PART 1

CHAPTER 1
IDENTIFICATION, TYPES AND CAUSES

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

1. General

Corrosion is a serious and costly problem. Repairing unchecked corrosion damage on aircraft consumes a great deal of time and money. A greater concern is for the aircraft's structural integrity throughout its projected life. Environment and poor maintenance practices combine to make aircraft materials particularly vulnerable to the insidious nature of corrosion. Unchecked corrosion can cause structural and system failures and, in extreme cases, loss of aircraft. In one instance an accident resulted from failure of the aft pressure bulkhead joint due to corrosion precipitated by toilet spillage. To avoid costly repairs or replacements, it is necessary to recognize corrosion in its early stages when it is amenable to simple repair procedures. Furthermore, the often highly localized nature of corrosion attack can lead to situations where deceptively little apparent surface damage accompanies extensive sub-surface metal deterioration. Consequently, a corrosion prevention and control program is of prime importance to check corrosion before it becomes an airworthiness concern. It is hoped that the operators will use the information in this chapter on corrosion mechanisms to characterize corrosion discovered during regular maintenance with regards to type, relative magnitude and relationship to the environment. In this way, cause/effect relationships can be generated and aircraft problem areas can be flagged for special attention.

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 corrosion.

B. Alloy and Carbon Steels – Corrosion is indicated by brown or 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. Forms of Aircraft Corrosion

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

A. Surface Corrosion

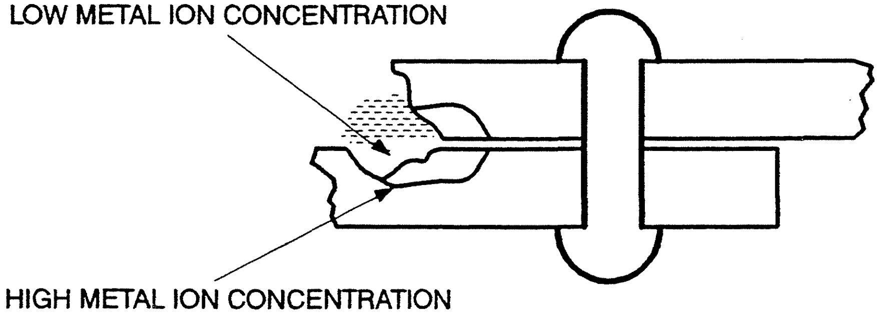
General corrosion occurs as a chemical or electro-chemical attack, characterized by a fairly uniform reduction in the part thickness. The chemical damage is caused by dissolution of the metal from contact with acids or bases. The electro-chemical attack occurs from exposure to industrial or marine atmospheres and is characterized by a general dulling of the metal with a white powder deposit or residue (for aluminum) similar to dust.

B. Galvanic and Crevice Corrosion (Figures 1 and 2)

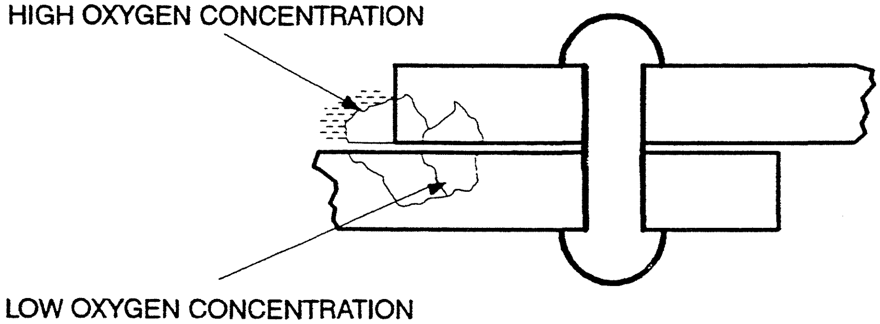
Galvanic corrosion occurs when two dissimilar metals are in direct contact and exposed to an electrolyte such as water or water containing dissolved salts. A potential difference is established and current flows between them. The less corrosion resistant metal in the couple will become anodic and be subject to corrosive attack. The more resistant metal will become cathodic. The greater the electrical potential between two metals, the more rapid is the attack; conversely, the lower the potential, the slower the attack. The magnitude of the potential difference is given by the separation of the two metals forming the couple in the galvanic series. The greater the separation, the higher the potential difference. For example, a steel bolt in aluminum sheet will corrode the sheet in the presence of moisture at a faster rate than a titanium bolt would. The less noble metal (lower corrosion voltage) is always attacked while the other metal is unaffected. The corrosion rate is also increased by a larger contact area between two contacting metals.

In aircraft, galvanic corrosion is experienced most frequently in articulated joints and bearing housings where the use of dissimilar metals cannot be avoided. It can be recognized by the build−up of corrosion products at the joint between two metals. Typically, painting and/or plating are used to minimize the effects of galvanic corrosion. For example, steel components are cadmium plated if they are to contact aluminum.

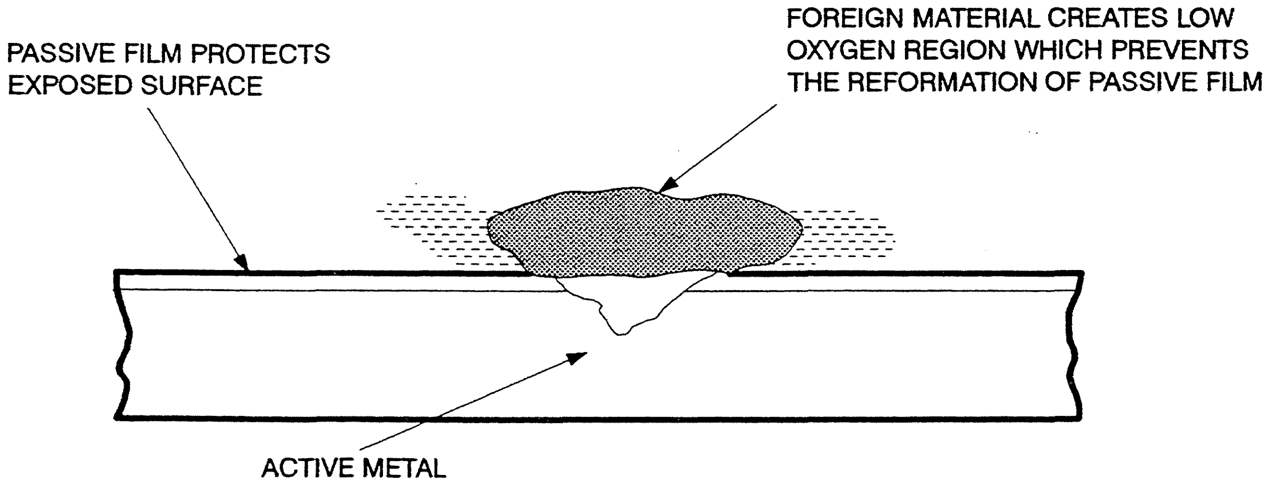
The same type of galvanic cell that develops between two different metals may also develop on a single metal surface. Concentration cell (crevice) corrosion occurs as a result of differences in potential from point to point due to differences in the environment at a metal surface. A commonly encountered form is oxygen differential cell corrosion where moisture entrapped by surface contamination or fastener heads for example has a lower oxygen content than at the surface. Consequently, current flow between the low and high oxygen content region occurs and the low oxygen concentration region becomes anodic and is attacked. Similarly, a metal ion concentration cell can lead to corrosion. In addition, when moisture and salt are present in a joint, the chloride ion (Cl^-) migrates to the oxygen depleted zone (anode) inside the joint creating a very acidic and corrosive condition, Fig. 2. This is the most common aircraft corrosion type especially in marine environments and can be very aggressive.



METAL ION CONCENTRATION CELL
RIVETED LAP JOINT



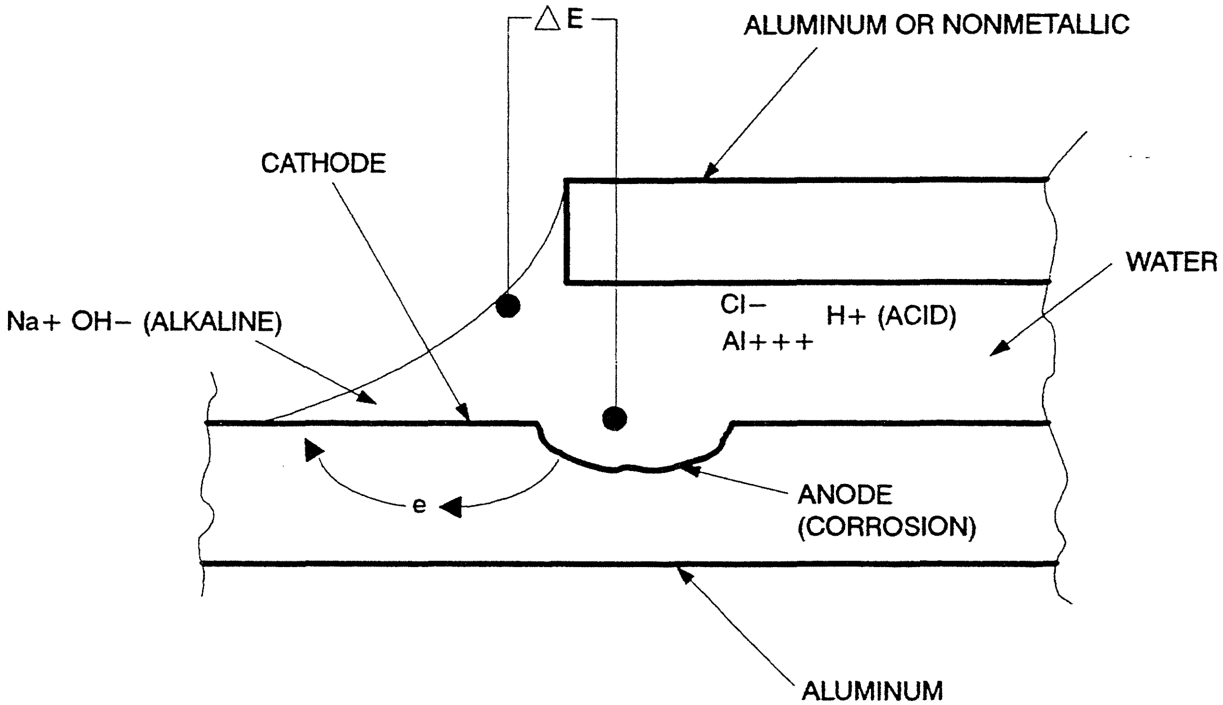
OXYGEN CONCENTRATION CELL



ACTIVE – PASSIVE CELL

GALVANIC CORROSION CONCENTRATION CELLS

FIGURE 1



SCHEMATIC OF A TYPICAL CONCENTRATION CELL
(CREVICE) WITH SALT (NaCL) PRESENT

FIGURE 2

C. Pitting Corrosion

Pitting corrosion is characterized by the formation of a cavity in a metal surface where the depth of the cavity is equal to or exceeds the diameter. In aluminum pitting first appears as a white, powdery deposit, but when the surface is buffed it reveals tiny pits or holes. Either chemical or galvanic action can cause pitting, local variations in metal structure at the surface such as surface defects lead to localized galvanic corrosion resulting in pits. Another cause of pitting is contact with chemical–laden moisture originating in engine exhaust, lavatories, batteries, galleys, cargo and other sources not of natural origin.

Pitting corrosion on its own is seldom responsible for destroying a part. However, in a fatigue sensitive part, a pit is a notch, and therefore it can initiate a fatigue crack.

D. Intergranular and Exfoliation Corrosion (Figure 3)

Metal structure consists of numerous grains or small crystals of different orientation. Where they meet, at grain boundaries, the crystal structure is disturbed and the existence of many vacant atomic sites leads to the preferential segregation of impurities to these sites. Consequently, the chemical nature of grain boundaries is quite different from the material within the grain itself. This can lead to rapid selective corrosion along the grain boundaries known as intergranular corrosion. This type of corrosion is associated with improper heat treatment of materials and is seldom found on aircraft.

Exfoliation corrosion is a form of intergranular corrosion found mainly in aluminum alloys and is characterized by delamination along grain boundaries of highly elongated grains on a plane parallel to the part surface. The corrosion attack proceeds along the grain boundaries producing large volumes of corrosion products which tend to have a wedging action and split the grains apart like wet plywood. This form of corrosion is recognizable by a flaky and/or blistered surface appearance, which proceeds in the direction of grain distortion (i.e. rolling direction).

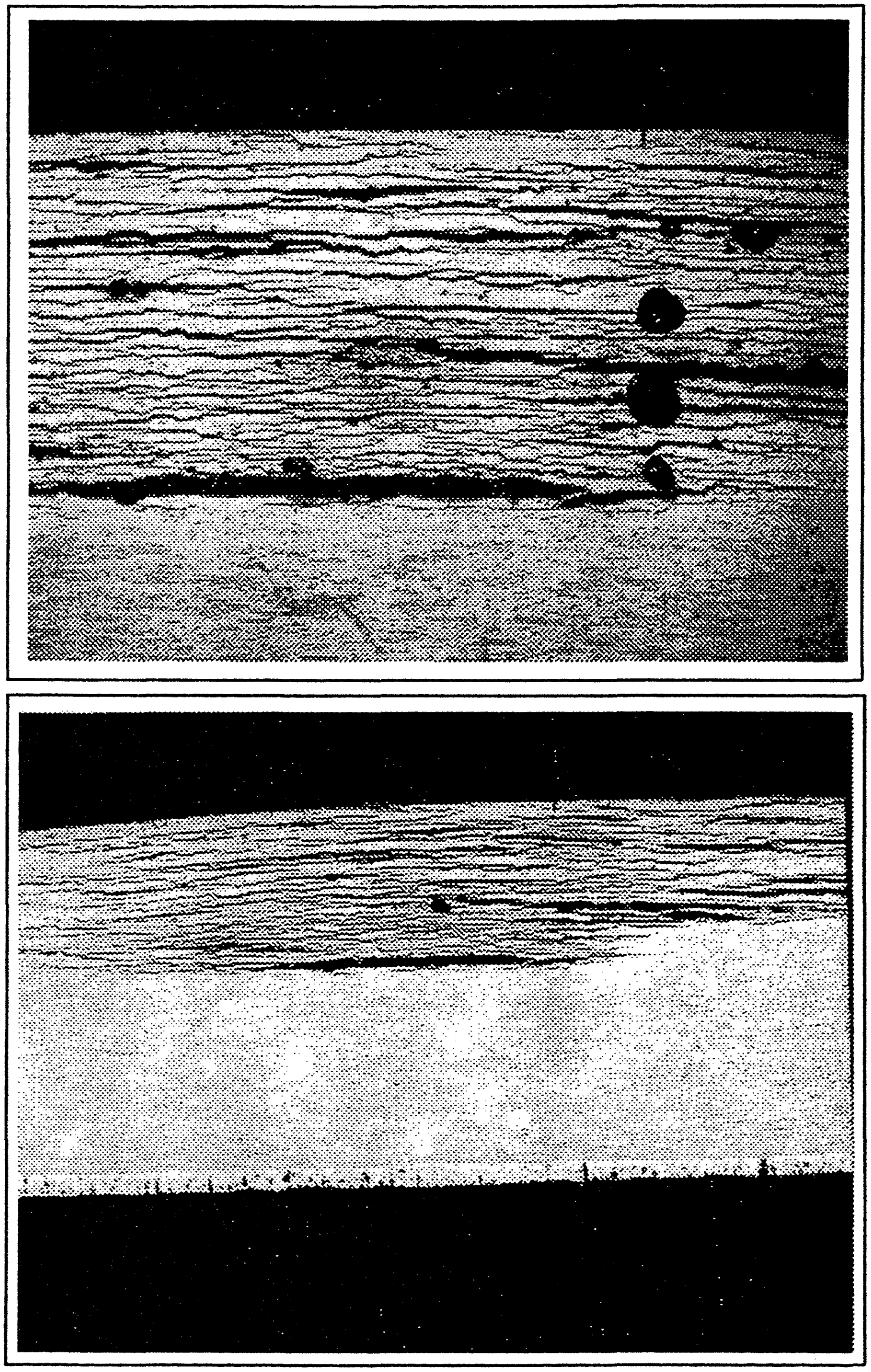
Susceptibility to exfoliation is associated with the following physical conditions:

(1) the material must have highly elongated grains that resemble platelets;

and

(2) the material must have an unfavourable precipitate condition that is produced by intermediate aging (e.g. 2024–T3 and 7075–T6).

Generally exfoliation corrosion is easily detectable by its flaky and blistered surface appearance, but sometimes exfoliation corrosion can be insidious when the delamination occurs only over a few grains thicknesses and is located below the surface of the part.



EXFOLIATION CORROSION OF ALUMINUM ALLOYS

FIGURE 3

E. Microbial Corrosion

Microbial corrosion occurs in integral fuel tanks and is caused by the presence of bacteria, fungus or yeast in contaminated kerosene–type jet fuel. Organisms commonly existing in the soil, carried by the air and ground water, may be found growing in the water/fuel interface that exists in a fuel tank after incomplete drainage. Although the exact mechanism of corrosion is not fully understood, several organisms are known to be capable of penetrating the protective coating inside a tank, permitting other bacteria and their metabolic products to attack the aluminum directly.

Microbial corrosion can be prevented by providing for complete water drainage of tanks, periodic monitoring of the fuel distribution system, addition of a biocide to the fuel, or by filtering and dewatering fuel during final transfer.

F. Filiform Corrosion

Filiform corrosion occurs around fasteners, at skin butt joints, or at breaks in coating films caused by excessive humidity. The electrolytic attack is due to the presence of moisture, oxygen, and corrosive ions. This particular type of corrosion evidences itself in the form of fine molelike trenches under the paint that spread out from the fastener, skin butt joint, or coating break in a filiform or threadlike manner.

G. Bondline Corrosion

Refers to the occurrence of corrosion at the interface between the metal and structural adhesive in a bondment. Typically, delamination due to poor surface preparation prior to bonding allows moisture ingress at the interface leading to crevice cell corrosion. This situation is further complicated by the ability of some structural adhesives to absorb atmospheric moisture. The application of corrosion inhibitor to the bonding surfaces considerably reduces bondline corrosion problems.

H. Corrosion Fatigue

Corrosion increases the rate of growth of fatigue cracks in most metals and alloys; this is known as corrosion fatigue. As an example, the stress at which a steel part can be cyclically loaded to give a specified usefull life decreases four times in a salt–laden environment. The crack growth rate is larger, often much larger than the sum of the rates of corrosion and fatigue, each acting alone. Consequently, fatigue sensitive aircraft areas must be given careful corrosion damage inspection.

I. Fretting Corrosion

Wear from differential movement between two surfaces can repeatedly remove the protective oxide exposing fresh metallic surfaces. In addition, metal particles may be dislodged by galling or fretting or shear action, and these particles will corrode rapidly because of the large surface area exposed, adding to the corrosion and oxidation products, thereby compounding the wear. Pits may be generated by such fretting which then can become stress risers and lead to fatigue cracking.

J. Stress Corrosion Cracking

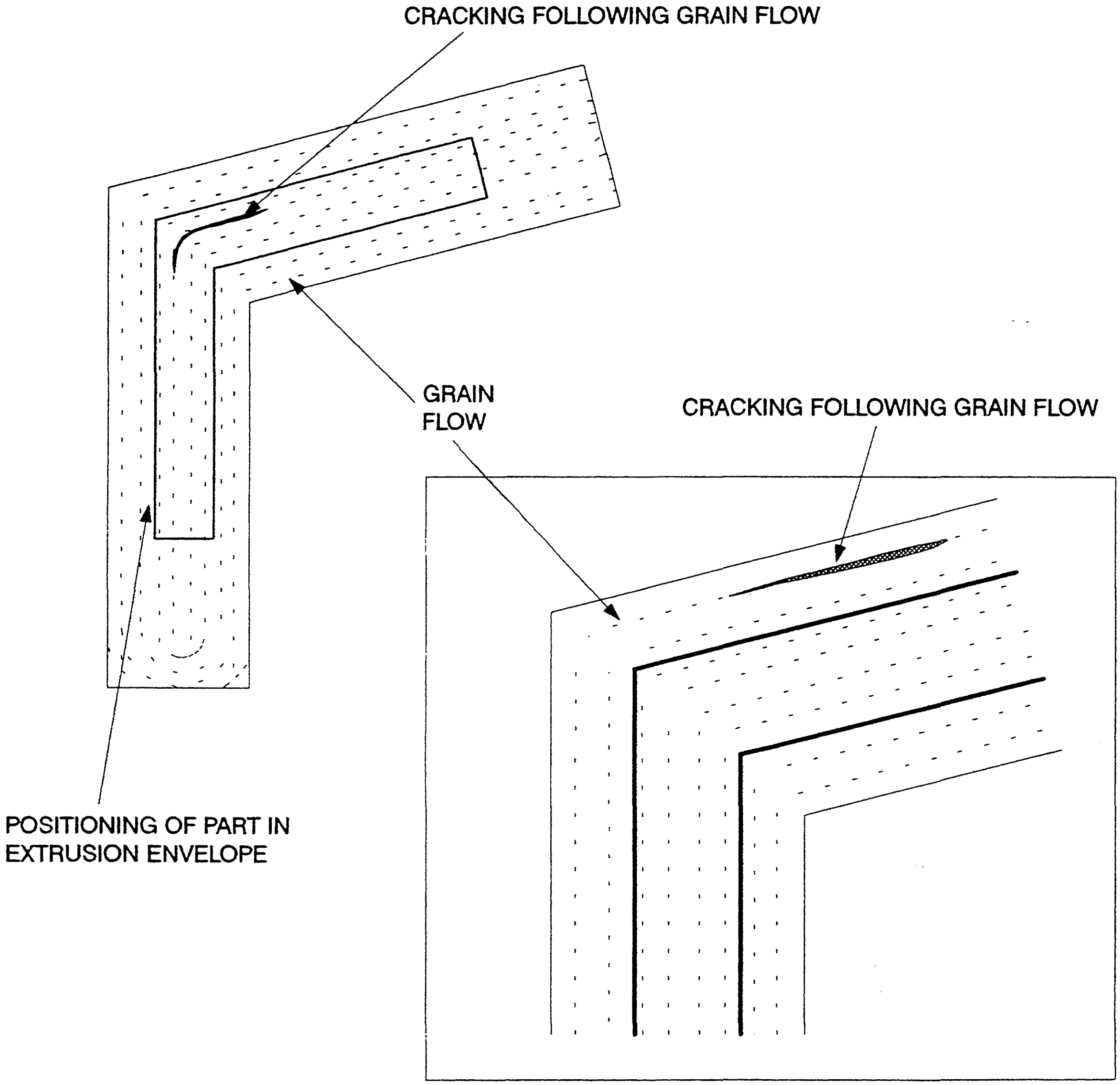
Stress corrosion cracking of a metallurgically susceptible material may be defined as the combined action of a corrosive environment and the sustained static surface tensile stresses. The corrosive environment must contain moisture and can be as seemingly benign as tap water.

The sustained static surface tensile stresses can be residual or applied and generally are well below the yield strength of the material. Residual stresses may originate during any cold work operation such as forming, machining or heat treatment quenching.

Applied stresses may be introduced in service by aerodynamic loads or, during fabrication, by poor fit–up, press fits, high interference fit fasteners, excessive torque on fittings or temperature gradients in the structure.

In wrought heat treatable high strength aluminum alloys, stress corrosion cracking is intergranular, and the general crack direction is perpendicular to the direction of the tensile stress.

Stress corrosion cracking together with fatigue cracking can be considered as one of the most insidious forms of metal failure because on the surface it reveals only a faint crack, but below the surface the crack may have propagated to a point in the part where unexpected overload failure may occur due to reduction of the cross section (Fig. 4).



Stress corrosion cracking tends to follow a single plane or path usually related to the grain flow formed by rolling, extruding, and forging parts.

EXAMPLE OF STRESS CORROSION CRACKING OF AN EXTRUDED SECTION

FIGURE 4

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PART 1

CHAPTER 2
INSPECTION AND DETECTION

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

1. Inspection for Corrosion

A. General

A systematic program of inspection for corrosion followed by proper treatment of affected areas should be part of the routine maintenance requirements. Not only should the areas be inspected for actual corrosion damage, but conditions that could promote corrosion (i.e., damaged finishes, accumulated lint, dirt, moisture traps, obstructions in drain holes, etc.) should be observed and corrected. Since corrosion is a continuing problem, inspection of accessible suspect areas should be accomplished at frequent intervals. Under extreme operating conditions due to geographical locations (Chapter 3 Environmental Effects) the frequency of inspections may vary.

B. Typical Locations

In general, all parts of the aircraft should be considered corrosion suspect areas and therefore, each of the areas on the aircraft must be inspected on a timely basis. Refer to PART 2 for specific details of possible areas of corrosion and recommended frequencies of inspection/treatment. Typical areas and/or items requiring attention are listed below.

(1) Interior Surfaces and Lap Joints

Particular attention should be given where drain holes may become plugged with foreign matter. Fittings and braces, component parts inside the aircraft and sections where structural design considerations (gussets, stiffener webs, recesses, etc.) produce areas where foreign matter and moisture may accumulate because of improper drainage or disposal outlet are corrosion suspect areas.

(2) Unpainted and Painted Exterior Skin Areas

Exterior skin areas on fuselage, wing or tail should receive careful inspection, especially around fastener locations and panel edges.

(3) Exposed Fittings

Fittings and brackets exposed to wear or damage to surface finish can result in corrosion. Fittings which may be vulnerable to corrosion are found in, but not limited to, 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 exposed areas of the rear spars of the wing.

(4) Underfloor Structure

Traces of spillage under flooring should be investigated to determine if corrosion has occurred on underfloor structure. Areas around galleys, door entrances, 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 area beneath fairings must be checked for erosion, wear and other forms of deterioration to the protective coatings.

(6) Seat Tracks

The slots in the seat track are receptacles that collect dirt and moisture and as a result are particularly susceptible to corrosion.

(7) Baggage Compartment

The stringers and frames under the baggage compartment should be inspected for corrosion resulting from accumulation of dirt, moisture and spillage from the cargo.

(8) Plumbing Hardware

Exposed tubing coupling 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 foam rubber, soundproofing and insulation attached to or laying against 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 Type Fuel Tanks

Periodic inspections of the integral fuel tanks for corrosion, pitting and blistering of the coatings on the interior surfaces of the integral fuel tanks should be made. For aircraft with bladder tanks, refer to PART 2.

(12) Control Cables

Cables should be inspected at scheduled inspection periods when specified in

PART 3. One of the main contributing factors to cable corrosion is the removal or absence of the corrosion preventive coating.

C. Special Inspections

In instances where loading of non–standard cargo (i.e., livestock) or cargo spillage of harmful products (e.g., 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 Chapter 4.

(2) Livestock Cargo

Subsequent to livestock hauling on an aircraft, specific areas should be inspected for signs of contaminants that cause corrosion. Detail procedures are given in Chapters 7 and 8.

2. Corrosion Detection

A. General

Painted metals, plated surfaces, or aluminum clad normally will not be susceptible to corrosion as unpainted, unplated or non–clad 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 depending on the corroded material. Refer to Chapter 1 for identification of the different types of aircraft corrosion.

B. 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 cargos 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 aircraft structure between frames, stringers, skins and under repair patches. Mercury is highly corrosive when in contact with aluminum and its alloys and will compromise the structural integrity of the 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. Detailed inspection, detection and treatment of mercury corrosion is explained in Chapter 4.

(2) Livestock

Special provisions are made for the transportation 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 Chapters 7 and 8.

C. Marking

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

Note: Do not use pencils for marking as localized corrosion may result.

3. Visual Detection

Visual inspection procedures are used for identifying the existence of corrosion. For general inspection, visual means aided by magnifying glasses, borescopes, etc., are used extensively. Inaccessible areas may be inspected with mirrors mounted on flexible supports, a series of mirrors and illuminating sources may be necessary (i.e., endoscopes/borescopes, etc.). 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, an appropriate Non Destructive Inspection (NDI) procedure can be used for the assessment.

4. Detection by Other NDI Methods

In specific areas where inspection by visual means is not possible or where extent of corrosion has to be determined after visual detection, NDI methods may be used. The following NDI methods are used to inspect the localized areas. The method used should be at the judgement of an experienced NDI technician qualified to a standard acceptable to the Local Airworthiness Authority. The first three methods referenced are the primary and recommended ones. Methods 4 D. through G. are complimentary of the primary methods and may be used in special circumstances such as to detect bondline corrosion, etc.

A. Eddy Current

Low frequency Eddy current may be used in locating corrosion in remote surfaces of panels (skin, doubler and spar areas). The method measures the overall conductivity of the object being inspected such that loss of materials thickness (due to corrosion) reduces the overall conductivity. A calibration standard simulating corroded and non–corroded structure is required to calibrate the measuring device and carry out the inspection.

B. Ultrasonic

This method utilizes thickness measurement in determining loss of material and hence reduced thickness due to corrosion. A calibration standard is also required to carry out the inspection.

C. Radiographic

This method is primarily used as a back–up method to other inspection techniques. Using Radiography it is possible to detect severe corrosion where material reduction due to corrosion is in excess of 20%. This method alone should not be relied upon for corrosion detection.

D. Penetrant

The penetrant technique can be used on magnetic or non–magnetic parts such as thick skins, forgings, etc., after paint stripping to determine the presence of cracks. This technique is also used to detect surface and intergranular corrosion.

E. Magnetic Particle

This technique may be used on magnetic parts only. After paint stripping the presence of microcracks, resulting from stress corrosion or intergranular attack can be detected.

