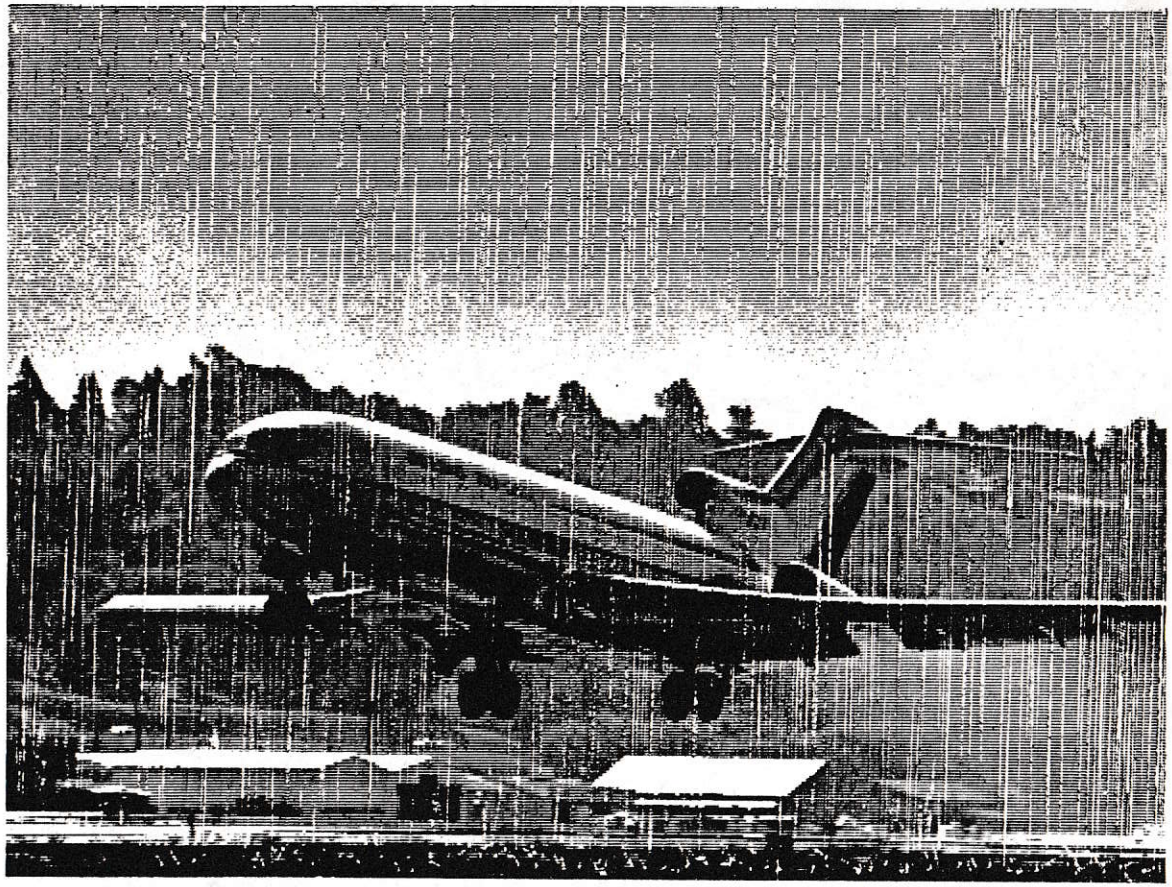
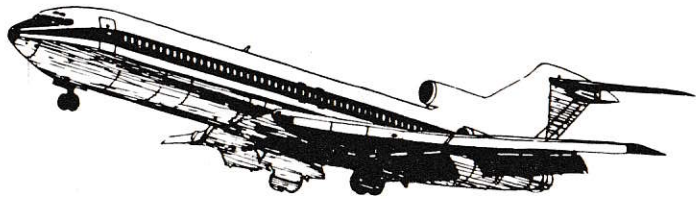


CORROSION PREVENTION PROGRAM

727

BOEING COMMERCIAL AIRPLANE GROUP ■ 707/727/737 DIVISION

INDEX



INTRODUCTION

The Boeing Company has engaged in a campaign to minimize corrosion in all commercial airplanes since introducing its first Model 707 into commercial service. New materials, material finishes, and manufacturing techniques are continually being developed to retard and control corrosion. When proven effective, they are introduced into production models as soon as possible to provide the operator with a product incorporating the latest technology in this field. This document summarizes the major corrosion-preventative measures incorporated on 727 airplanes during the 1970-1973 time period. These improvements have been made in response to in-service problems reported since January 1, 1969.

TYPES OF CORROSION AND PREVENTION TECHNIQUES

The following types of corrision can be found on any service-proven airplane and have been encountered on the 727. The corrective action noted has been taken to reduce the possibility of corrosive action in the particular area of the airplane affected considering configuration, environment, and operating requirements.

Intergranular Corrosion often starts at fasteners and can appear as blisters in the paint, with severe cases causing material exfoliation. This problem has been corrected by one or more of the following methods:

- Use of a flexible paint system (Corogard) in areas not subject to hydraulic fluid contamination
- Installation of nonaluminum countersunk fasteners with wet primer or wet sealant
- Application of fillet seal to protruding head fasteners
- Assembly with faying surface seal

Pitting Corrosion can be identified by small pits in the affected surface, and may develop into intergranular corrosion if not detected and corrective action taken. Corrective action includes one or both of the following methods:

- Use of improved finish systems
- Assembly with faying surface seal

Another form of pitting corrosion is known as "filiform" corrosion. This is found primarily at fasteners in painted clad skins. This problem has been corrected by the use of an improved paint system. The corrosion preventative capability of polyurethane paint systems, which are used over a major portion of the airplane exterior surfaces, has been substantially enhanced by the following changes:

Nondecorative Areas–Incorporation of an improved epoxy primer exhibiting superior adhesion characteristics has been coupled with a polyurethane paint compounded to provide greater flexibility. Environmental protection is improved in areas such as the wing lower surface, flaps, and horizontal tail surfaces.

Decorative Areas–Use of the above improved epoxy primer provides a new level of protection.

Stress Corrosion Cracking has been encountered primarily in 7079-T6 fittings. This phenomenon results from the combined action of a sustained tensile stress and a corrosive environment. The sustained stress may be a residual stress due to machining or a preload due to clamp up. This problem has been corrected by the use of 7075-T73, an aluminum alloy which is virtually immune to stress corrosion cracking. The new material was implemented on a priority basis. All parts involving flight integrity, and all parts that would be difficult to replace in service, will be incorporated on airplanes delivered in early 1973. The ultimate goal is to replace all 7079-T6 alloy usage with 7075-T73.

WING – CORROSION PREVENTION

Figure 1 illustrates the following product improvement changes that have been incorporated into the 727 wing:

- Fillet seal fasteners at spar chords
- Faying surface seal spar chord to spar web joint
- Fillet seal spar chord to inspar skin joint
- Apply teflon coating at leading-edge panel attachment surfaces to front spar
- Install all nonaluminum fasteners in primary structure with wet primer or sealant
- Faying surface seal front spar chord plate to inspar skin joint
- Change upper front and rear spar chord material from 7178-T6 to 7075-T73
- Apply improved (polyurethane) paint system on wing lower surface
- Fillet seal front spar upper chord to fixed leading-edge skin joint
- Faying surface seal all fittings and stiffeners to spar chords

The following pages in this section cover the individual product improvement areas.

