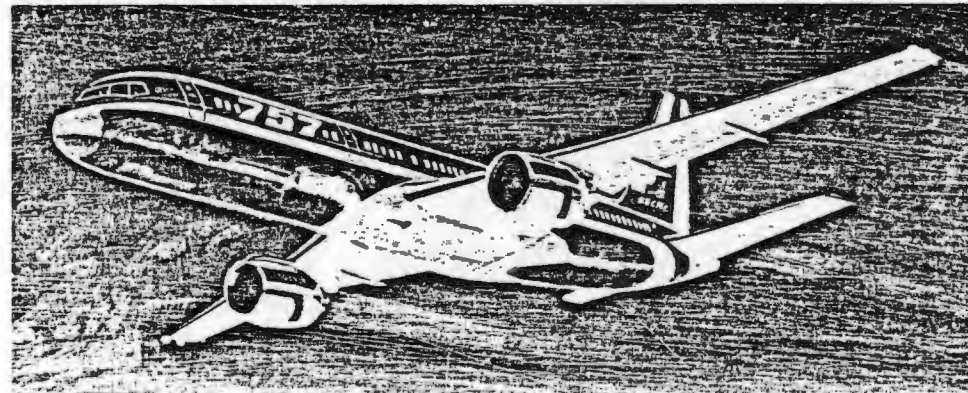


# Corrosion Control in Commercial Airplanes

J.C. McMillan  
Chief, Materials Technology-Airplane Programs



Boeing Commercial Airplane Company

November 5-7, 1980

Tri-service Conference on Corrosion ■ United States Air Force Academy, Colorado

# Corrosion Control in Commercial Airplanes

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## In production airplane

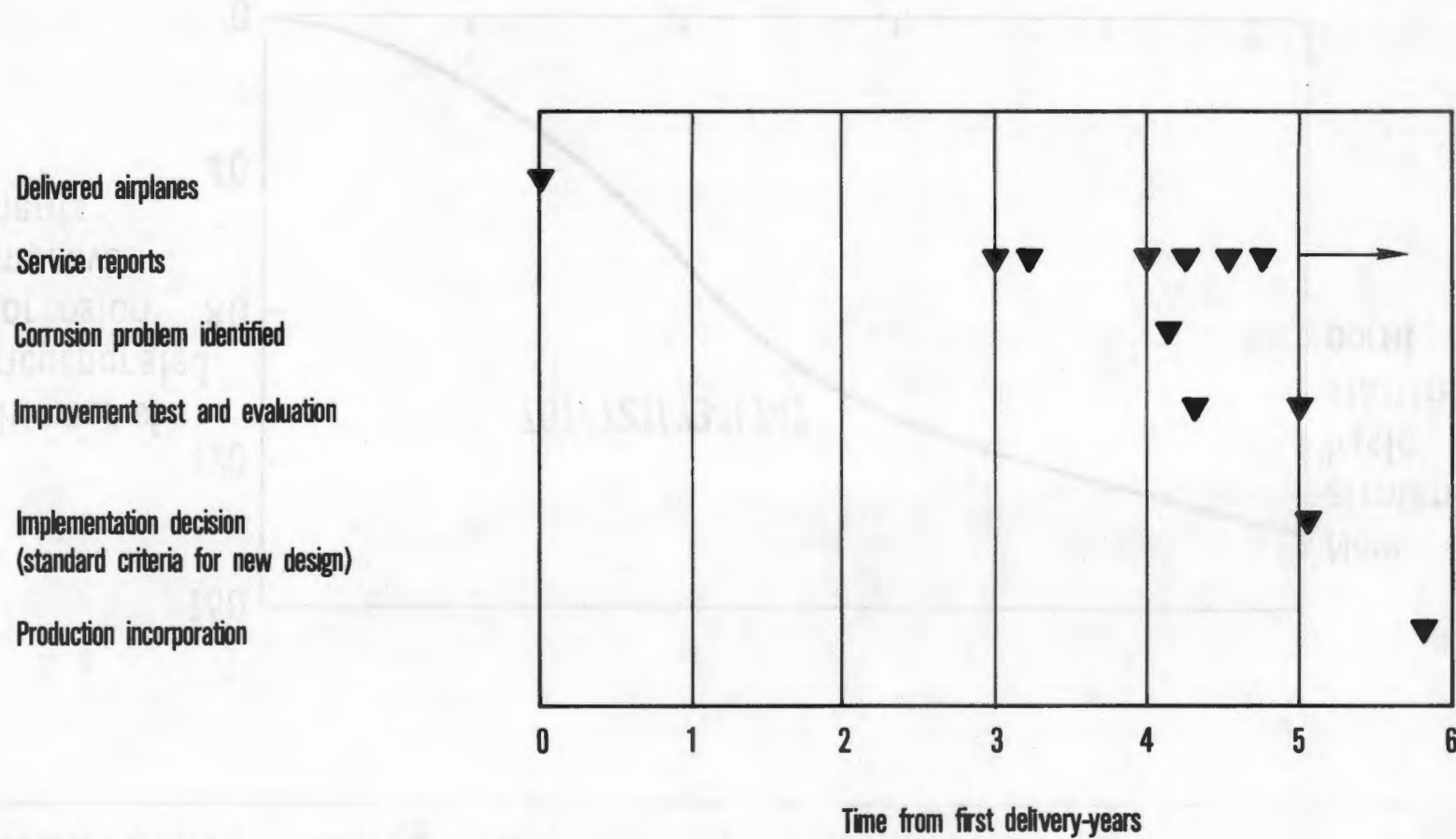
- Monitor fleet experience
- Identify corrosion problems
- Initiate correction action
  - Production change
  - In service action
  - Establish new design guidelines