F. Disbonding and Delamination Testing Devices

These devices use acoustic principles and provide effective means of determining delamination or disbonding of adhesively bonded structures which may be linked to bondline corrosion. A variety of pulse echo and continuous signal devices which operate at different frequencies are available. The type of device chosen by the NDI technician depends on the size, accessibility and make up of the bonded structure.

G. Tap Test

The tap test is a quick and rudimentary method for evaluating the integrity of bonded structure. Since this method is capable of detecting only delamination in a single bondline, and only when the bondline is near the surface, the limitations and reliability of this method should be kept in mind.

PART 1

CHAPTER 3
ENVIRONMENTAL EFFECTS

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

1. General

A. The probability of encountering corrosion damage in an aircraft 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 aircraft 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 not 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 spray. 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 electrolyte and therefore, a promotor of corrosion.

(2) Contaminated Atmosphere

The atmosphere of urban and industrial areas usually contains a high concentration of pollutants. These pollutants combine with water to form highly corrosive liquids;
for example, sulphur compounds can form sulphur based acids. This can be an even greater hazard when the prevailing winds carry pollutants from a nearby industrial plant to the aircraft 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 coupled with hot humid atmosphere have a tendency to accelerate 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 aircraft 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 the least harmful conditions are those with a low relative humidity.

(5) Temperature

High temperature and low humidity are the most desirable conditions because any moisture in the aircraft is dried out. Similarly, an extremely cold atmosphere is also usually dry. However, combinations of high temperature and high humidity provide the worst environment from the corrosion standpoint.

(6) Runway Conditions

Aircraft 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

Aircraft operating at relatively low altitudes are exposed to a greater extent to airborne pollutants and a marine atmosphere than aircraft operating at higher levels.

(8) Air Time

Frequent cycling of the aircraft, especially in hot, humid zones, will create a greater moisture build–up than can be expected on aircraft with longer air time. This is due to the aircraft 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.

(10) Airborne Abrasives

Blowing sand, volcanic ash 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 logical corrosion prevention program to meet the operator's individual requirements, it should 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. It would be preferable to be able to specify frequencies of inspection or corrosion prevention action for each of the above operating environment categories. However the data available is insufficient for that to be done. A single frequency based on fairly sever operating environments will be specified. Very sever conditions may require a more frequent corrosion inspection schedule while operators in mild conditions may be able to negotiate some inspection alleviations via their local airworthiness authority.

Note : Some operators choose 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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CHAPTER 4
CORROSION REMOVAL TECHNIQUES

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

1. General Removal of Corrosion

A. The foremost consideration in removing corrosion and/or corrosion products is to ensure complete removal. Failure to remove all residues may result in continuance of corrosion even after the affected areas are refinished. Areas to be treated for corrosion must be clean, unpainted and free of grease and oil. There are two methods of corrosion removal, chemical or mechanical. The method used will depend on the metal and the degree of corrosion. The removal in each case is outlined in the following paragraphs.

B. Some operators have used the dye–penetrant technique on inspection cases where suspected corrosion products may still be present. This technique alone may not ensure that the clean–up area is free of corrosion contaminants. It is the operator's responsibility to thoroughly inspect the area after clean–up to ensure that no visible corrosion residue is present.

2. Safety Procedures

A. Rules for handling materials with hazardous properties used in corrosion removal work are contained in the general safety precautions. The immediate treatment of personnel who inadvertently come into contact with one of the hazardous materials is contained in the emergency safety precautions paragraph of those procedures.

B. General Safety Precautions

The following safety precautions shall be observed when using or handling solvents, special cleaning compounds, paint strippers (strong alkalies and acids), etchants (corrosion removers containing acids) or conversion coating chemicals.

(1) Avoid prolonged breathing of solvent or acid vapours. Solvents and acids must not be used in confined spaces without adequate ventilation or approved respiratory protection.

(2) Never add water to acid. Always add acid to water at a very slow rate.

(3) Do not mix chemicals except as prescribed by procedure.

(4) Clean water for emergency use shall be available in the immediate work area before starting work.

(5) Avoid all contact of solvents, cleaners, etchants (acid), or conversion coating material with skin. Rubber or plastic gloves should be worn when using solvents, cleaners, paint strippers, etchants, or conversion coating materials. Goggles or plastic face shields and rubber raincoats and rainhats shall be worn when cleaning, stripping, etching, or conversion coating overhead surfaces.

(6) When mixing alkalies with water or other substances, use containers which can withstand the heat generated by this process.

(7) Wash body skin or clothing immediately after contact with any paint stripper, etchant or conversion coating material.

(8) Materials splashed in the eyes shall be promptly flushed out with clean water and the injured person sent to the medical department for further treatment.

(9) Do not eat or keep food in areas where they may absorb these chemicals. Always wash hands before eating or smoking.

(10) All equipment should be cleaned after work has been completed.

C. Emergency Safety Procedures

Personnel must be thoroughly familiar with the following emergency safety procedures before using any materials which are referenced to an emergency safety procedure paragraph.

WARNING: IMMEDIATE ATTENTION IS MOST IMPORTANT IN SKIN, EYE AND INHALATION TREATMENT

(1) If exposed to physical contact with any of the following materials, treat as shown below:

Methyl alcohol	Xylene
Methyl Ethyl Ketone	Petroleum naphthas
Methyl Isobutyl Ketone	Chromates
Toluene	Dichromates
Trichloroethylene	Acetates
Epoxy resin	Cyclohexanone
Methylene chloride	Cellosolve
Brush alodine	Carbon tetrachloride

(a) If splashed into eyes, do not rub. Flush eyes immediately with clean 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 re–wearing.

(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 over–exposure, move to fresh air immediately and seek medical attention.

(e) If vapours 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	Phenol
Nitric acid	Cresols
Phosphoric acid	Tricresyl phosphate

Treat as follows:

WARNING: IT MUST BE EMPHASIZED 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 for medical attention immediately.

(b) Exposed Skin

If splashed on skin, wash affected area with large amounts of water for at least 15 minutes. Report to medical centre.

(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 re–use. Report to medical centre.

(d) Inhalation

If vapours are inhaled, remove worker to fresh air and apply artificial respiration if necessary. Call for medical attention.

NOTE: **Tricresyl phosphate is not considered an inhalation hazard.**

(e) Internally

Proceed as follows:

Worker Unconscious:

Do not give any liquid. Begin artificial respiration and have someone call for medical attention immediately.

Worker Conscious:

(a) Phenols and Cresols

Do not attempt to induce vomiting. Encourage victim to wash out mouth with large quantities of water. Call for medical attention immediately.

(b) Phosphoric Acid

Do not induce vomiting. Call for medical attention 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 for medical attention immediately.

(d) Nitric Acid

Do not induce vomiting. Drink large quantities of water, if possible. Call for medical attention 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 for medical attention 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 a sound maintenance judgement. 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) 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 can normally be removed by extensive mechanical sanding or grinding.

NOTE: **Classification of corrosion into these categories is intended to aid the operator in the evaluation of the damage and not as corrosion rework limits. For example, corrosion in certain skins may be classified as moderate, however, the rework limits may have been exceeded. See paragraph 6.E of Introduction re numerical definition of corrosion severity level, and paragraph 3.H of this chapter fore rework limits.**

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 provided that actual thickness remaining after corrosion cleanup is within limits. Suitable NDT equipment (such as eddy–current or ultrasonic instruments) is recommended both for crack detection and thickness measurement.

D. Depth Measurement Using Straightedges

Depth measurement is often possible using two straightedges 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:

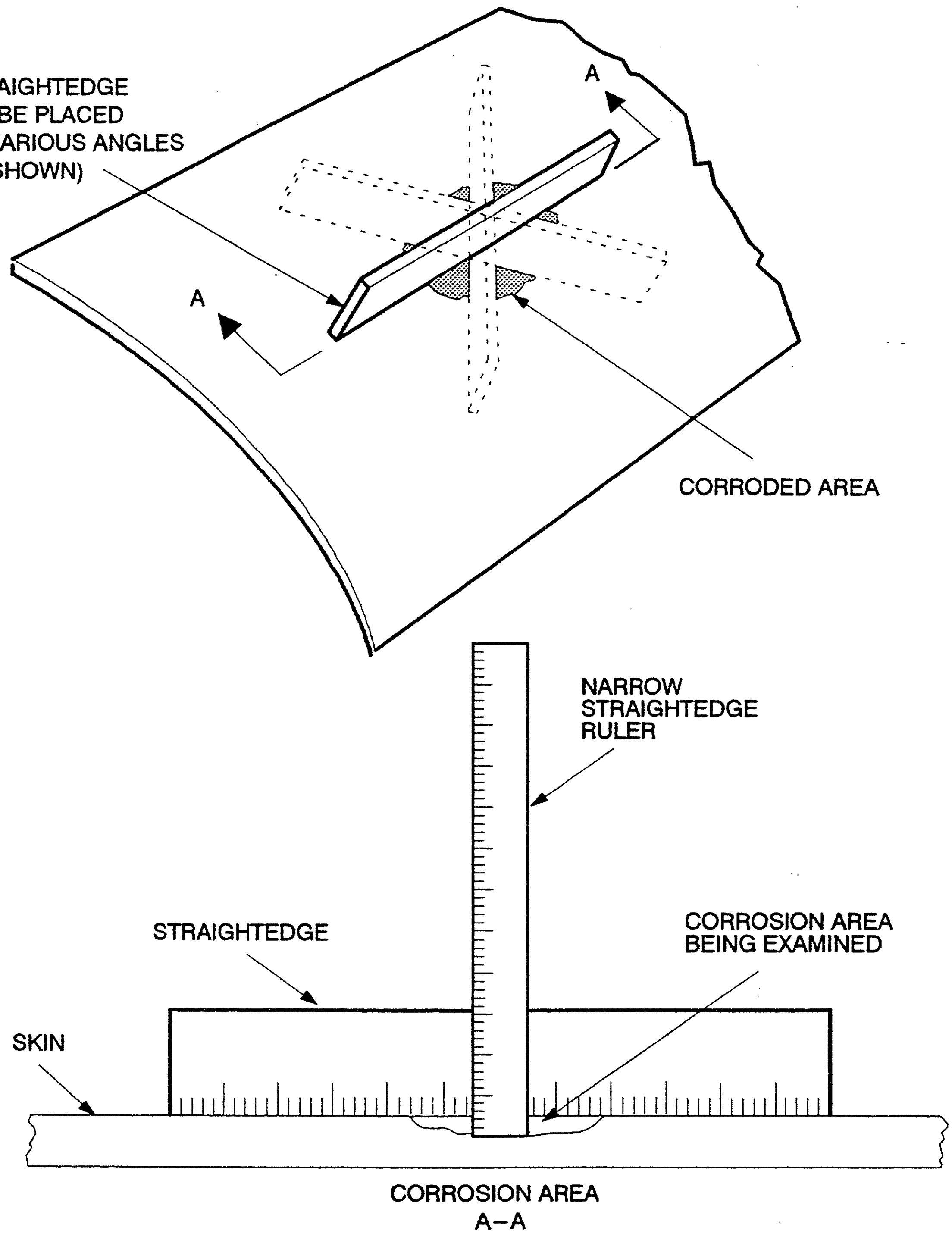
(1) Remove corroded material and blend out the damage.

NOTE: **The base of the depth gage shall be flat against the undamaged surface on each side of the corroded area. 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.

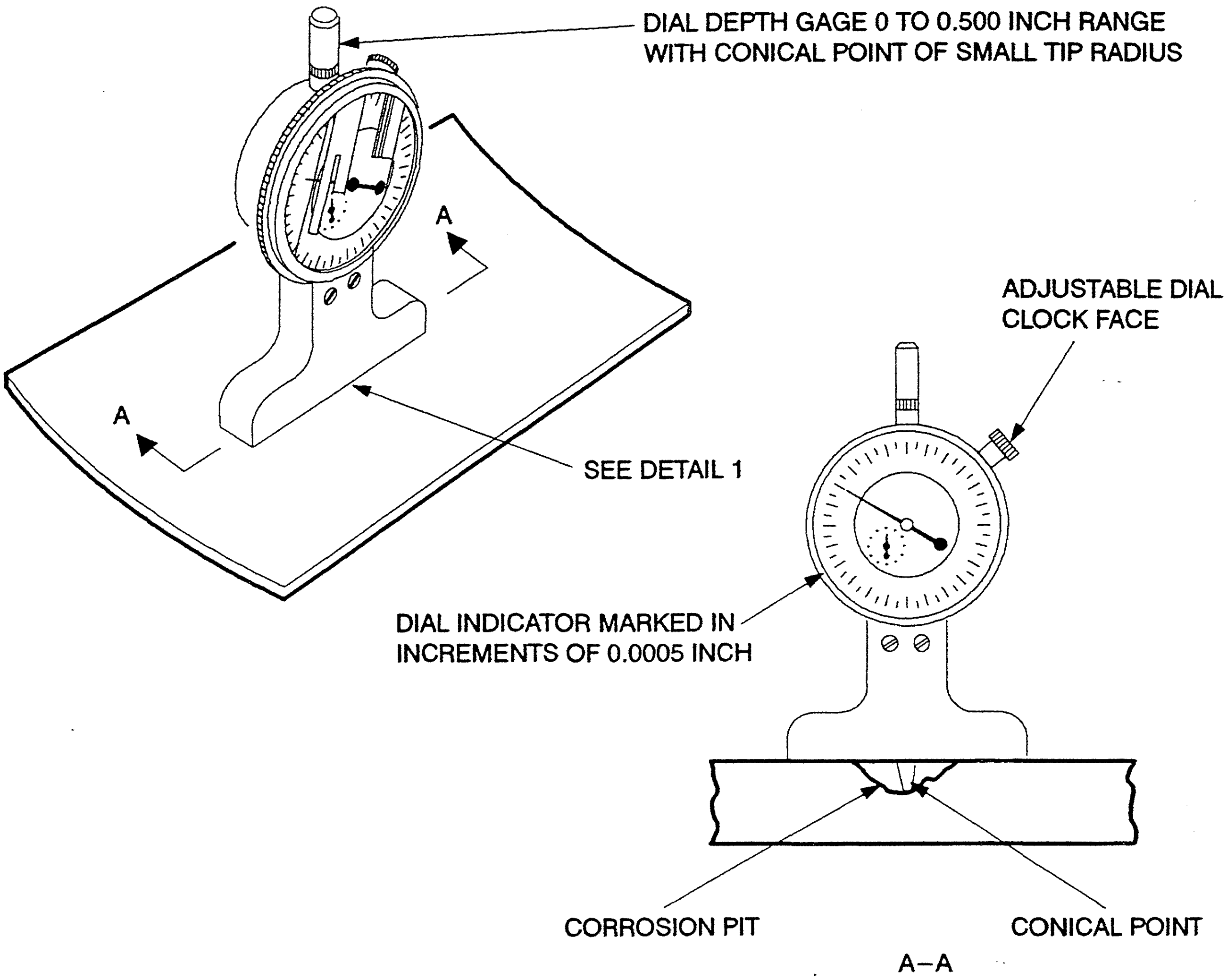
(3) Take several additional depth readings.

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



TYPICAL USAGE OF STAIGHTEDGE IN DETERMINING DEPTH OF CORROSION

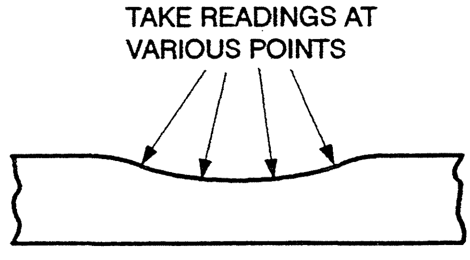
FIGURE 1



CORROSION DEPTH MEASUREMENT

1. TAKE MEASUREMENT READINGS PERPENDICULAR TO THE RADIUS OF CONCAVE OR CONVEX SURFACES, SEE TOP FIGURE.

2. TAKE SEVERAL READINGS AROUND CENTER OF CORROSION DAMAGE OR BLEND DEPRESSION (SEE DETAIL 1) AND CONSIDER THE DEEPEST READING TO BE THE DEPTH OF CORROSION



DETAIL 1

CORROSION DAMAGE AND REWORK MEASUREMENT USING DIAL DEPTH GAGE

FIGURE 2

F. Measuring Corrosion Damage with an Optical Micrometer

Optical Depth Micrometers are very versatile, simple to use and very accurate depth measurement tools. The column can be mounted on a variety of bases permitting accurate corrosion depth measurements on curved and flat surfaces. The depth of corrosion is carried out by first focussing the instrument on an area to obtain a reference or zero point. The instrument is then focussed at the bottom of the corrosion pit or depression and the depth is determined by reading the vernier scale on the column.

The range and accuracy of a typical optical depth micrometer is 0.03 inch and ± 0.0002 inch respectively at a magnification of 200 times.

The method of measurement is as follows:

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

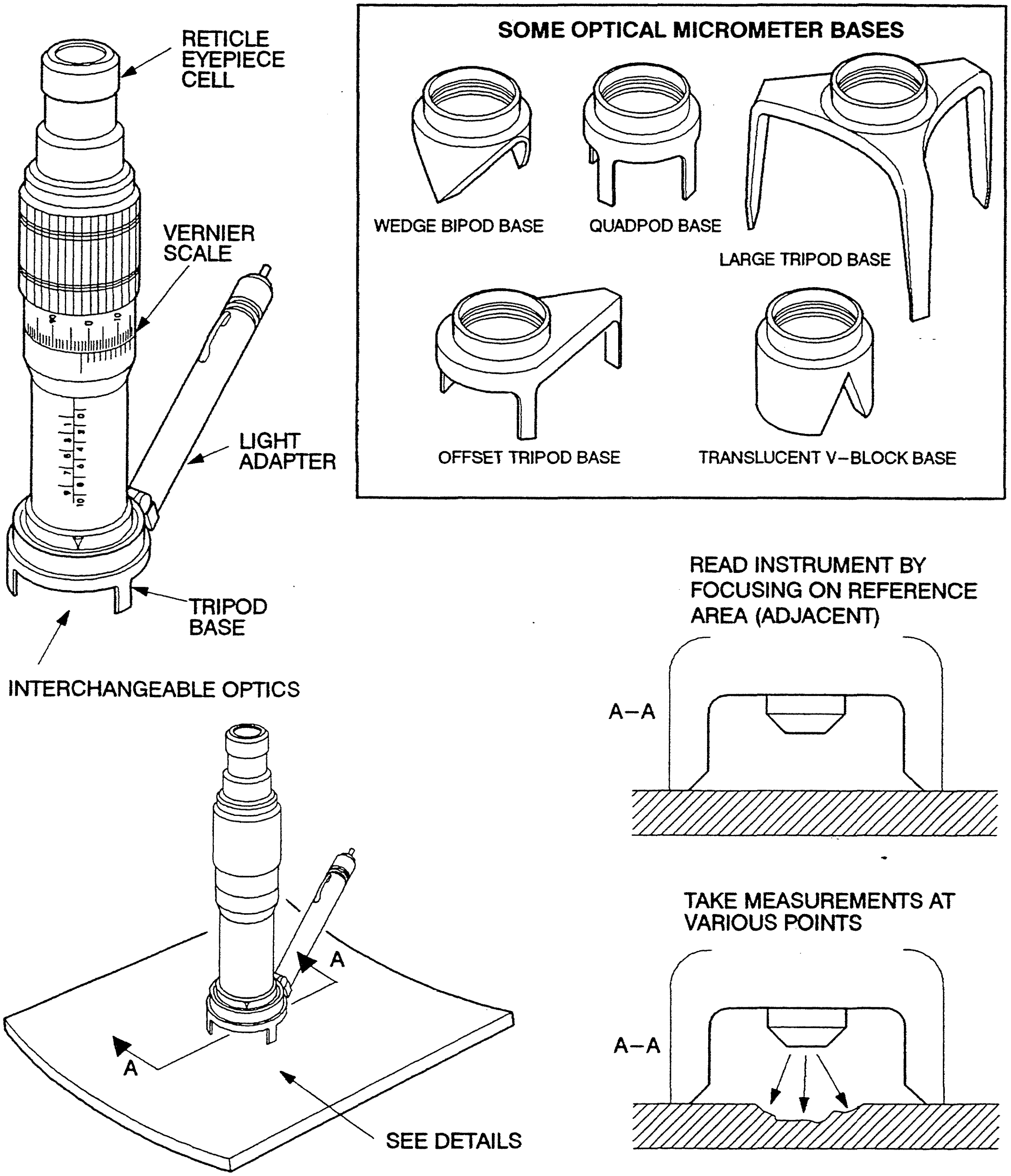
(2) From the geometry of the area, determine which micrometer base would be best suited for an accurate depth measurement. Some bases are shown in Fig. 3.

(3) Zero the instrument by focussing on a smooth surface having the same radius of curvature as the affected surface (Fig. 3, Detail 1.a).

(4) Position Optical Micrometer as illustrated in Fig. 3, Detail 1.b and focus at bottom of the corrosion depression.

(5) Take several readings around centre of corrosion damage or blend out. Consider the deepest reading to be the depth of corrosion.

NOTE: **Where physically possible, this method is recommended over the methods described in paragraphs 3D & E.**



CORROSION DAMAGE AND REWORK MEASUREMENT USING AN OPTICAL DEPTH MICROMOMETER

FIGURE 3

G. Measuring Corrosion Damage with Impression Materials

In the event the corrosion area is inaccessible for use of the dial depth gage or optical depth micrometer, the use of impression materials is recommended.

(1) **Clay.** Modelling 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 an optical comparator or other accurate measurement means.

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

H. Rework Limits

The maximum rework limitations should be determined from the criteria in the Structural Repair Manual or applicable reference in PART 2. If no criteria are available and the damage is on primary structure, consult de Havilland Inc. 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 reworked area, the material removed measurement must include the thickness removed during previous rework.

4. Identification of Alloy and Condition

Before corrosion rework of a component may be initiated it is vital that the alloy and its heat treat condition be identified beyond doubt, since rework methods vary greatly between materials and conditions. Furthermore, to avoid rework practices that may compromise the integrity of the component affected the following steps shall be taken:

(1) Refer to the Illustrated Parts Manual and identify part/s affected.

(2) Once the part number has been determined consult applicable Chapter of Structural Repair Manual to determine material.

(3) If the information sought is not in the Structural Repair Manual contact your Bombadier Regional Aircraft Customer Support representative to provide the bill of materials for part number affected.

NOTE: **Special considerations must be given to the effectivity regarding pre/post mod status as well as previous repairs or replacement of parts by other than original parts, when identifying alloy and condition.**

5. Corrosion Rework Preparations

A. Prior to starting any corrosion rework, the aircraft and the area affected by corrosion 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 aircraft in wash rack or provide apparatus which will permit rapid rinsing of all affected surfaces of the aircraft.

(2) Statically ground the aircraft. (Ref. Maintenance Manual Chapter 11).

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

(3) Remove or disconnect aircraft batteries as required.

NOTE: **Some preventive maintenance procedures also require large quantities of water to be used, such as paint removal and alodining. 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 and aircraft interior from moisture and chemical agents used.

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

6. General Cleaning

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 12 of the Maintenance Manual. Special cleaning procedures may be required in some cases and will be outlined in PART 2. Precautions necessary when working with cleaning chemicals are noted in para. 7.A.3.

7. **Cleaning and Stripping of Painted Surfaces**

A. General procedures for removing protective finishes from corrosion areas or parts are outlined in Chapter 51 of the Dash–8's Structural Repair Manual. Twin–Otter and Dash–7 operators may use the procedure outlined below. Special removal procedures which are not included here or in Chapter 51, will be outlined in the appropriate sections of PART 2. Safety precautions when working with paint removal chemicals are outlined in para. 7.A.3. .

(1) General

(a) This section specifies the procedures for cleaning and stripping painted surfaces.

(b) Painted composite surfaces are not normally stripped, particularly when re–painting major components or complete aircraft. Such surfaces are masked while stripping adjacent metal surfaces and are then prepared for painting in accordance with the applicable Standard Practice for the paint to be applied.

(c) When it is necessary to remove paint from composite surfaces, remove the paint by sanding with 180 or 220 grit silicon carbide abrasive paper.

(d) Painted plastic surfaces (kydex, polycarbonate, etc.) shall not be stripped. Such surfaces shall be masked off while stripping adjacent metal surfaces and then prepared for painting in accordance with the applicable Standard Practice for the paint to be applied.

(2) Materials Equipment:

(a) Materials:

(i) Soap – Woods Commercial, or equivalent.

(ii) Abrasive Paper – 180 or 220 grit silicon carbide (3M TRI–M–ITE or equivalent).

(iii) Paint Remover – to MIL–R–81294.

(iv) Aluminum Foil.

(v) Aluminum Foil Tape – Adhesive Backed (3M #425).

(b) Equipment:

(i) Suitable ladders and staging.

(ii) Wooden or hard rubber scrapers.

(iii) Suitable containers and brushes.

(iv) Caps, goggles and rubber gloves, aprons and boots.

(3) Safety Precautions

(a) Paint strippers are toxic and contain ingredients which are harmful to the eyes and skin.

(b) When handling paint stripper, operators shall be completely protected from contact with the stripper by wearing caps, goggles, rubber gloves, masks, aprons and rubber boots of suitable acid repellent material.

(c) If any paint stripper comes in contact with the skin, wash off thoroughly with clean flowing water for at least 15 minutes.

(d) Paint strippers shall be kept in self venting type containers only and under no circumstances shall paint strippers be kept in sealed containers.

(e) Where possible, paint removal shall be done in the open air, away from direct sunlight. Inside locations shall be suitably ventilated.

(f) Personnel shall be restricted from the interior of the aircraft during paint stripping and cleaning operations.

(g) Smoking is prohibited in areas where paint stripping is being carried out.

(h) Aircraft and subassemblies shall not be stripped while standing on asphalt floors or runways.

(4) Preparation for Cleaning or Stripping

Where large areas are to be cleaned or stripped, ladders and staging shall be arranged to permit easy access to the surfaces.

(5) Masking

(a) Prior to cleaning or stripping, transparent surfaces such as windshields, side window and their flexible seals, etc., shall be protected by masking with aluminum foil and 3M #425 adhesive backed aluminum foil tape.

(b) Static vent holes and openings in the airframe, engines, or landing gear that would trap or allow the ingress of strippers to inner surfaces, shall be masked as above.

(c) De–icer boots (if not to be removed), radomes, tires, or any other exposed rubber or non–metallic parts, shall be masked as above.

(d) Metallic areas not to be cleaned or stripped shall be suitably masked, using kraft paper and masking tape.

(e) Care shall be taken when stripping painted sealant and "O" ring seals to prevent damage.

(6) Cleaning of Painted Surfaces

(a) Painted surfaces requiring cleaning shall be washed with a solution of 2 to 3 ounces of Wood's Commercial Soap, or equivalent, to one gallon of warm water, using soft cloths or mops.

(b) Stubborn areas shall be wiped with a cloth soaked in naphthol spirits and then washed as above.

(c) After washing, rinse surfaces thoroughly with clean water and allow to dry.

(7) Stripping Metal Surfaces

(a) Primers lacquers and enamels shall be removed from metal surfaces using DHMS S5.03 strippers (or commercial equivalent).

(b) Thoroughly stir the stripper and pour the required amount into a suitable container.

(c) Apply a liberal coating of stripper to the surface using a suitable brush. Stir stripper periodically during use.

(d) On large surface areas, apply the stripper in sections removing paint from one section before commencing another.

(e) Allow the stripper to remain on the surface until the paint is soft (15–30 minutes).

(f) Remove the soft paint from the surface, using a wooden or hard rubber scraper.

(g) Where necessary, apply a second coating of stripper, and scrape off softened paint.

(h) Stubborn areas shall be lightly rubbed with aluminum wool or Scotch–Brite.

(i) Paint particles remaining around rivet heads and along seams and weld beads shall be removed using a stiff, short bristle, nylon brush.

(j) Particular care shall be taken when stripping around rivet heads, seams or other protrusions to ensure that the surface is completely stripped.

(k) Remove masking and, using a small brush, carefully apply stripper up to the edge of the previously protected area.

(l) When the paint has softened, scrape off using a wooden or hard rubber scraper.

(m) Thoroughly rinse stripped metal surfaces with water spray to remove remaining stripper and loosened paint.

(n) Where necessary, any remaining traces of stripper or loosened paint film shall be removed by solvent wiping as follows:

(i) Solvent wiping shall consist of wiping the stripped surface using a clean cloth dampened with Methyl Ethyl Ketone (MEK) and wiping dry with a clean cloth before the solvent evaporates.

(ii) Extreme care shall be taken to avoid MEK coming in contact with previously protected areas.

(8) Final Clean–Up Procedure

(a) Aluminum and aluminum alloy surfaces shall be de–oxidized after stripping using Deoxidine #624, Metal Prep 33, or Turco W01 in accordance with manufacturers instructions.

(b) Painted surfaces which have been cleaned, shall show no smudges, fingerprints, oily sections or other contamination.

(c) Stripped surfaces shall be free from all paint, primer or other contaminants. Particular care shall be taken when inspecting around rivet heads, seams or other protrusions.

(d) After final clean–up, paint removal areas shall be checked for evidence of corrosion.

(9) Additional Information

(a) Masking material shall be considered effective protection from small amounts of stripper only. Paint strippers shall not be allowed to remain on the masking any longer than absolutely necessary.

(b) Under no conditions shall DHMS S5.03 or equivalent stripper be used on composite surfaces.