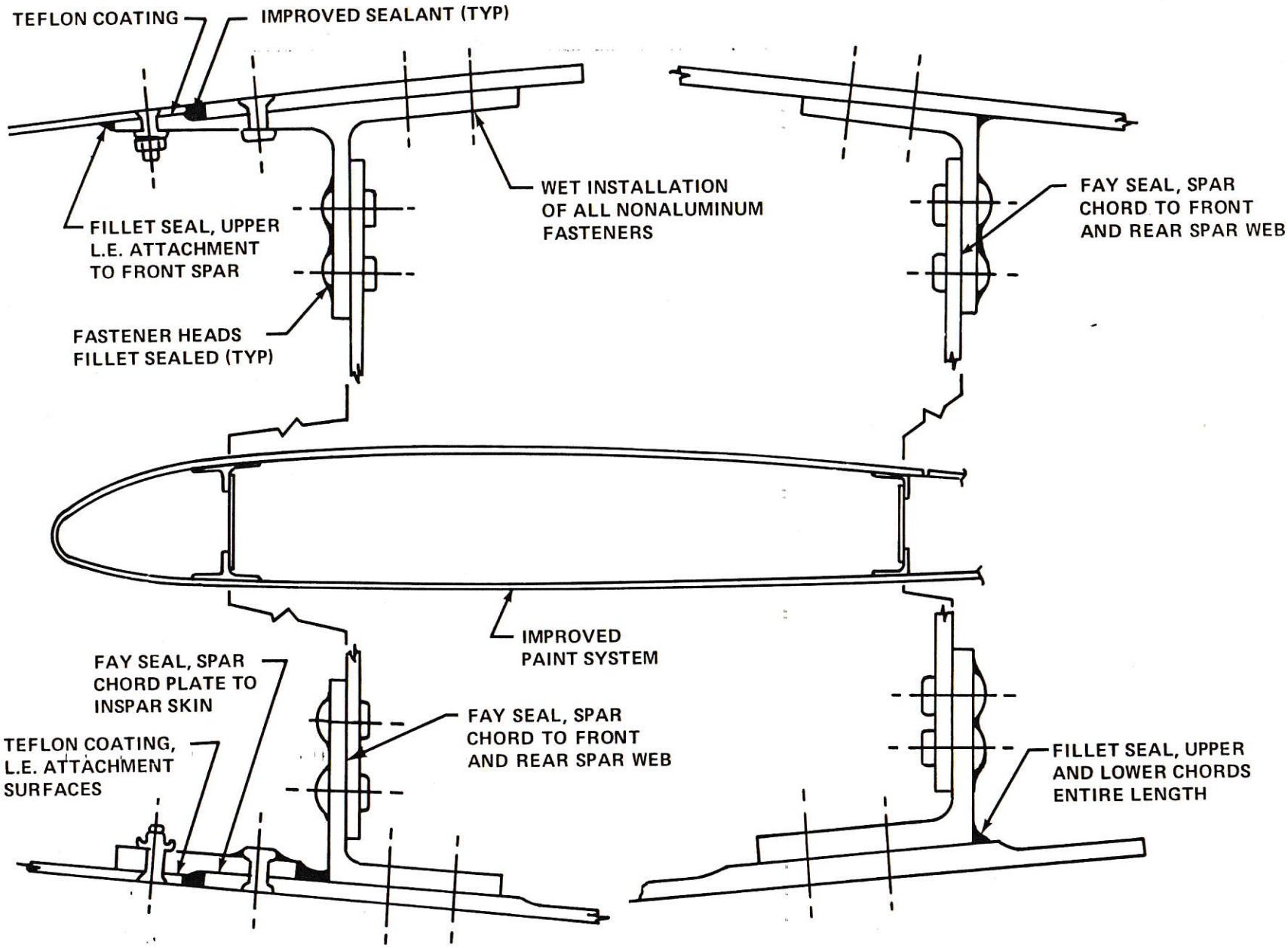

TEFLON COATING
IMPROVED SEALANT (TYP)
FILLET SEAL, UPPER L.E. ATTACHMENT TO FRONT SPAR
WET INSTALLATION OF ALL NONALUMINUM FASTENERS
FAY SEAL, SPAR CHORD TO FRONT AND REAR SPAR WEB
FASTENER HEADS FILLET SEALED (TYP)
IMPROVED PAINT SYSTEM
FAY SEAL, SPAR CHORD PLATE TO INSPAR SKIN
FAY SEAL, SPAR CHORD TO FRONT AND REAR SPAR WEB
TEFLON COATING, L.E. ATTACHMENT SURFACES
FILLET SEAL, UPPER AND LOWER CHORDS ENTIRE LENGTH

Figure 1.

Intergranular corrosion has appeared around nonaluminum fasteners in the lower wing skin, as shown in Figure 2. To eliminate this problem, airplanes delivered after early 1973 will have all nonaluminum fasteners on the wing lower surface installed with wet sealant (or primer) in the countersink, as illustrated in Figure 3. Additionally, airplanes delivered after early 1973 will incorporate the use of an improved paint system in this area.

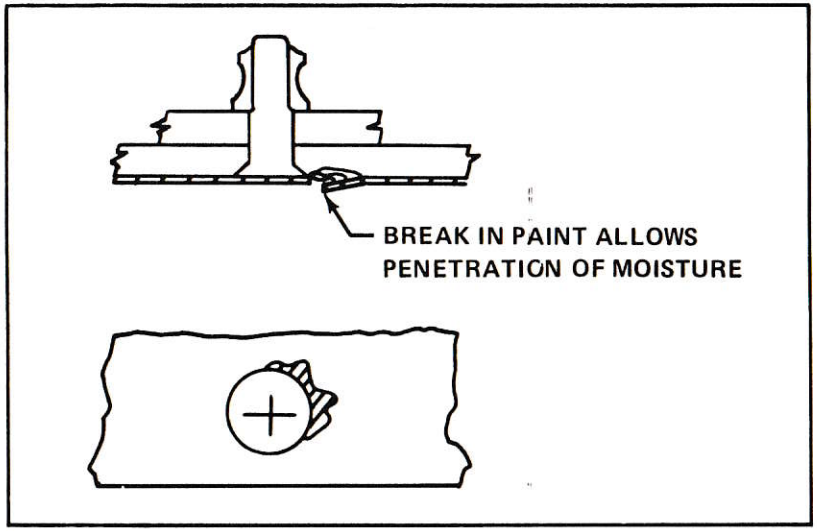


Figure 2.

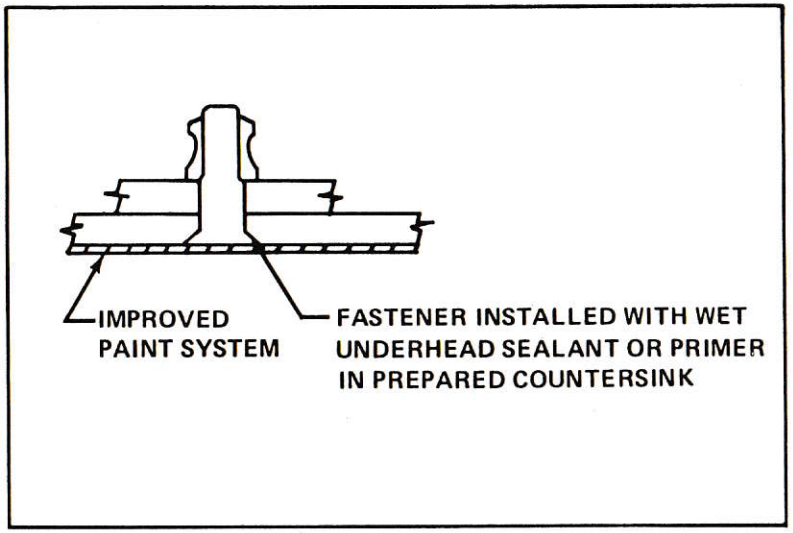


Figure 3.

Intergranular corrosion of the lower wing inspar skin at the front spar chord plate interface has occurred in service (see Figure 4). Elimination of this problem has been accomplished by installing a faying surface seal between the spar chord plate and lower inspar skin (see Figure 5). Airplanes delivered after early 1970 have this improvement incorporated.

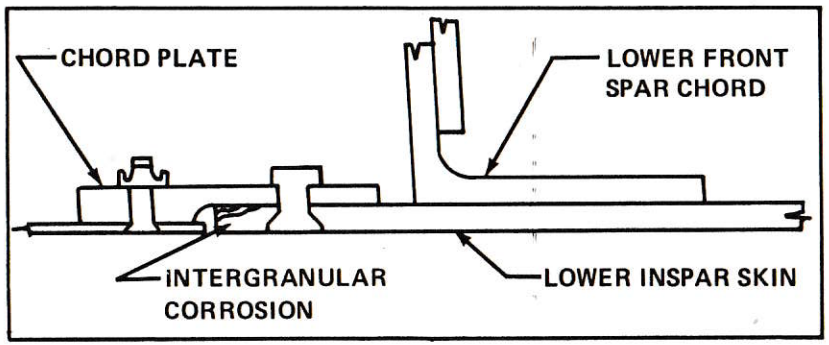


Figure 4.

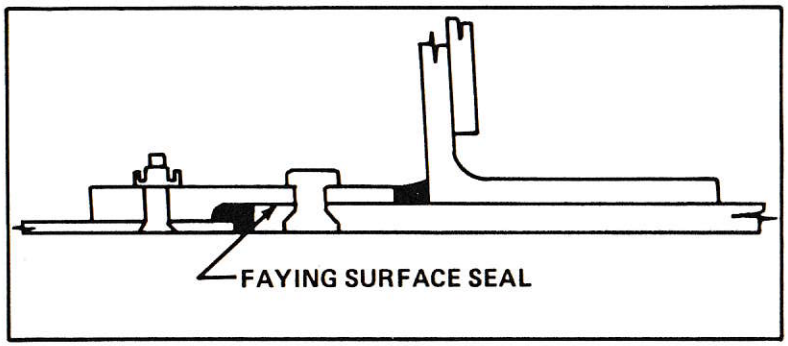


Figure 5.

Intergranular corrosion has been encountered around wing front and rear spar chord fasteners due to penetration of moisture under the paint at fastener locations as shown in Figure 6.