## New airplane designs

- Establish design objectives
- Design for avoidance
- Design for protection

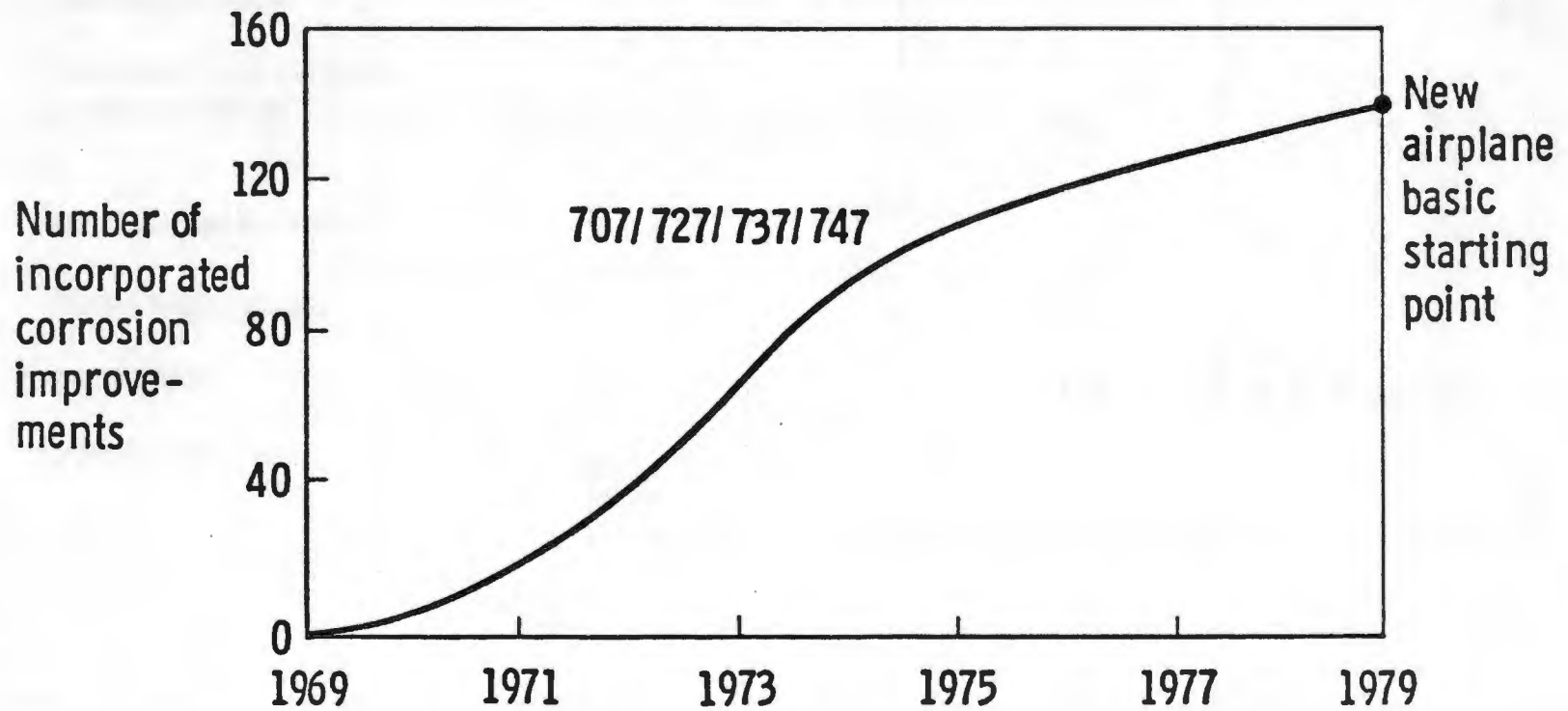
# Evolution of Major Corrosion Improvements

