



**U.S. Department  
of Transportation**  
Federal Aviation  
Administration

# Advisory Circular

---

**Subject:** Corrosion Control for Aircraft

**Date:** 9/11/18

**AC No:** 43-4B

**Initiated by:** AFS-300

**Change:**

This advisory circular (AC) is a summary of the current available data regarding identification and treatment of corrosive attack on aircraft structures and engine materials. Corrosion inspection frequency, corrosion identification, and especially corrosion treatment continues to be the responsibility of the operator. These inspections should be accomplished per this AC, the manufacturer's recommendations, or the operator's own maintenance program. The procedures in this AC are an acceptable means, but not the only acceptable means, of corrosion treatment. The information in this AC is applicable to aircraft for which the manufacturer has not published corrosion control information. Where the airframe or engine manufacturer has published a recommended corrosion inspection schedule and treatment program, the applicable program must take precedence over the recommendation of this AC. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

Rick Domingo  
Executive Director, Flight Standards Service

## CONTENTS

| Paragraph                                                           | Page |
|---------------------------------------------------------------------|------|
| Chapter 1. General .....                                            | 1-1  |
| 1.1 Purpose of This Advisory Circular (AC) .....                    | 1-1  |
| 1.2 Audience .....                                                  | 1-1  |
| 1.3 Where You Can Find This AC .....                                | 1-1  |
| 1.4 What This AC Cancels .....                                      | 1-1  |
| 1.5 Related Reading Material .....                                  | 1-1  |
| 1.6 Background .....                                                | 1-1  |
| 1.7 Catastrophic Corrosion Events .....                             | 1-2  |
| 1.8 Corrosion Control Program .....                                 | 1-2  |
| 1.9 AC Feedback Form .....                                          | 1-3  |
| 1.10–1.99 Reserved .....                                            | 1-3  |
| Chapter 2. Corrosion Theory .....                                   | 2-1  |
| 2.1 Introduction .....                                              | 2-1  |
| 2.2 Background .....                                                | 2-1  |
| 2.3 Development of Corrosion .....                                  | 2-2  |
| 2.4 Factors Influencing Corrosion .....                             | 2-2  |
| 2.5 Forms of Corrosion .....                                        | 2-4  |
| 2.6 Corrosion and Mechanical Factors .....                          | 2-10 |
| 2.7 Common Corrosive Agents .....                                   | 2-14 |
| 2.8 Microorganisms .....                                            | 2-16 |
| 2.9 Metallic Mercury Corrosion on Aluminum Alloys .....             | 2-17 |
| 2.10–2.99 Reserved .....                                            | 2-17 |
| Chapter 3. Effects of Corrosion .....                               | 3-1  |
| 3.1 General .....                                                   | 3-1  |
| 3.2 Effects of Corrosion on Metals .....                            | 3-1  |
| 3.3–3.99 Reserved .....                                             | 3-5  |
| Chapter 4. Corrosion Prone Areas and Preventative Maintenance ..... | 4-1  |
| 4.1 General .....                                                   | 4-1  |
| 4.2 Exhaust Trail Areas .....                                       | 4-1  |
| 4.3 Battery Compartments and Battery Vent Openings .....            | 4-1  |

|                                                      |      |
|------------------------------------------------------|------|
| 4.4 Lavatories, Buffets, and Galleys .....           | 4-2  |
| 4.5 Bilge Areas.....                                 | 4-2  |
| 4.6 Wheel Wells and Landing Gear .....               | 4-2  |
| 4.7 External Skin Areas .....                        | 4-5  |
| 4.8 Water Entrapment Areas .....                     | 4-9  |
| 4.9 Engine Frontal Areas and Cooling Air Vents ..... | 4-9  |
| 4.10 Electronic Package Compartments.....            | 4-11 |
| 4.11 Miscellaneous Trouble Areas .....               | 4-12 |
| 4.12 Factors in Corrosion Control.....               | 4-17 |
| 4.13 Preventative Maintenance .....                  | 4-21 |
| 4.14–4.99 Reserved .....                             | 4-35 |
| Chapter 5. Inspection Requirements .....             | 5-1  |
| 5.1 General .....                                    | 5-1  |
| 5.2 Frequency of Inspections .....                   | 5-1  |
| 5.3 Recommended Depth of Inspection.....             | 5-2  |
| 5.4 Primary Approach .....                           | 5-3  |
| 5.5–5.99 Reserved.....                               | 5-13 |
| Chapter 6. Corrosion Removal Techniques .....        | 6-1  |
| Section 1. Safety Procedures.....                    | 6-1  |
| 6.1 General .....                                    | 6-1  |
| 6.2 General Corrosion Control Work Procedures.....   | 6-4  |
| 6.3–6.9 Reserved.....                                | 6-4  |
| Section 2. Corrosion Removal Techniques.....         | 6-5  |
| 6.10 General .....                                   | 6-5  |
| 6.11 Standard Methods.....                           | 6-5  |
| 6.12 Preparations for Rework.....                    | 6-5  |
| 6.13 Paint Removal .....                             | 6-6  |
| 6.14 Special Techniques.....                         | 6-6  |
| 6.15 Fairing or Blending Reworked Areas.....         | 6-7  |
| 6.16 Chemical Testing.....                           | 6-13 |
| 6.17 Chemical Spot Analysis of Magnetic Metals ..... | 6-14 |