8. Corrosion Removal Procedures

A. General

There are several corrosion removal techniques available. The methods normally used are chemical, hand sanding with abrasive paper or metal wool, mechanical sanding or buffing with abrasive mats, grinding wheels or rubber mats and abrasive blasting, including abrasive blasting with glass beads. The method used will depend on the metal alloy, the degree of corrosion and the accessibility to the area or part. All methods, however, can be classified as chemical or mechanical. In most corrosion rework the mechanical method is recommended. The chemicals used in the chemical removal method are very aggressive and care should be exercised to prevent flow of chemicals into joints and seams and onto highly stressed parts.

B. Fairing and Blending Reworked Areas

After corrosion removal, all depressions should be faired or blended with the surrounding surface to minimize stress concentrations. Fairing shall be accomplished as follows:

(1) Remove rough edges and all corrosion from damaged area per the removal procedures presented in the following paragraphs.

NOTE: **Select the proper abrasive for fairing from Table 1. All dish–outs are to be elliptically shaped.**

(2) Rework depressions by smoothly blending dish–outs as shown in Fig. 4. In areas having multiple pits closely spaced, the intervening material shall be removed to minimize surface irregularities or waviness (Fig. 5).

(3) Blend areas where proper clearance does not exist to provide an elliptical configuration as specified in Figs. 4 and 5. The remaining areas must be faired gradually with no sharp or abrupt changes (Fig. 6).

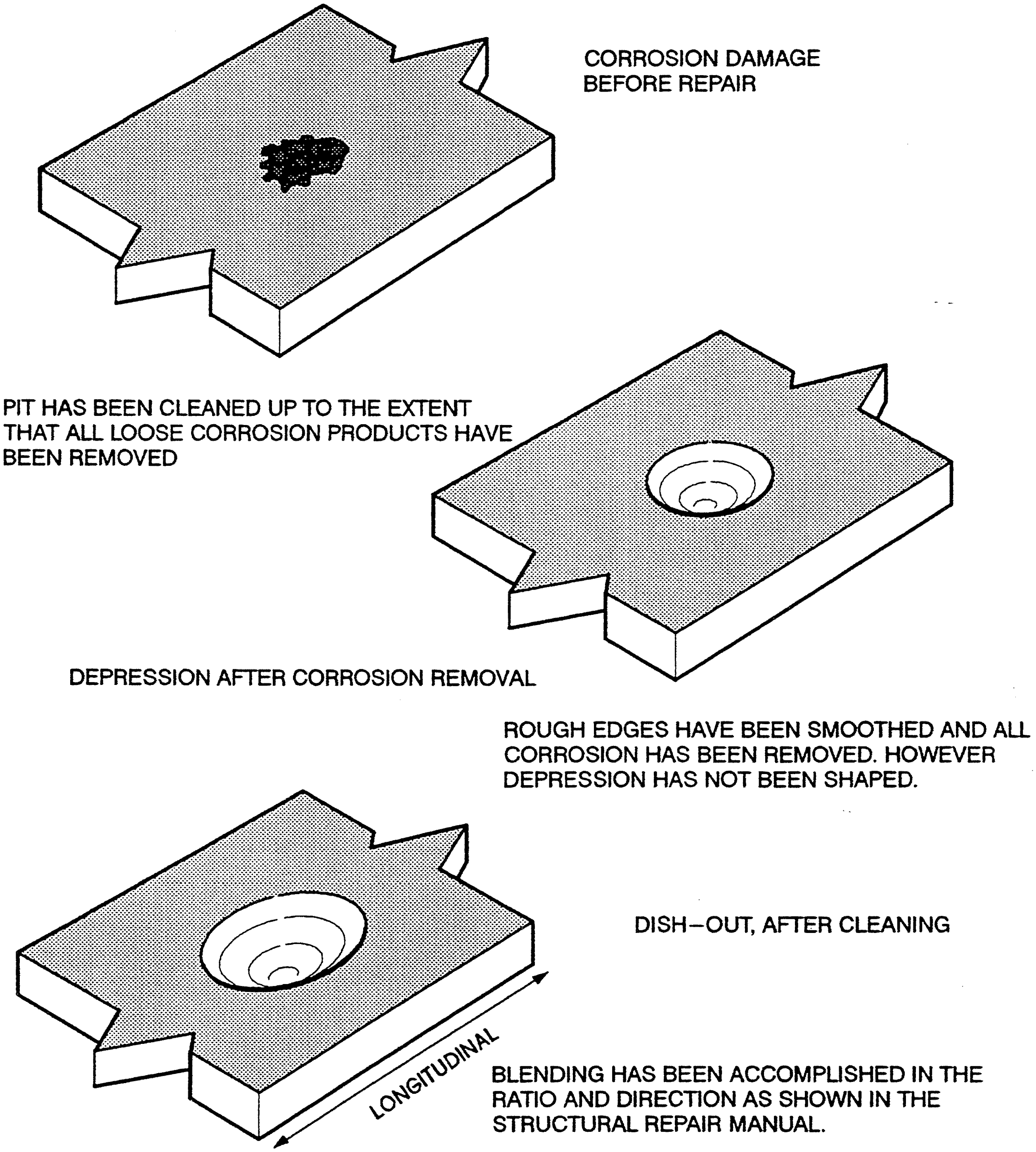
(4) Remove all surface blemishes. Select proper abrasive to obtain desired surface finish.

C. Rework Measurement

After corrosion removal and fairing of the corrosion area, depth measurements must be made to ensure that limits (as specified in the Structural Repair Manual) of material removal have not been exceeded. A dial depth gage or impression materials may be used to obtain the desired measurements. Refer to Paragraphs 3 through 4.

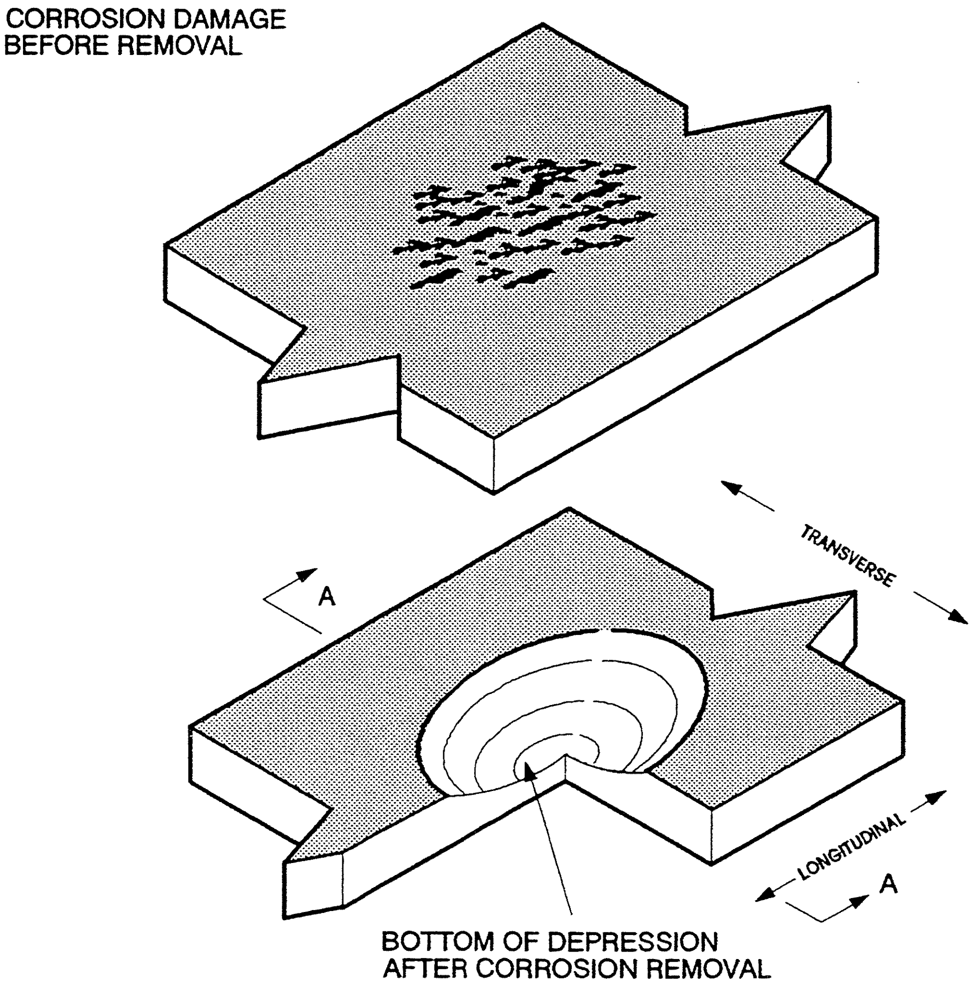
ABRASIVES FOR CORROSION REMOVAL
TABLE 1

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	SILICONE CARBIDE	GARNET		ALUMINUM	STAINLESS STEEL		
Ferrous Alloys Heat Treated to 150 KSI and above	Do not use acid base rust removers. Do not use hand–held power tools	Corrosion removal or Fairing	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 to strengths to 150 KSI and above.	Corrosion removal or Fairing	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 or Fairing	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 or Fairing	240–Finer		7/0–Finer	Very Fine and Ultra–Fine			X	X
		Finishing	400						X	
Titanium		Cleaning and Finishing	150–Finer	180–Finer				X	X	X



SINGLE DEPRESSION FAIRING

FIGURE 4



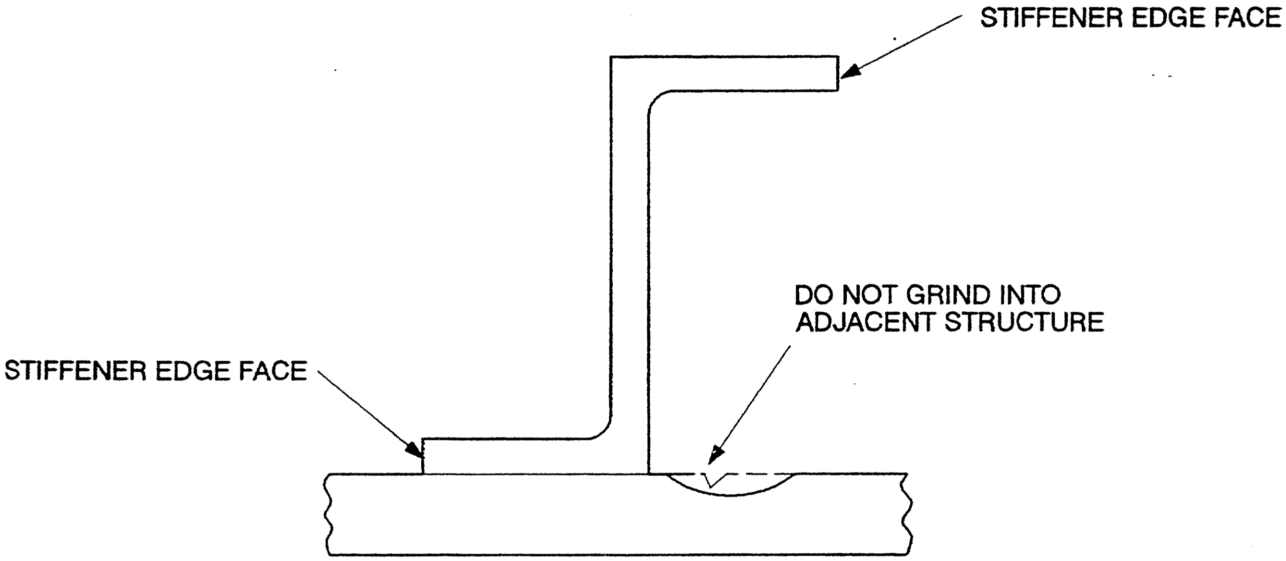
DAMAGE REMOVED AND SURFACE SMOOTHED WITH SHALLOW ELLIPTICAL DISH-OUT

NOTES:

1. SEE SPECIFIC REPAIR FOR MAXIMUM ALLOWABLE DEPTH.
2. THE BLENDING RATIO, I.E. DEPTH TO LENGTH TO WIDTH, AS SPECIFIED IN THE STRUCTURAL REPAIR MANUAL.

MULTIPLE DEPRESSION FAIRING

FIGURE 5



LIMITED CLEARANCE FAIRING

FIGURE 6

D. Corrosion Removal – Mechanical

The mechanical corrosion removal method is recommended for most cases of corrosion damage. The mechanical means used for corrosion removal and rework are: hand sanding with abrasive paper or metal wool, mechanical sanding or buffing with abrasive mats, grinding wheels, wire brushes or rubber mats, the use of carbide–tipped scrapers and abrasive blasting. The general procedures for mechanical corrosion removal are presented in the following paragraphs. For corrosion removal for specific alloys, refer to the applicable paragraphs of this section.

(1) Wire Brushing

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

Wire brushing is a mechanical abrasive operation usually 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 embedded 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 grease or soil are present, clean area as outlined in para. 6.

(c) Remove any loose corrosion products 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 products. A typical grinding procedure follows:

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

(b) If grease or soil are present, clean area per para. 6.

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 products by grinding until a firm, corrosion free surface is reached. Continue grinding to remove coarse irregularities. Use fine abrasive paper to polish the surface to the desired finish.

(3) Abrasive Blasting

Abrasive blasting is a process for cleaning or finishing metals and other materials by bombarding a surface with a stream of abrasive particles. Abrasive blasting is a fast method for removing surface corrosion and scale from metal surfaces. Standard blasting practices should be adopted with the following requirements observed:

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 when in–cabinet blasting is not practical, and if adequate confinement and recovery are provided for the abrasives.

(i) Abrasive to be used is glass bead (150 mesh or finer).

(ii) The part to be cleaned shall be removed from component if possible; otherwise areas adjacent to the part shall be protected from scale, chips, corrosion products and abrasive impingement.

(iii) If grease or soil are present, clean area as outlined in para. 6.

(iv) Close tolerance surfaces on bushings, bearings, close shafts and threads, shall be protected from blast impingement.

(v) Remove only 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:

(i) Remove any heavy soils with alkaline emulsion cleaner.

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

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

(iv) 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, a brief description of a typical unit used by the Boeing Company follows:

(i) One unit found to be effective is the Model E–10A Clemco Eductomatic Portable Blast Cleaner, manufactured by Clemco Industries, P.O. Box 7680, San Francisco, California 94124 (Fig. 7). The blast cleaner 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.

(ii) The blast head has a concentric arrangement. The inner tube blasts the glass beads against the aircraft 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 makes it possible to direct the blast in any direction by rotating the blast head while holding the main body of the machine in an upright position.

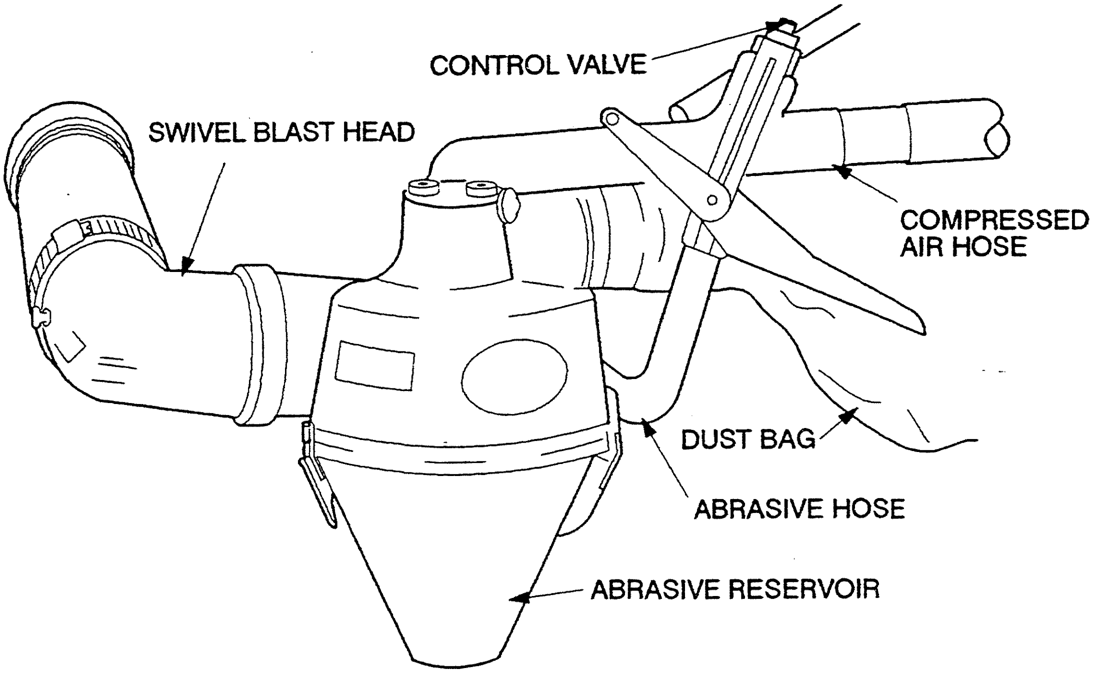
(iii) During blasting, the air source should be regulated to 80 pounds pressure maximum. The blast nozzle should be held on the surface so that it removes corrosion in an approximate one–inch diameter path. Use of the equipment requires a moderate amount of skill that can be gained by practicing on a test panel.

(iv) The glass beads quickly remove corrosion products (about 36 linear inches a minute) but almost none of the cladding on the aluminum surface or other metal substrates.

(v) The blast gun, glass beads, air source, and a work stand are all that are needed to accomplish the mechanical corrosion removal.

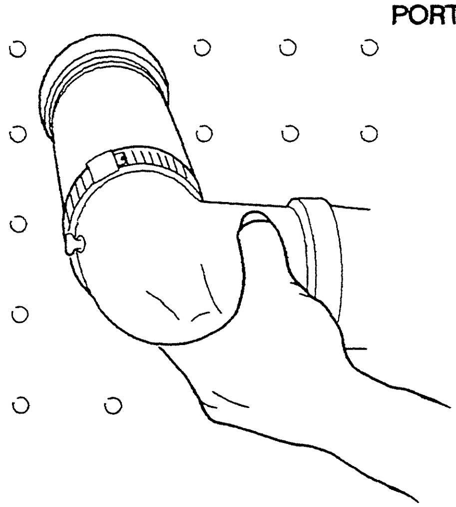
E. Corrosion Removal – Chemical

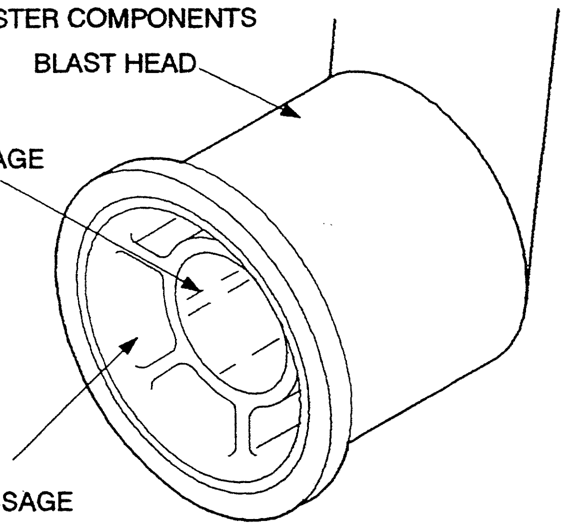
The chemical corrosion removal method may be used on the aircraft where chemical flow can be controlled and the applied area can be thoroughly washed with water. Since the chemical used in the removal is highly corrosive in itself, extreme care must be exercised to prevent the chemical from being trapped in lap joints, faying surfaces, splices, etc. On parts removed from the aircraft, the chemical removal method may be found to be most desirable. The chemical agents used in corrosion removal are of the acid type. There are specific chemical products to be used for corrosion removal in each metal, the procedures will be outlined in the paragraphs applicable to the metal.



MAJOR COMPONENTS OF THE MODEL E-10A CLEMCO PORTABLE BLAST CLEANER ARE IDENTIFIED. IT, AND SIMILAR UNITS, QUICKLY REMOVE FILIFORM CORROSION.

PORTABLE ABRASIVE BLASTER COMPONENTS





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

BLAST NOZZLE ON WORK SURFACE

THE BLAST HEAD OF THE CEMCO 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

PORTABLE ABRASIVE BLASTER

FIGURE 7

F. Special Corrosion Removal Techniques

Special corrosion removal techniques shall be used when corrosion damage has occurred due to causes other than normal airline service. An example of this is corrosion damage from mercury spillage where corrosion can occur very rapidly. Livestock hauling can cause a highly corrosive environment for structures and needs special detection, inspection and removal techniques. The general procedures are provided in the applicable paragraphs of this section.

9. Corrosion Removal Procedure for Aluminum Alloys

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

A. General

Aluminum alloys are the most widely used materials in the construction of aircraft. The metal is nontoxic, nonmagnetic and because of its high energy absorption properties, it will not spark when struck against other metals. Although aluminum appears relatively high in the electrochemical series, the formation of tightly adhering inert oxide film on the surface offers increased resistance to mild corrosion conditions. One sign of corrosion is a whitish deposit of corrosion products. General etching, pitting or roughness of the surface gives an indication of early stages of corrosion damage. Procedures for corrosion removal by either the mechanical or chemical method are provided in the following paragraphs.

B. Corrosion Removal – Mechanical

(1) Positively identify metal as an aluminum alloy. See para 4 (Identification of Alloy and Condition).

(2) Protect adjacent areas to prevent additional corrosion damage caused by entrapment of corrosion products removed during mechanical removal.

(3) If grease or soil is present, clean the area per para. 6.

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

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

(6) Remove corrosion by one of the following:

CAUTION: DO NOT USE CARBON STEEL BRUSH OR STEEL WOOL ON ALUMINUM SURFACES, OR DISSIMILAR METAL PARTICLES WILL BECOME EMBEDDED IN THE ALUMINUM CAUSING FURTHER CORROSION. STEEL FASTENERS SHALL BE REMOVED PRIOR TO CORROSION CLEAN-UP TO ENSURE THAT CORROSION IS COMPLETELY REMOVED AND ALUMINUM SKINS DO NOT BECOME CONTAMINATED WITH STEEL PARTICLES. CONTAMINATION OCCURS WHEN FASTENER HEADS ARE GROUND DOWN WHILE REMOVING ADJACENT SKIN CORROSION.

(a) Light corrosion shall be removed by light hand sanding selecting abrasive paper indicated in Table 1 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. 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:

(i) Carbide–tipped scraper

(ii) Fine fluted rotary file

(iii) 400 grit aluminum oxide (alumina) abrasive paper

(iv) Stainless steel brush (bristles of the brush not to exceed 0.010 inch in diameter).

After use of the stainless steel brush or file, surface shall be polished with 400 grit aluminum oxide abrasive paper, then with 600 grit aluminum oxide 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 brushing with a stainless steel wire brush, grinding or abrasive blasting with glass beads. Refer to para. 8.D., for procedures.

NOTE: **On non–clad surfaces which have been anodized, care must be exercised to avoid damage to the anodized surface adjacent to the corrosion area.**

Bristles of stainless steel wire brush shall not exceed 0.010 inch in diameter.

(e) Dry abrasive blasting with glass beads is an approved method of corrosion removal for aluminum and aluminum alloys. Refer to para. 8.D. Air pressures of 40 to 80 psi shall be used.

(7) After removing all corrosion visible through a 10–power magnifying glass, remove an additional 0.002 inch of material to ensure complete removal of corrosion products.

(8) Fair depressions resulting from rework per para. 8.B., and surface finish with 400 or 600 grit alumina abrasive paper. Select appropriate abrasive material per Table 1.

(9) Clean reworked area.

(10) Determine depth of faired depression per para. 8.C., to ensure that rework depth limits have not been exceeded.

(11) Treat reworked area per Chapter 5 (Standard Surface Treatment Methods).

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 corrosion removing compound from contacting 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 ACCIDENTALLY 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 at a slow rate.

(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 short–fibered 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 clean water.

(6) Dry area with clean, dry cloth and inspect area for complete removal of 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 through 6 if any corrosion remains.

(8) Fair depressions resulting from rework per para. 8.B., and surface finish with 400 or 600 grit alumina paper.

(9) Clean reworked area.

(10) Determine depth of faired depression per para. 8.C., to ensure that rework depth limits have not been exceeded.

(11) Treat reworked surface as indicated in Chapter 5 (Standard Surface Treatment Methods).

10. Corrosion Removal Procedures for Low Alloy Steel.

A. General

Carbon steel in its heat–treated form is used in areas where high structural or aerodynamic loads occur on the aircraft. 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 low alloy steel and generally caused from the 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 draws moisture from the air and promotes additional corrosion. The red rust first shows on unprotected aircraft 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 aircraft 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 PARA. 2.

B. Corrosion Removal – Mechanical

(1) Positively identify the metal as steel and determine its heat–treat condition. See para. 4.

(2) Protect adjacent area to prevent additional corrosion damage caused by entrapment of corrosion products removed during mechanical removal.

(3) If grease or soil is present, clean the rework area per para. 6.

(4) Strip paint per para. 7, if applicable.

CAUTION: HAND–HELD POWER TOOLS MUST NOT BE USED ON STEELS HEAT–TREATED TO 150 KSI 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 150 KSI and above shall be accomplished by dry abrasive blasting as outlined in para. 8.D., with blasting pressure ranging from 40 to 70 psi.

(6) Mechanically remove all corrosion from steel parts heat–treated below 150 KSI as follows:

(a) Remove heavy corrosion products using stainless steel hand brush. Use dry abrasive blasting per 8.D., 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 8.D. Select appropriate abrasive from Table 1.

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

(8) Fair depressions resulting from rework per para. 8.B., and surface finish with 400 grit abrasive paper selected from Table 1.

(9) Clean reworked area.

(10) Determine depth of faired depression per para. 8.C., to ensure that rework depth limits have not been exceeded.

(11) Treat reworked area as indicated in Chapter 6 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 150 KSI ARE SUBJECT TO HYDROGEN EMBRITTLEMENT, AND THE USE OF ACID IS PROHIBITED.

(1) Inhibited Phosphoric Acid/Water Rust Remover – Brush-on Method

(a) Positively identify the metal as steel and determine its heat treat condition. See para. 4.

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

(c) If grease or soil is present, clean the corrosion area as per para. 6.

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

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

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

(g) Examine corroded area visually with a 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 para. 8.B.

(j) Determine depth of faired depressions per para. 8.C., to ensure that rework limits have not been exceeded.

(k) Treat surface of reworked area per Chapter 5 immediately upon finish of rework.

(2) Inhibited Phosphoric Acid/Water Rust Remover – Immersion Method

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

(a) Positively identify the metal as steel and determine its heat treat condition. See para. 4.

(b) If grease or soil is present, clean the corrosion area per para. 6.

(c) Remove heavy corrosion by chipping and/or wire brushing with a 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°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 a 10–power magnifying glass.

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

(i) After removal is complete, fair or blend the reworked area per para. 8.B.

(j) Determine depth of faired depression per para. 8.C., to ensure that rework limits have not been exceeded.

(k) Treat surface of reworked area per Chapter 5 immediately upon finish of rework.

(3) Alkali Type Rust Remover – Immersion Procedure

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 metal as steel and determine its heat treat condition. See para. 4.

(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 para. 6.

(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. The temperature of the bath may be raised to near the boiling point of the solution to increase the rate of removal.

(g) Rinse thoroughly in clean water.

(h) Visually inspect 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 para. 8.B.

(k) Determine depth of faired depressions per para. 8.C., to ensure that rework limits have not been exceeded.

(l) Treat surface of reworked area per Chapter 5 immediately upon finish of rework.

11. Corrosion Removal Procedure for Corrosion Resistant Steels

A. General

Corrosion resistant steels 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 protection by organic coatings. Corrosion resistant steels, however, are not free from corrosion attack. Corrosion usually appears as pits, usually black in color. The existence of corrosion products prevents formation of a passivated oxide film at the steel's surfaces and creates an active–passive corrosion cell. 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 low alloy steels.

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 low alloy steels are applicable.

12. Corrosion Removal Procedure for Titanium Alloys

A. General

Titanium alloys are used in several locations in the aircraft, 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 causes hydrogen embrittlement subsequently leading to pitting of the surface. This case, however, will be treated in PART 2. The alloy is generally corrosion resistant. Corrosion products, however, do appear as white or black color oxides. Corrosion removal shall be accomplished per the following procedures:

WARNING: SMALL CHIPS OR SLIVERS 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) Positively identify the material as a titanium alloy. See Section 4.

(2) If grease or soil is present, clean the area per para. 6.

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

(4) Remove the polish with soft cloth.

(5) Treat reworked area per Chapter 6.

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 Cadmium Plated or IVD Coated 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. Cadmium plated parts exhibit, in general, good corrosion resistance in mildly corrosive environments. Aluminum coated parts by Ion Vapour Deposition (IVD) process exhibit good corrosion resistance due to the inherent properties of the aluminum coat. Many parts are subsequently treated with conversion coating chemicals to improve the corrosion resistance of the aluminum (Ref. Chapter 5 Surface Treatment for Cadmium Plated or IVD Coated Parts). Cadmium plating corrosion will appear as a dull gray product. Corrosion of IVD coated parts will appear very similar to corrosion of aluminum alloys.

B. Corrosion Removal for Cadmium Plated Surfaces

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

(2) If grease or soil is present, clean area per para. 6.

(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 it to remain on surface for 30 to 60 seconds. The solution strength shall be 4 ounces of chromium trioxide to 1 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 PART 2 if part shall be reworked or replaced.

(b) If part can be reworked, identify the base metal and remove corrosion per 8.D.

(5) Treat rework surface per Chapter 5.

C. Corrosion Removal from IVD Coated Surfaces

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

(2) If grease or soil is present, clean area per para. 6.

(3) If corrosion appears only on the IVD coated 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.