387



# Corrosion Control Improvements New Airplane Starting Point

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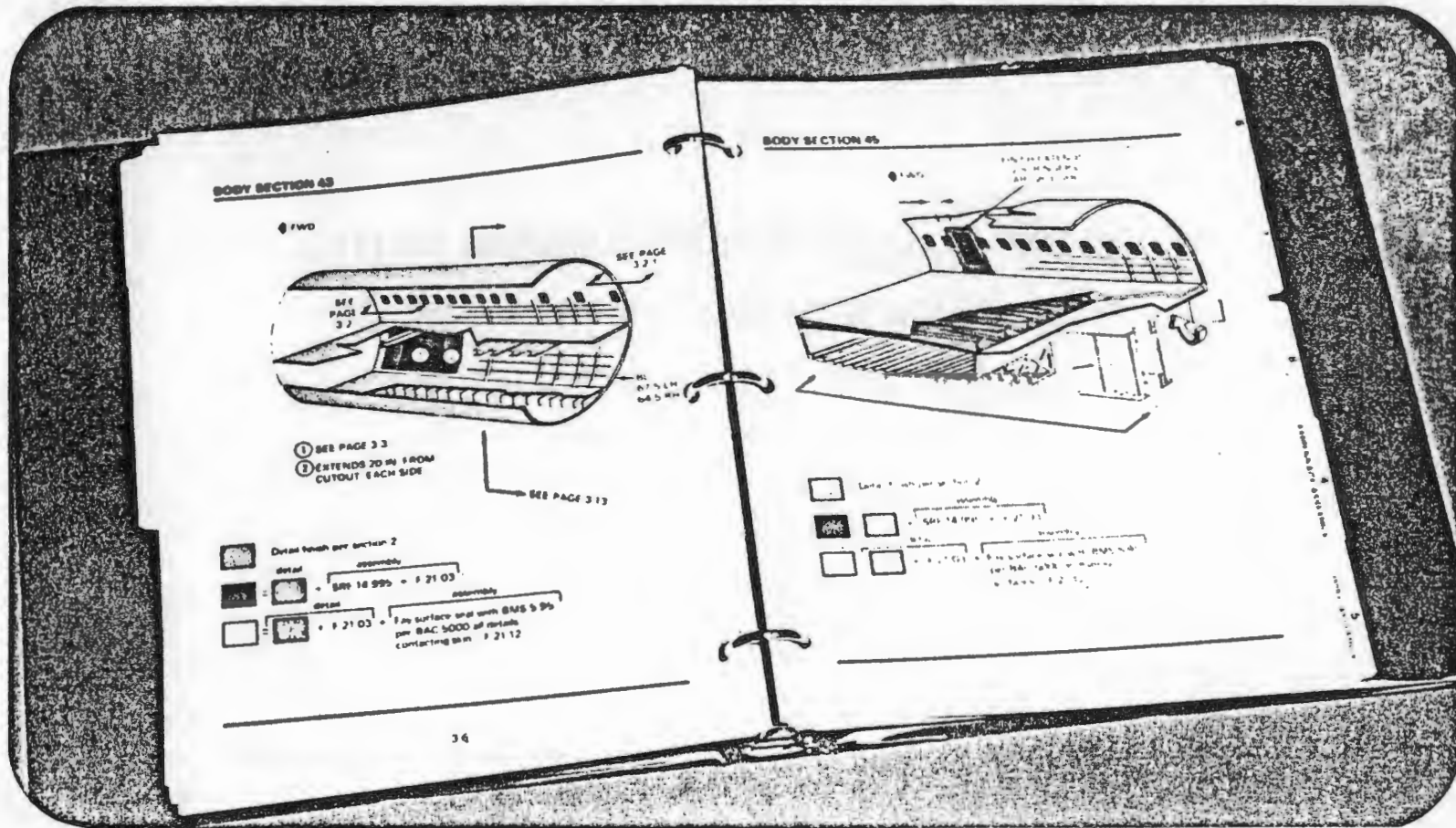
# New Airplane Corrosion Control Objectives

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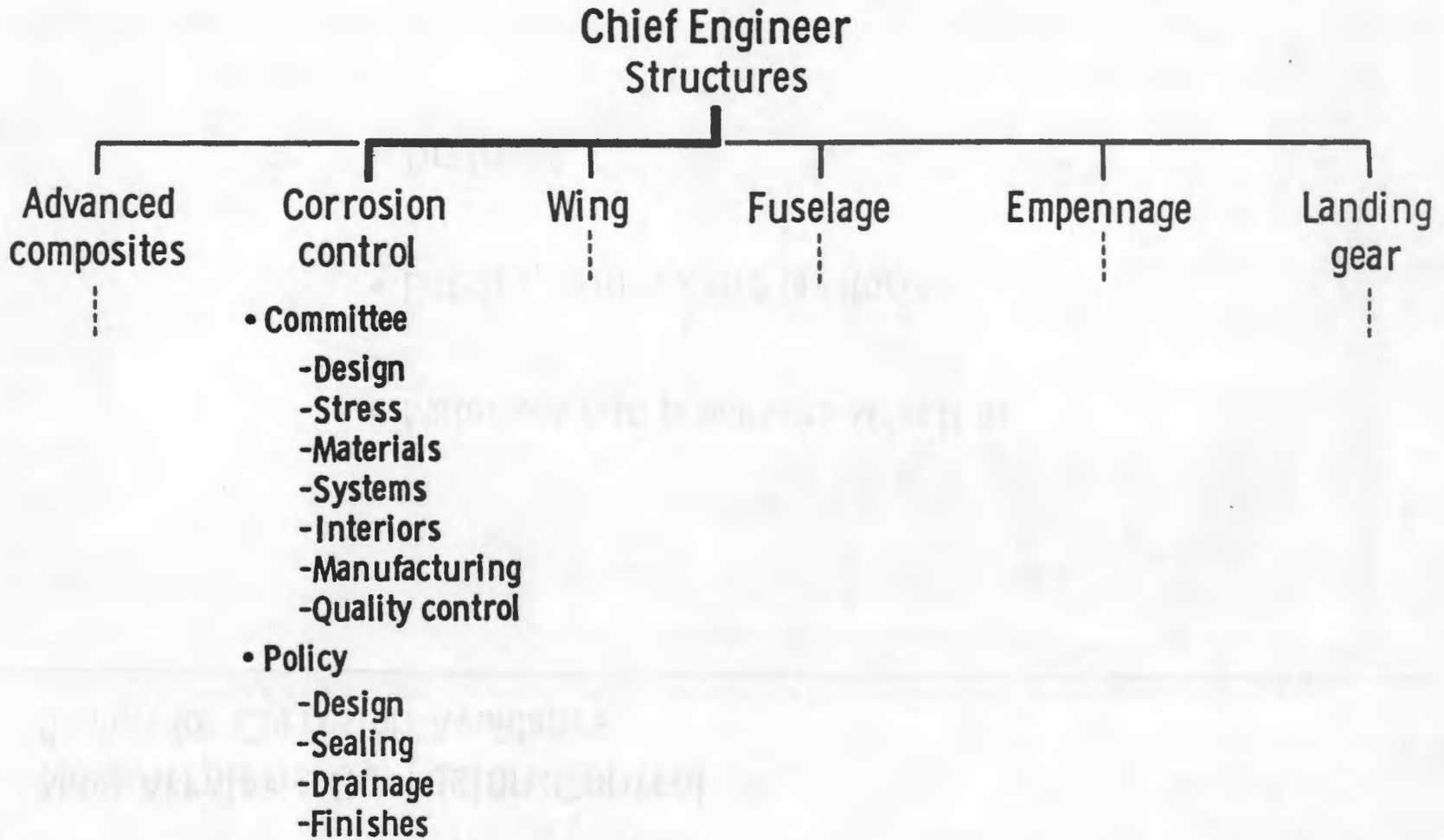
- Control corrosion to assure structural integrity of the airplane with normal airline maintenance over a 20 year period