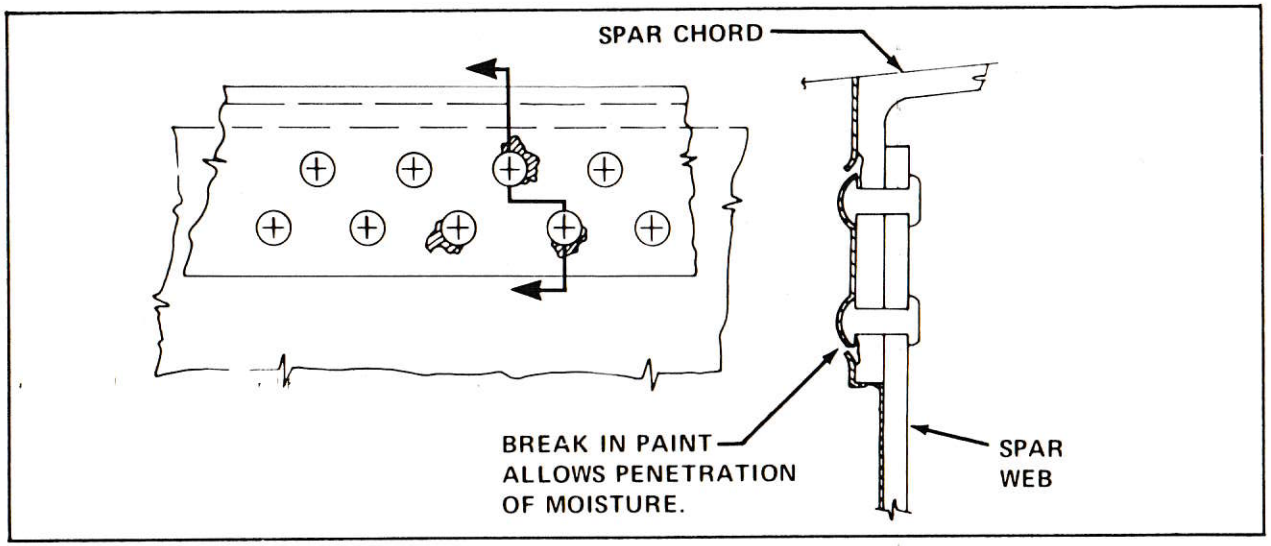


Figure 6.

All airplanes delivered after October 1969 have all the fasteners through the wing front and rear spar chords, common to the spar web, fillet sealed and painted as shown in Figure 7.

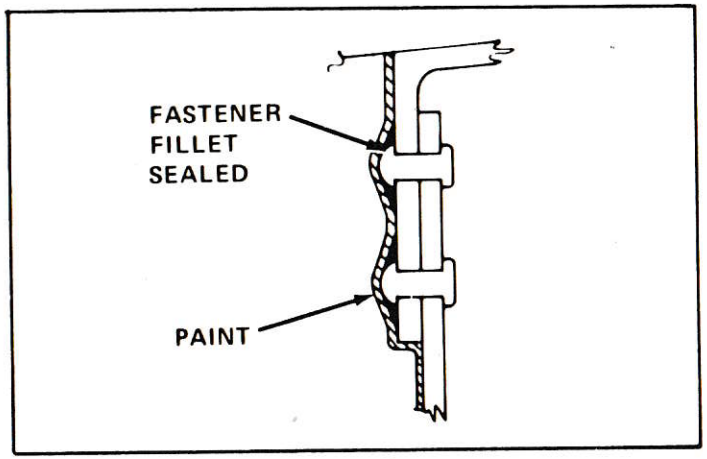


Figure 7.

Intergranular corrosion of the front and rear spar chords, originating at the edge of the spar chord/spar web interface, has been found (see Figure 8).

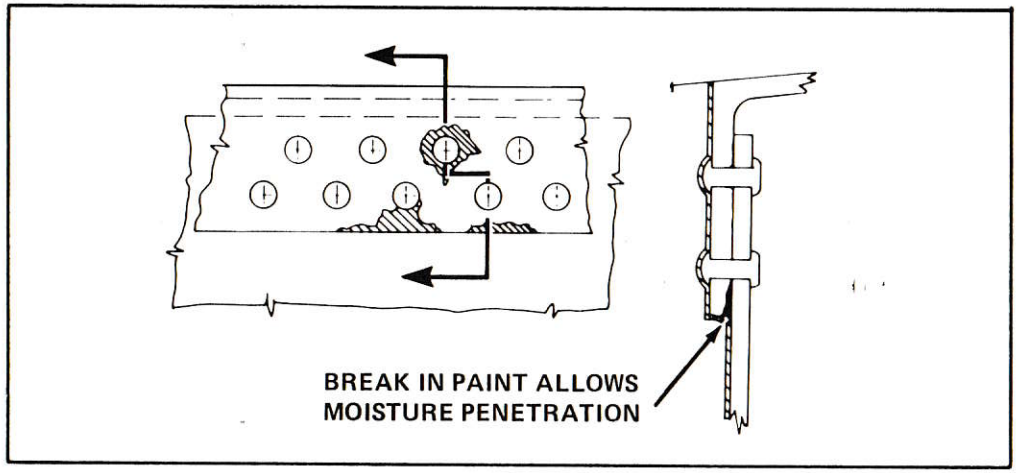


Figure 8.

As a product improvement, fillet seals were added at front and rear spar chords and their respective webs on airplanes delivered during the period January 1972 through mid-1972. Faying surface seal of spar web/chord mating surfaces replaces the above fillet seal on airplanes delivered after mid-1972 (see Figure 9). Faying surface seal of spar stiffeners and fittings at the spar chord interface has also been added on airplanes delivered after mid-1972. The upper front and rear wing spar chord material will be changed to 7075-T73511, replacing 7178-T6, on airplanes delivered after early 1973.

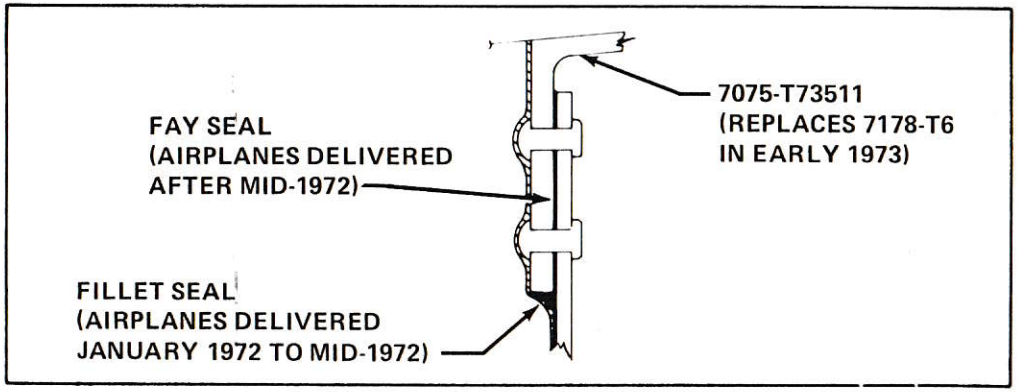


Figure 9.

Intergranular corrosion around fastener heads on the external surface of the lower wing skin (wing center section) in the area of the ram air inlet has been reported (see Figure 10).

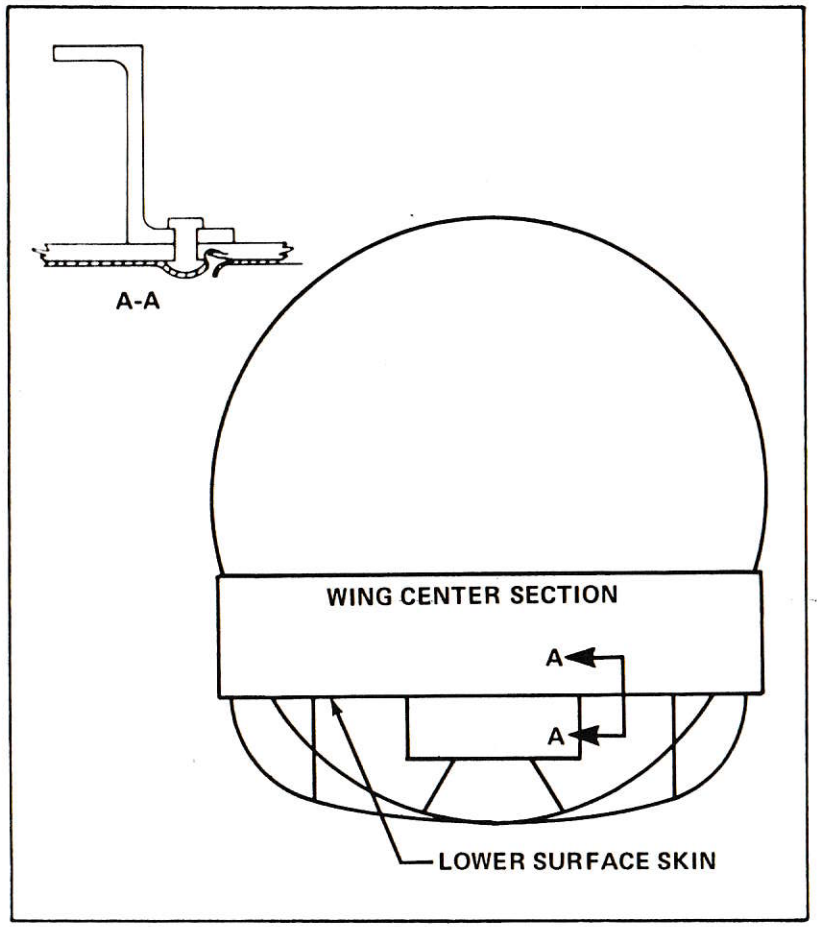


Figure 10.