|                                                                              |      |
|------------------------------------------------------------------------------|------|
| 6.18 Chemical Spot Analysis of Nonmagnetic Metals.....                       | 6-15 |
| 6.19 Surface Treatment Testing .....                                         | 6-16 |
| 6.20 Post Identification Cleaning and Refinishing.....                       | 6-17 |
| 6.21–6.25 Reserved .....                                                     | 6-17 |
| Section 3. Mechanical Corrosion Removal by Blasting .....                    | 6-18 |
| 6.26 General .....                                                           | 6-18 |
| 6.27 Safety Precautions .....                                                | 6-18 |
| 6.28–6.39 Reserved .....                                                     | 6-18 |
| Section 4. Corrosion Damage and Rework Limits .....                          | 6-19 |
| 6.40 Discussion .....                                                        | 6-19 |
| 6.41 Removal of Corrosion .....                                              | 6-20 |
| 6.42 Determining Degree of Corrosion Damage.....                             | 6-21 |
| 6.43 Determining Rework Limits.....                                          | 6-21 |
| 6.44 Determining Material Thickness Reduction After Corrosion Cleanup.....   | 6-21 |
| 6.45–6.49 Reserved .....                                                     | 6-22 |
| Section 5. Aluminum and Aluminum Alloys .....                                | 6-23 |
| 6.50 Treatment.....                                                          | 6-23 |
| 6.51 Processing of Aluminum Surfaces .....                                   | 6-23 |
| 6.52 Repair of Aluminum Alloy Sheet Metal .....                              | 6-27 |
| 6.53 Corrosion Removal Around Countersunk Fasteners in Aluminum Alloy .....  | 6-28 |
| 6.54 Examples of Removing Corrosion from Aluminum and Aluminum Alloys .....  | 6-28 |
| 6.55–6.59 Reserved .....                                                     | 6-30 |
| Section 6. Magnesium Alloys .....                                            | 6-31 |
| 6.60 Treatment of Wrought Magnesium Sheets and Forgings.....                 | 6-31 |
| 6.61 Repair of Magnesium Sheet Metal After Extensive Corrosion Removal ..... | 6-31 |
| 6.62 In-Place Treatment of Magnesium Castings .....                          | 6-31 |
| 6.63 Example of Removing Corrosion from Magnesium .....                      | 6-32 |
| 6.64–6.69 Reserved .....                                                     | 6-34 |
| Section 7. Ferrous Metals .....                                              | 6-35 |
| 6.70 General .....                                                           | 6-35 |
| 6.71 Mechanical Removal of Iron Rust.....                                    | 6-35 |