# New Airplane Corrosion Control Corrosion Control Design Handbook

AFWAL-TR-81-4019  
Volume II



# New Airplane Corrosion Control Organization



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# New Airplane Corrosion Control Design for Corrosion Avoidance

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- Materials and processes selection
- Entries, galleys and lavatories
- Drainage



# New Airplane Corrosion Control Materials Selection

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- Aluminum alloys
  - Extensive use of stress corrosion and corrosion resistant tempers
  - No 7079 alloy
- Magnesium
  - No structural applications

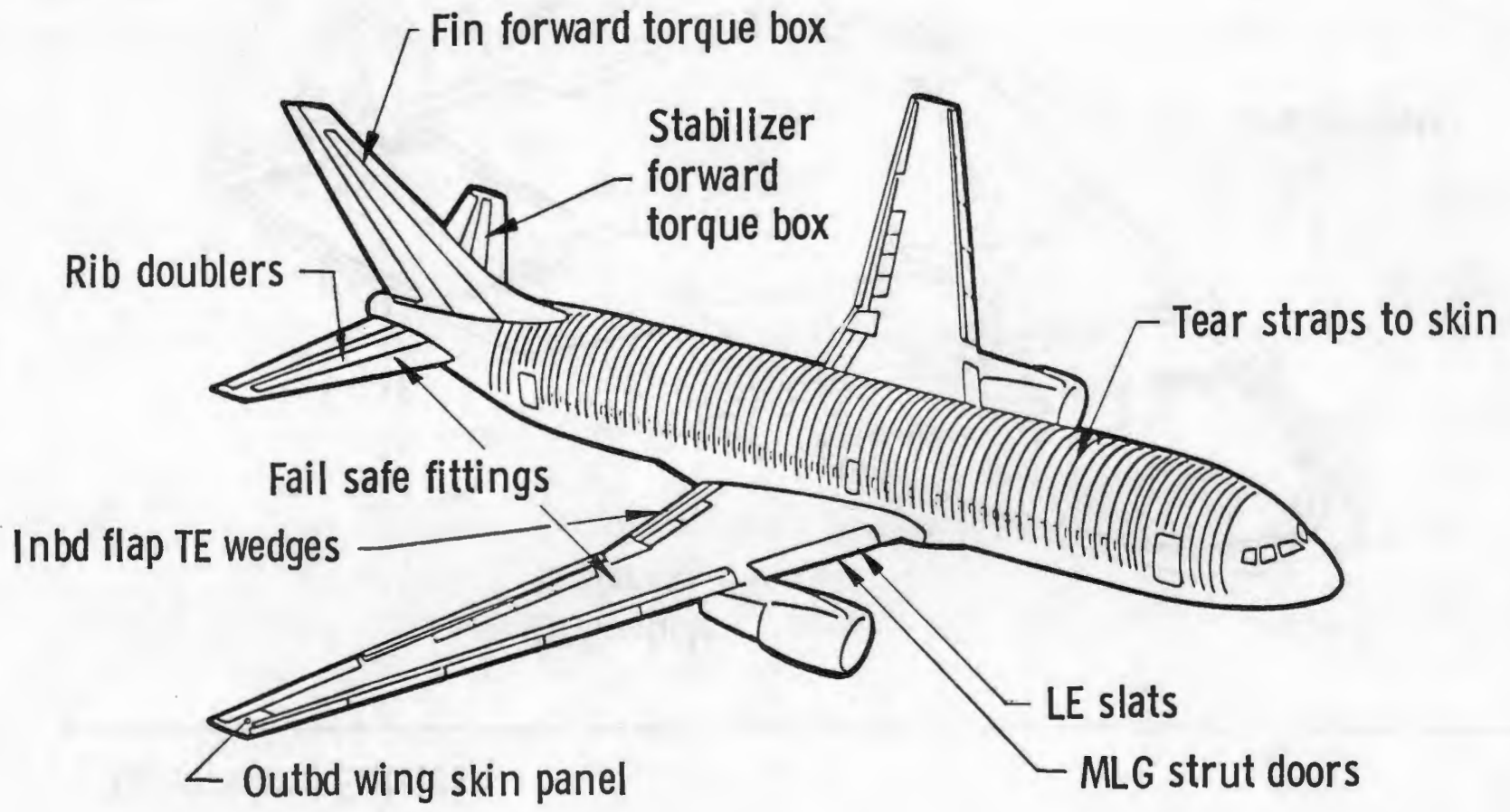
# New Airplane Corrosion Control Metal Bonding Guidelines