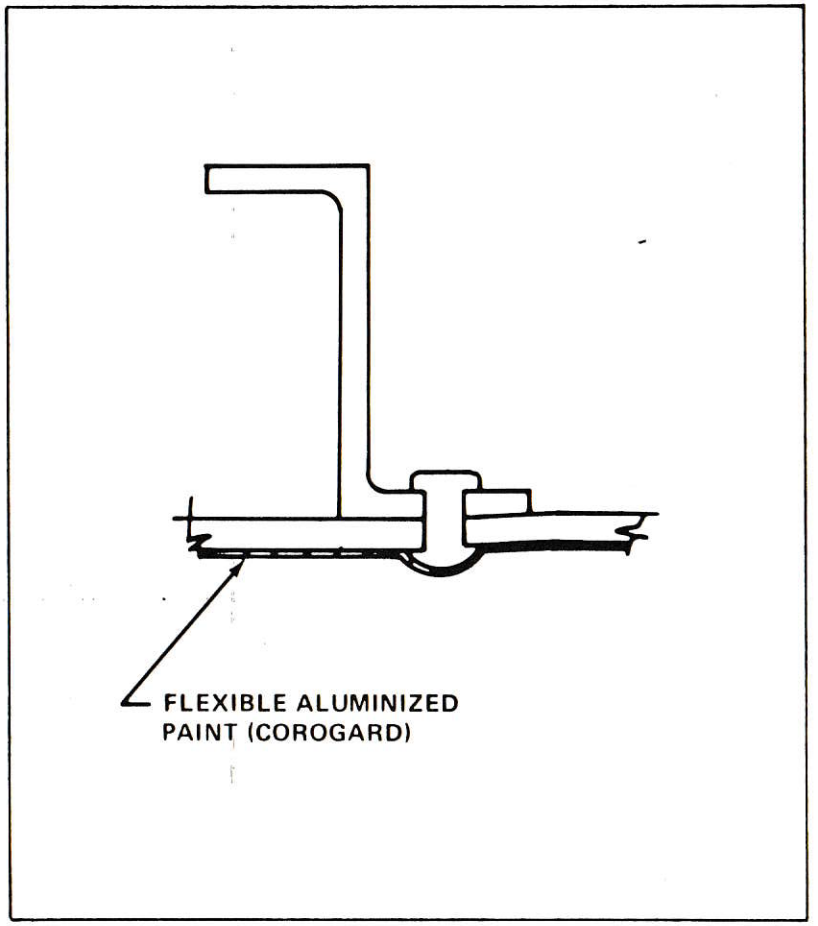


Figure 11.

All airplanes delivered after early 1973 will have the original epoxy enamel finish replaced by Corogard on portions of the lower wing skin (see Figure 11).

FUSELAGE – CORROSION PREVENTION

The fuselage corrosion preventative measures incorporated on the 727 are listed below and are generally illustrated in Figure 12.

- Apply improved decorative paint system with greater resistance to filiform corrosion
- Add corrosion inhibiting adhesive primer (CIAP) to hot bonded skin panels and doublers
- Faying surface seal lap splices
- Faying surface seal all structures below cargo floor common to interior of body skin

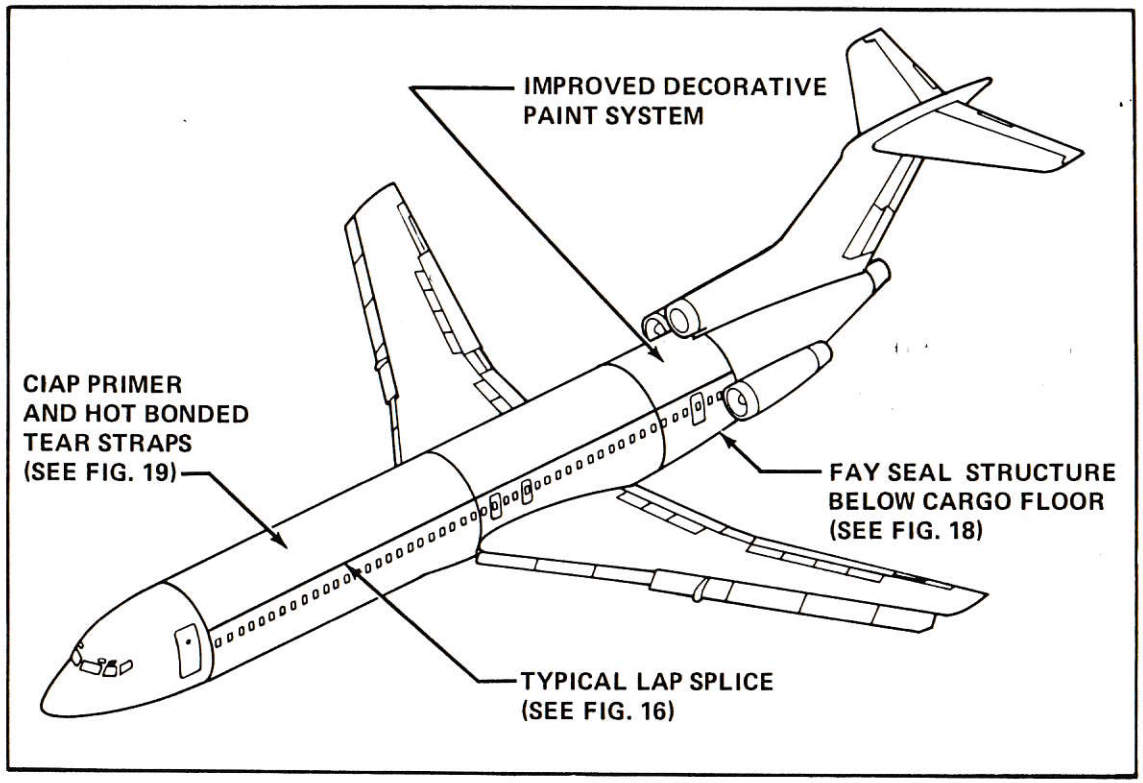


Figure 12.

Subsequent pages in this section cover individual product improvement areas of the fuselage.

Decorative painted exterior skins have experienced filiform corrosion at fasteners under the decorative paint, as illustrated in Figure 13.

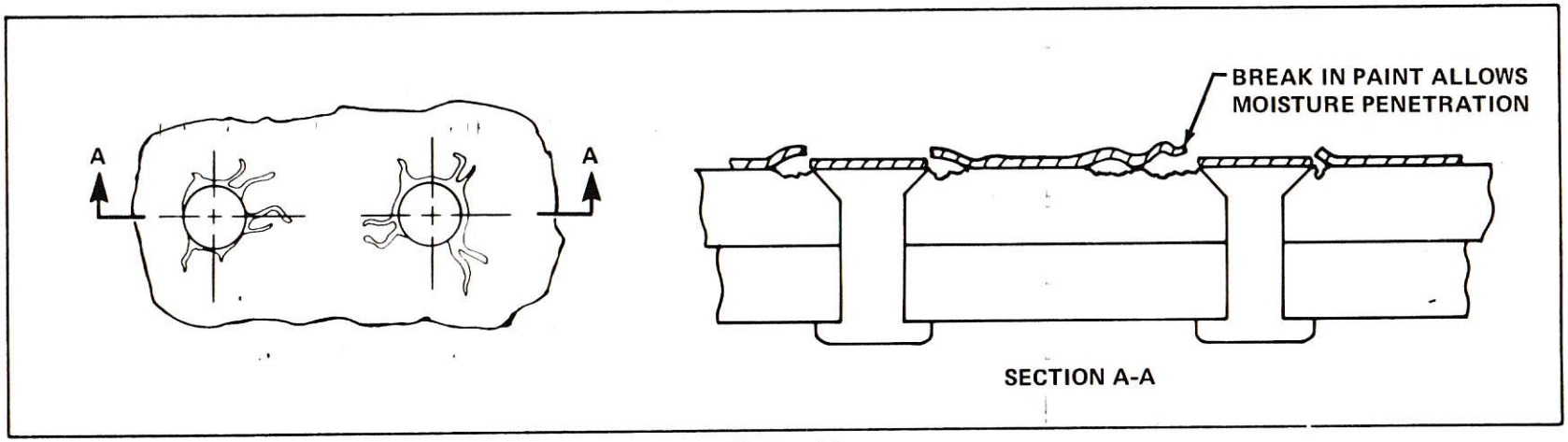


Figure 13.

Elimination of this problem was accomplished in February 1970 with incorporation of an improved decorative paint system (see Figure 14).