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

(a) Determine from PART 2 if part shall be reworked or replaced.

(b) If part can be reworked, identify the base metal per 4 and remove corrosion per applicable procedures.

(5) Treat rework surface per Chapter 5.

14. Corrosion Removal Procedure after Mercury Spillage

A. General

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

(2) 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.

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

(4) 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.

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

B. Detection

(1) The presence of corrosion caused by spilled mercury is indicated by a grayish–white powder or fuzzy coating on aluminum surfaces.

(2) 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.

(3) Mercury can best be detected by x–ray which will show up on the film as small white spots. Corrosion may show up as tree–like forms penetrating the affected component.

C. 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.

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

(2) Free mercury or amalgam must not be picked up by hand.

(3) Clean tools with soap and hot water or steam bath. Discard drill bits after use on structure contaminated by mercury according to local mercury disposal procedures.

D. Isolation of Contaminated Areas

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

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

(b) If hands become contaminated, do not touch any exposed metal in the surrounding area to avoid further contamination.

(c) 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.

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

(e) Consider protecting uncontaminated areas by securing protective material such as plastic sheets or toweling to the under–structure. Plastic sheeting or toweling can also be secured over a contaminated area to isolate it while equipment is being collected for the removal of mercury.

E. Mercury Removal

(1) 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.

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

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

(c) Use a medicine dropper for globules.

(d) Use a high–powered vacuum cleaner with a trap. See Fig. 8 for a suggested method of making a trap.

(e) Use one of the special mercury pickup brushes which attract the mercury. Foam pads are also commercially available that will pick up mercury. Refer to para. 14.F. for details of a suitable brush.

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

WARNING: **ALL DETECTABLE MERCURY MUST BE REMOVED FROM THE AIRCRAFT.**

(2) 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.

(3) 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.

F. Removal of Mercury Using Brushes

(1) A special brush is available made from nickel plated carbon fibers which will pick up mercury. Refer to para. 14.G. for the source of supply.

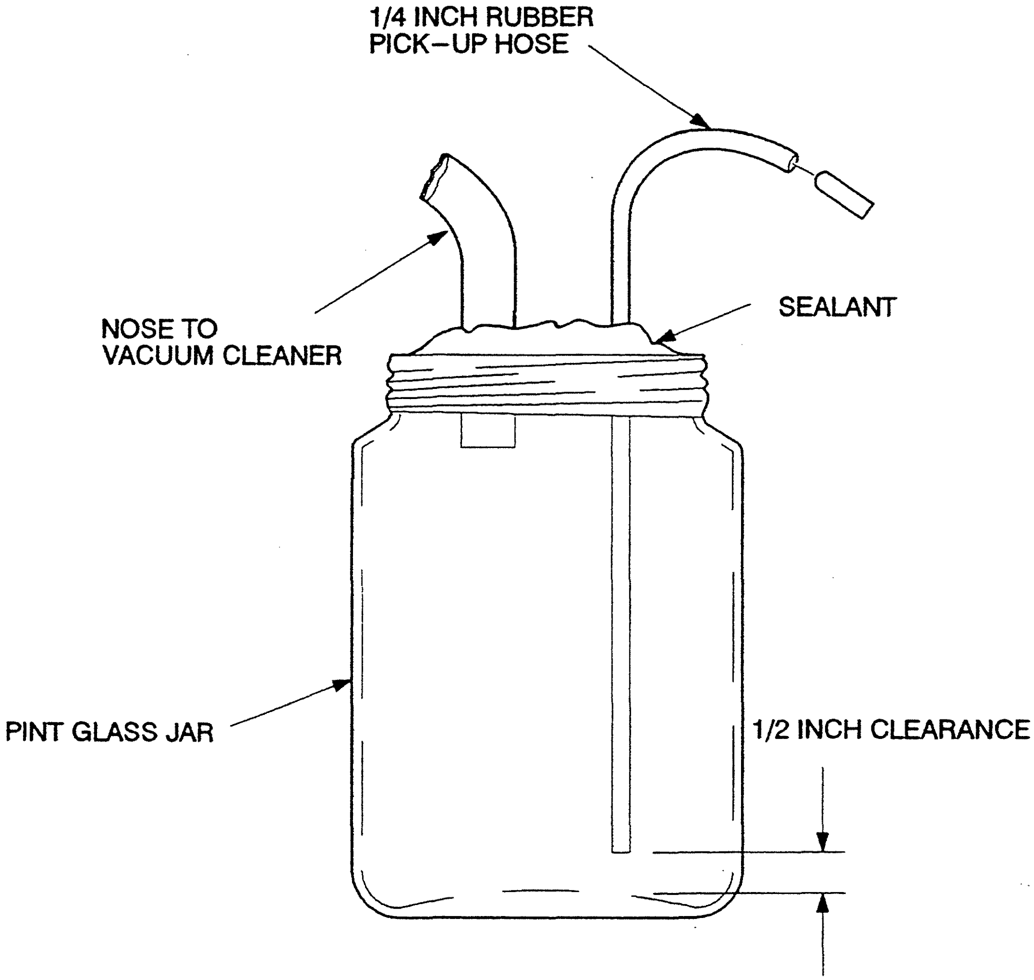
(2) A brush made from fine copper wire can also be used to pick up mercury. It is suggested that a suitable brush could be manufactured locally by using the fine wires used in domestic flexible electrical cable. The procedure for using the copper brush is as follows:

(a) Dip the brush in nitric acid (HNO_3) to clean the wires.

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

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

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



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

VACUUM CLEANER MERCURY TRAP

FIGURE 8

G. Special Equipment

(1) Because of the urgency involved in removing mercury from the aircraft, most of these procedures utilize materials which are readily available locally. However, the use of some special equipment is beneficial in ensuring that all traces of mercury are removed, a possible source of supply for these items are as follows:

(a) Hg Vacuum cleaner: Nilfisk of America Inc., 224 Great Valley Parkway, Malvern, Pennsylvania 19355–1311 or equivalent.

(b) Sensing device (mercury sniffer): Beckman Industrial Technologies, Subsidiary of Emerson Electric Co., 4141 Palm Street, Fullerton, California 40512, or Sunshine Scientific Instruments Inc., 1810 Grant Avenue, Philadelphia, Pennsylvania 19115 or equivalent.

(c) Nickel–plated carbon–fiber brushes: International Research and Development Co or equivalent.

(d) Mercury sponge: J.T. Baker Chemical Co.. 222 Red School Lane, Phillipsburg, New Jersey 08865–2219 or equivalent.

15. Corrosion Removal Procedure After Fire Damage

A. General

(1) 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.

(2) The dry powder type fire extinguishers are considered very effective in combatting aircraft 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 aircraft 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.

(3) 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.

B. Preventive Maintenance

(1) 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.

(2) Screen or mask off areas not affected.

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

(4) 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.

(5) Remove and replace structure damaged beyond repair.

NOTE: **Use eddy current technique to determine any change in heat–treat of any suspect structure.**

WARNING: **TRICHLOROETHANE 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.**

(6) Remove soot by washing affected areas with 1,1,1 – Trichloroethane, 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.**

(7) 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 inhibitor 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.**

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

(9) Remove corrosion using one of methods described in para. 6 through 13.

(10) Treat reworked surfaces per Chapter 5 and paint same as surrounding area

(11) Apply clear (Type I) DHMS C4.12 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 rag or brush to spread puddles. A thin even application is all that is required to provide corrosion protection and to prevent moisture from dissolving sodium dichromate into solution again, with possible staining of exterior surfaces.

(12) Replace all interior items and restore aircraft to serviceable condition.

16. Corrosion Removal Procedure After Alkaline Spills

A. General

(1) Alkaline spills are caustic and can cause corrosive damage to aircraft structure unless neutralized.

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

(3) Alkali–based corrosion removal compounds and aircraft cleaners are used quite extensively during routine maintenance operations. Without thorough neutralizing and/or rinsing, a spilled alkaline compound can produce corrosion damage.

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

B. Detection

(1) Alkaline liquids can be 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.

(2) 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.

(3) 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 produces a white powdery deposit. This white deposit is not corrosive and otherwise harmless but is an indication that electrolyte has spilled or otherwise escaped.

C. Personnel Protection

WARNING: ALKALINE LIQUIDS ACCIDENTALLY 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.

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

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

(3) Waste materials, solvents, chemical solutions, wiping rags, masking materials, and such, must be collected and disposed of in a safe manner.

D. Isolation of Contaminated Area

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

(a) Do not allow alkaline spills to spread to adjacent areas which will not be cleaned.

(b) In battery areas, protection of equipment beneath may be accomplished with plastic sheets. If equipment is operating, venting should be maintained.

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

E. Alkaline Spillage Cleanup

(1) If equipment is adjacent to the treatment area, use plastic sheets to cover the equipment and prevent splashing of alkalies or treatment fluids.

(2) Wipe up excess fluids with cloth and discard cloth into plastic container for disposal.

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

(4) Continue to apply the solution until the mixture is neutral. Neutralization of the alkaline fluid should be determined with litmus paper. 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.

(5) Remove the neutralized mixture with a mop or sponge.

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

(7) Wipe dry with clean cloths.

(8) After thoroughly drying, repair or replace damaged finishes if at all possible. Refer to Section 5.0 and Section 6.0.

(9) Apply DHMS C4.12 (F13) water displacing corrosion inhibiting compound over entire area.

NOTE: For details of application of DHMS C4.12, refer to Chapter 6.

17. Corrosion Removal Procedure After Acid Spills

A. General

(1) Acid spills, unless neutralized, can rapidly corrode metallic structure.

(2) The primary source of acid spillage is in the battery compartments (when acid batteries are installed) where acid electrolytes may overflow during charging or spill during battery servicing.

(3) Acid–based corrosion removal compounds and aircraft cleaners are sometimes used during routine maintenance and repair. Spills do occur at times and thorough neutralizing and/or rinsing is necessary to preclude corrosion damage.

(4) 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 steps (2) and (3). It is, therefore, advisable that the acid spillage be neutralized as soon as possible.

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

(6) 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.

B. Detection

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.

C. Personnel Protection

WARNING: ACIDS ACCIDENTALLY 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.

(1) 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.

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

(3) Waste materials, solvents, chemical solutions, wiping rags, masking materials and such, shall be collected and disposed of in a safe manner.

D. Isolation of Contaminated Area

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

(a) Do not allow acid spills to spread to adjacent areas which will not be cleaned.

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

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

E. Acid Spillage Cleanup

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

(2) Wipe up excess fluids with cloth and discard cloth into plastic container for disposal.

(3) 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.**

(4) Continue to apply the solution until bubbles cease. Neutralization of the acid fluid should be determined with litmus paper. Then allow the solution to remain on the surface for an additional 5 minutes.

(5) Remove the neutralized mixture with mop or sponge.

(6) Rinse the affected area with generous quantities of clean water.

Occasionally agitate the surface with a soft brush.

(7) Wipe dry with clean cloths.

(8) After thoroughly drying, repair or replace damaged finishes if at all possible. Refer to Chapters 5 and 6 for protective finish systems.

(9) Apply DHMS C4.12 (F13) water displacing corrosion inhibiting compound over entire area.

NOTE: **For details of application of DHMS C4.12, refer to Chapter 6.**

18. Rework Procedure for Corroded Structures Exceeding Allowable Limits

A. When the corroded structure exceeds the allowable limits stated in the Structural Repair Manual, the following steps shall be taken:

(1) For affected structures or components that may be removed from the airframe and replaced: these components must be replaced by new components or restored components having the structural integrity of new ones.

(a) Consult the Structural Repair Manual for removal procedures, and procedures for restoring the structure to working order.

(2) For airframe structures that may not be removed, a special procedure should be followed, depending on the specific affected area.

(a) Consult the Structural Repair Manual for rework procedure.

NOTE: **If the Structural Repair Manual does not contain a rework procedure for the affected component, contact the Bombardier Regional Aircraft, Airline Support Group, for instructions.**

PART 1

CHAPTER 5
STANDARD SURFACE TREATMENT METHODS

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

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 immediatley treated after rework. These treatments include conversion coating, plating or the application of thin protective films, 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, require less extensive surface protection. In some cases 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 PART 2.

Note: An index of de Havilland Inc finish codes for surface treatments referenced in this manual is provided at the end of this chapter.

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 the 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 in accordance with instructions in Chapter 4 or applicable methods in PART 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 0.00005 inch) non–metallic chromated film as on integral part of the metal. This film is resistant to corrosion and an excellent adherent for primers. The conversion coating can be applied by Alodine or by Iridite treatment. Solutions used in both treatments are proprietary but are readily available through most sources handling chemicals. There are two Alodine chemicals used and the treatment procedure for each is presented below. The treatment procedure for Iridite is also included.

C. Alodine

The conversion coating chemicals used for treatment are:

Alodine 1200 or 1200S (colored film)
Nitric acid.

The colored film of parts treated with Alodine 1200 or 1200S will vary from light golden irridescent to gold–brown. Treatment of reworked areas may be accomplished either by immersion where parts are removed from the airplane or by manual coating methods for in–situ application.

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 FLOWING CLEAN WATER FOR AT LEAST 15 MINUTES.

IF SOLUTION IS SPILLED ON CLOTHING, IMMEDIATELY REMOVE CONTAMINATED CLOTHING AND WASH CLOTHING AND BODY WITH FLOWING CLEAN WATER FOR AT LEAST 15 MINUTES.

(1) Solution Preparation

(a) All solutions must be made up in and contained in stainless steel tanks or in tanks lined with acid–resistant plastic or rubber.

(b) The cleaned tank must be half filled with de–ionized water. Sprinkle the powder chemicals uniformaly 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 or 1200S solutions for immersion application in accordance with proportions and control shown in Table 1.

(e) Prepare Alodine solutions for manual application in accordance with instructions in Table 2.

TABLE 1
ALODINE SOLUTION PREPARATION FOR IMMERSION METHOD

MATERIAL	VARIABLE	MAKE–UP (A)	CONTROL
1200	Concentration PH Temperature	1.2 oz/gal. – – – – – –	1.0 to 3.0 oz/gal. 1.5 to 1.7 (B) 60 to 100°F
1200S	Concentration PH Temperature	1.2 oz/gal. – – – – – –	1.0 to 3.0 oz/gal. 1.3 to 1.8 (B) 60 to 100°F

(A) After make–up, allow the solution to set undisturbed for 24 hours before using. The small amount of precipitate which forms will not interface with coating process.

(B) Higher concentrations will tend to have low 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.

TABLE 2
ALODINE SOLUTION PREPARATION FOR MANUAL APPLICATION

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 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.

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.

(2) Alodine Surface Treatment

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

(b) Wipe with cheesecloth dampened (not saturated) with Methyl Ethyl Ketone (MEK). 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 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

(i) Immerse part in alodine–solution until an irridescent light golden colour is obtained. Use of test sample is recommended to ascertain the correct immersion time.

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

(f) Manual Application

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

(ii) Allow solution to act on surface until an irridescent, light golden colour coating is formed by maintaining a continuous wet film on surface of work area. Coating time will depend on the temperature of the part.

(iii) 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.

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

(v) 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 the length of time the solution is allowed to react and produce 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 FLOWING CLEAN WATER FOR AT LEAST 15 MINUTES.

IF SOLUTION IS SPILLED ON CLOTHING, IMMEDIATELY REMOVE CONTAMINATED CLOTHING AND WASH CLOTHING AND BODY WITH FLOWING CLEAN WATER FOR AT LEAST 15 MINUTES.

(1) Solution Preparation

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

(b) All containers for Iridite solution must 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 until reaching the 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 Table 3.

TABLE 3
IRIDITE SOLUTION PREPARATION

MATERIAL	VARIABLE	MAKE–UP (A)	CONTROL
Iridite 14	Concentration PH Temperature	2.8 oz/gal. – – – – – –	2.7 to 3.3 oz/gal. 1.0 to 1.7 (B) Room temp. to 95°F
Iridite 14–2	Concentration PH Temperature	1.45 oz/gal. – – – – – –	1.25 to 2.25 oz/gal. 1.1 to 1.6 (B) Room temp. to 95°F

(A) 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.

(B) 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.

(2) Iridite Surface Treatment

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

(b) Wipe with cheesecloth dampened (not saturated) with Methyl Ethyl Ketone (MEK). 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 continuous wet film for 3 to 6 minutes.

(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 must be wiped off with clean dry rags after parts are dry.

(i) Apply original finish.

(j) Remove masking and protective covering.

3. Surface Treatment for Low–Alloy Steels

A. General
Bare surfaces of carbon (alloy) steels are highly reactive when exposed to the environment. Carbon steel is either cadmium plated or Ion Vapour Deposited Aluminum (IVD) coated after machining and heat treatment. Steel parts absorb hydrogen during the cadmium plating 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 150 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. All steel parts heat treated to 150 ksi and above 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 para. 4 and 5 for plating procedures. Apply original finish after plating.

C. Substitution of cadmium plating by IVD Aluminum Coating of the same thickness is allowed for components not having threads and consequently torque requirements. The IVD coating shall be supplemented by a conversion coating treatment (Alodine, Iridite).

NOTE: **Torque values can vary greatly between cad plated and IVD coated threads due to the difference in friction coefficients.**

4. Low Hydrogen Embrittlement Cadmium Plating

A. Introduction

(1) The following information is based on the Boeing Process Specification, BAC5718, for low hydrogen embrittlement cadmium plating.

(2) The information presented is intended to be general in nature. It does not necessarily cover all situations or specific installations, but is to be used only as a guide in establishing minimum standards.

(3) Low hydrogen embrittlement cadmium plating is used primarily for the purpose of providing an inorganic corrosion preventive plate on high strength steel parts, heat–treated above 220 ksi, and at the same time porous enough to allow the diffusion of hydrogen ions from the metal substrate during subsequent baking processes. This process may also be used on steels of lower heat treatment (150 ksi and above).

B. Materials

(1) Sodium Cyanide – 97% NaCN minimum. Shall not contain more than 5 ppm (weight) sulphides (sulphur) or 10 ppm (weight) of chloroform extractable material.

(2) Anodes – Cadmium (QQ–A–61), mild steel, or 300 series CRES.

(3) Cadmium Oxide (MIL–C–6151)

(4) Sodium Hydroxide – Flaked or Granulated, 76% NaOH, Federal Specification 0–S–598

(5) Sodium Dichromate Dihydrate – Tech. Grade, Federal Specification 0–S–595

(6) Nacconol 40 F or Nacconol 90 F – National Aniline Division, Allied Chemical Corporation

(7) Filter Pads – Dynel Fabric or Polyethylene Fabric

(8) Carbon Filter Aid Nerofil B – Great Lakes Carbon Company

(9) Activated Charcoal – Norit A, American Norit Company; or equivalent

(10) Sulfuric Acid – 66° Be, Technical, Federal Specification O–S–809

(11) Maskant – Mascoat #2, or equivalent, Turco Products Inc., or equivalent. Equivalents are those from which organic plasticizers cannot be leached out by the plating solution.

(12) Filter Aid – Celite 501, Johns–Manville Co.

(13) Chromic Acid – Technical, O–C–303.

C. Solution Preparation and Control

(1) Solution Preparation (Table 4)

(a) Dissolve cadmium oxide into a portion of sodium cyanide solution.

(b) Completely dissolve all materials in the water.

(c) Add cadmium anodes to tank.

(d) Let tank stand for 8 to 16 hours prior to use.

(2) Solution Control

(a) Carbonate may be removed from plating solution by any approved method compatible with maintaining contamination below the level specified in Table 4.

(b) After carbonate removal, solution shall be immediately brought back to the concentration limits specified in Table 4.

(c) Filtration shall maintain a clean uncontaminated plating solution. Only approved filtering systems, materials, and filtering aids shall be used.

(d) Immersion rinse tanks shall be maintained at a temperature not to exceed 160°F and an overflow rate regulated to ensure that maximum total dissolved solids do not exceed 500 ppm above total contamination level of incoming water, when incoming water has less than 500 ppm dissolved solids. When incoming water has more than 500 ppm dissolved solids, limit total contamination to 1000 ppm.

TABLE 4
LOW EMBRITTLEMENT CADMIUM SOLUTION

MATERIAL	ORIGINAL PREPARATION	CONTROL CONCENTRATION
Sodium Cyanide	146 lbs/100 gal.	
Cadmium Oxide	47 lbs/100 gal.	
Cadmium (Metal)		6.5 to 7.5 oz/gal.
Sodium Carbonate		8.0 oz/gal. maximum
Sodium Hydroxide		3.5 to 5.0 oz/gal.
Free Sodium Cyanide (total NaCN – 1.75 x Cd)		9 to 15 oz/gal.
Water, Deionized	Maintain Volume	
Operating Temperature	–	70 to 85°F

D. Auxiliary Anodes

NOTE: **Steel anodes which have been completely plated with cadmium, without copper or nickel strike, are considered as cadmium anodes.**

(1) Due to the relatively poor covering power (ability to plate in recessed areas) of the plating bath, special auxiliary anodes will be required to plate recesses and inside diameter areas.

(2) If the part configuration requires the use of contour conforming external anodes, these anodes shall be of cadmium or mild steel.

(3) Where the ratio of hole depth to inside diameter exceeds 1:1 for open holes or 0.5:1 for blind holes, internal anodes of cadmium, mild steel, or 300 series CRES shall be used. Where mild steel or CRES anodes are used, perform one of the following:

(a) Use a procedure that will ensure that minimum plating thickness is obtained on inside diameters.

(b) Regulate current to internal steel anodes separately from the current to the tank and external anodes to ensure proper current density on the inside diameters.

E. Preplate Treatment

(1) Prior to plating, all carbon and low alloy steel parts shall be stress relieved in accordance with applicable overhaul instructions. Where no stress relief details are given, stress relieve per Table 6 or 7. Inconel 625 and 718, copper based alloys, and 300 series corrosion resistant steels do not require stress relieving.

(a) Parts which have not been machined or cold worked after heat–treating do not require stress relieving.

(b) Parts on which honing or lapping are the only operation performed after heat–treatment do not require stress relieving.

(c) Parts which have been stress relieved per Table 6 or 7 prior to shot peening or before a previously applied plating, including plating which has been stripped for replating, need not be stress relieved again.

(2) Vapor degrease per Chapter 20 of Maintenance Manual. Parts shall be completely dry before proceeding.

(3) Abrasive blast as specified in Chapter 4, para. 8. Use only dry blasting methods and abrasives.

(4) Within 10 minutes, cold water rinse for 1 minute maximum. Plating shall start within 1 minute after rinse, except as noted below.

NOTE: **Option: Within 10 minutes, immerse part in cyanide holding bath, prepared in accordance with Table 5, until part is ready to plate. Maximum holding time is 4 hours. Proceed without rinsing.**

TABLE 5
CYANIDE HOLDING BATH

MATERIAL	ORIGINAL PREPARATION	CONTROL CONCENTRATION
Sodium Cyanide	0.31 lb/gal.	4.5 oz/gal.
Sodium Hydroxide	0.1 lb/gal.	1–2 oz/gal.
Operating Temperature	– – –	70–85°F

TABLE 6
STRESS RELIEF (HARDENED PARTS) AND EMBRITTLEMENT RELIEF

ALLOY	CONDITION	STRESS RELIEF		EMBRITTLEMENT RELIEF	
		TEMPERATURE °F ± 25°F	SOAKING TIME (hrs)	TEMPERATURE °F ± 25°F	SOAKING TIME (hrs)
1095	180–200 KSI (R_C 40–43)	675 (1)	1–2 (1)	395	4–5 (3)
	200–220 KSI (R_C 43–46)	605 (1)	1–2 (1)		
4330V	220–240 KSI	525 (1)	1–2 (1)	395	8–9 (3)
4340	150–170, 160–180 KSI	N/A	N/A	395	8–9 (3)
	180–200, 200–220 KSI	700 (1)	1–2 (1)		
	260–280 KSI	375 (2)	3–4	375 (2)	8–9 (3,4)
					23–25 (3,5)
52100	R_C 55 and up	N/A	N/A	300	4–5 (3)
300M	275–305 KSI	500 (1)	4 (1)	395	12 (3)
HY–TUF	220–240 KSI	450 (1)	1–2 (1)	395	8–9 (3)
H–11 MOD.	220–240 KSI	700 (1)	1–2 (1)	395	23–25 (3)
QQ–W–470 MUSIC WIRE	and up As Purchased	500 (1)	1/2 (1)	395	23–25 (3)
CARBURIZED, CARBONITRITED OR CYANIDE PARTS	Case or Core: 150–170, 160–180 KSI and up	Consult de Havilland for stress relief information		300	4–5 (3)
LIQUID NITRIDED PARTS	Case or Core: 150–170, 160–180 KSI and up	Consult de Havilland for stress relief information		395	4–5 (3)
GAS NITRIDED PARTS	Case or Core: 150–170, 160–180 KSI and up	Consult de Havilland for stress relief information		395	4–5 (3)
ALL INTERNALLY AND EXTERNALLY THREADED PARTS	150–170, 160–180 KSI	N/A	N/A	395	23–25 (3)
	180–200 KSI and up	395	3–4		
ALL OTHERS (4130, 8630, ETC.)	150–170, 160–180 KSI	N/A	N/A	395	4–5 (3)
	180–200 KSI and up	650 (1)	1–2 (1)		

NOTES:
1. Stress relief temperature and soaking time applies to parts other than shot peen parts. Parts requiring stress relief which have previously been shot peened must be stress relieved at 395 ± 25°F for 10–12 hours.
2. ± 15°F
3. For acid or electrolytic cleaned parts and for macro etch (burn detection) treated parts, a soaking time of 3–4 hours must be used.
4. For stylus cadmium plated parts and chrome (deposited directly on base metal) plated parts.
5. For parts other than stylus cadmium plated or chrome (deposited directly on base metal) plated parts.

TABLE 7 (SHEET 1)
STRESS RELIEF AND EMBRITTLEMENT RELIEF FOR CORROSION RESISTANT STEEL

ALLOY	MATERIAL SPECIFICATION	FORM	HOMOGENIZING	SOLUTION HEAT TREATMENT	AUSTENITE CONDITIONING	PRECIPITATION HEAT TREATMENT	STRESS RELIEF	EMBRITTLEMENT RELIEF
17-4PH	AMS 5643	BAR	N/A	1900 ± 25°F See Note 1	N/A	H1025 (155-175 KSI) 1025 ± 10°F 4 hours	800± 25°F See Note 5	395 ± 25°F 4-5 hours See Note 5
						H1150 (125-155 KSI) 1150± 10°F 4 hours		
	AMS 5342	INVEST-MENT CASTINGS	2100 ± 25°F 90 minutes	1900± 25°F See Note 1	N/A	H1100 (130-160 KSI) 1085-1115± 10°F 90-120 minutes		
	AMS 5343					H1000 (150-180 KSI) 1000 ± 10°F 90 minutes		
	AMS 5344					H900 (180-210 KSI) 900 ± 10°F 90 minutes		
17-7PH	AMS 5528	SHEET	N/A	1950 ± 25°F See Note 2	"T" 1400± 25°F 90 minutes	TH1050 (180-200 KSI) 1050 ± 10°F 90 minutes		
	MIL-S-25043	STRIP AND PLATE			"R" 1750 ± 25°F 10 minutes	RH950 (200-240 KSI) 950 ± 10°F 1 hour		
	AMS 5673	WIRE SPRING TEMPER		N/A	N/A	CH900 900 ± 10°F 60 ± 5 minutes		

CONTINUED ON SHEET 2

TABLE 7 (SHEET 2)
STRESS RELIEF AND EMBRITTLEMENT RELIEF FOR CORROSION RESISTANT STEEL

ALLOY	MATERIAL SPECIFICATION	FORM	HOMOGENIZING	SOLUTION HEAT TREATMENT	AUSTENITE CONDITIONING	PRECIPITATION HEAT TREATMENT	STRESS RELIEF	EMBRITTLEMENT RELIEF
CUSTOM 455	AMS 5617	BAR	N/A	1525 ± 25°F 30 minutes	N/A	H950 (220–240 KSI) 950 ± 10°F 4 hours H1000 (195–215 KSI) 1000 + or – 10°F 4 hours H1050 (180–200 KSI) 1050 ± 10°F 4 hours	800 ± 25°F See Note 5	
410	AMS 5350	CASTING					395 ± 25°F 3 to 4 hours (Notes 4 & 5)	395 ± 25°F 4–5 hours See Note 5
431	MIL–S–18732	BAR TUBE					500 ± 25°F 4 to 5 hours (Notes 4 & 5)	

NOTES:

1. Soak for 30 minutes per 1/2 inch of thickness or fraction thereof.
2. Soak for 15 minutes per 1/8 inch of thickness or fraction thereof.
3. THICKNESS – Minimum dimension of the heaviest section of the part or the minimum dimension of a multi–layer load, whichever is greater.
4. Stress relief temp. applies to parts other than shot peened parts. Parts which have been shot peened and require stress relief must be stress relieved at 450 + or – 25°F for 4 to 5 hours.
5. Air cool to room temperature.

F. Plating Procedure

(1) General

NOTE: When plating bath is initially established or has been shut down for a period, the following procedure is recommended prior to plating parts.

(a) Provide 4 test panels 4 by 6 inches by 0.040 thick, low carbon cold rolled steel.

(b) Plate test panels in accordance with this procedure except that three of the test panels shall be chromate treated and two left untreated.

(c) Check test panels as follows:

(i) Plating deposit shall be free from blisters, pits, nodules and indications of burning.

(ii) Plating deposit shall completely cover test panels to a thickness specified in the overhaul manual or; where no thickness is specified, the minimum thickness shall be 0.0005 inch.