|                                                                         |      |
|-------------------------------------------------------------------------|------|
| 6.72 Chemical Surface Treatment of Steel Surfaces .....                 | 6-36 |
| 6.73 Removal of Corrosive Products from High-Stressed Steel Parts ..... | 6-37 |
| 6.74 Special Treatment of Stainless Steel Alloys.....                   | 6-37 |
| 6.75 Example of Process for Removal of Corrosion from Steel Parts ..... | 6-37 |
| 6.76–6.79 Reserved .....                                                | 6-38 |
| Section 8. Plated Parts.....                                            | 6-39 |
| 6.80 Chromium and Nickel Plated Parts .....                             | 6-39 |
| 6.81 Cadmium and Zinc Plated Parts .....                                | 6-39 |
| 6.82–6.89 Reserved .....                                                | 6-39 |
| Section 9. Other Metals and Alloys .....                                | 6-40 |
| 6.90 Noble Metal Coatings—Cleanup and Restoration .....                 | 6-40 |
| 6.91 Copper and Copper Alloys .....                                     | 6-40 |
| 6.92 Titanium Alloys.....                                               | 6-40 |
| 6.93–6.99 Reserved .....                                                | 6-41 |
| Chapter 7. Special Problems .....                                       | 7-1  |
| 7.1 Mercury Spills/Corrosion Damage .....                               | 7-1  |
| 7.2 Corrosion Protection for Agricultural Aircraft .....                | 7-3  |
| 7.3–7.99 Reserved.....                                                  | 7-4  |

### List of Figures

|                                                                                                              |      |
|--------------------------------------------------------------------------------------------------------------|------|
| Figure 2-1. Simplified Corrosion Cell Showing Conditions which Must Exist for Electrochemical Corrosion..... | 2-1  |
| Figure 2-2. Elimination of Corrosion by Application of an Organic Film to Metal Surface ....                 | 2-2  |
| Figure 2-3. Uniform Etch Corrosion .....                                                                     | 2-4  |
| Figure 2-4. Pitting Corrosion.....                                                                           | 2-5  |
| Figure 2-5. Galvanic Corrosion of Magnesium Adjacent to Steel Fastener.....                                  | 2-5  |
| Figure 2-6. Concentration Cell Corrosion .....                                                               | 2-7  |
| Figure 2-7. Intergranular Cracking and Corrosion on a Wing Spar Chord .....                                  | 2-7  |
| Figure 2-8. Severe Exfoliation Corrosion of a Seat Track .....                                               | 2-8  |
| Figure 2-9. Severe Exfoliation Corrosion.....                                                                | 2-8  |
| Figure 2-10. Filiform Corrosion .....                                                                        | 2-9  |
| Figure 2-11. Filiform Corrosion Before and After Paint Removal .....                                         | 2-10 |
| Figure 2-12. Stress-Corrosion Cracking of 7079 TG Fitting.....                                               | 2-11 |

|                                                                                                              |      |
|--------------------------------------------------------------------------------------------------------------|------|
| Figure 2-13. Stress-Corrosion Cracking Starting at a Pit in CRES Material.....                               | 2-12 |
| Figure 2-14. Stress-Corrosion Cracking of an Extruded Section .....                                          | 2-12 |
| Figure 2-15. Fretting Corrosion and Cracking from Cyclic Loading of Lug .....                                | 2-13 |
| Figure 4-1. Exhaust Trail Area Corrosion Control Points.....                                                 | 4-1  |
| Figure 4-2. Typical Damage to Floor Around Lavatories, Buffets, and Galleys .....                            | 4-2  |
| Figure 4-3. Landing Gear and Wheel Corrosion Points .....                                                    | 4-4  |
| Figure 4-4. Intergranular Corrosion of 7075-T6 Aluminum Adjacent to Steel Fastener .....                     | 4-5  |
| Figure 4-5. Crack and Skin Bulging Caused by Corrosion .....                                                 | 4-6  |
| Figure 4-6. Spot-Welded Skin Corrosion .....                                                                 | 4-7  |
| Figure 4-7. Hinge Corrosion Points.....                                                                      | 4-8  |
| Figure 4-8. Hinge Failure Caused by Corrosion.....                                                           | 4-8  |
| Figure 4-9. Reciprocating Engine Frontal Area Corrosion .....                                                | 4-10 |
| Figure 4-10. Jet Engine Frontal Area Corrosion Points .....                                                  | 4-11 |
| Figure 4-11. Spar Chord Lifting Caused by Corrosion Products .....                                           | 4-15 |
| Figure 4-12. Skin Bulging Around Fasteners.....                                                              | 4-15 |
| Figure 4-13. Opening of a Corroded Lap Joint for Repair .....                                                | 4-16 |
| Figure 4-14. Close-Up View of a Corroded Lap Joint .....                                                     | 4-16 |
| Figure 4-15. North America Corrosion Severity Map.....                                                       | 4-22 |
| Figure 4-16. South America Corrosion Severity Map.....                                                       | 4-23 |
| Figure 4-17. Africa Corrosion Severity Map.....                                                              | 4-24 |
| Figure 4-18. South Pacific Corrosion Severity Map .....                                                      | 4-25 |
| Figure 4-19. Asia Corrosion Severity Map.....                                                                | 4-26 |
| Figure 4-20. Europe and Asia Minor Corrosion Severity Map .....                                              | 4-27 |
| Figure 4-21. Blocked Drain Passages Resulted in Accumulation of Corrosion<br>Contaminates and Moisture ..... | 4-28 |
| Figure 5-1. Corrosion Found After Removing Cargo Door Threshold Covers.....                                  | 5-2  |
| Figure 5-2. Corrosion Under Chipped and Loose Paint on Wing Skin.....                                        | 5-4  |
| Figure 5-3. Corrosion Indicated by Blistering of Paint in Fuel Cell .....                                    | 5-4  |
| Figure 5-4. Popped Rivet Heads Resulting from Corrosion Products.....                                        | 5-5  |
| Figure 5-5. Skin Bulging Around Fasteners Caused by Pressure from Corrosion Products.....                    | 5-5  |
| Figure 5-6. Corrosion Cracking Between Fasteners on a Wing Spar.....                                         | 5-6  |
| Figure 5-7. Faying Surface Corrosion on Wing Spar Chord with Corrosion Cracking<br>Also Visible .....        | 5-6  |