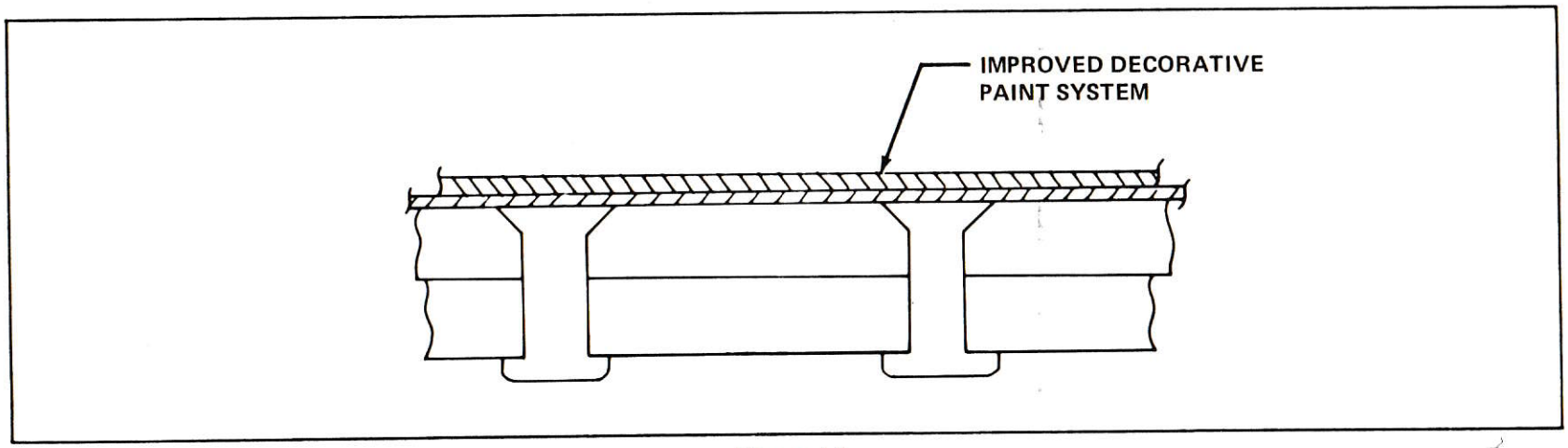


Figure 14.

Pitting and intergranular corrosion in fuselage lap splices bonded with BMS 5-10 room temperature curing adhesive has occurred on the 727 airplane (see Figure 15).

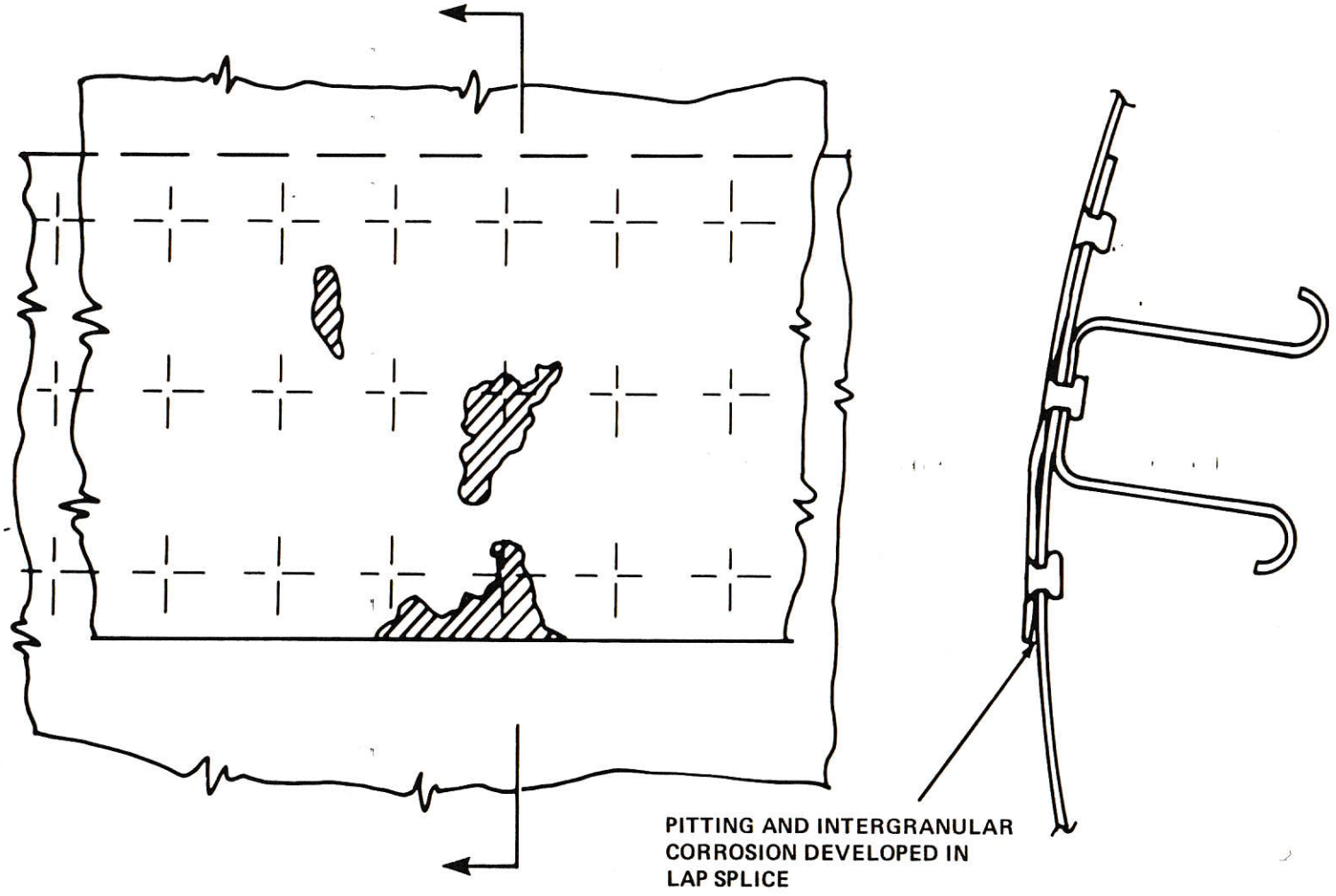


Figure 15.

Corrosion-inhibiting adhesive primer (CIAP) was added to all bonded skin panels on airplanes delivered after October 1969 to eliminate lap splice corrosion. In addition, BMS 5-10 adhesive in lap splices has been replaced with a redesigned joint incorporating a chromate loaded elastomeric faying surface sealant on airplanes delivered after January 1971 (see Figure 16).

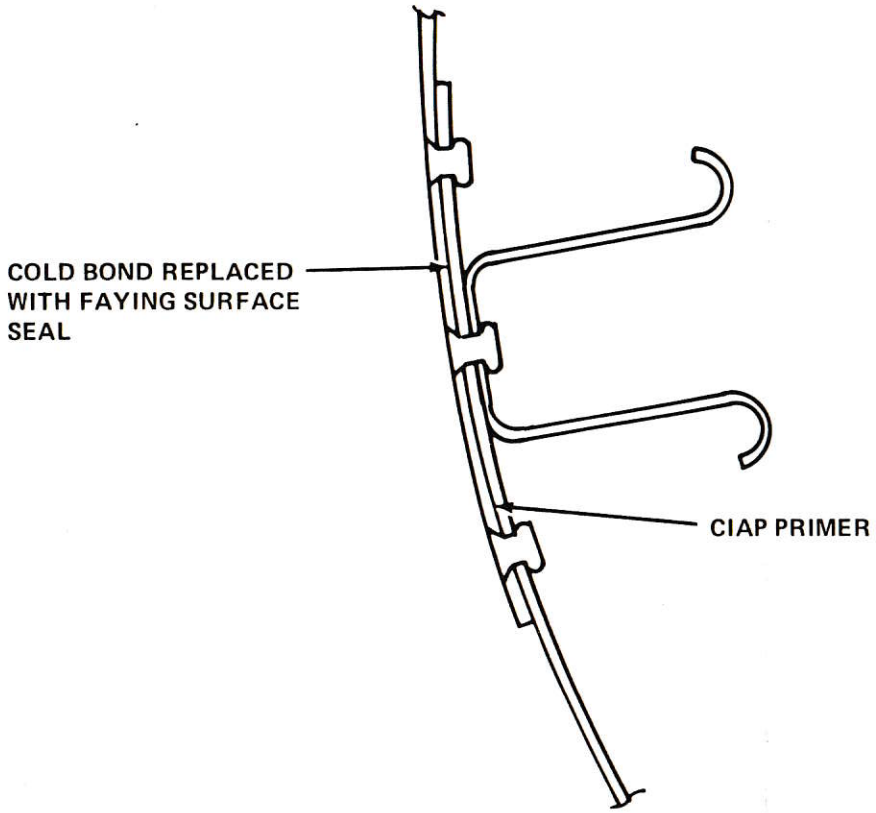


Figure 16.

Intergranular and pitting corrosion of body lower lobe skins and stringers has been found on some aircraft (see Figure 17).