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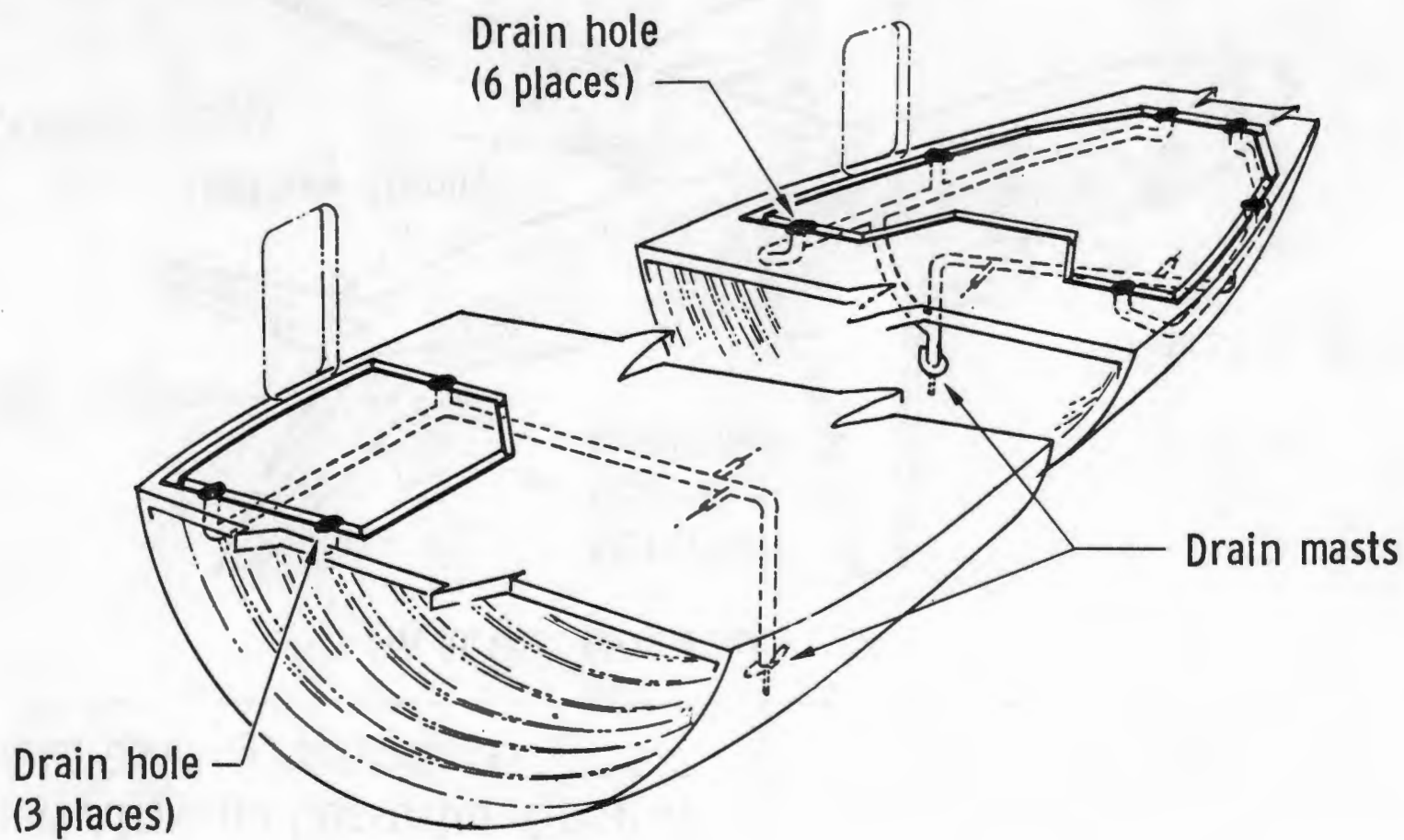
- Phosphoric acid anodize surface preparation
- Corrosion inhibiting adhesive primer
- Corrosion resistant-nonperforated core
- No bonding in bilge
- No cold bonding
- No bonded 7075 clad
- High toughness, high durability 250° F cure adhesives