(iii) Plate deposit thickness shall be even and uniform over entire plated surface.

(d) Plate deposit shall be firmly adherent when checked by one of the following methods:

(i) Scrape surface of one plated test sample with sharp knife to expose substrate metal. Examine scraped area at 4 diameters magnification and determine if removal of plate has been caused by tearing away of adherent plate deposit (passes test) or lifting or flaking of nonadherent plate deposit (fails test).

(ii) Using the same test panel as above, make adhesion check by bending the panel 180 degrees over a 0.040 mandrel. Examine the test panel at 4 diameters magnification for evidence of separation of cadmium plate deposit from substrate metal. Formation of cracks in cadmium plate deposit and/or base metal which do not result in peeling, blistering or flaking of plate deposit shall be considered as having passed test.

(e) Plate deposit shall have a dull, granular, porous appearance and shall vary from dull gray to frosty white when properly applied.

(f) Stains due to baking or rinsing are not cause for rejection.

CAUTION: NO BRUSHING, POLISHING OR BRIGHTENING AFTER PLATING IS PERMITTED.

(2) Plating Thickness

(a) Thickness of plating deposit to be as specified in the Structural Repair Manual. Where no thickness is specified, plate to 0.0005 inch minimum thickness.

(b) Unless otherwise noted, in overhaul manual and steps (c) and (d), thickness requirements shall only apply to visible surfaces which can be touched with 0.75 inch diameter ball. However, part must be completely covered by cadmium plating when visually examined.

(c) If procedure in step D. (3) (a) is used, minimum plating thickness on inside diameter of hollow and tubular parts must be maintained.

(d) If procedure in step D. (3) (b) is used, minimum plating thickness on inside diameter of hollow and tubular parts need not be maintained. Inside surfaces must be completely covered with cadmium, as determined by visual examination, and must be plated for the time required to deposit 0.0005 inch plating per Table 8.

(3) Plate

(a) Cadmium plate, using solutions prepared and maintained in accordance with Table 4.

(4) Continue uninterrupted plating to thickness as specified in rework instructions. See Table 8 for time selection of plating thickness.

TABLE 8

TIME SELECTION FOR PLATING

CURRENT DENSITY	MINIMUM TIME TO PLATE 0.0005 INCH OF CADMIUM
50 amps/sq.ft.	6.1 minutes
60 amps/sq.ft.	5.1 minutes
70 amps/sq.ft.	4.3 minutes
80 amps/sq.ft.	3.8 minutes

CAUTION: **ONCE PLATING HAS STARTED, DO NOT INTERRUPT CURRENT UNTIL PARTS ARE READY FOR REMOVAL FROM TANK. REMOVE PARTS IMMEDIATELY UPON BREAKING PLATING CURRENT.**

(5) Cold water rinse for 5 minutes (maximum).

CAUTION: IT IS MANDATORY THAT THE FINAL IMMERSION RINSE SHALL BE USED FOR NO OTHER PURPOSE WHATSOEVER.

NOTE: A bright, shiny, dense plate deposit indicates a malfunction of the plating process, which may produce hydrogen embrittled parts. If parts with such coatings are observed, hydrogen embrittlement tests shall be conducted in accordance with BAC5718.

G. Post Plate Treatment

(1) When post plate chromate treatment is not specified in applicable rework instructions, proceed as follows:

NOTE: The following process is optional for parts which are to receive post plate chromate treatment.

(a) Rinse parts in chromic acid solution for 0.5 to 2.0 minutes. Chromic acid solution to be prepared with 34 pounds of chromic acid to 100 gallons of water.

(b) Cold water rinse 0.5 to 5.0 minutes.

(c) Air dry at 160°F maximum.

(d) ***AS SOON AS PRACTICAL AND PREFERABLY WITHIN 30 MINUTES, BAKE PARTS IN ACCORDANCE WITH APPLICABLE OVERHAUL INSTRUCTIONS. WHERE NO INSTRUCTIONS ARE GIVEN, EMBRITTLEMENT RELIEVE PARTS ACCORDING TO TABLE 6 OR TABLE 7. SERIES 300 CORROSION RESISTANT STEELS DO NOT REQUIRE POST-PLATE BAKING. PROCEED TO STEP (3).***

(2) When the overhaul manual specifies post plate chromate treatment, proceed as follows:

(a) Air dry at 160°F maximum.

(b) Embrittlement relieve.

(c) Immerse parts in chromate treatment solution mixed and maintained per Table 9. Parts should hang freely so that all areas are wet by the solution. Maximum immersion time is 10 seconds.

(d) Immersion rinse parts in hot water 0.5 to 2.0 minutes. Maximum water temperature is 160°F.

(3) Magnetic particle examine when specified in applicable overhaul instructions.

(4) If part is to be painted, painting should be completed as soon as possible after plating, with a minimum of handling.

TABLE 9

CHROMATE TREATMENT SOLUTION

MATERIAL	ORIGINAL PREPARATION	CONTROL CONCENTRATION
Sodium Dichromate	170 lbs/100 gal.	24 to 27 oz/gal.
Nacconol 40F	10 oz/100 gal.	–
or		
Nacconol 90F	6 oz/100 gal.	–
Sulfuric Acid	1 gal/100 gal.	ph 0.65 to 1.0
Operating Temperature		70 to 85°F

5. Low Hydrogen Embrittlement Stylus Cadmium Plating

A. Introduction

(1) The following information is based on Boeing process specification BAC5854 for low hydrogen embrittlement stylus cadmium plating.

(2) The information presented is intended to be general in nature. It does not necessarily cover all situations or specific installations, but is to be used only as a guide in establishing minimum standards.

B. Materials and Equipment:

(1) Materials:

NOTE: Equivalent substitutes may be used.

(a) Cadmium Stylus Plating Solution

(i) Selectron LHE (#SPS−5070), V13929 or *(1)

(ii) Dalic Cadmium Code 2023, V11924

(b) Gauze tubing −− Cotton, dacron or cotton/dacron surgical tubing (Johnson and Johnson Surgitube, V99742)

(c) Cotton batting −− long fibre, lint−free, USP surgical grade

(d) Masking material −− Acid and alkaline resistant, electroplaters (3M #470, V76381)

(e) Pressure sensitive tape −− 60 ounce/inch tack, or greater, not over 6 months old from date of manufacture (3M, #250, V76381)

(f) Chromate conversion coating −− Manually applicable chromate coating (Allied Research Iridite #8)

(2) Equipment:

NOTE: Equivalent substitutes may be used.

(a) Power Supply: adjustable 30 volts dc, 25 amperes output, circuit breaker protected, ampere−hour meter readable to 0.01 ampere−hour; voltmeter, ammeter. Accuracy of each meter shall be + or − 5%. (Selectron type 2530 or 6035, V13929).

(b) Styli shall have aluminum cores cut for cooling, with plastic handle cover and capability of holding various sizes and shapes of anodes. (Selectron types MS, LR, SF, LF, HR, LA, PT, V13929).

(c) Rotary Anode Tool: −− Variable speed, capable of spinning anodes forward or reverse, with stepless speed control 0−900 rpm. (Selectron Rotostylus, V11924, V13929, or *(1)).

(d) Anodes: -- High purity, high density graphite, or drawn platinum, shaped flat, convex, or concave to match surface being plated.

(e) Filter Paper -- Whatman #4, V58485

(f) Industrial Abrasive Unit -- Single nozzle unit capable of producing abrasive stream which can be varied in rate of abrasive flow and in area of abrasive pattern. (S.S. White Industrial Airbrasive Unit Model F, *(2)).

C. Plating Procedure

(1) General

(a) Perform plating only in areas protected or away from corrosive atmosphere, dust and fume producing operations such as grinding, polishing, buffing, abrasive cleaning, tank plating, and area maintenance cleaning.

(b) Part shall be at ambient temperature, above 32°F, and shall be cool enough to preclude drying of surface during plating process.

(c) Complete all machining, forming, welding or brazing prior to plating. Unless otherwise specified in the Structural Repair Manual, plate only areas that are smooth and substantially free from blemishes, pits, tool marks, weld flash or slag and other irregularities except the evenly textured surface imparted during abrasive cleaning.

(d) Parts shall not be stylus plated while under load; that is, the part should not be in an assembled or installed state where external forces may be acting upon it. Preplate stress relief is not required for stylus plating.

(e) Unless otherwise specified by the rework instructions, apply a minimum of 0.0005 inch of plating; except, when plating holes of less than 0.75 inch diameter or internal curved surfaces of less than 0.375 inch radius, the thickness requirements need not be met (However, these surfaces must be plated for the ampere-hours calculated to give 0.0005 inch plating thickness).

(f) Stylus plating does not require subsequent embrittlement relieves. However, when stylus plating is accomplished prior to baking per para. 4.0, parts may be baked as part of these processes in accordance with their respective embrittlement relief schedule.

(g) Choice of anodes and styli

(i) Select an anode which most nearly matches the configuration of the part. For small holes, use 0.060 to 0.100 inch inert platinum anodes.

(ii) Where the application permits, a rotary tool may be used to turn the anode, and similarly, where applicable, a lathe or turning head (0 to 900 rpm) may be used to turn the part.

(h) Preparation of stylus straight rod and anode (Fig. 1)

(i) Remove oxidation or corrosion products from the metal stylus base using abrasive cloth. Remove loose carbon particles from the carbon anode part of the stylus assembly. Assemble the carbon anode to the stylus base and assure firm electrical continuity by tightening up the stylus chuck firmly.

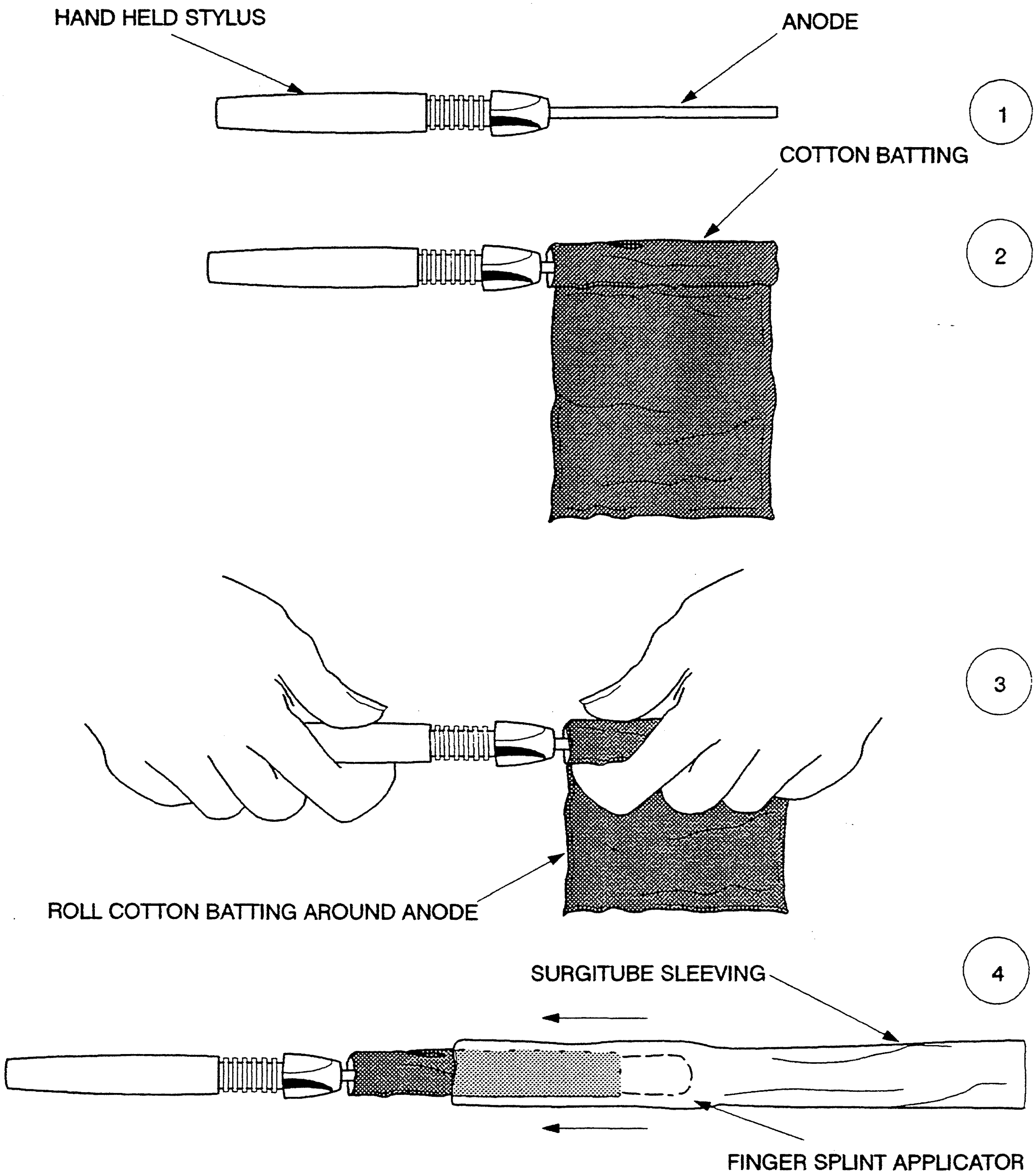
(ii) Tear off (do not cut) a thin layer of cotton batting, rectangular in shape approximately equal to the length, and long enough to make three wraps of the anode. If prolonged plating is anticipated, wrap the anode in filter paper prior to the cotton wrap to keep carbon particles from building up in the solution.

(iii) Wet the carbon anode with water and roll cotton around the anode, as shown. Wrap should be tight and free of lumps and thin spots. Apply tubegauze as an outside covering sleeve, using a standard plastic or aluminum finger splint applicator to support the tubegauze. Remove sizing from tubegauze by rinsing in tap water prior to use. Prepare anodes of different shapes in a similar manner as shown in Fig. 2.

NOTE: **Separate, wrapped anodes are required for each type of solution used (do not transfer any wrapped anode from one solution to another). Immediately following use of anodes, remove tubegauze and cotton, dismantle stylus assembly, rinse thoroughly, and dry with a blast of clean, dry air.**

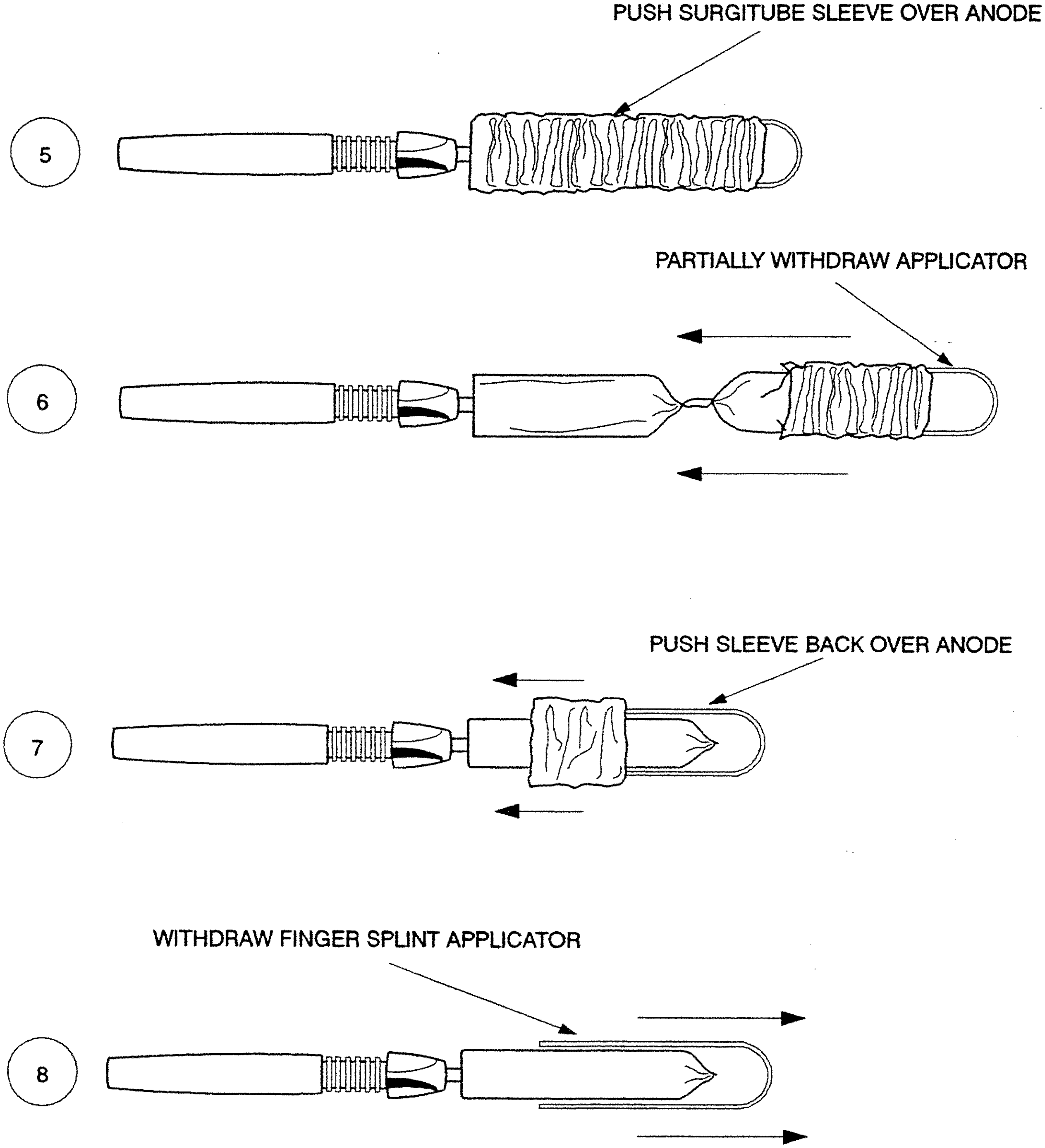
(i) Calculate the number of ampere–hours required to plate the required thickness by multiplying the number of ten–thousandths of an inch by 0.006 for Selectron LHE (#SPS–5070) or 0.007 for Dalic 2023 and then by the number of square inches to be plated. For example, to deposit 0.0005 inch of cadmium on 4 square inches of surface by the Dalic method would require 5 x 0.007 x 4, or 0.140 ampere–hours.

CORROSION PREVENTION AND CONTROL
PART 1



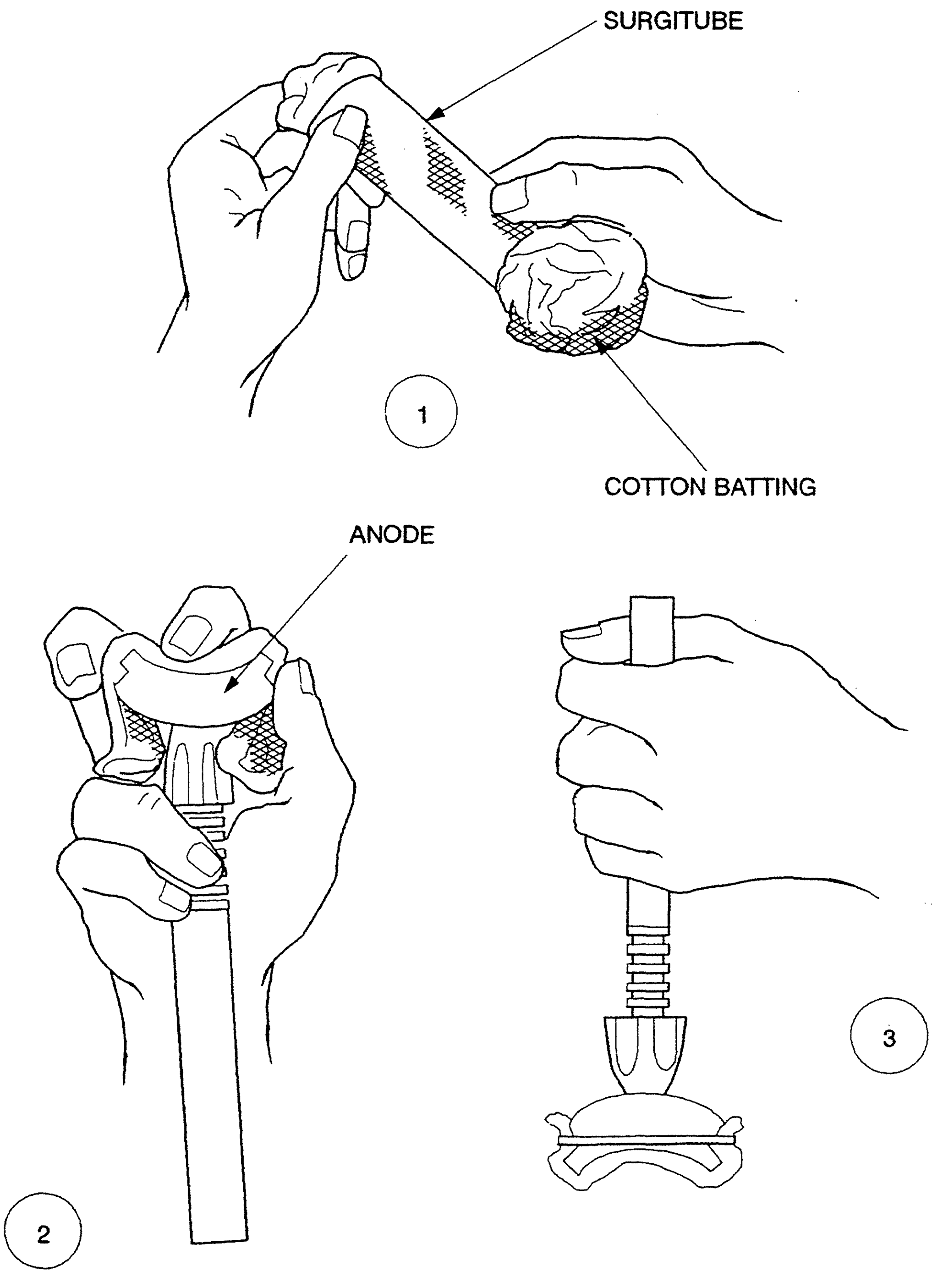
PREPARING STRAIGHT ROD STYLUS

FIGURE 1 (SHEET 1)



PREPARING STRAIGHT ROD STYLUS

FIGURE 1 (SHEET 2)



PREPARING CONCAVE STYLUS (TYPICAL)

FIGURE 2

(j) Prior to processing, ensure that all parts are at ambient temperature range, or adhesion may be substantially decreased.

(k) Plating solution

(i) Do not store or use stylus plating solution below 32°F. Store new solutions in their original containers.

(ii) Do not return used solution to original containers. Discard all used solutions or any solution which has contacted a part or a stylus plating anode.

(2) Detail Notes (Fig. 3)

(a) During stylus plating operation, hold or position the stylus and anode assembly so that the anode surface is flush with the area being plated, as shown. Use minimum pressure to prevent solution loss and excessive wear on the stylus anode covering.

(b) Use a circular motion while plating, as shown. Plate at a uniform rate of speed using relative anode to cathod speed of 20 to 80 feet per minute (4 to 16 inches per second). Slower speeds may cause burning. If anode motion is impaired, reduce voltage to lower end of range.

CAUTION: **AVOID STRAIGHT BACK AND FORTH MOTION AS THE PAUSE WHEN MOTION IS REVERSED WILL CAUSE BURNING IN THE REVERSE AREA.**

(i) For plating IDs or ODs of cylindrical parts, convert anode to cathode speeds to rpms, when using variable speed turning head or anode rotating tool. RPM = speed (ft/min.) divided by circumference (ft.).

(c) Use an anode soaked with plating solution and resoak or exchange the anode regularly, while plating, to provide sufficient solution for quality plating.

(d) Prior to plating, wet area to be plated, make flush contact between anode and cathode, start proper motion, and then turn on the current. Do not allow anode to come to rest while current is on.

(e) No mechanical or manual abrading, polishing or brushing is permitted on areas of parts which have been stylus plated.

(3) Stylus Plate

(a) During subsequent processing steps, protect all areas on the part such as faying surfaces, recesses or other natural solution traps from processing materials using masking tape or other suitable materials.

(b) For parts which have been previously painted, remove paint from area to be reworked per Chapter 51 of the Structural Repair Manual. Area of rework (12 square inches maximum) includes the damaged area and extends on either side to allow for abarasive cleaning and painting (Fig. 4).

NOTE: **Prior to further processing, a test for adhesion of existing plate per para. D. (3) is recommended.**

(c) Solvent clean rework area to remove any lubricants soil, or other contamination. Dry area thoroughly.

WARNING: CADMIUM DUST AND FUMES ARE TOXIC. DO NOT BREATHE DUST OR FUMES. CONDUCT ABRASIVE CLEANING IN LOCAL EXHAUST BOOTH OR WEAR APPROVED DUST RESPIRATORS. AVOID INGESTION BY WASHING HANDS BEFORE EATING OR SMOKING.

(d) Dry–abrasive clean area. Make certain that there will be an area of existing plate surrounding the bare area to provide an interface of about 1/8 inches where stylus plating and existing plating will overlap. Lightly abrade the area of existing plate but do not abrade down to bare substrate (Fig. 4). Do not use power tools on steels heat–treated 150 ksi or over.

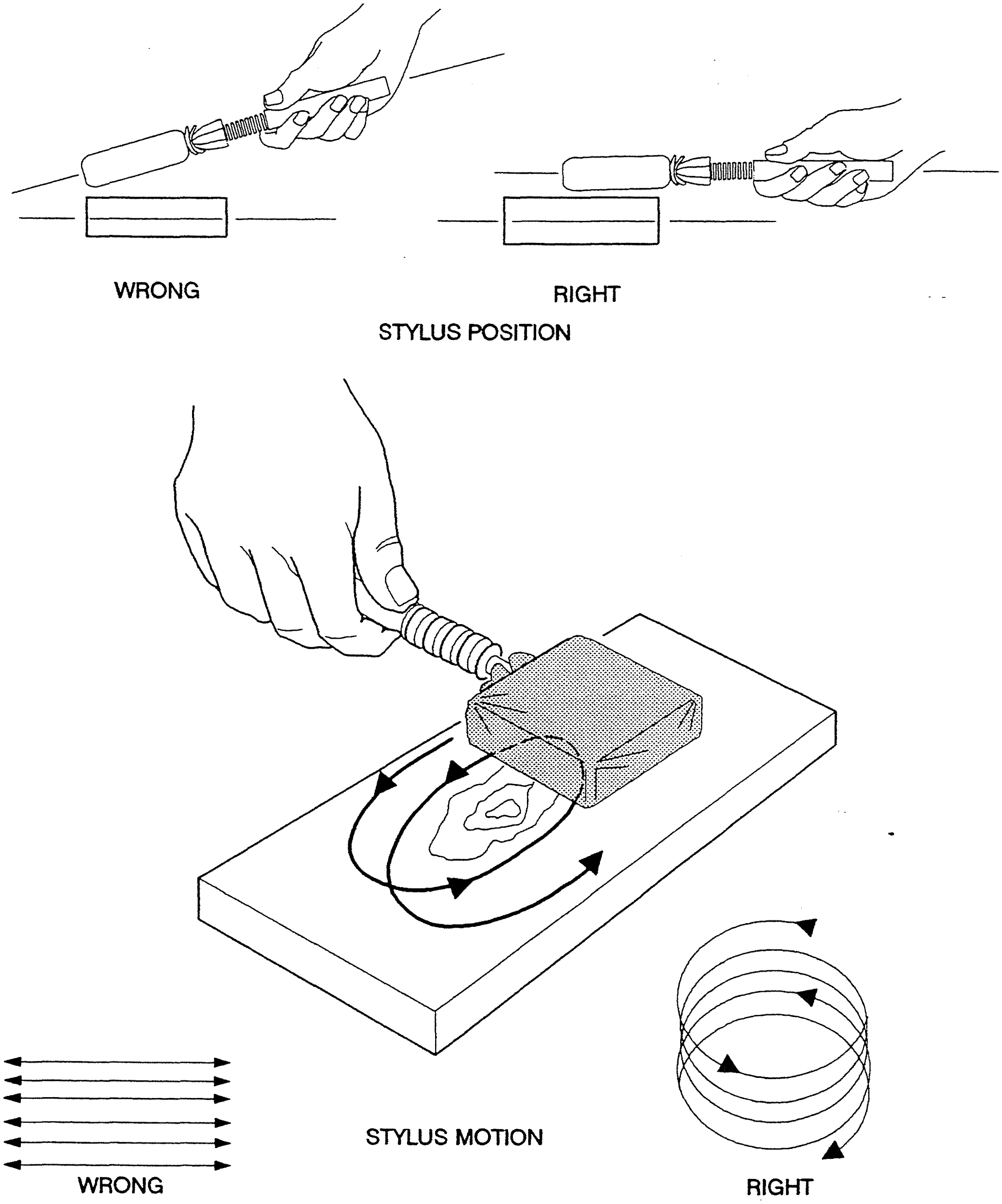
(e) Remove all abrasive dust with clean cloth dampened with solvent.

(f) Mask as required to limit area to be plated and to prevent contamination or damage of adjacent area from plating solution and rinse water.