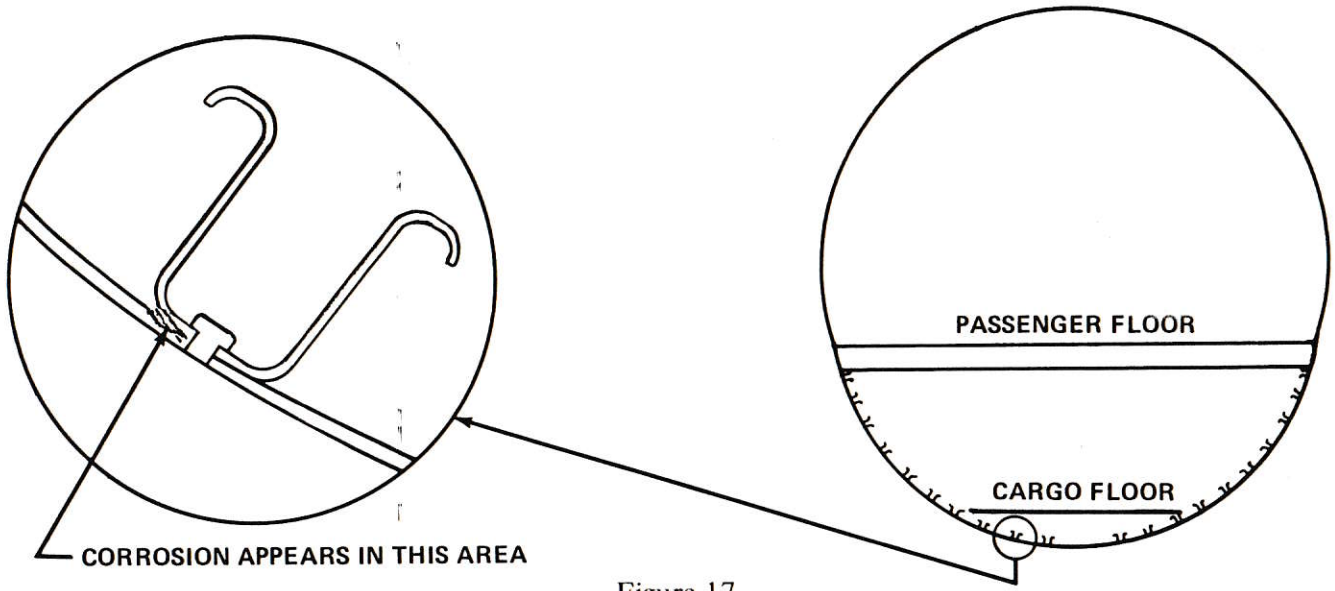


Figure 17.

All airplanes delivered after early 1973 will incorporate a faying surface seal at all structural interfaces below the cargo floor, common to the interior surface of body skins, to eliminate any possibility of corrosion (see Figure 18).

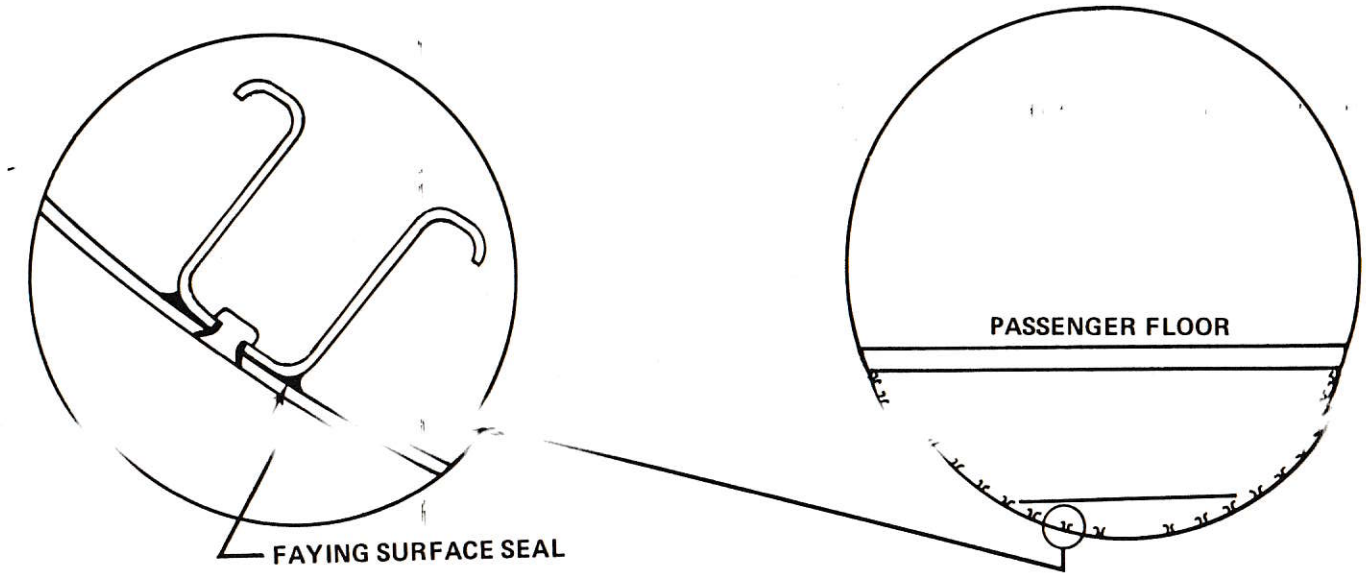


Figure 18.

Intergranular corrosion of fuselage skin and fail-safe straps at bonded surfaces has been eliminated by adding corrosion-inhibiting adhesive primer (CIAP) to all bonded skin panels and replacing the cold bond method of attaching doublers and tear straps with a hot bond process on airplanes delivered after October 1969 (see Figure 19). In addition, a fillet seal has been added to the edges of the body "Buttock Line 0" bonded fail-safe strap on airplanes delivered after November 1969.

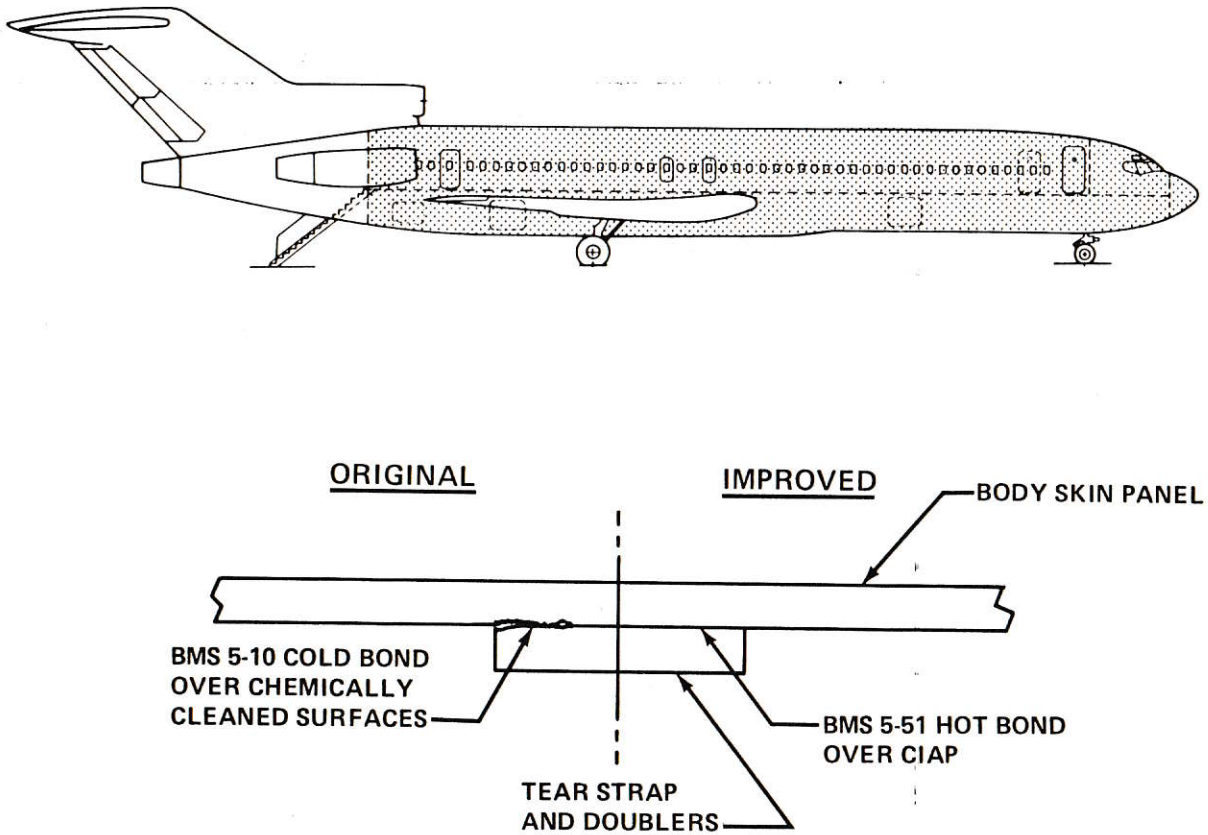


Figure 19.

EMPENNAGE – CORROSION PREVENTION

Product improvement changes to prevent corrosion in the empennage areas are illustrated in Figure 20 (Vertical Stabilizer) and Figure 21 (Horizontal Stabilizer). Specific improvements follow, with details on subsequent pages.