|                                                                                                                            |      |
|----------------------------------------------------------------------------------------------------------------------------|------|
| Figure 5-8. Severe Crown Stringer Corrosion.....                                                                           | 5-7  |
| Figure 5-9. Spar Chord Corrosion .....                                                                                     | 5-7  |
| Figure 5-10. Removal of Fillet Seal from Internal Edge of Lap Joint Exposed Full Extent<br>of Corrosion .....              | 5-8  |
| Figure 5-11. Removal of Insulation Blankets Exposed Corrosion.....                                                         | 5-8  |
| Figure 5-12. Corrosion Developed Under Leveling Compound Installed During Previous<br>Repair of Overwing Exit.....         | 5-9  |
| Figure 5-13. Corrosion Behind a Structural Component on a Wing Spar.....                                                   | 5-9  |
| Figure 5-14. Severely Corroded Lap Joint .....                                                                             | 5-10 |
| Figure 5-15. Severely Corroded Lap Joint .....                                                                             | 5-10 |
| Figure 5-16. Local Paint Removal Required to Expose Full Extent of Corrosion .....                                         | 5-11 |
| Figure 5-17. Corroded Area After Paint Removal from Wing Skin.....                                                         | 5-11 |
| Figure 5-18. Bonderite 1200 Treatment Prior to Painting May Highlight Presence of<br>Remaining Corrosion or Cracks.....    | 5-12 |
| Figure 6-1. Blendout of Corrosion as Single Depression Width.....                                                          | 6-9  |
| Figure 6-2. Typical Example of Acceptable Cleanup of Corrosion Pits .....                                                  | 6-10 |
| Figure 6-3. Blendout of Multiple Pits in Corroded Area.....                                                                | 6-10 |
| Figure 6-4. Profile of Reworked Corroded Areas in Regions of Limited Access.....                                           | 6-11 |
| Figure 6-5. Steel Particles from Fasteners or Nutplates May Cause Future Corrosion<br>Problems in Aluminum Structure ..... | 6-11 |
| Figure 6-6. Incomplete Removal of Corrosion Products Resulted in Reoccurrence of<br>Corrosion.....                         | 6-12 |
| Figure 6-7. Incomplete Removal of Corrosion Products Resulted in Reoccurrence of<br>Corrosion.....                         | 6-12 |
| Figure 6-8. Severe Corrosion Requiring Trimming Out of Damaged Area.....                                                   | 6-20 |
| Figure 6-9. Corrosion at Fastener Holes Removed by Spot Facing .....                                                       | 6-20 |
| Figure 6-10. Corrosion Damage and Rework Measurement Using Depth Dial Gauge .....                                          | 6-22 |
| Figure 6-11. Removing Oil and Surface Dirt .....                                                                           | 6-24 |
| Figure 6-12. Polishing and Brightening Alclad Surfaces .....                                                               | 6-24 |
| Figure 6-13. Cleaning and Stripping Paint .....                                                                            | 6-25 |
| Figure 6-14. Cleaning and Inhibiting Corroded Aluminum Surfaces .....                                                      | 6-26 |
| Figure 6-15. Removing Excess Inhibitor Solution .....                                                                      | 6-27 |
| Figure 6-16. Applying Wax to Cleaned Surfaces.....                                                                         | 6-27 |
| Figure 6-17. Removing Corrosion Products from Ordinary Steel Surfaces.....                                                 | 6-36 |
| Figure 6-18. Removing Corrosion Products from Highly-Stressed Steel Parts .....                                            | 6-36 |