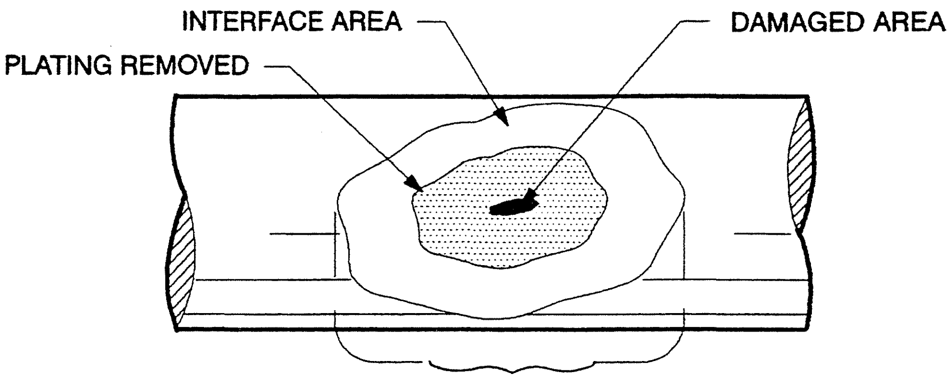
(g) Apply the cadmium stylus plating solution to surface to be plated by squeeze bottle, saturated cotton, cheesecloth, brush, etc.

(h) Stylus cadmium plate at 20 volts, until a visible layer of plate has been deposited, then reduce voltage to 8–14 volts and continue until calculated number of ampere–hours has elapsed. During plating, anode–cathode movement should be 20 to 80 feet per minute (4 to 16 inches per second).

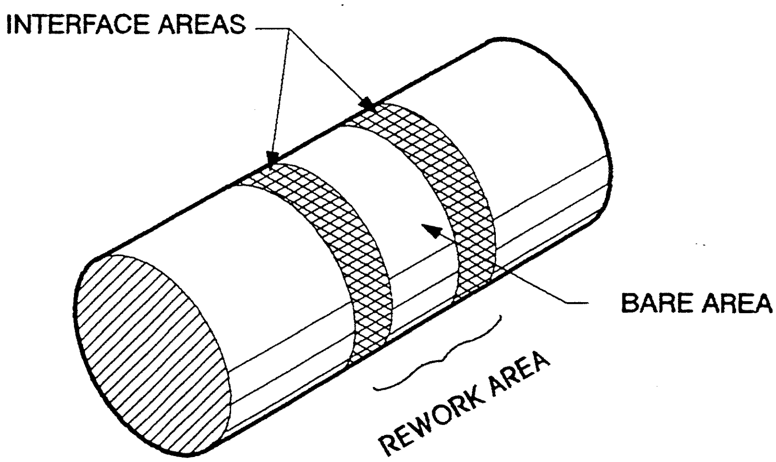
CAUTION: TURN ON POWER SUPPLY, SET DESIRED VOLTAGE, AND BEGIN ANODE–CATHODE MOVEMENT PRIOR TO INITIAL CONTACT OF THE STYLUS WITH THE PART TO BE PLATED.



USE OF STYLUS FOR PLATING
FIGURE 3



1. STRIP EXISTING PAINT.
2. TAPE TEST EXISTING PLATE
3. REMOVE EXISTING PLATE
4. LIGHTLY ABRADE INTERFACE AREA APPROXIMATELY 1/2 INCH WIDE BAND AROUND BARE AREA.
5. STYLUS PLATE ENTIRE REWORK AREA



1. THOROUGHLY ABRADE BARE AREA.
2. LIGHTLY ABRADE INTERFACE AREA APPROXIMATELY 1/2 INCH ON EITHER SIDE OF BARE AREA.
3. STYLUS PLATE ENTIRE REWORK AREA.

SURFACE PREPARATIONS FOR STYLUS PLATING

FIGURE 4

(i) Manually cold water rinse 0.5 to 5 minutes with fresh water, using clean cotton, and dry within 5 minutes after rinsing.

(j) For repair type plating perform the following:

(i) Apply chromate conversion coating manually according to manufacturer's instructions.

(ii) Manually cold water rinse 0.5 to 5 minutes with fresh water, using clean cotton, and dry.

(iii) Check for quality of plate. Adhesion requirement per para. D. (3) must be met on all rework areas.

(iv) For previously painted parts, repaint over stylus plated areas. Paint as soon as possible with minimum handling.

D. Quality Control

(1) The stylus plated deposit shall be smooth, fine–grained, adherent and free from blisters, pits, nodules, indications of burning, and other defects.

(2) The chromate conversion coatings shall be adherent and free of powder.

(3) There shall be no evidence of separation between stylus plating and its substrate, nor shall there be any evidence of separation between stylus plating and previously applied platings when tested by the following procedure:

(a) To the portion of the stylus plated area, including the interface between brush plating and previously applied plating, (or to the previously applied plating before stylus plating), apply pressure sensitive tape, 3M #250 or equivalent, using finger tip pressure. Grasp a free end of the tape and remove rapidly in a direction perpendicular to the plated surface. Examine the adhesive side of the tape under 10 power magnification for evidence of separation (presence of cadmium plate).

(4) Clean adhesive residues from tested surface with a suitable solvent.

E. Vendors

11924	SIFCO SELECTIVE PLATING DIV. OF SIFCO INDUSTRIES, 5708 SCHAAF RD., INDEPENDENCE, OHIO 44131.
13929	SELECTRONS, LTD., 137 MATTATUCK HEIGHTS RD., P.O. BOX 115, WATERBURY, CONNECTICUT 06725.
58485	WHATMAN, INC., 9 BRIDEWELL PLACE, CLIFTON, NEW JERSEY 07014.
76381	3M COMPANY, 3M CENTER, ST. PAUL, MINNESOTA 55101.
99742	JOHNSON & JOHNSON, INC., PERMACEL DIVISION, U.S. HIGHWAY 1, P.O. BOX 671, NEW BRUNSWICK, NEW JERSEY 08903.
(1)	VANGUARD PACIFIC, INC., 1216 W. WASHINGTON AVE., LOS ANGELES, CALIFORNIA.
(2)	S.S. WHITE CO., LOS ANGELES, CALIFORNIA.

6. Surface Treatment for Corrosion Resistant Steels

A. No surface treatment is required after rework on corrosion resistant steels. Refer to para. 8 for plated alloys. Stainless steel requires passivation after rework.

7. Surface Treatment for Titanium Alloys

A. No surface treatment is required after rework on titanium alloys. Apply original finish. Titanium alloy skins may be conversion coated as per para. 2 to improve primer and paint adhesion.

8. Surface Treatment for Cadmium Plated or IVD Coated Parts

CAUTION: **STEEL PARTS HEAT-TREATED ABOVE 150 KSI ARE SUBJECT TO HYDROGEN EMBRITTLEMENT. LOW HYDROGEN EMBRITTLEMENT PLATING MUST BE USED. REFER TO PARA. 4 AND 5 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 or cadmium plating (para. 5). Major rework requires stripping and replating.

B. Rework of Parts Coated with Ion Vapor Deposited Aluminum (IVD) indicates a break in the surface and exposure of the base metal. Parts that are not subjected to fretting, galling or erosion are to be reworked as follows:

(1) Clean area surrounding defect thoroughly – wipe area with Methyl Ethyl Ketone and allow to dry.

(2) Mask off adjacent areas.

(3) Apply cold galvanizing compound No. 7007 (Crown Industrial Products Ltd., 1 Crown Court, Whitby, Ontario) or L.P.S. cold galvanize (LPS Research Lab. Inc., 2050 Cotner Ave., Los Angeles, CA 90025), either by brush or spray to the affected area. Refer to manufacturer's directions on cure times, coating thickness, and retreatments.

TABLE 10
INDEX – FINISH CODES FOR SURFACE TREATMENTS

A1	= Chromic Acid Anodize
C1	= Chromate Conversion Coating Process (Alodine)
E1	= Cadmium Plating
M2	= Ion Vapour Deposited Aluminum Class 1 – 0.001 – 0.002 Inch Thick Class 2 – 0.0005 – 0.0009 Inch Thick Class 3 – 0.0003 – 0.0005 Inch Thick Type 1 – As Coated (No Supplementary Treatment) Type 2 – With Supplementary Chromate Treatment
FPL	= Forest Products Laboratory Etch Process
PAA	= Phosphoric Acid Anodize
BR 127	= Adhesive bonding primer to DHMS A6.03 (American Cyanamide)
PR 1436	= Polysulfide Sprayable Sealant (PRC Corporation)
F13	= Water Displacing Corrosion Inhibiting Compound Grade 1 – Hard Film (MIL–C–16173) to DHMS C4.12 Grade 2 – Soft Film (MIL–C– 16173) to DHMS C4.12 Grade 3 – Water Displacing Soft Film to DHMS C4.12 Grade 4 – Soft, Medium, Heavy Duty Compound to BMS 3–26, TY 1
F19	= Epoxy Primer to DHMS C4.04 – Type 2 (Strontium Chromate) Green – Type 3 (Zinc Phosphate) White
F21	= Fuel Tank Primer to DHMS C4.06 – BMS 10–20 – Type 1 Polyurethane – Type 2 Epoxy
F22	= Epoxy Enamel to DHMS C4.11
F23	= Urethane Compatible Epoxy Primer – Type 3 to DHMS C4.18 or to BMS 10–79 TY 2, TY 3
F24	= Polyurethane Enamel to DHMS C4.04 – Type 3 for Aircraft Interior – Type 4 High Flexibility and Impact for Aircraft Exterior
F33	= Surface Finishing Compound to DSC 206
F36	= Erosion Resistant Polyurethane, Unpaved Runway Protection to MIL–C–83231 TY 1, class A
F37	= Polyurethane Enamel – High Resistance to Skydrol
F41	= Conductive Epoxy – Anti–Static Coating to BMS 10–21 TY 1

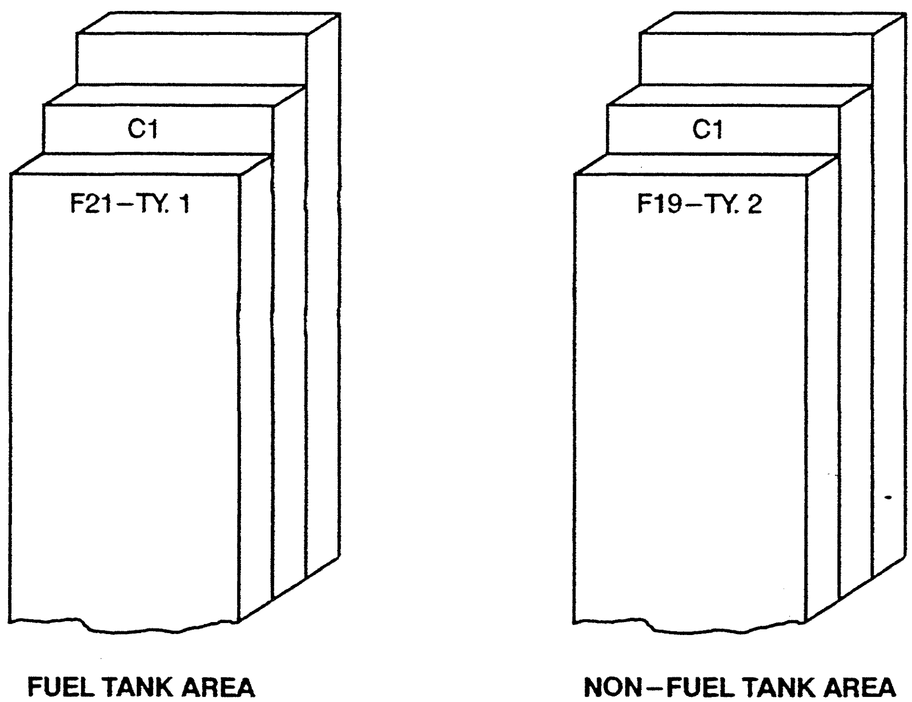
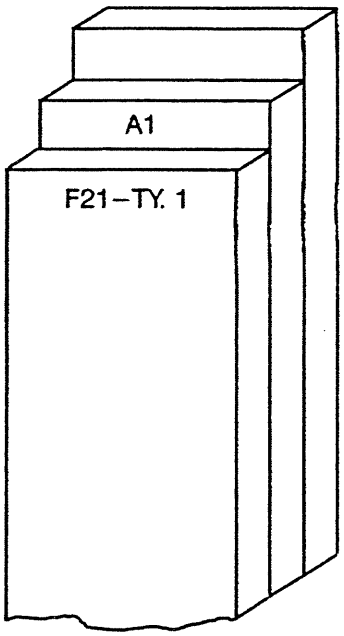
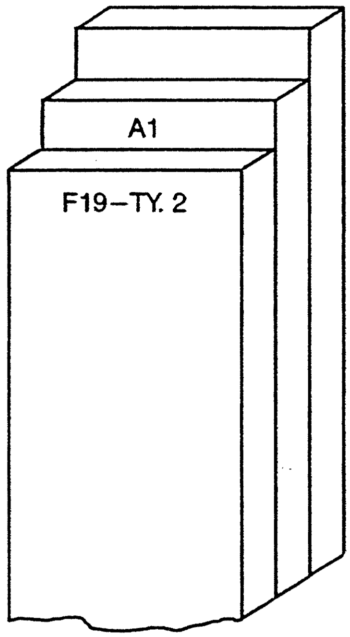


FIGURE 5 (SHEET 1) SURFACE TREATMENT CODES – NON–BONDED SKINS AND SHEET FORMED STRUCTURAL PARTS

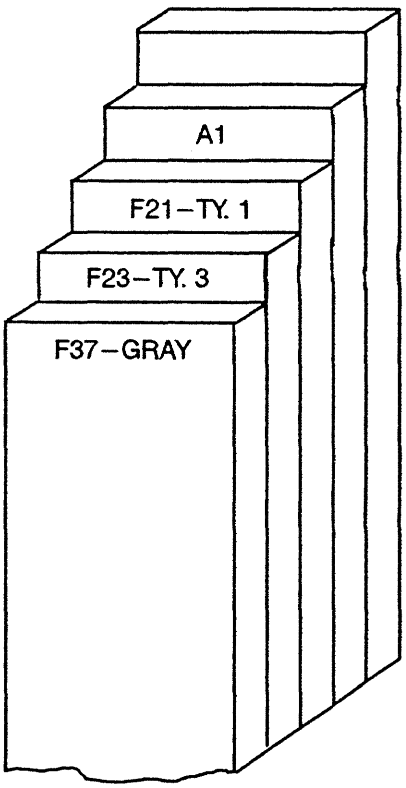


FUEL TANK AREA

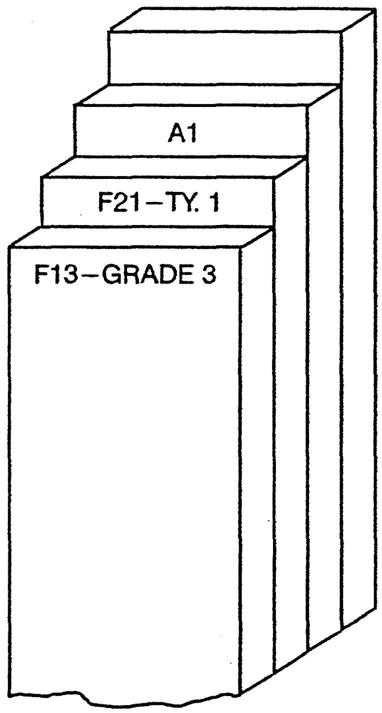


NON–FUEL TANK AREA

FIGURE 5 (SHEET 2) SURFACE TREATMENT CODES – NON–BONDED MACHINED PARTS AND EXTRUDED SHAPES



WING SPAR REAR



WING SPAR FRONT

FIGURE 5 (SHEET 3) SURFACE TREATMENT CODES – NON-BONDED MACHINED PARTS AND EXTRUDED SHAPES

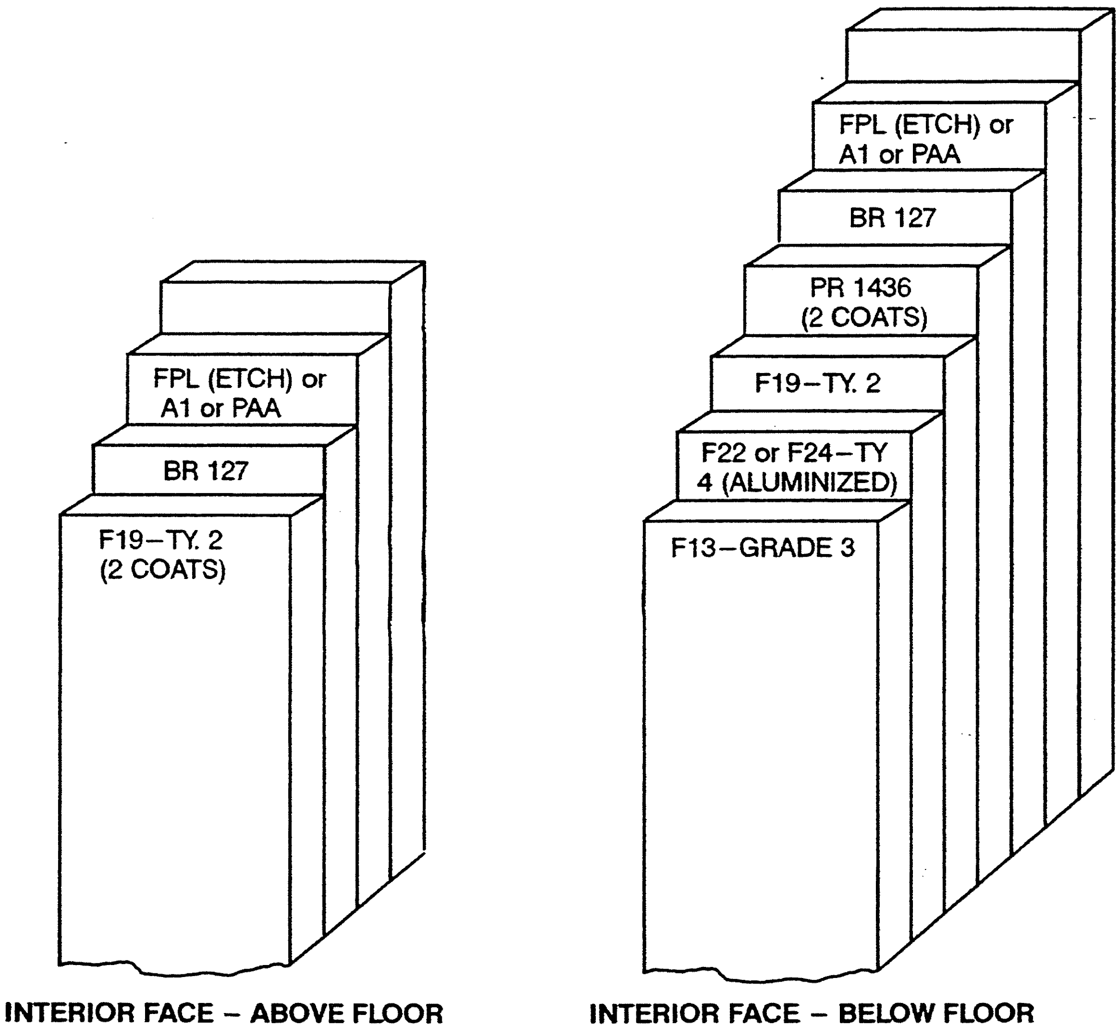
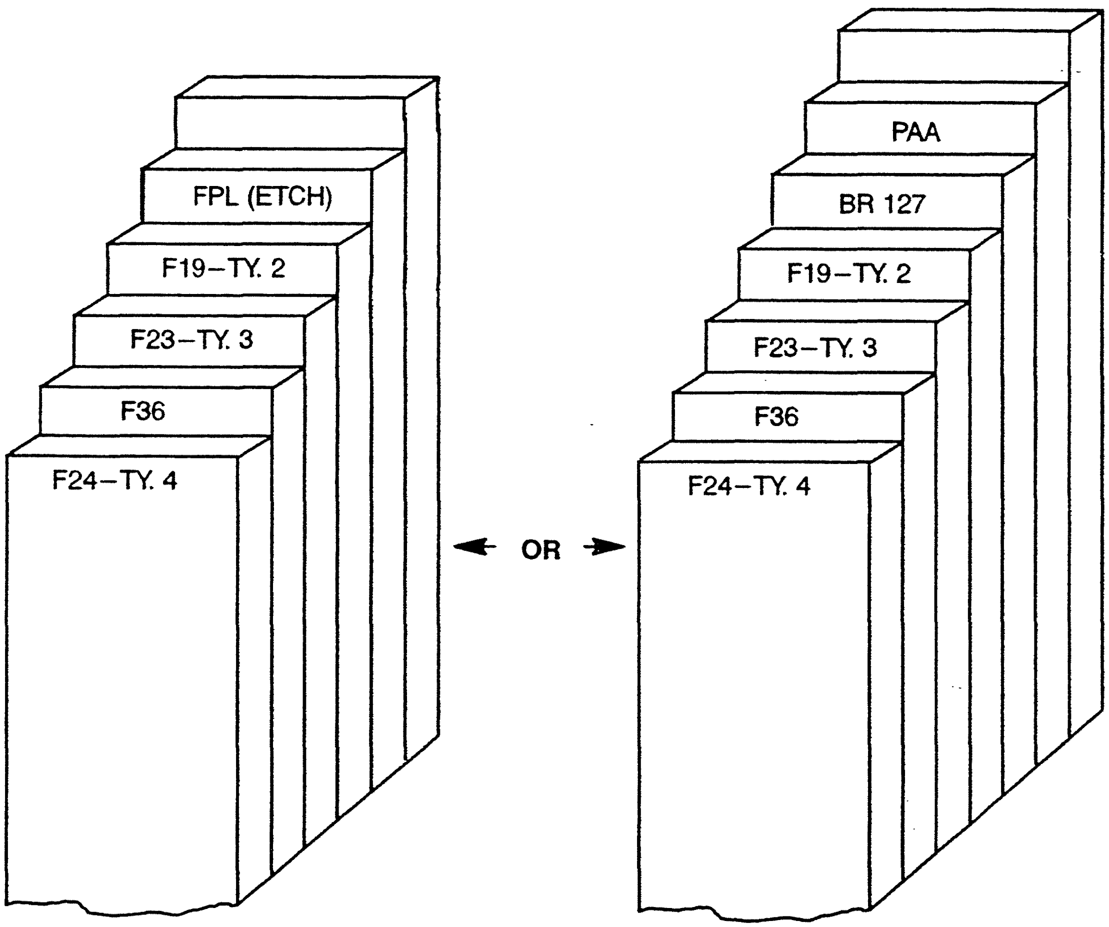