Vertical Fin

- Faying surface seal inspar skins to spar chords and splice stiffeners
- Faying surface seal rear spar chords to spar web
- Apply an improved decorative paint system with greater resistance to filiform corrosion
- Apply Corogard paint on aft surface of rear spar in areas not subject to hydraulic fluid
- Fillet seal fasteners on rear spar chord in areas subject to hydraulic fluid
- Teflon coat removable leading- and trailing-edge panels and faying surface seal permanent panels at trailing-edge attachment surfaces to spar chords

Horizontal Tail

- Faying surface seal spar chords to inspar skins
- Apply Corogard paint on aft surface of rear spar in areas not subject to hydraulic fluid
- Faying surface seal rear spar chords to rear spar web
- Teflon coat removable leading- and trailing-edge panels and faying surface seal permanent panels at trailing-edge attachment surfaces to spar chords
- Apply an improved paint system to exterior surfaces
- Fillet seal rear spar fasteners in areas subject to hydraulic fluid

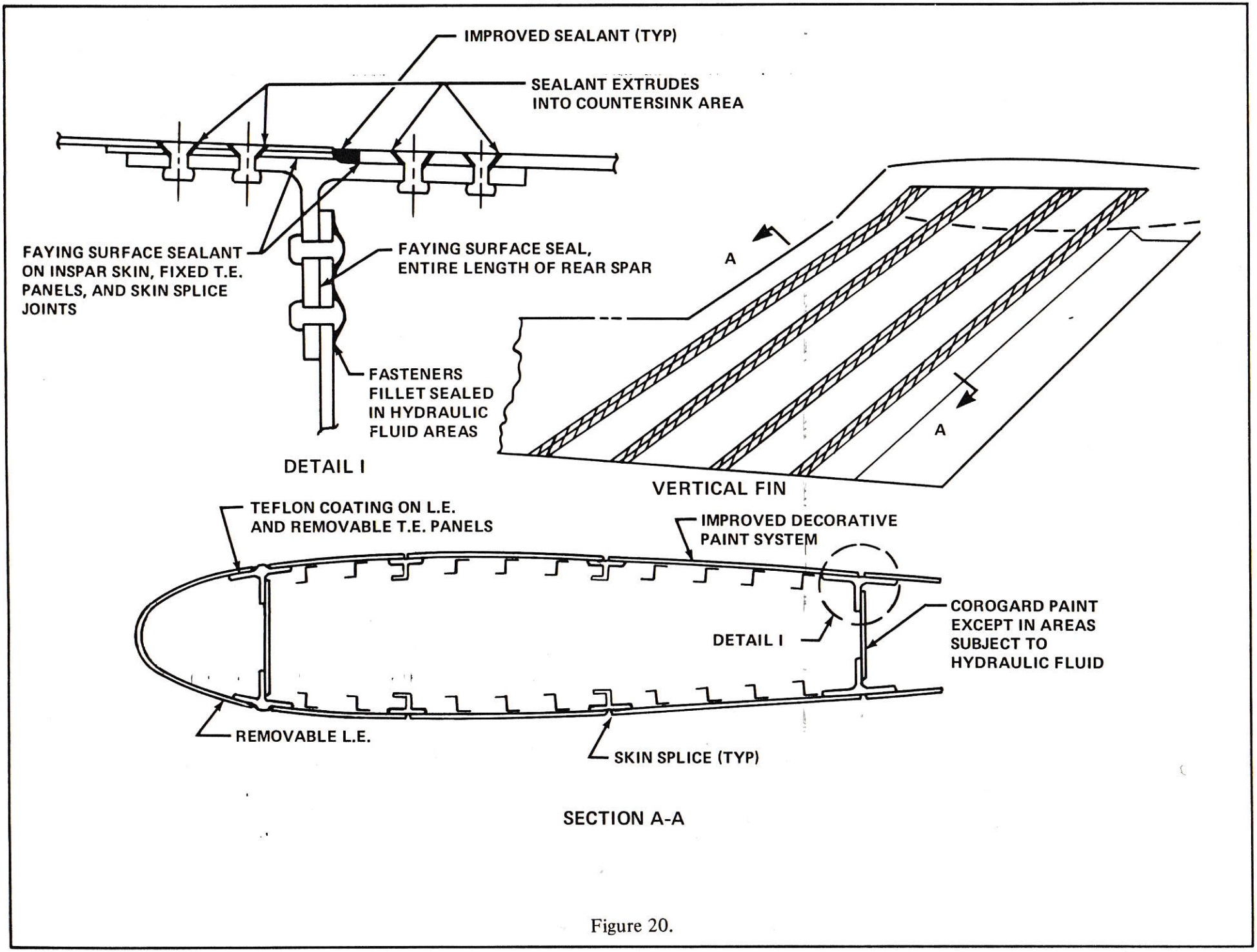

IMPROVED SEALANT (TYP)
SEALANT EXTRUDES INTO COUNTERSINK AREA
FAYING SURFACE SEALANT ON INSPAR SKIN, FIXED T.E. PANELS, AND SKIN SPLICE JOINTS
FAYING SURFACE SEAL, ENTIRE LENGTH OF REAR SPAR
FASTENERS FILLET SEALED IN HYDRAULIC FLUID AREAS
DETAIL I
A
A
VERTICAL FIN
TEFLON COATING ON L.E. AND REMOVABLE T.E. PANELS
IMPROVED DECORATIVE PAINT SYSTEM
COROGARD PAINT EXCEPT IN AREAS SUBJECT TO HYDRAULIC FLUID
DETAIL I
REMOVABLE L.E.
SKIN SPLICE (TYP)
SECTION A-A

Figure 20.

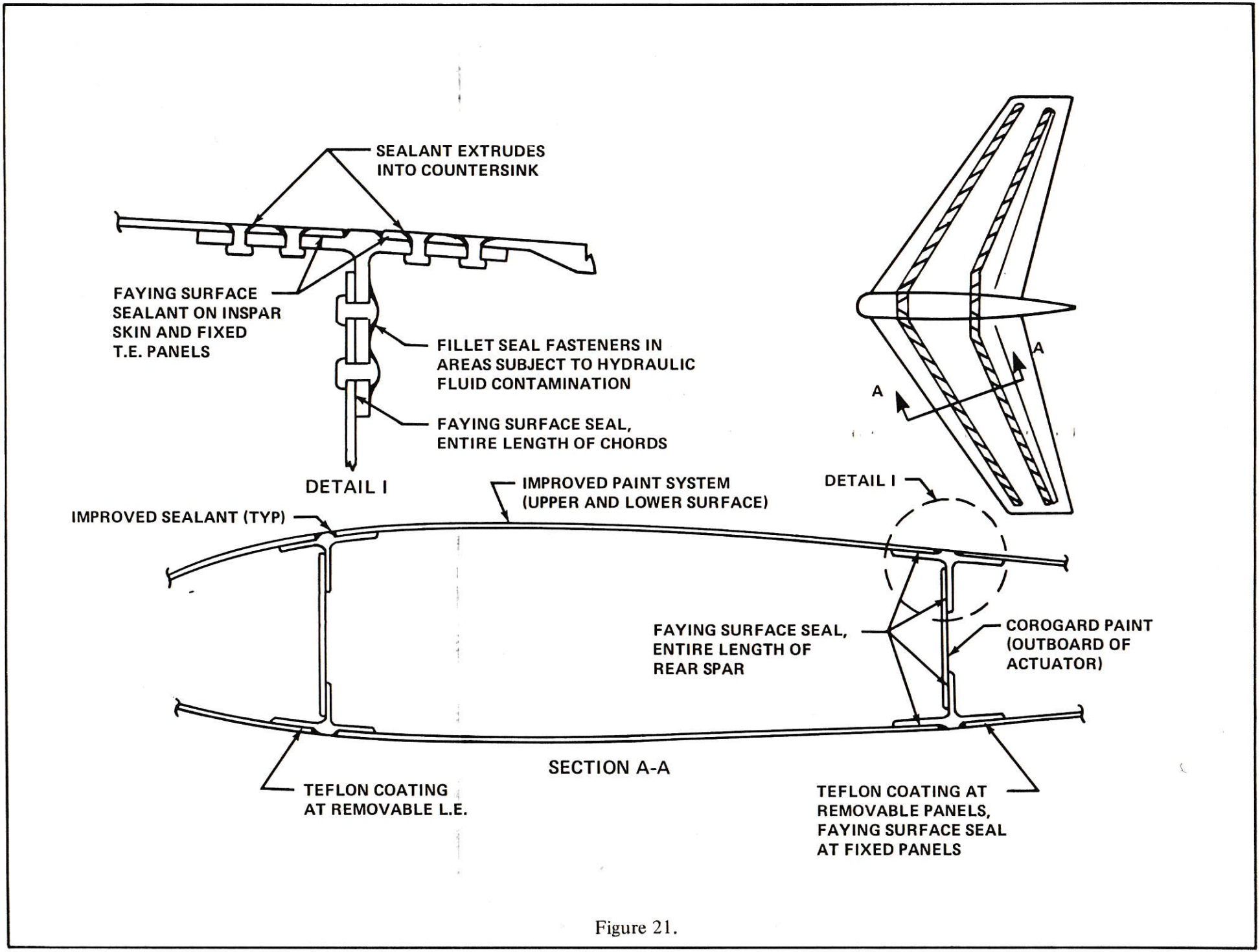

SEALANT EXTRUDES
INTO COUNTERSINK
FAYING SURFACE
SEALANT ON INSPAR
SKIN AND FIXED
T.E. PANELS
FILLET SEAL FASTENERS IN
AREAS SUBJECT TO HYDRAULIC
FLUID CONTAMINATION
FAYING SURFACE SEAL,
ENTIRE LENGTH OF CHORDS
DETAIL I
A
A
DETAIL I
IMPROVED PAINT SYSTEM
(UPPER AND LOWER SURFACE)
IMPROVED SEALANT (TYP)
FAYING SURFACE SEAL,
ENTIRE LENGTH OF
REAR SPAR
COROGARD PAINT
(OUTBOARD OF
ACTUATOR)
SECTION A-A
TEFLON COATING
AT REMOVABLE L.E.
TEFLON COATING AT
REMOVABLE PANELS,
FAYING SURFACE SEAL
AT FIXED PANELS

Figure 21.