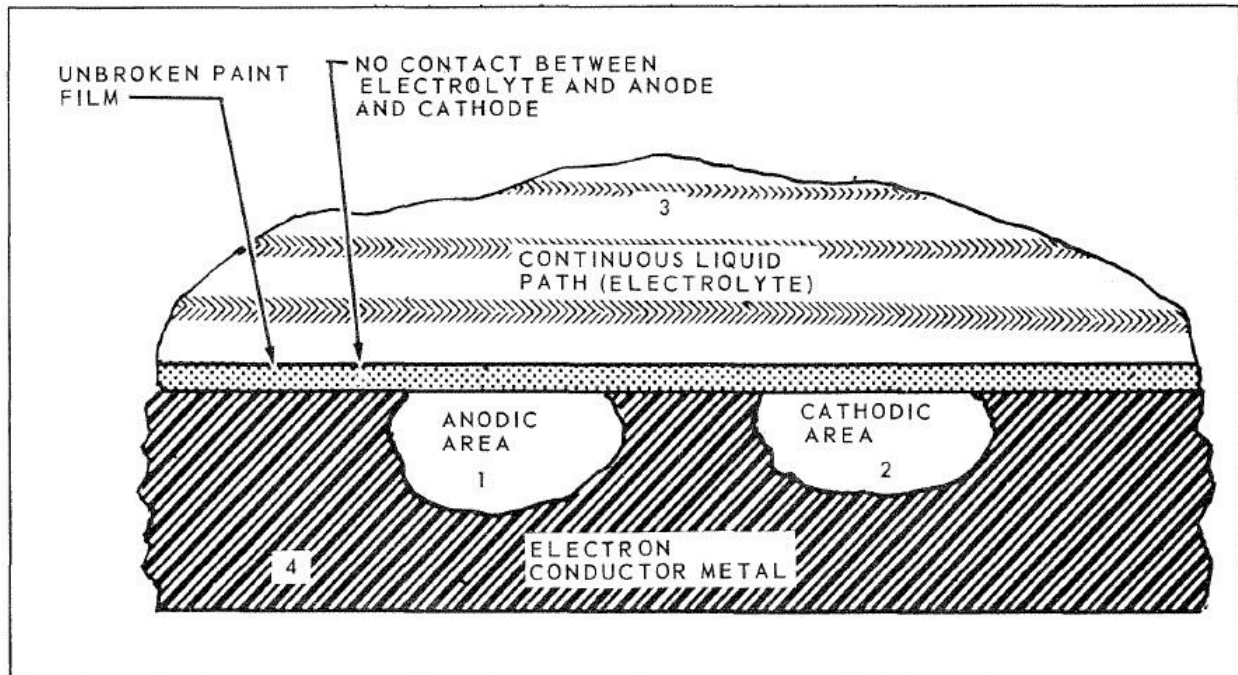
**List of Tables**

|            |                                           |      |
|------------|-------------------------------------------|------|
| Table 3-1. | Corrosion of Metals .....                 | 3-4  |
| Table 4-1. | Galvanic Series of Metals and Alloys..... | 4-19 |
| Table 4-2. | Grouping of Metals and Alloys.....        | 4-20 |
| Table 6-1. | Abrasives for Corrosion Removal .....     | 6-8  |



invisible oxide, or passive, film, preventing further corrosion. When a film of corrosion products is loose and porous, such as those of aluminum and magnesium, an electrolyte can easily penetrate and continue the corrosion process, producing more extensive damage than surface appearance would show.

