the water be given time to separate out and reach the area of the drain. As flight schedules do not always permit time for the water to settle out, sumping before refueling is recommended to remove water accumulated from previous refueling operations. All 767 airplanes have an automatic sumping system which provides environmental protection with the fuel tanks. This system functions whenever either boost pump in a main tank is running, and in the auxiliary tank, left or right, sumping will take place when the respective override pump is running. This will pick up water at several points between pairs of lower stringers near tank ends thus preventing the accumulation of large amounts of water at tank end low points. This will reduce the amount of residual water and the incidence of microbial growth, however, manual sumping and biocide treatment may still be required, based on operator experience.

B. The frequency of biocide treatment should be determined from operator experience with regard to fuel quality from his suppliers (refer to par. 5.C.). Airlines operating in temperate climates with proven supplies of uncontaminated fuel can eliminate the biocide treatment if they do not have microbial contamination.

STANDARD PREVENTIVE MAINTENANCE METHODS

TRANSPORTATION OF FISH

1. General

A. This information is about the transportation of fish and seafood. Operators may elect to use the information for shipment of similar products.

B. Corrosion problems arising from the transportation of fish occur from spillage from the containers.

2. Equipment

A. On some airplanes, you can hose-out the cargo compartments. These airplanes would be better for the routes where fish shipment traffic is the greatest. Spillage can be more easily washed out. But fish slime does not wash off as easily (Ref to par. 7.C.).

NOTE: On airplanes without the hose-out option, additional care should be exercised when loading and stacking containers to minimize spillage. Reports have been received where boxes were tipped on their sides with eventual leakage of fluids and fish slime.

3. Shipping Standards

A. Air carriers servicing a common area should establish fish packaging standards so that the shipping customer will be alerted of the need for properly packaging fish for air shipment. In addition, the standards will provide some guidance to air carrier personnel to refuse improperly packaged shipments.

4. Shipping Containers

A. In order to minimize problems associated with spillage of fish slime and liquids, certain water-tight shipping containers are used by air carriers and shippers.

(1) Wax-impregnated cardboard boxes.

(a) A two-piece fully-telescoping wax-impregnated cardboard box is currently used with some degree of success. It has reinforced gussets at the bottom and top. An example is the Wet Lok Line of boxes from Menasha Corporation, V1L860.

(b) The size of the box should be limited for maximum of 80 to 100 pounds of fish.

(c) A 4-mil polyvinyl or plastic liner of a sack type should be used which will allow the fish to be wrapped a minimum of 3 times.

(d) Dry ice to keep the fish cool should be added as required. If dry ice is added to the shipment the air carrier must be notified.

(e) Nylon or plastic tape should be used to wrap the width and the length of the box.

(f) On large shipments some operators place the boxes in large open topped fiberglass containers.

(2) Plastic tub with cover

(a) A plastic tub made from high-density polyethylene is also used for high-volume shipment (Fig. 1, Detail I). An example is the KT-8 tub from Trayco, Inc., V5X376.

(b) The tub is designed for about 500 pound (8 bushel) capacity, and has nesting characteristics for storing.

(c) The cover has seals. Indentations in the cover permit stacking. Cover-tiedown provisions are also available if you drill appropriate holes in the cover.

(d) But, if you want to use it again, you must bring it back empty at additional cost.

(3) Aluminum totes

(a) Several shippers have designed and made their own aluminum containers with covers. Some of these containers have legs of extruded aluminum for stacking and handling with forklifts or pallet jacks (Fig. 1, Detail II).

(b) The covers have seals and can be strapped to minimize leakage.

(c) These containers are suited for shipment of large quantities of fish but again the drawback is the deadheading at a tariff for reuse.

5. Shipment of Live Fish

A. Some requirements exist for the shipment of live fish.

B. One operator which transports only live fish ships the fish in a plastic bag sealed with water and oxygen. The bag is then placed in a can or cardboard box.

C. The live fish are normally shipped in cargo compartments for containerized loading or the cargo floor and wall is lined with a one piece vinyl mat. The mat curves up the wall about 6 inches where it is taped.

6. Fish Odor

A. Some operators have loaded fish on the main deck. Severe odor problems were encountered when leakage occurred and fish slime or juice flowed in the seat tracks to the passenger compartments and soaked the carpet.

B. To reduce the occurrence of offensive fish odors air carrier personnel should be alerted to load fish in properly packaged containers. Educational efforts should be made for the proper stacking of containers and close monitoring of packaging that appears marginal.

7. Preventive Maintenance

CAUTION: DISINFECTANTS MAY CONTAIN CHEMICALS WHICH ARE HARMFUL TO AIRPLANE STRUCTURES. SODIUM HYDROXIDE SOLUTION, SODIUM CARBONATE SOLUTION (PLAIN OR WITH 0.1% SODIUM SILICATE) AND CHLORINATED LIME SOLUTION WILL ALL CORRODE ALUMINUM. CRESYLIC AND LIQUIFIED PHENOL SOLUTIONS WILL SEVERELY ATTACK ORGANIC FINISHES, SEALANTS AND PLASTICS INCLUDING THE ACRYLIC WINDOWS OF THE AIRPLANE INTERIOR.