# New Airplane Corrosion Control Metal Bonding Applications

395



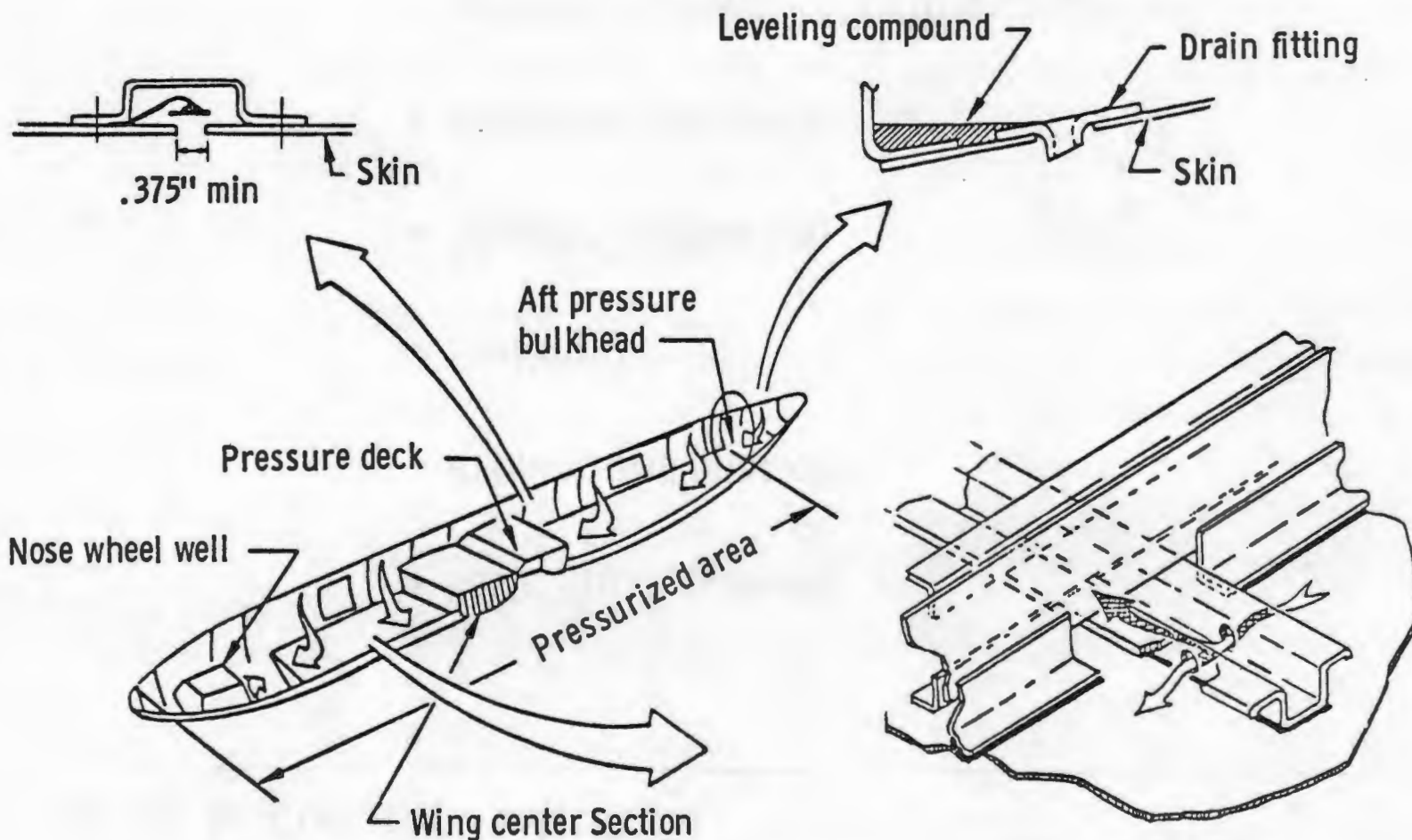
# New Airplane Corrosion Control Galleys and Entries



# New Airplane Corrosion Control Drainage - Lower Lobe/Bilge

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BMT80-48 - A

# New Airplane Corrosion Control Design for Corrosion Protection

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Volume II

- Basic finish systems
- Priming and enameling
- Sealing
- Fastener installation
- Advanced Composites
- Organic corrosion inhibiting compounds

# New Airplane Corrosion Control

## Basic Finish-Details

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### Aluminum

- Interior – Anodize and primer-bare  
Alodine and primer- clad
- Exterior – Alodine all clad  
Anodize and primer-bare