**Figure 2-2. Elimination of Corrosion by Application of an Organic Film to Metal Surface**



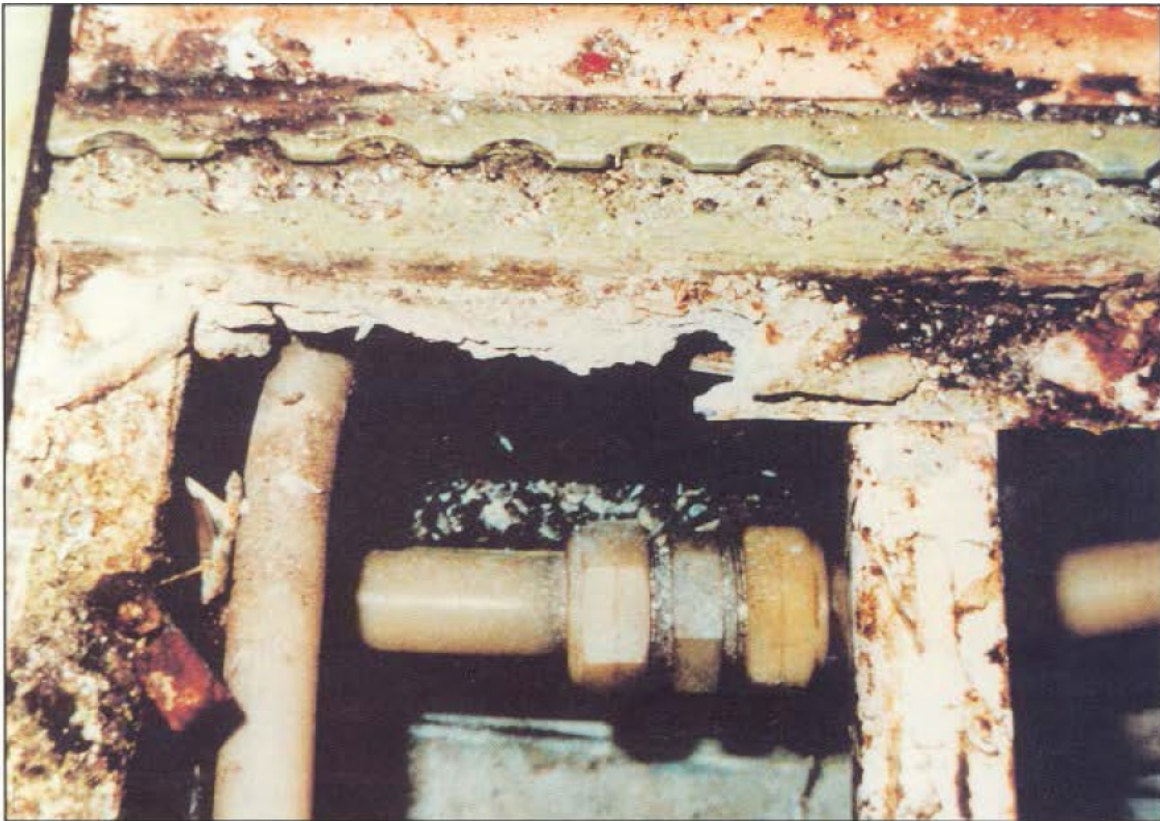
### 2.3 Development of Corrosion.

- 2.3.1** All corrosive attack begins on the surface of the metal, and the corrosion process involves two chemical changes: 1) the metal that is attacked or oxidized undergoes an anodic change, and 2) the corrosive agent is reduced or undergoes a cathodic change. The tendency of most metals to corrode creates one of the major problems in aircraft maintenance, particularly where adverse environmental or weather conditions exist.
- 2.3.2** Paint coatings can mask initial stages of corrosion. Since corrosion products occupy more volume than the original metal, paint surfaces should be inspected often for such irregularities as blisters, flakes, chips, and lumps.