A. The use of airplanes for shipment of fish requires periodic cleaning and deodorizing of the airplane using locally available supplies. As this requires removal of cabin lining and insulation blankets it also provides an excellent opportunity to perform corrosion preventive maintenance.

B. At each available opportunity inspect the inner skin surface and fuselage structure for signs of corrosion. Ensure that all drains are unobstructed, and that there are no trapped liquids.

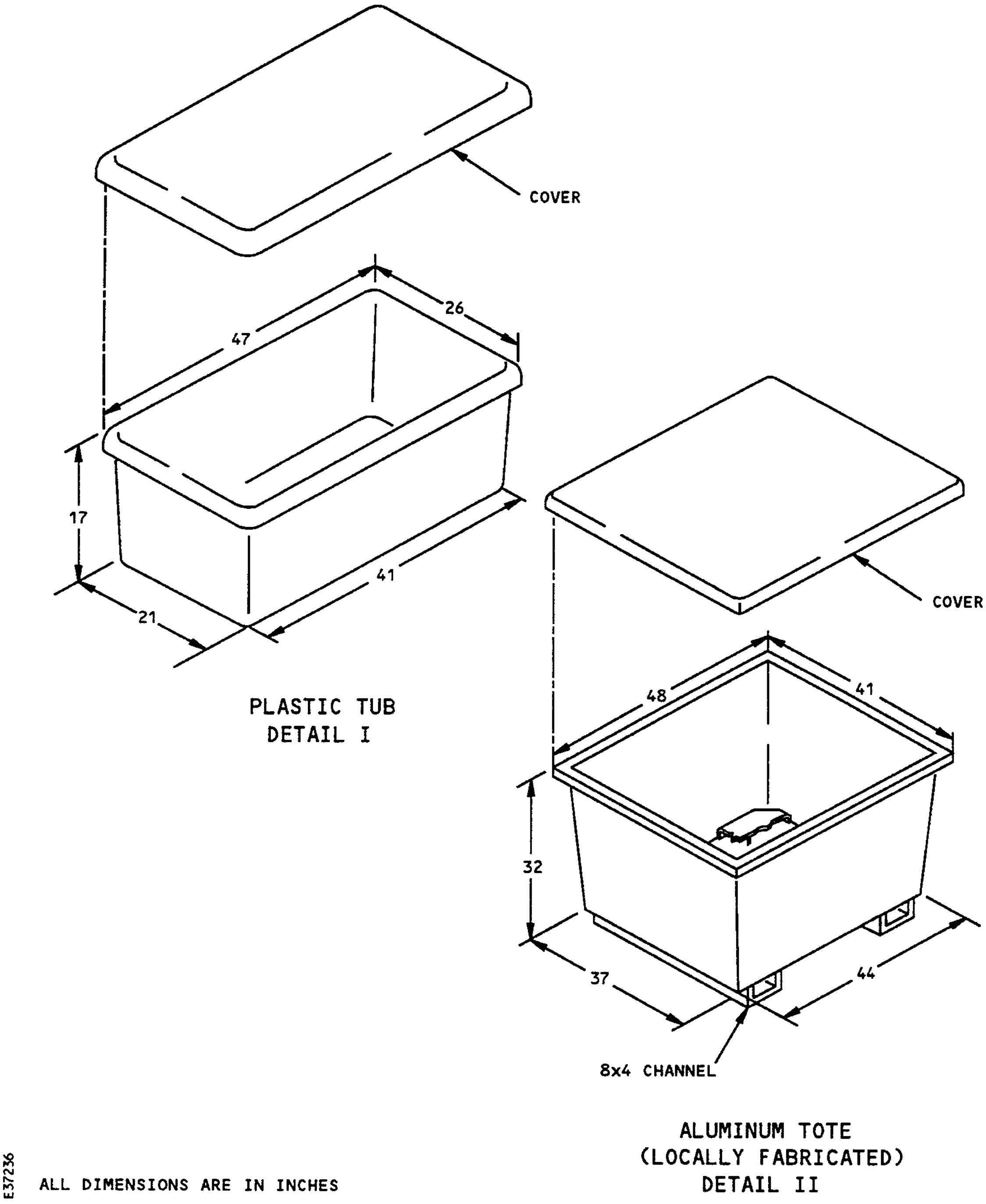
C. When known spills have occurred local clean-up procedures include wiping up spills with swabs. The affected area should be scrubbed with soap and water and wiped dry with swabs. Use scrub water sparingly to avoid spreading the spilled fluids or soaking through the floors.

D. Carpets soaked with spills should be removed for cleaning.

E. Clean spills on seat tracks per par. C.

F. Dry all insulation blankets before reinstallation.

G. After the airplane has been cleaned and deodorized and before reinstallation of the insulation blankets and cabin lining, treat the inner skin surface and structure with water displacing corrosion inhibiting compound per 20-60-00.



Typical Containers for Fish
Figure 1