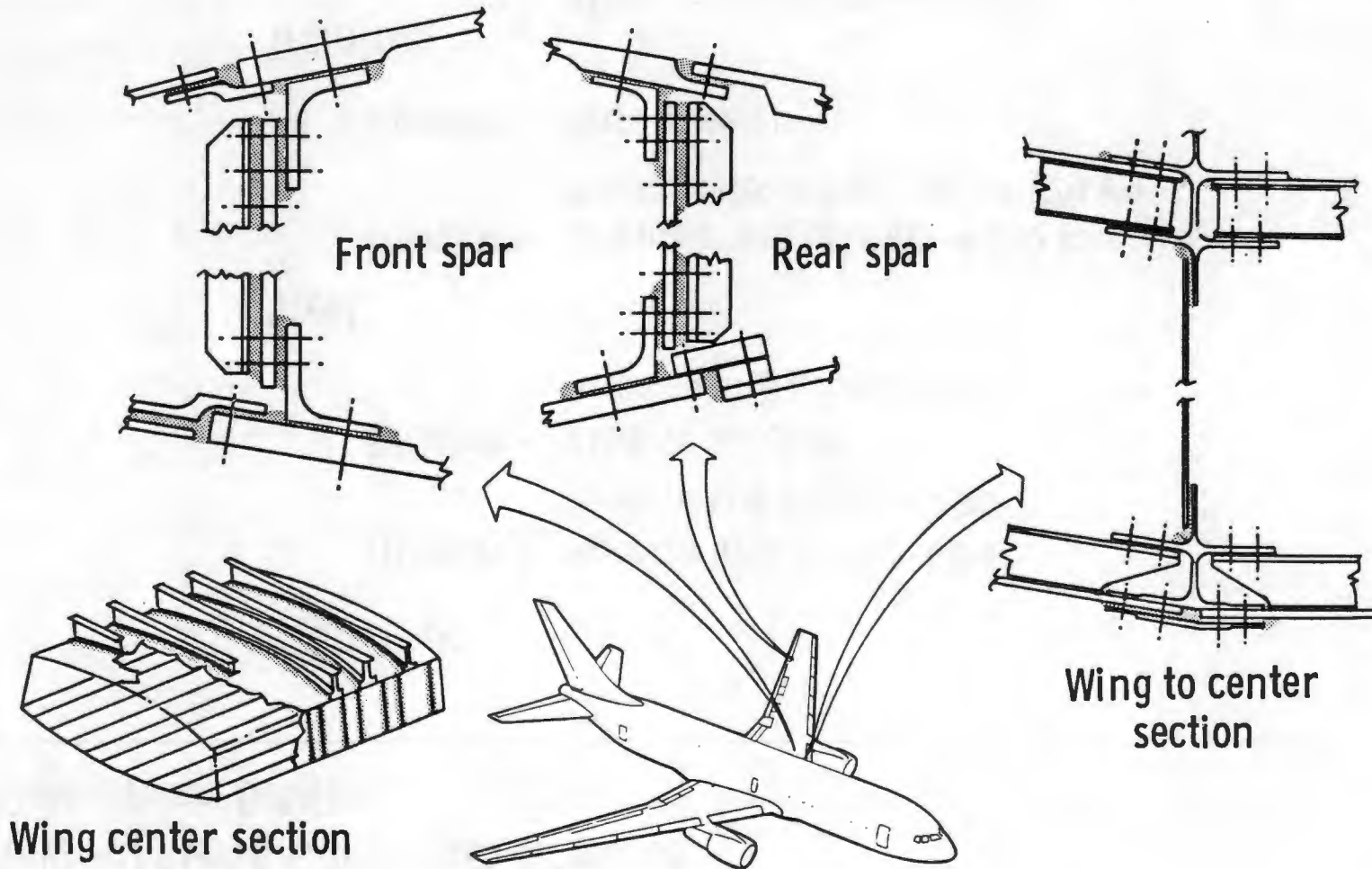
### Steel

- Interior – Cad plate and primer- < 220 ksi  
Ti/cad plate and primer- > 220 ksi
- Exterior – Plus enamel

### Titanium

- Aluminum interface-primer
- Hydraulic fluid areas-protective coating

# New Airplane Corrosion Control Sealing-Wing



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# New Airplane Corrosion Control Fastener Installation

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- Wet installation- All permanent nonaluminum fasteners penetrating exterior skin
- Wet installation and/or cap sealing- Many fasteners in known corrosion prone areas
- Titanium fasteners- Aluminum coated

## New Airplane Corrosion Control Advanced Composites

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- Extraordinary corrosion protection measures required when graphite reinforced parts are directly coupled with aluminum

# New Airplane Corrosion Control

## Graphite/aluminum Protection Measures

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### Aluminum detail

- Anodize, prime, enamel

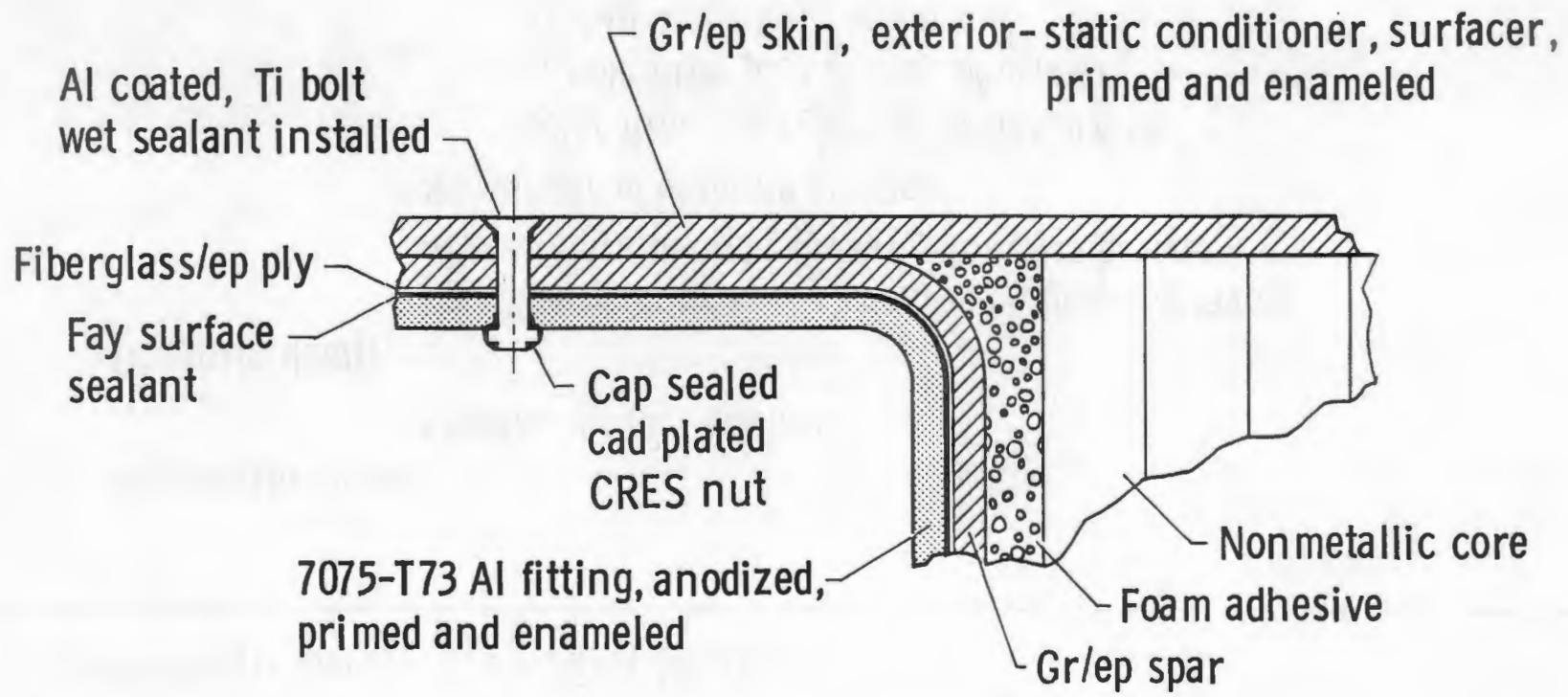
### Graphite detail

- 1 ply fiberglass or kevlar cocured on graphite faying with aluminum and extending 4 inches beyond
- Remainder of graphite surface
  - Tedlar film, fiberglass or kevlar ply, or pinhole filler plus 2 coats of primer
  - Graphite cut edges, sealant or primer plus enamel