### 2.4 Factors Influencing Corrosion.

- 2.4.1** Some factors which influence metal corrosion and the rate of corrosion are the:
1. Type of metal;
  2. Heat treatment and grain direction;
  3. Presence of a dissimilar, less corrodible metal (galvanic corrosion);
  4. Anode and cathode surface areas (in galvanic corrosion);

**Figure 2-8. Severe Exfoliation Corrosion of a Seat Track**



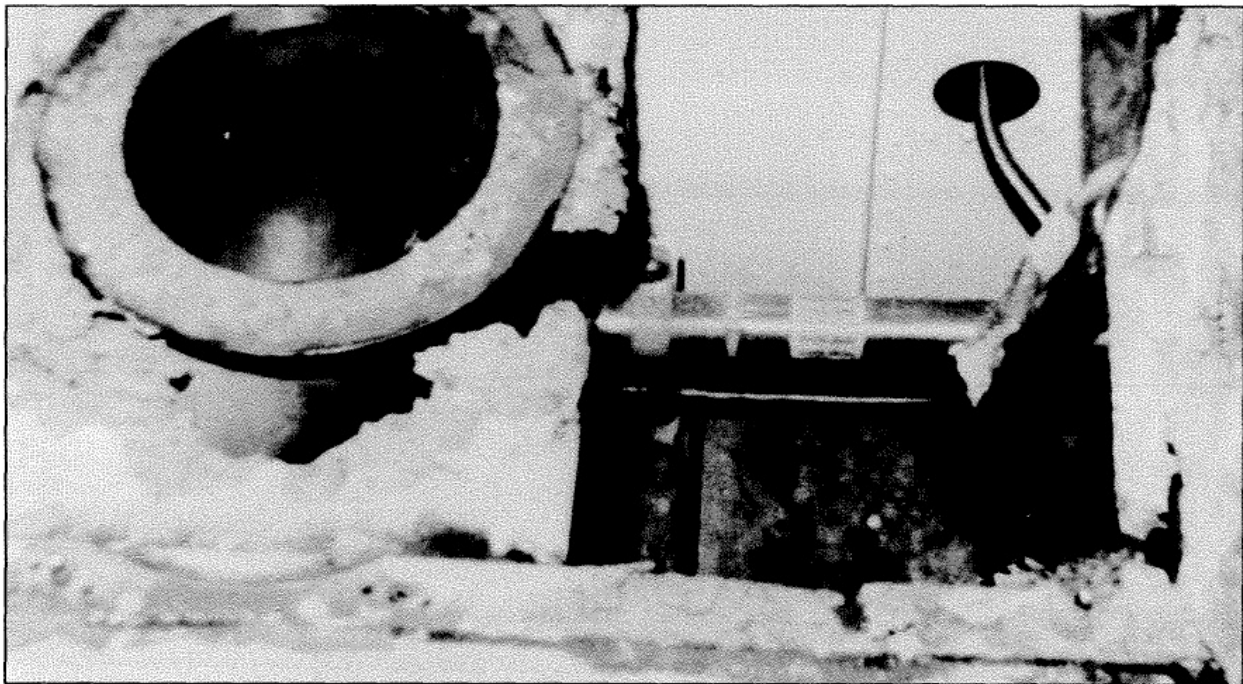
**Figure 2-9. Severe Exfoliation Corrosion**



installation includes external vent openings on the aircraft skin, these areas should be included in inspection and maintenance procedures. If aircraft have batteries with electrolytes of either sulfuric acid or potassium hydroxide, electrolyte leakage will cause corrosion. Consult applicable maintenance manuals to determine the battery type installed and recommended maintenance practices. Clean nickel cadmium compartments with ammonia or boric acid solution, dry thoroughly, then paint with an alkali-resistant varnish.

- 4.4 Lavatories, Buffets, Galleys, Doorways, and Cockpit Floorboards.** These areas, particularly deck areas behind lavatories, sinks, and ranges, are potential trouble areas where spilled food and waste products may collect. Even though some contaminants are not corrosive, they will attract and retain moisture, and promote corrosive attack. Pay particular attention to bilge areas and aircraft structure located under galleys and lavatories. Clean these areas frequently and maintain protective sealant and paint finishes.