FIGURE 6 (SHEET 1) SURFACE TREATMENT CODES –
BONDED SKINS WAFFLE AND STRINGERS–FUSELAGE



EXTERIOR FACE – UNPAVED RUNWAY PROTECTION

FIGURE 6 (SHEET 2) SURFACE TREATMENT CODES – BONDED SKINS WAFFLE AND STRINGERS – FUSELAGE

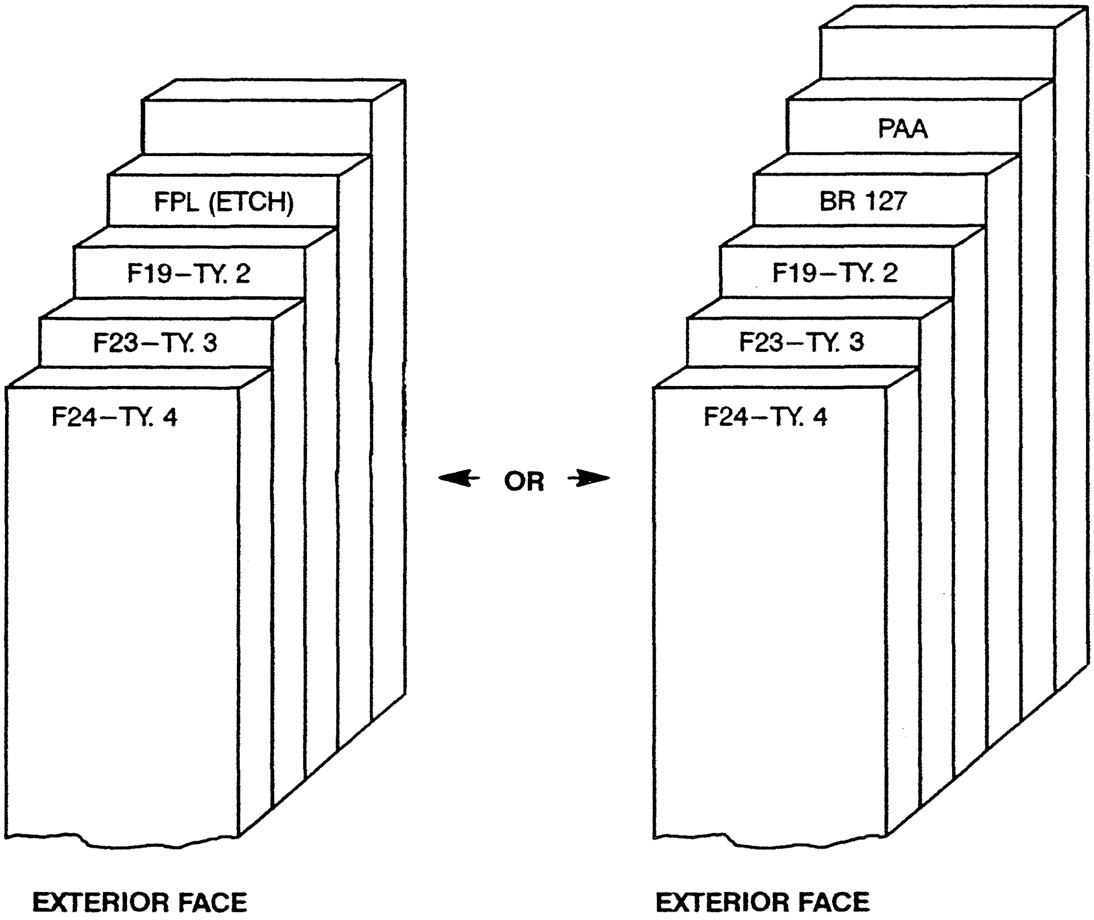


FIGURE 6 (SHEET 3) SURFACE TREATMENT CODES – BONDED SKINS WAFFLE AND STRINGERS – FUSELAGE

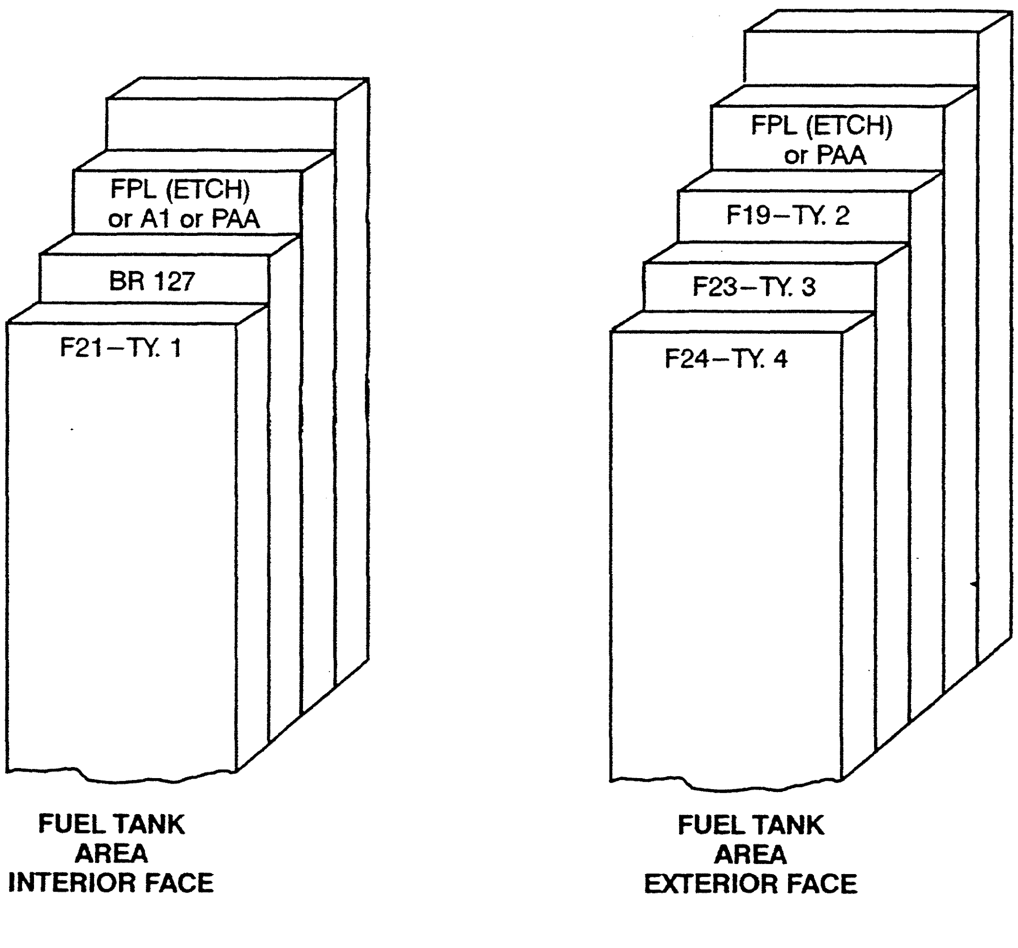


FIGURE 7 SURFACE TREATMENT CODES –
BONDED SKINS – WING

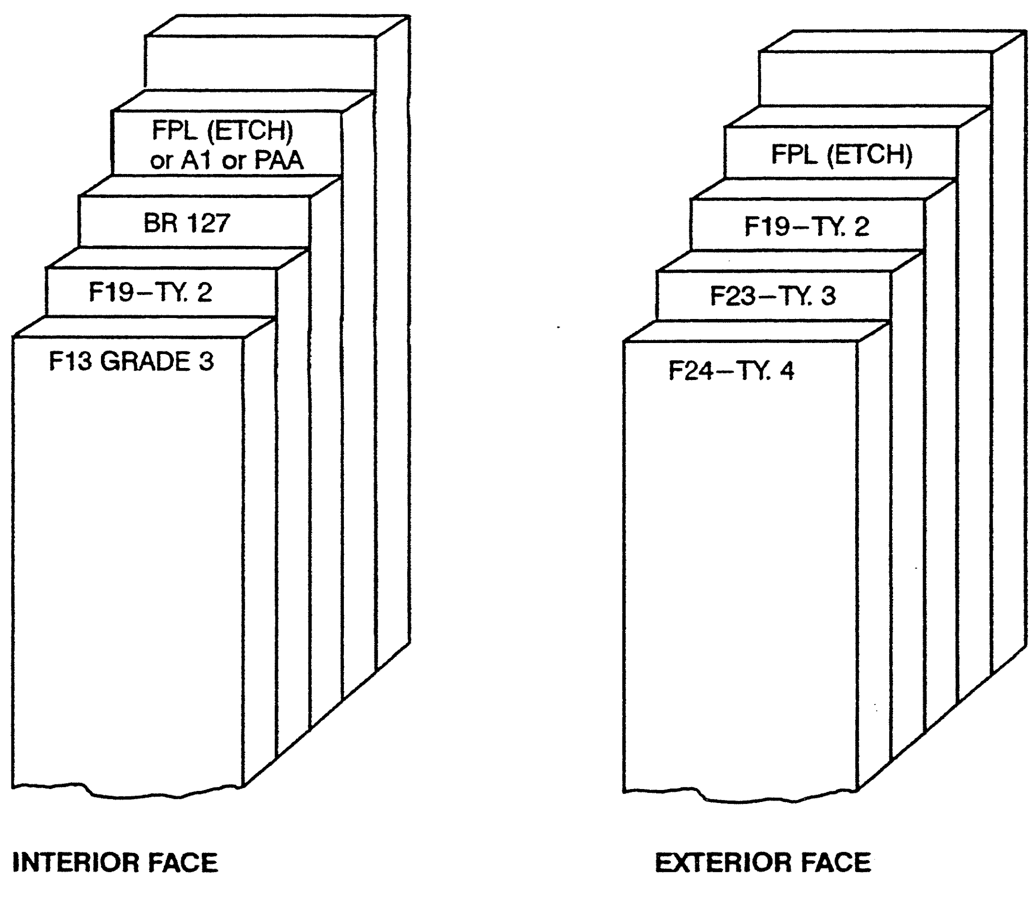


FIGURE 8 (SHEET 1) SURFACE TREATMENT CODES –
BONDED SKINS – VERTICAL AND HORIZONTAL STABILIZERS

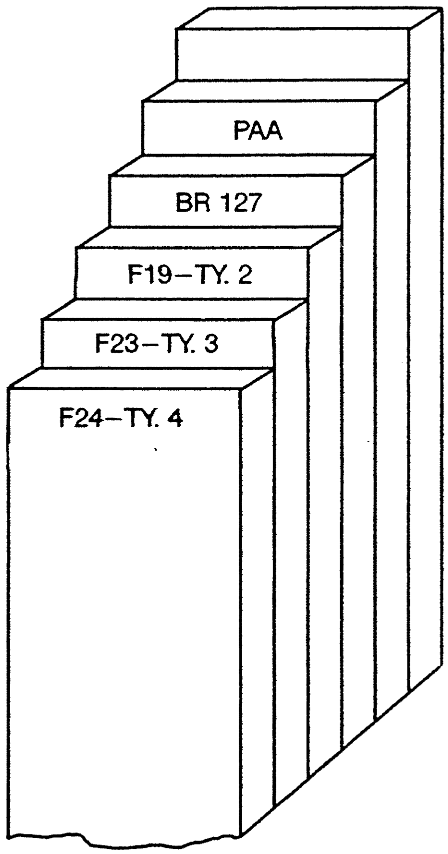


FIGURE 8 (SHEET 2) SURFACE TREATMENT CODES – BONDED SKINS – VERTICAL AND HORIZONTAL STABILIZERS

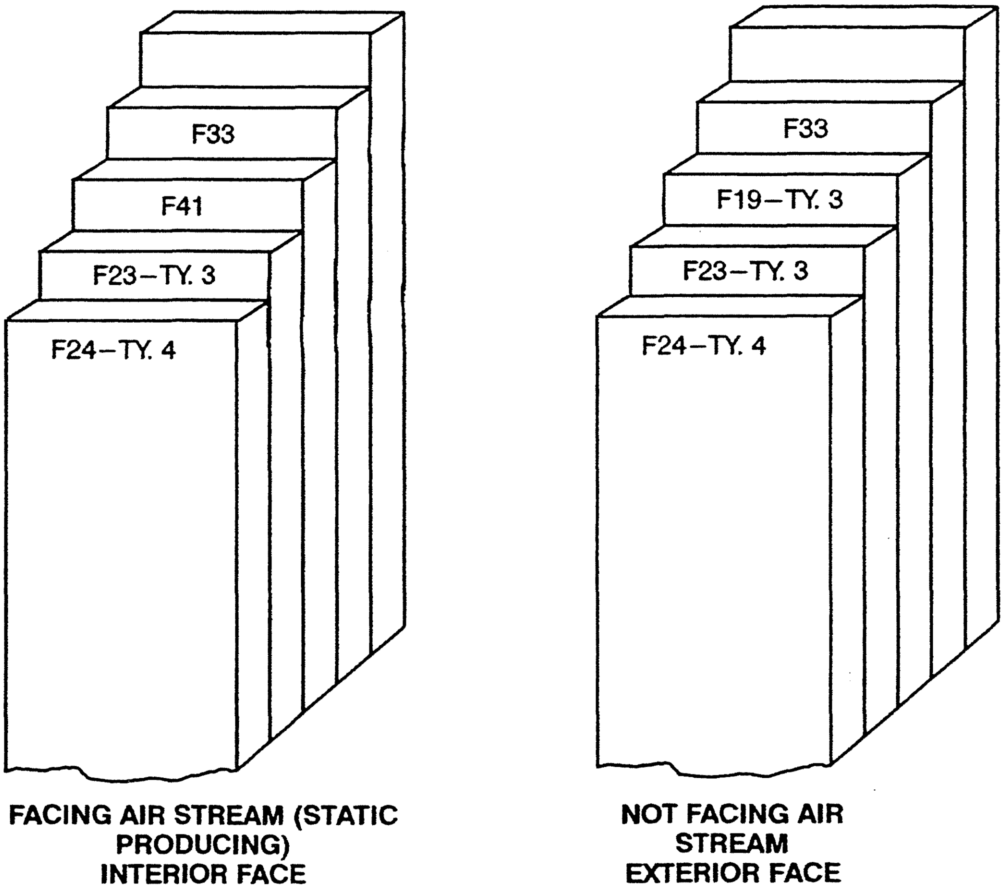


FIGURE 9 SURFACE TREATMENT CODES – COMPOSITE FAIRINGS

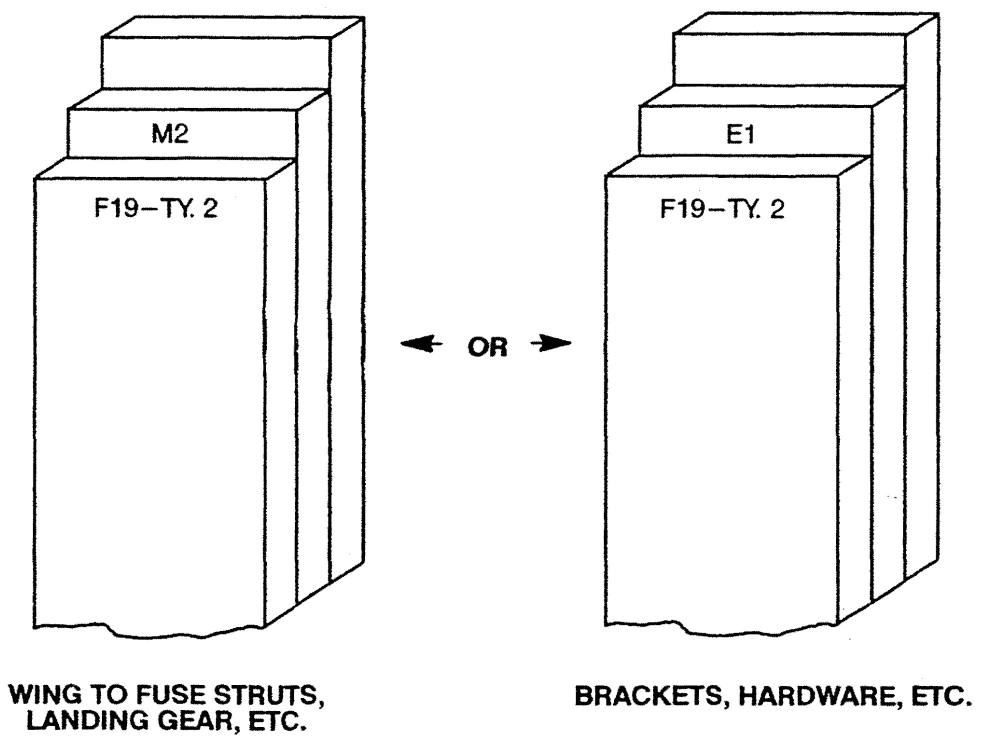


FIGURE 10 SURFACE TREATMENT CODES – LOW ALLOY STEELS – TYPICAL

TABLE 11
QUALIFIED MATERIALS AND SUPPLIERS

MATERIAL	SPECIFICATION	MANUFACTURER'S NAME & ADDRESS	IDENTIFICATION NUMBER
Enamel Polyurethane (F24)	DHMS C4.04 Type 4 = Aircraft Exteriors BMS 10-60 Type 2	De Soto Coatings Ltd. 895 Rangeview Road Mississauga, Ont. L5E 3E7 (416) 274-9500	800 Series Base 91C06 Catalyst 950 Series Base 91C25 Catalyst 02S16 Reducer
		Tempo Paint & Varnish Co. Div. of Tower Chemical Co. 205 Fenmar Drive Weston, Ont. M9L 2X4 (416) 746-2233	6600 Series Base and Catalyst
		Trebor Ind. Ltd. Tristar Coating Div. 18 Cadetta Road RR #9, Brampton, Ont. L6T 3Z8 (416) 794-1100	620H Starthane High Gloss Enamel 620H Base 620C Catalyst SB61 Reducer
Compound, Water Displacing Corrosion Inhibiting (F13)	DHMS C4.12 Type I = Colour Less Film Compound	Oxy Metal Ind. Corp. 32100 Stephenson Hwy Madison Heights, MI. 48071, USA (313) 583-9300	Boeshield T-9
		LPS Research Lab. Inc. 2050 Cotner Avenue Los Angeles, CA 90025 USA (213) 478-0095	LPS-3
		Dinol International AB Spangatan 3 Box 149, S-281 01 Hassleholm, Sweden	Dinitrol AV5B-2 Dinitrol AV8
	Type II = Coloured Film Compound	Oxy Metal Ind. Corp. 32100 Stephenson Hwy Madison Heights, MI. 48071, USA (313) 583-9300	Boeshield T-9
	BMS 3-26A Type IV	Dinol International Inc. 14021 E. Ten Mile Road PO Box 1065 Warren, MI 48090-1065 USA	Dinitrol AV25B NVC = 37.1 percent wt.

TABLE 11 (Cont'd)
QUALIFIED MATERIALS AND SUPPLIERS

MATERIAL	SPECIFICATION	MANUFACTURER'S NAME & ADDRESS	IDENTIFICATION NUMBER
Compound, Water Displacing Corrosion Inhibiting (F13) (Cont'd)		Dinol International Inc.	Dinitrol AV25B–2 1/ NVC = 37.1 percent wt. Dinitrol AV30
		Holt Loyd Corp. 4647 Hugh Howell Road Box 3050 Tucker, GA 30084 USA	LPS Formula B997 NVC = 36.3 percent wt.
		Ardrox Inc. 16961 Knott Ave. LaMirada, CA 90638 USA	Ardrox 3321 NVC = 36.0 percent wt.
Intermediate Primer (F23)	DHMS C4.18, TY.3	Tempo Paint & Varnish Co.	4500–PB–60X Base 4500–C–60X Catalyst
		Trebor Ind. Ltd.	425IP0501 Base
		Tristar Coating Div.	420C0078 Catalyst SB43 Thinner
	BMS 10–79J Grade A, Class A Type II	Desoto Inc. Fourth & Cedar Berkeley, CA 94710 USA	513x329 Primer Base 910x456 Curing Solution 010–011 Thinner
	Type III		515x336 Primer Base 910x458 Curing Solution 010–011 Thinner
	Grade A, Class A Regulation II Type II		513x384 Primer Base 910x456 Curing Solution
	Type III		515x349 Primer Base 910x533 Curing Solution
Anti–Static Polyurethane Coating (F31)	DHMS C4.13 Type I	Tempo Paint & Varnish Co. Div. of Tower Chemical Co. 205 Fenmar Drive Weston, Ont. M9L 2X4 (416) 746–2233	2800–B–1 Base 2800–C–1 Catalyst

TABLE 11 (Cont'd)

QUALIFIED MATERIALS AND SUPPLIERS

MATERIAL	SPECIFICATION	MANUFACTURER'S NAME & ADDRESS	IDENTIFICATION NUMBER
Integral Fuel Tanks, Temp. Resistant, Sealing Compound	DHMS S3.13 Class A	PRC Chemical Corp. of Canada Ltd. 266 Humberline Drive Rexdale, Ont. M9W 5X1 Canada	PR1422–A1/2 PR1422–A2 PR1436
Epoxy Primer, Fluid Resistant (F19)	DHMS C4.01 Type II	Tempo Paint & Varnish Co. Div. of Tower Chemical Co. 205 Fenmar Drive Weston, Ont. M9L 2X4 (416) 746–2233	4500–PB–23A Primer Base 4500–C–23A Catalyst 4500–S–23X Thinner
		Trebor Ind. Ltd. Tristar Coating Div. 18 Cadetta Road RR #9, Brampton, Ont. L6T 3Z8 (416) 794–1100	42 Series Primer 42–425P Green 426P Primer Base 420C Catalyst S42 Thinners
Epoxy–Polyamide, Enamel (F22)	DHMS C4.11	Tempo Paint & Varnish Co. Div. of Tower Chemical Co. 205 Fenmar Drive Weston, Ont. M9L 2X4 (416) 746–2233	Durathane 1900
Integral Fuel Tank Primer (F21)	DHMS C4.06 Type I Polyurethane	PRC Chemical Corp. of Canada Ltd. 266 Humberline Drive Rexdale, Ont. M9W 5X1 Canada	PR1563
		Desoto Coatings 120 – 4th Street Toronto, Ont. (416) 259–9671	Base 823–707 Catalyst 910–702 Reducer 020–707
Enamel Polyurethane High Resistance to Skydrol (F37)	DHMS C4.04 Type II	Tempo Paint & Varnish Co. Div. of Tower Chemical Co. 205 Fenmar Drive Weston, Ont. M9L 2X4 (416) 746–2233	4600 Series Base and Catalyst 4700 Series Base and Catalyst

TABLE 11 (Cont'd)
QUALIFIED MATERIALS AND SUPPLIERS

MATERIAL	SPECIFICATION	MANUFACTURER'S NAME & ADDRESS	IDENTIFICATION NUMBER
Primer, Intermediate (F23)	DHMS C4.18 Type III	Tempo Paint & Varnish Co. Div. of Tower Chemical Co. 205 Fenmar Drive Weston, Ont. M9L 2X4 (416) 746–2233	4500–PB–60X Base & Catalyst
		DeSoto Inc. 1606 Fourth St. Berkeley, CA 94710 (415) 526–1530	515x336 Primer Base 515x458 Curing Solution 010–011 Thinner 515x349 Primer Base 910x533 Curing Solution
Adhesive Primer	DHMS A6.03	American Cyanamid, Bloomingdale Products, Havre de Grace, Maryland 21078.	BR127
Aircraft Paint Remover (Stripper)	DHMS S5.03	Turco Products, Distributed by Deane & Co., 259 Norseman St. Toronto, Ont. M8Z 2R5	Turco 5469
		Cee–Bee Chemical Chemtron Corp. 9520E Ceebee Drive Downey, CA 90241 Distributed by: McGean Rohco 907 Oxford Street Toronto, Ont. M8Z 5T1	Cee–Bee R256A
		Ardrox Limited PO. Box 814 19 Woodburn Ave. St. Catharines, Ont. L2R 6Y3	Ardrox 2526
		Dubois Chemicals of Canada Limited 64 Kenhar Drive Weston, Ont. M9L 1N3	TPT–13
Surface Finish Compound (F33)	DSC 206	Adtech 815 West Sheppard Charlotte, Michigan 48813 (517) 543–7510	Adtech–Ultra Filler 15–3*

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CHAPTER 6
STANDARD PREVENTIVE MAINTENANCE METHODS

PART 1

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CORROSION PREVENTION AND CONTROL

PART 1

1. **General Preventive Procedures**

   A. The information contained in this subject is intended to supplement the specific preventive maintenance recommended in PART 2 of this manual.

2. **Aircraft Washing**

   A. Washing is a means of enhancing the appearance of the aircraft and minimizing corrosion. Procedures for aircraft washing are contained in Chapter 12 of the Maintenance Manual.

   B. Washing removes any corrosive deposits that have accumulated on the aircraft. Dirt retains moisture which in turn promotes corrosion. Furthermore, other factors must be taken into consideration in establishing a washing program:

      (1) Washing, and in particular the use of high pressure water or steam, can lead to the entry of moisture into areas not normally contaminated.

      (2) The detergents used for washing can promote corrosion if they are not thoroughly rinsed off. Rinsing can be a problem if high pressure hoses have forced the washing solution into small cavities and crevices.

      (3) Any effective washing solution which removes unwanted grease and oil will also remove the grease and oil required for lubrication. Re–lubrication is required after aircraft washing.

      (4) Frequent washing will eventually remove any corrosion inhibiting compounds, such as DHMS C4.12. Re–application times will be affected by the frequency of washing and detergent strength.

   C. Washing frequency must be determined by the operator on an individual basis, depending on the operating environment and external appearance of the aircraft. As a guide the following frequencies are suggested:

   Mild Zones – every 90 days

   Moderate Zones – every 45 days

   Severe Zones – every 15 days

3. Protective Finishes

A. Maintenance of surface finish is important if corrosion problems are to be avoided. Damage to paint or similar surface coatings should be repaired at the earliest convenient opportunity. Until such times as the finish can be restored, consideration should be given to using corrosion inhibitor to minimize the risk of corrosion.

B. Where damage to the finish is not confined to the paint, the metal should be protected by one of the treatment processes described in Chapter 5 before the paint is re–applied. Unpainted surfaces should be similarly treated where necessary.

C. Finish systems are shown diagrammatically at the end of Chapter 5. Refer to Chapter 20 of the Maintenance Manual and Chapter 51 of the Structural Repair Manual for specific details of the application and removal of finishes.

4. Water Displacing Corrosion Inhibiting Compound (F13)

A. General

Corrosion inhibitors are used to supplement finish systems and to prevent or retard corrosion where the finish system has been damaged. These materials are volatile liquids which may be sprayed or brushed on the surfaces to be treated. The liquid carrier evaporates quickly to leave a thin film of wax–like residue over the coated surface. This material has the ability to penetrate into extremely small cavities and to displace water. Consequently, the corrosion inhibitor is able to enter between faying surfaces or between fasteners and holes, where the finish has been broken. It is a durable material, not easily removed by normal use, and where used externally will withstand a certain amount of washing, although eventually re–application will be required.

NOTE: **Each operator should evaluate their aircraft's environment, the inhibitor used, and the application schedule to ensure adequate corrosion protection. Although Boeing de Havilland has developed DHMS C4.12 and BMS 3–23 as a standard for organic corrosion inhibitors and recommends its use, other water displacing corrosion inhibiting compounds may be satisfactorily based on operator's evaluation and experience.**

After assembly, water displacing corrosion inhibiting compounds, because of various reasons such as time and environmental effects, tend to dry out and deteriorate in their corrosion inhibiting properties. In order to maintain corrosion resistance of the structure, re–treatment with the water displacing corrosion inhibiting compound is necessary.

B. Material Selection

Material selection philosophy is based on appearance criterion as follows:

– Colorless/clear film is used in areas which are used by maintenance personnel such as fuselage.

– Colored film is used in areas not accessible to maintenance personnel such as Horizontal and Vertical Stabilizer, Elevators and Rudder.

For re–treatment purposes, the above rule may be waived.

Corrosion inhibiting compounds that are approved for use in re–treatment schedule, as well as the classification into F13 Grade 3 and Grade 4, are listed in Table 1.

TABLE 1

APPROVED CORROSION INHIBITING COMPOUNDS

APPROVED CORROSION INHIBITING COMPOUNDS										
MATERIALS SPECIFICATION	QUALIFIED PRODUCTS									
	BOESHIELD T–9HF, T–9, TYPE I	BOESHIELD T–9, TYPE II	BOESHIELD T–9HF, TYPE II	LPS–3	DINITROL AV5	DINITROL AV5B–2, DINITROL AV–8	DINITROL AV25B	DINITROL AV25B–2, DINITROL AV–30	LPS, FORMULA B997	ARDOX 3321
F13 GRADE 3										
DHMS C4.12 TYPE I	X			X	X	X				
DHMS C4.12 TYPE II		X	X							
BMS 3–23 TYPE I	X									
BMS 3–23 TYPE II		X	X	X		X				
F13 GRADE 4										
BMS 3–26 TYPE I							X	X	X	X

C. Precautions for Use of Compounds

WARNING: CORROSION INHIBITING COMPOUNDS ARE APPROXIMATELY EQUAL TO KEROSENE OR ALIPHATIC NAPHTHA IN TOXICITY. TO PROTECT SKIN, USE SAME PRECAUTIONS AS FOR KEROSENE. WHEN APPLYING THESE COMPOUNDS BY SPRAY 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 PERSON 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 CONFINED AREAS, MECHANICAL VENTILATION IS MANDATORY. RESPORATORY AND SKIN PROTECTION MUST BE USED.

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

(1) Hydrocarbon 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, MATERIAL SHOULD BE KEPT AWAY FROM SURFACES THAT WILL GET HOTTER THAN 300°F IN SERVICE. THE DRY FILM FLASH POINT IS 500°F.

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.

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

(3) Mask electrical connectors where there is a possibility of contamination of electrical contacts.

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.

(4) The use of corrosion inhibiting compounds on control cables is not considered a suitable substitute for the cleaning and corrosion protective procedures in the aircraft maintenance manual. Laboratory tests show that the endurance life of carbon steel cable is reduced by the direct application of these compounds, overspray as you apply these compounds to adjacent structure should not have a significant bad effect on cable life. 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 HYDRAULIC FLUID RESISTANT SEALS TO SWELL.

(5) 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.

(6) 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.

(7) Do not apply corrosion inhibiting compounds on insulation blankets. The compounds reduce the water–repellent quality of the blankets.

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

(9) 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.

D. Compatibility of Compounds

(1) As these materials are all usually hydrocarbons, new applications of a different compound may be applied over existing corrosion inhibitors without adverse effects.

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

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

5. Application of Compounds

A. All areas to be re–coated shall be cleaned as follows:

– Remove dust and other loose particles by vacuuming.

– Dirt not removed by vacuuming and all oily and wet deposits must be removed with solvent cleaning or water/detergent washing.

– Examine the area to be re–coated for corrosion and primer, enamel damaged areas.

– Corrosion and damaged protective treatment areas to be reworked per appropriate Maintenance Manual or Corrosion Manual Section.

– The method used shall depend on the contamination type, extent and location in the aircraft with respect to drainage holes and extent of enclosed space.

B. Method of Application

The compound may be applied by any suitable method, such as airless spraying, brushing, etc. Normal precautions for flammable liquids, as required during spray applications of primer and paint, should be observed. See para. 4.C. for specific precautions.

C. Coating Thickness

The compound should be applied to a very thin coat of approximately 0.0002 inches. When the surface appears wet, the coating is considered as being sufficiently thick. Runs should be wiped up with an absorbent clean cloth.

D. Drying Time (Evaporation of Volatile Solvents)

The evaporation of volatile solvents takes approximately 6–8 hours at an ambient temperature of 70° F. Higher temperatures and forced ventilation will decrease volatile evaporation time.

6. **Application Restrictions**

In order to achieve the best coverage of the specified structure with the hindrance of installed services, the following items shall be shielded or masked from direct application of the compound:

- limit switches
- limit switch operating mechanisms
- dump valves
- open electrical connectors
- electrical or electronic equipment
- relay bases
- windows
- oxygen pipes and fittings
- all non–oxygen system piping open ends and loose fittings

When spraying is used as a method of application, direct spray on the following items is to be avoided.

- bearings
- pulleys
- rubber items
- system components
- ducts
- non–oxygen systems piping

7. Removal of Compounds

A. Complete removal of corrosion inhibiting compounds is required before re–painting 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

(6) Stoddart Solvent

NOTE: Methyl Ethyl Ketone (MEK) or Acetone are not recommended.

B. When using solvents for the removal of water displacing corrosion inhibiting compounds, ventilate the area in the same manner as described for corrosion inhibitor application.

8. Re–Treatment Schedule

The aircraft operating environment can vary from rural temperature climate to tropical rain forest to industrially polluted tropical marine climates. Therefore, it is difficult to establish re–treatment schedule that would satisfy all exposure combinations.

The re–treatment times presented in Figure 1, 2 or 3 are intended only as a rough guide, and each operator shall be responsible for establishing a re–treatment schedule that is suitable for their flying environment. For example, some operators may find from experience, that a more relaxed re–treatment schedule from the one shown in Figure 1, 2 or 3 is satisfactory, while other operators may find that a more frequent re–treatment schedule is necessary.

9. Areas to be Treated (Figure 1, 2 or 3)

A. Fuselage

The compound shall be applied on primed and painted fuselage interior skin areas below the floor line, and the floor support structure from the front pressure bulkhead to the rear pressure bulkhead. The compound shall be applied to both sides of the front and rear pressure bulkheads and extending six (6) inches (minimum) fore and aft of the pressure bulkhead on the fuselage skin. For unpressurized aircraft the front fuselage bulkhead and rear baggage compartment bulkhead do not require the same consideration as with pressurized aircraft. However, application of the compound to both sides is not discouraged.

For aircraft with bladder fuel tanks, all accessible areas beneath bladder shall be treated.

B. Horizontal Stabilizer, Elevators, Vertical Stabilizer and Rudder

The compound shall be applied to all accessible interior surfaces of the above assemblies. The best coverage is achieved when the compound is applied with suitable spray equipment (spray lance with a 360° spray head) through access and lightening hole in the part.

C. Airstair, Baggage and Emergency Exit Doors

The compound shall be applied to inside face of the skin and all interior structure and operating mechanism.

D. Wing

The compound shall be applied to:

(1) All interior surfaces of wing dry bay compartments, including wing tip dry bays and centre wing dry bay.

(2) Front spar, front face from wing tip to wing tip.