### Assembly

- Fay surface seal
- Fasten with aluminum coated titanium fasteners, wet sealant installed
- Use aluminum or cadmium plated CRES washers, nuts or collars on aluminum side and cap seal

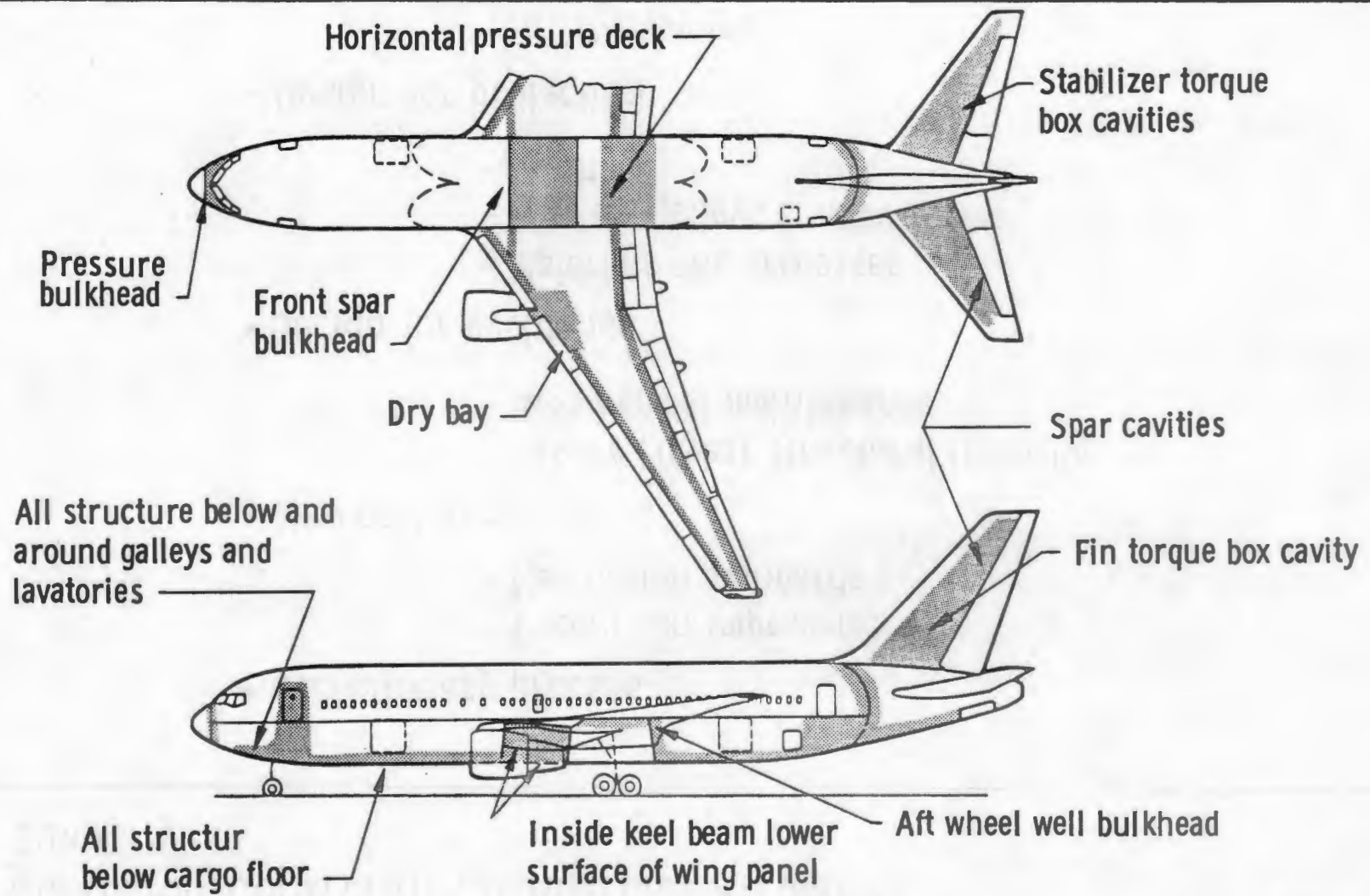
# New Airplane Corrosion Control Graphite/aluminum Protection Details



404

# New Airplane Corrosion Control Organic Corrosion Inhibiting Compound

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# Corrosion Control in Commercial Airplanes

## Summary

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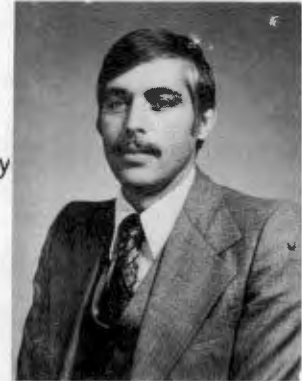
- Evolutionary process
  - Production improvements
  - New design standards
- New design objectives
  - Assure 20 year structural integrity with normal maintenance
- Design for avoidance
  - Materials and processes
  - Entries, galleys and lavatories
  - Drainage
- Design for protection
  - Finish systems
  - Sealing
  - Corrosion inhibitors

## Biography

**Name:** J. Corey McMillan

**Present Affiliation:** Boeing Commercial Airplane Company

**Title:** Manager, Materials Technology



**Field of Interest/Responsibilities:**

Responsible for all materials and processes engineering activities within Boeing Commercial Airplane Company

**Previous Affiliations/Titles:**

**Academic Background:**

B.S. Metallurgical Engineering, University of Washington

M.S. Metallurgical Engineering, University of Washington

**Society Activities/Offices:**

**Publications/Papers:**

Numerous papers and publications in the general areas of fractography, fracture, fatigue, adhesive bonding and corrosion control.