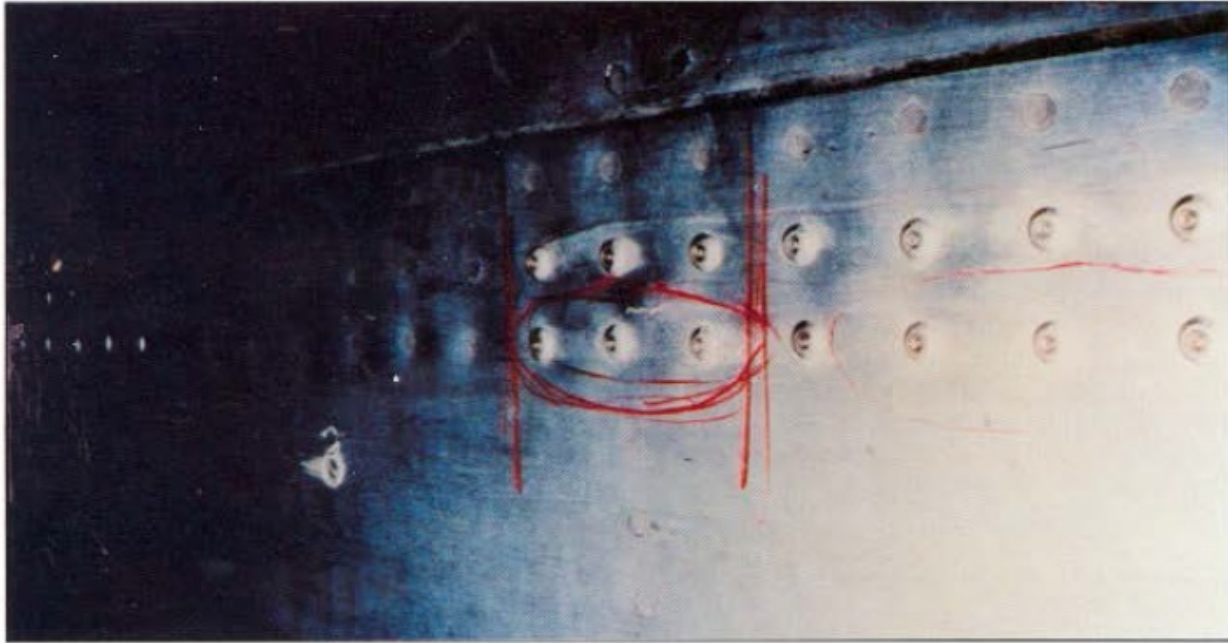
**Figure 4-2. Typical Damage to Floor Around Lavatories, Buffets, and Galleys**



- 4.5 Bilge Areas.** On all aircraft, the bilge area is a common trouble area. The bilge is a natural sump or collection point for waste hydraulic fluids, water, dirt, loose fasteners, drill chips, and other debris. Residual oil quite often masks small quantities of water which settle to the bottom and set up a hidden potential corrosion cell. Except for water displacing corrosion-preventing compounds, keeping bilge areas free of extraneous material, including water and oil, will insure the best protection against corrosion. A good vacuum cleaner and clean wiping cloths are handy tools to clean such areas.
- 4.6 Wheel Wells and Landing Gear.** The wheel well area probably receives more punishment than any other area of the aircraft. It is exposed to mud, water, salt, gravel,



**Figure 4-5. Crack and Skin Bulging Caused by Corrosion**



- 4.7.3** Magnesium Skins. Properly surface-treated, insulated, and painted magnesium skin surfaces give relatively little corrosion-related trouble if the original surface is maintained. However, trimming, drilling, and riveting destroy some of the original surface treatment, which may not be completely restored by touch-up procedures.
- 4.7.3.1** Some aircraft have steel fasteners installed through a magnesium skin, with only protective finishes under the fastener heads and fillet sealant or tape over the surface for insulation. Paint coatings are inherently thin at abrupt changes in contour, such as at trimmed edges. With magnesium's sensitivity to moisture, these conditions add up to a potential corrosion problem whenever magnesium is used.
- 4.7.3.2** Corrosion inspections should include all magnesium skin surfaces and magnesium fittings or structural components, with special attention to edges, areas around skin edges and fasteners, and cracked, chipped, or missing paint.
- 4.7.4** Spot-Welded Skins. Corrosion of this type is chiefly the result of the entrance and entrapment of moisture or other corrosive agents between layers of metal. See Figure [4-6](#), Spot-Welded Skin Corrosion.
- 4.7.4.1** Spot-welded assemblies are particularly corrosion prone, and corrosive attack causes skin buckling or spot-weld bulging and fracture. This type of corrosion is evidenced by corrosion products appearing at crevices through which the corrosive agents enter. Some corrosion may originate from fabricating processes, but its progress to the point of skin bulging or spot-weld fracture is the direct result of moisture or other corrosive agents moving through open

**Figure 4-11. Spar Chord Lifting Caused by Corrosion Products**



**Figure 4-12. Skin Bulging Around Fasteners**