NOTE: **Any runs or puddling of the compound shall be wiped up with an absorbent clean cloth.**

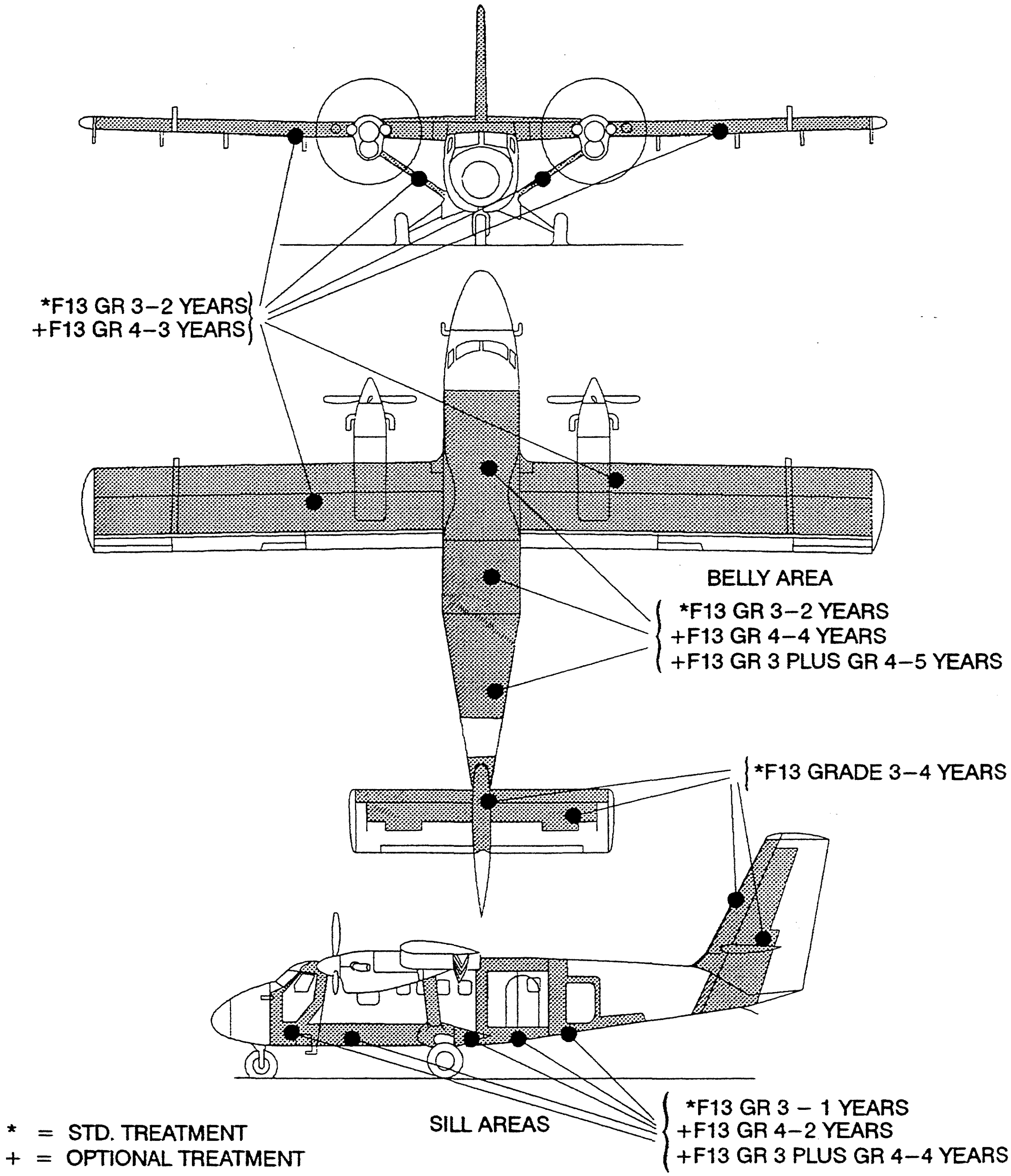
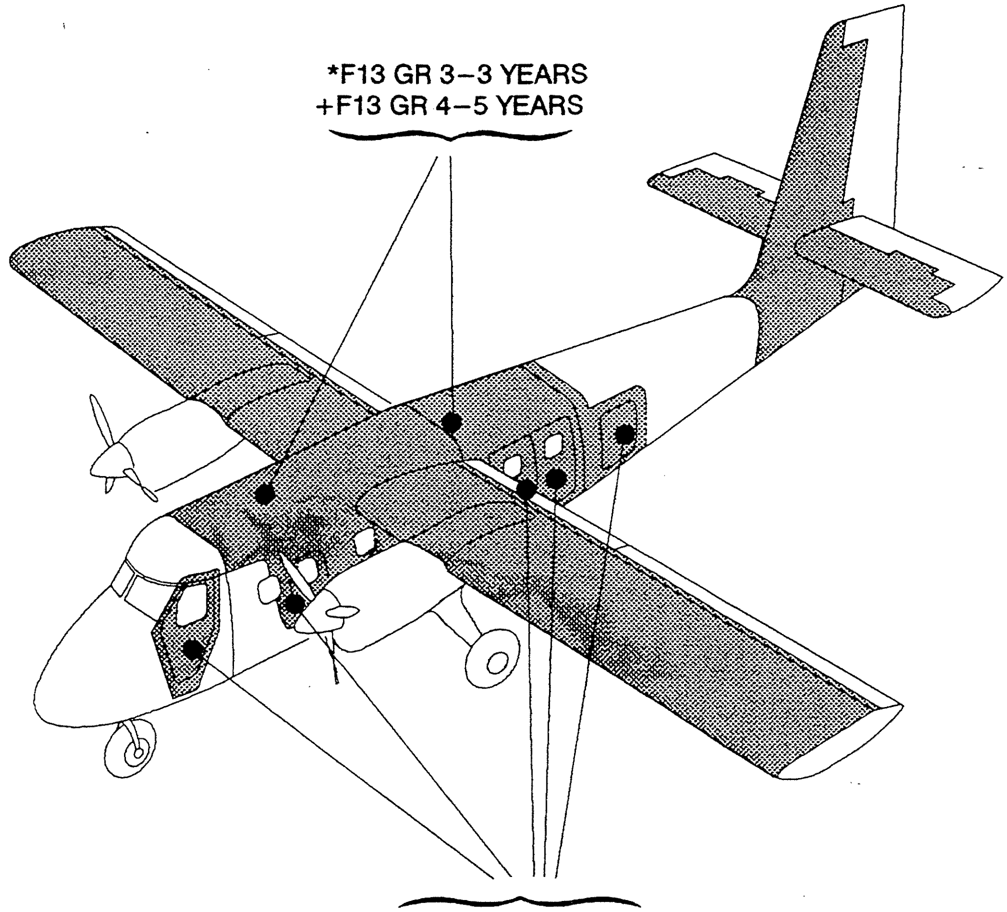


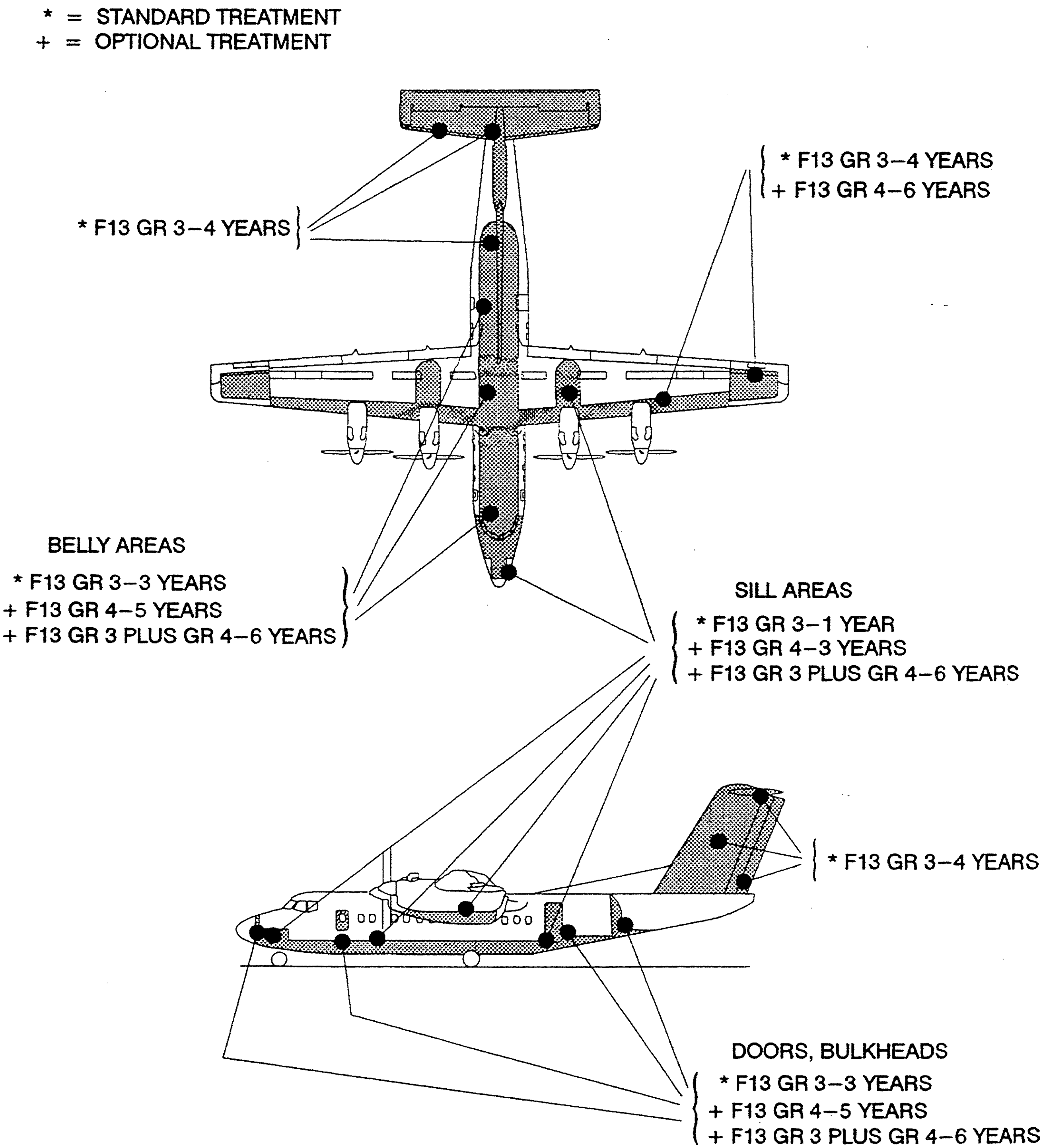
FIGURE 1 (SHEET 1)

RE–TREATMENT SCHEDULE FOR DHC–6 TWIN OTTER



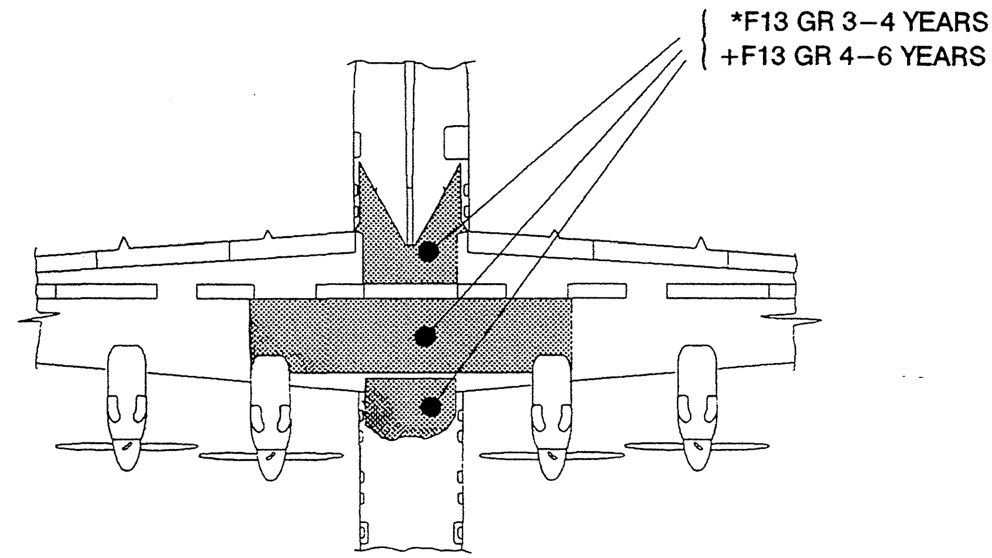
RE–TREATMENT SCHEDULE FOR DHC–6 TWIN OTTER

FIGURE 1 (SHEET 2)

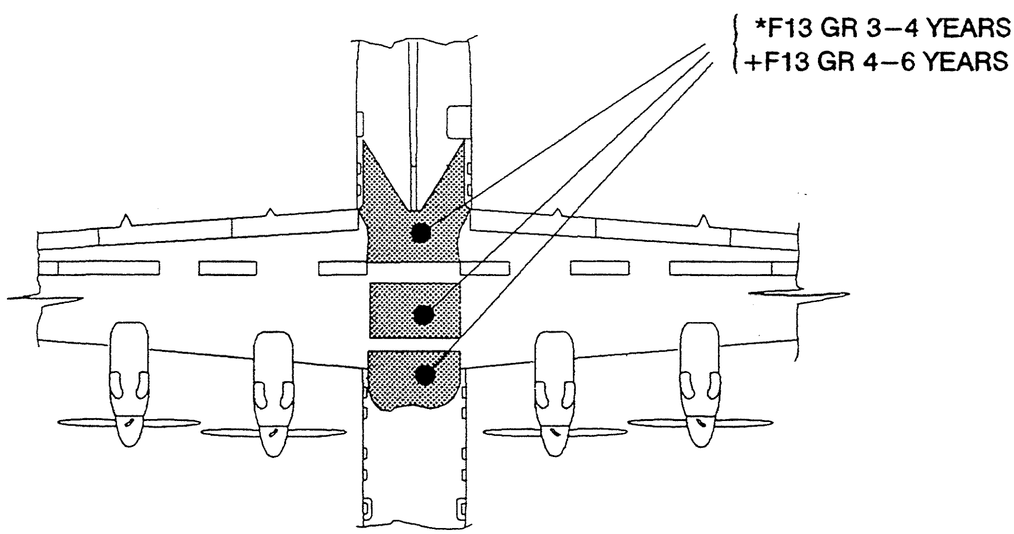


RE–TREATMENT SCHEDULE FOR DASH 7

FIGURE 2 (SHEET 1)



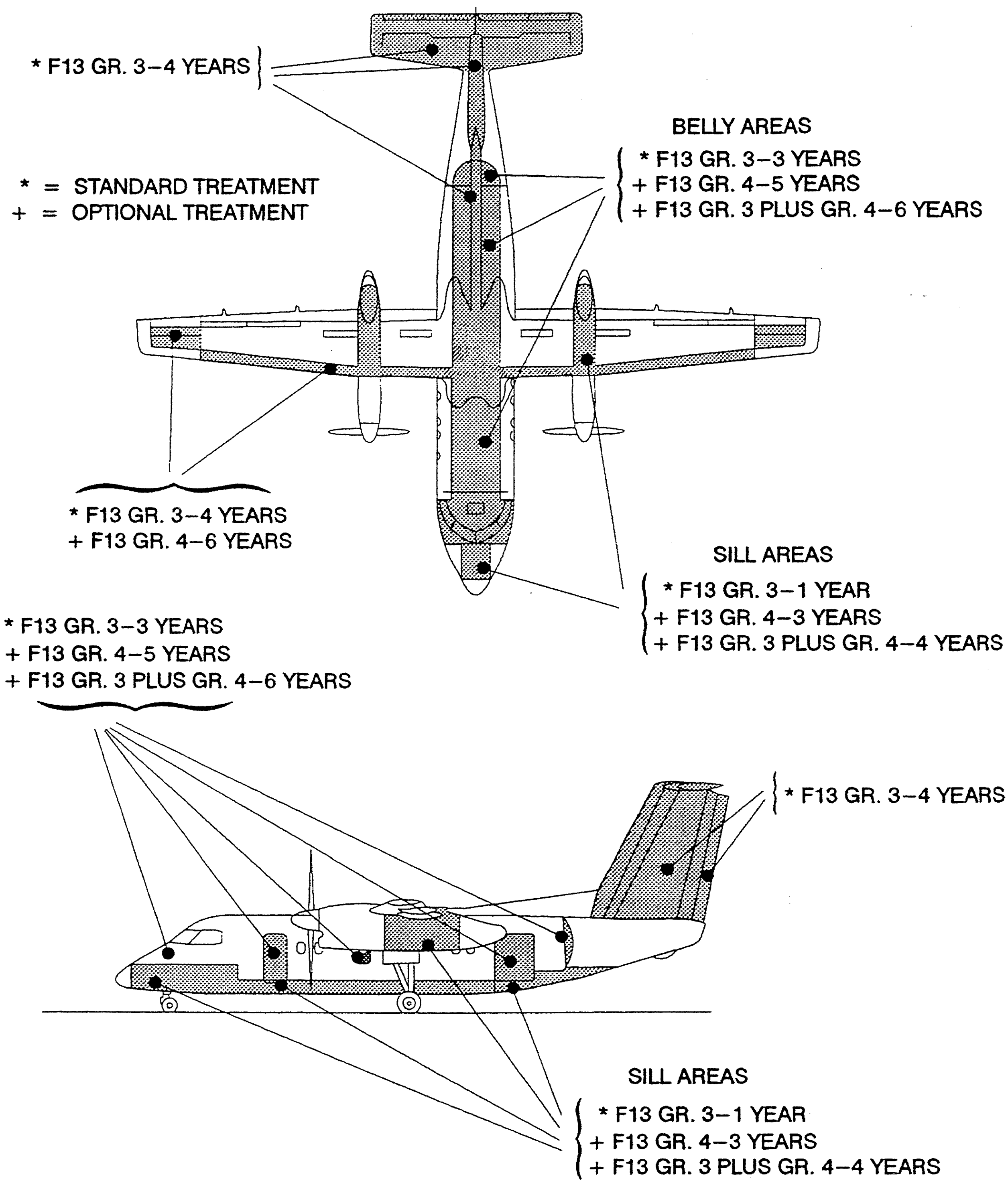
DASH 7 WITH STANDARD RANGE FUEL TANKS



DASH 7 WITH LONG RANGE FUEL TANKS

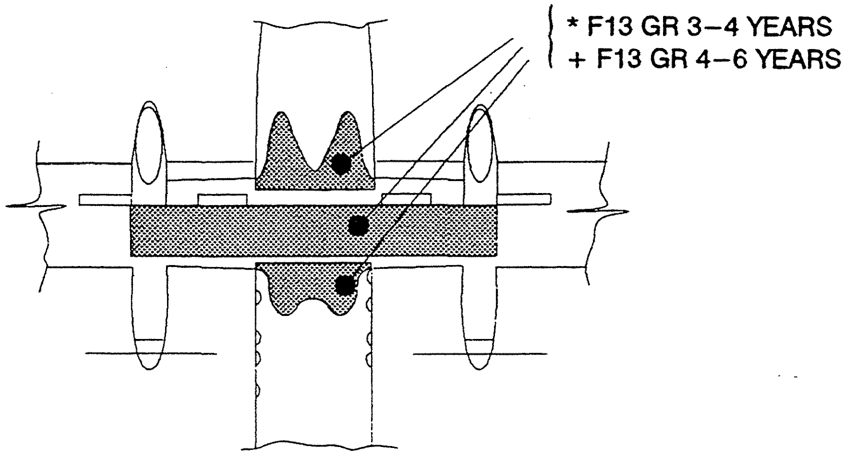
RE−TREATMENT SCHEDULE FOR DASH 7

FIGURE 2 (SHEET 2)

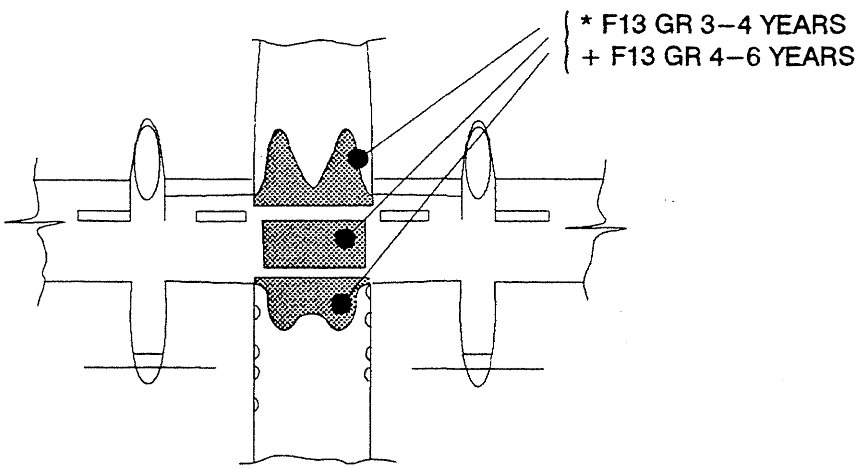


RE-TREATMENT SCHEDULE FOR DASH 8, 100 & 300

FIGURE 3 (SHEET 1)



DASH 8 WITH STD. RANGE FUEL TANKS



DASH 8 WITH LONG RANGE FUEL TANKS

RE–TREATMENT SCHEDULE FOR DASH 8, 100 & 300

FIGURE 3 (SHEET 2)

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PART 1

CHAPTER 7
TRANSPORTATION OF LIVE ANIMALS

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

1. General

A. Corrosion problems arising from the transportation of live animals are 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 aircraft does not become contaminated. The second problem source is the increase in humidity inside the aircraft.

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 aircraft.

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 aircraft is on the ground.

4. Preventive Maintenance

A. The use of aircraft for bulk shipment of live animals necessitates periodic cleaning and deodorizing of the aircraft. 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 AIRCRAFT STRUCTURES. SODIUM HYDROXIDE SOLUTION, SODIUM CARBONATE SOLUTION (PLAIN OR WITH 0.1 PERCENT SODIUM SILICATE) AND CHLORINATED LIME SOLUTION WILL CORRODE ALUMINUM. CRESYLIC AND LIQUIFIED PHENOL SOLUTIONS WILL SEVERELY ATTACK ORGANIC FINISHES, SEALANTS AND PLASTICS, INCLUDING THE ACRYLIC WINDOWS OF THE AIRCRAFT INTERIOR.

C. After the aircraft 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 Chapter 6 para. 3.

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

PART 1

CHAPTER 8
TRANSPORTATION OF FISH

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

1. General

A. The information contained herein pertains to 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. De Havilland Aircraft do not have a hose–out option in the cargo compartment, consequently the liberal use of water to wash fish slime and other residues is forbidden. Washing of contaminated areas can be better accomplished with mops and sponges which can absorb and contain water, rather than spread the contaminants through the cargo compartment. Extreme care shall be exercised in the stacking and fastening of containers to avoid spills from containers tipping over.

3. Shipping Standards

A. Air carriers servicing a common area should establish fish packaging standards so that the shipping customer will be alerted to 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 bleed–water mixture, watertight shipping containers must be utilized by air carriers and shippers.

(1) Wax impregnated cardboard boxes

(a) A two piece full telescoping wax impregnated cardboard box is currently used with some degree of success. Reinforced gussets are used at the bottom and top.

(b) The size of the box should be limited for maximum of 80 to 100 pounds of fish.

(c) A 4–mil polyvinyl or similar plastic liner of a sack type should be used which will allow the fish to be wrapped a minimum of 3 times.

(d) If dry ice is used to keep the fish cool 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 by some shippers for high volume shipment, Fig. 1 Detail I.

(b) The tub is designed for about 500 pound (8 bushels) capacity and has nesting characteristics for storing.

(c) A cover with seals is provided. The cover is indented to allow stacking. Cover tiedown provisions are also available by drilling appropriate holes in the cover.

(d) Although this container is ideally suited for fish shipment, there is a drawback in that it must be deadheaded at a tariff for reuse.

(3) Aluminum totes

(a) Several shippers have designed and fabricated their own aluminum containers with covers. In some cases these containers are made with legs made from extruded aluminum for stacking and handling with forklifts or pallet jacks, Fig. 1 Detail II.

(b) The covers are provided with seals and can be strapped to minimize leakage.

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.

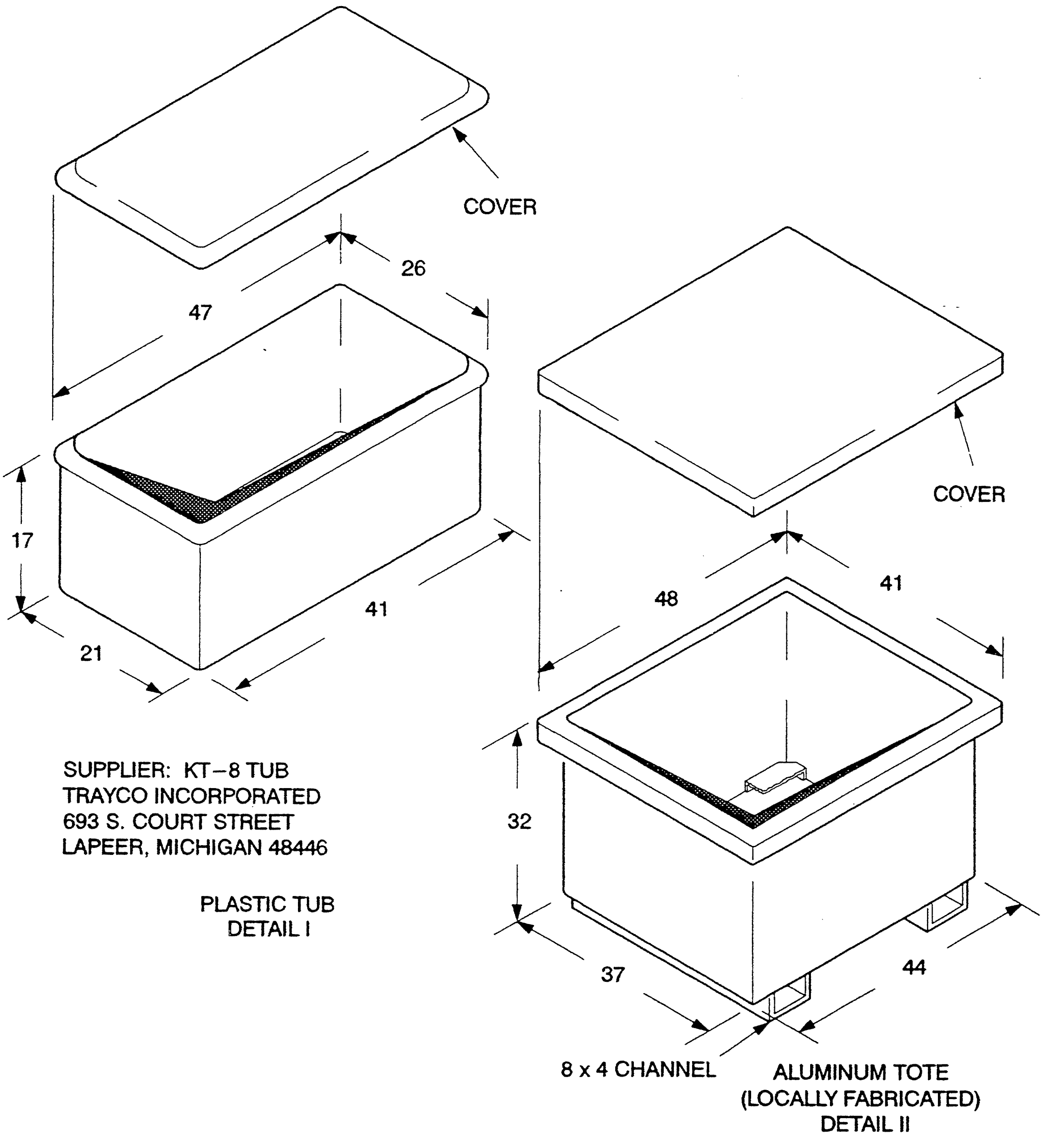
C. When known spills have occurred, local clean—up procedures include wiping up spills with swabs. The affected area should be scrubbed with soap and water and wiped dry with swabs. Use scrub water sparingly to avoid spreading the spilled fluids or soaking through the floors. After cleaning, remove floor boards and check under floor area for water entrappment; mop up water found and treat area as per para. C. Replace floorboards.

D. Carpets soaked with spills should be removed for cleaning.

E. Clean spills on seat tracks per para. C.

F. Dry all insulation blankets before reinstallation.

G. After the aircraft 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 Chapter 6 para. 3 thru 8.



TYPICAL CONTAINERS FOR FISH

FIGURE 1

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PART 1

CHAPTER 9
MICROBIAL GROWTH IN INTEGRAL FUEL TANKS

PART 1

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CORROSION PREVENTION AND CONTROL
PART 1

1. General

A. Corrosion of integral fuel tanks has been encountered due to microbial growth caused by micro–organisms contained in the fuel. Aircraft 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 sumping 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 aircraft operate in these regions.

2. Detection of Microbial Contamination

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

B. Fuel supplies can be checked for the presence of micro–organisms by the use of Microb–Monitor Test Kit available from the Boron Oil Company, Midland Building, Cleveland, Ohio 44115. This kit contains two bottles to which a fuel sample is added 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 indicates by color change within 48 hours when the fuel sample is contaminated. The kit is good for one testing only. Any additional testing will require new kits.

C. Upon discovery of any microbial contamination during a check of the fuel–water interface following tank sumping, it is recommended that tank entry be made as soon as possible after draining and purging. Long delays in removing microbial growth exposes 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.

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 within 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 DHMS C4.06 (F21).

E. Corrosion removal and restoration of damaged finish is required after removal of microbial deposits (refer to Chapter 5).

4. Removal of Corrosion

A. Corrosion should be removed by one of the methods described in Chapter 4. Refer to the Structural Repair Manual for damage limitations after clean–up.

B. Restore damaged finish after corrosion removal in accordance with Chapter 5.

5. Biocide Treatment

A. The introduction of a biocide into the fuel storage tanks, to the tanker supplying the aircraft or directly into the aircraft tanks will reduce the incidence of microbial growth. The recommended biocide is Biobor JF supplied by the United States Borax and Chemical Corporation, 3075 Wilshire Blvd., Los Angeles, California 91010.

B. The quantity of Biobor JF approved by engine manufacturers to treat aviation fuel is 270 ppm (parts per million) for intermittent applications. The concentration can be used for initial treatment. Follow–up treatment of 135 ppm to 150 ppm with application time periods made in conjunction with service checks that will allow the biocide to remain in the tanks for the period of time noted in para. F are recommended. Intermittent applications should be made. Incremental increases up to the maximum of 270 ppm 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 will achieve a 270 ppm concentration and half the amount is required 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 of 15°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 conduct the initial 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 aircraft tank indicates 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. 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 aircraft tank and fuel the aircraft.

Method 2 — Fill the aircraft 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 or fuselage 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 Make sure no water is trapped in the tank. Fill the aircraft tank to at least 60% full and add the required amount of Biobor JF directly to the tank. Immediately finish filling the tank through the over wing or fuselage port and then mix by starting the boost pumps and circulating the fuel to make sure that the Biobor JF is mixed thoroughly.

E. Before performing the treatment of aircraft fuel with biocide, drain any residual water from the tank as described in Chapter 12 of the Maintenance Manual.

F. For effective biocide treatment, the supplier of Biobor JF recommends that the treated fuel remain in the fuel tank for 24 to 72 hours as follows:

(1) For 24 hours in a very lightly infested fuel tank or for maintenance dosages.

(2) For 72 hours in a heavily infested fuel tank for complete kill of microbes.

6. Frequency of Preventive Maintenance

A. As water is necessary for microbial growth, fuel tanks should be water drained 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 down, water draining before refueling is recommended to remove water accumulated from previous refueling operations.

B. The frequency of biocide treatment should be determined from operator experience with regard to fuel quality from the suppliers (refer to para. 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.