Vertical Fin

No major corrosion problems have been experienced in the vertical tail section of the 727 airplane. A number of product improvement changes have been made, however, to incorporate corrosion preventative manufacturing techniques and materials that have proven to be effective in other applications.

- Faying surface seals have been added between the fin inspar skin and spar chords and at inspar skin splice joints on airplanes delivered after mid-1972.
- Faying surface seals have been added to the rear spar web/chord interfaces on airplanes delivered after mid-1972.
- Fillet sealing of fasteners common to the rear spar chords has been accomplished in areas subject to hydraulic fluid contamination on airplanes delivered after mid-1972.
- A coat of epoxy primer has been added to the exterior surfaces of the rear spar in areas subject to hydraulic fluid contamination, and Corogard paint has been added to the remaining exterior spar surfaces on airplanes delivered after early 1972.
- Faying surface seals or teflon coatings have been added to permanent and removable attachment surfaces of the fin leading- and trailing-edge panels as applicable.

Horizontal Tail

Intergranular corrosion of the horizontal stabilizer skin at spar fasteners has occurred in service. An improved decorative paint system, replacing the epoxy primer and polyurethane enamel system, will be applied to airplanes delivered after mid-1972 as a product improvement. In addition, a faying surface seal has been added between the inspar skin and spar chords on airplanes delivered after mid-1972 (see Figure 22).

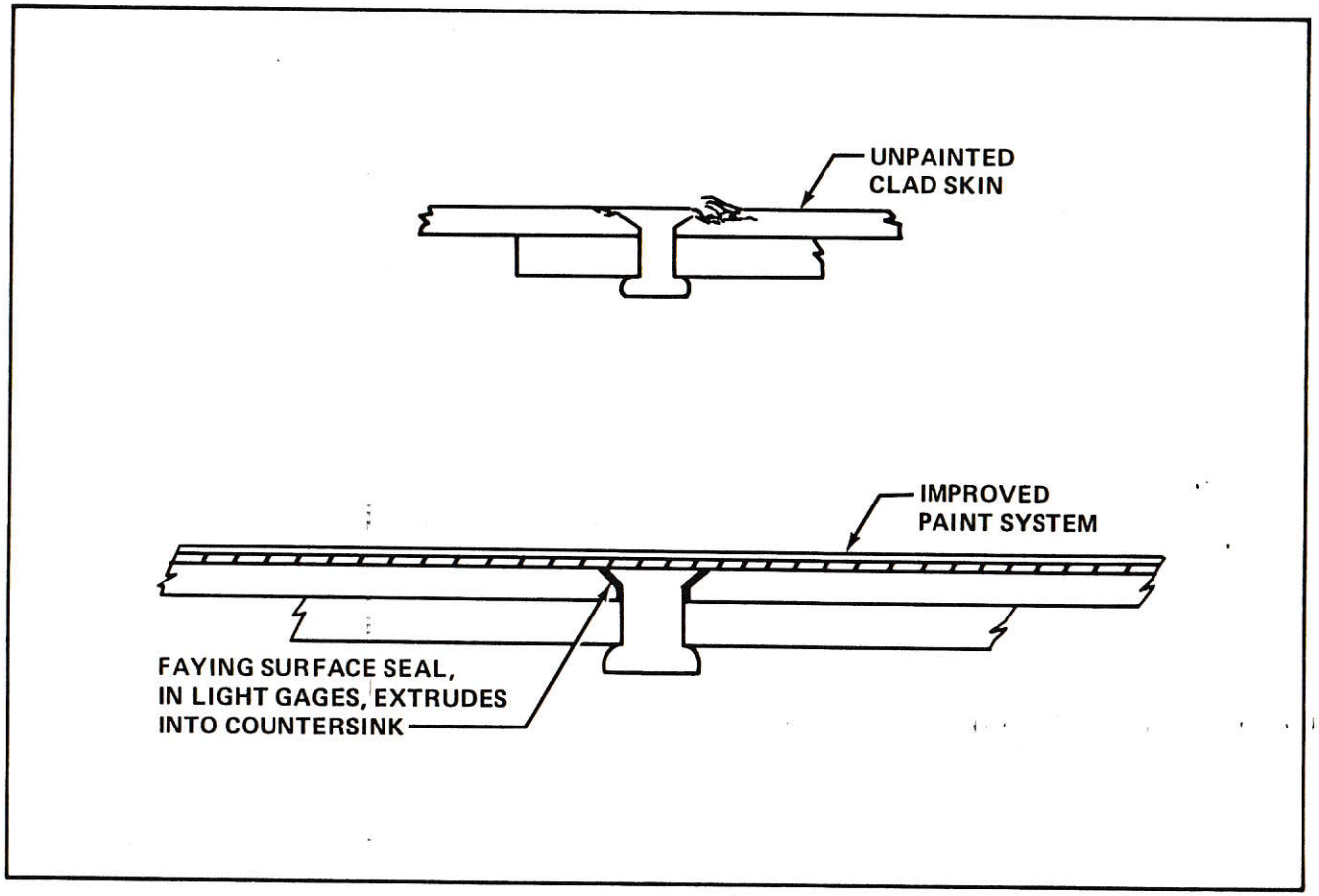


Figure 22.

Intergranular corrosion of the horizontal stabilizer rear spar chord at fasteners common to the spar web has occurred on some 727 airplanes. Corrosion resistance has been improved by fillet sealing fasteners that are subject to hydraulic fluid contamination through the rear spar chord and common to the spar web. Exposed spar surfaces in this area also receive a second coat of primer. Exposed spar surfaces not subject to hydraulic fluid contamination receive a second coat of primer and Corogard paint. These changes are illustrated in Figure 23 and are incorporated in airplanes delivered after early 1972.

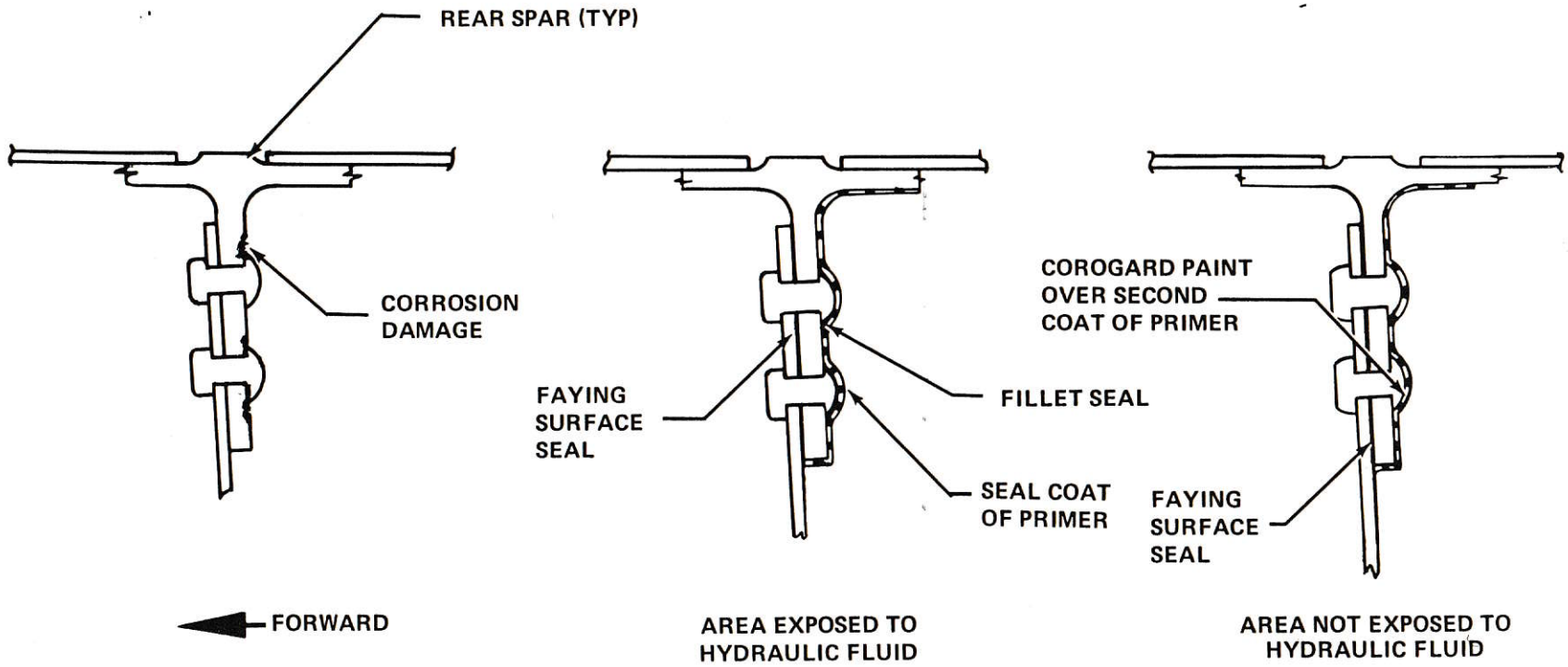


Figure 23.

LANDING GEAR – CORROSION PREVENTION

Product improvement changes to prevent corrosion in the landing gear area are: (1) the addition of a hard anodize finish to the nose gear steering collar and (2) the addition of chrome plating to the nose gear drag brace actuating arm. These changes are illustrated in Figure 24.

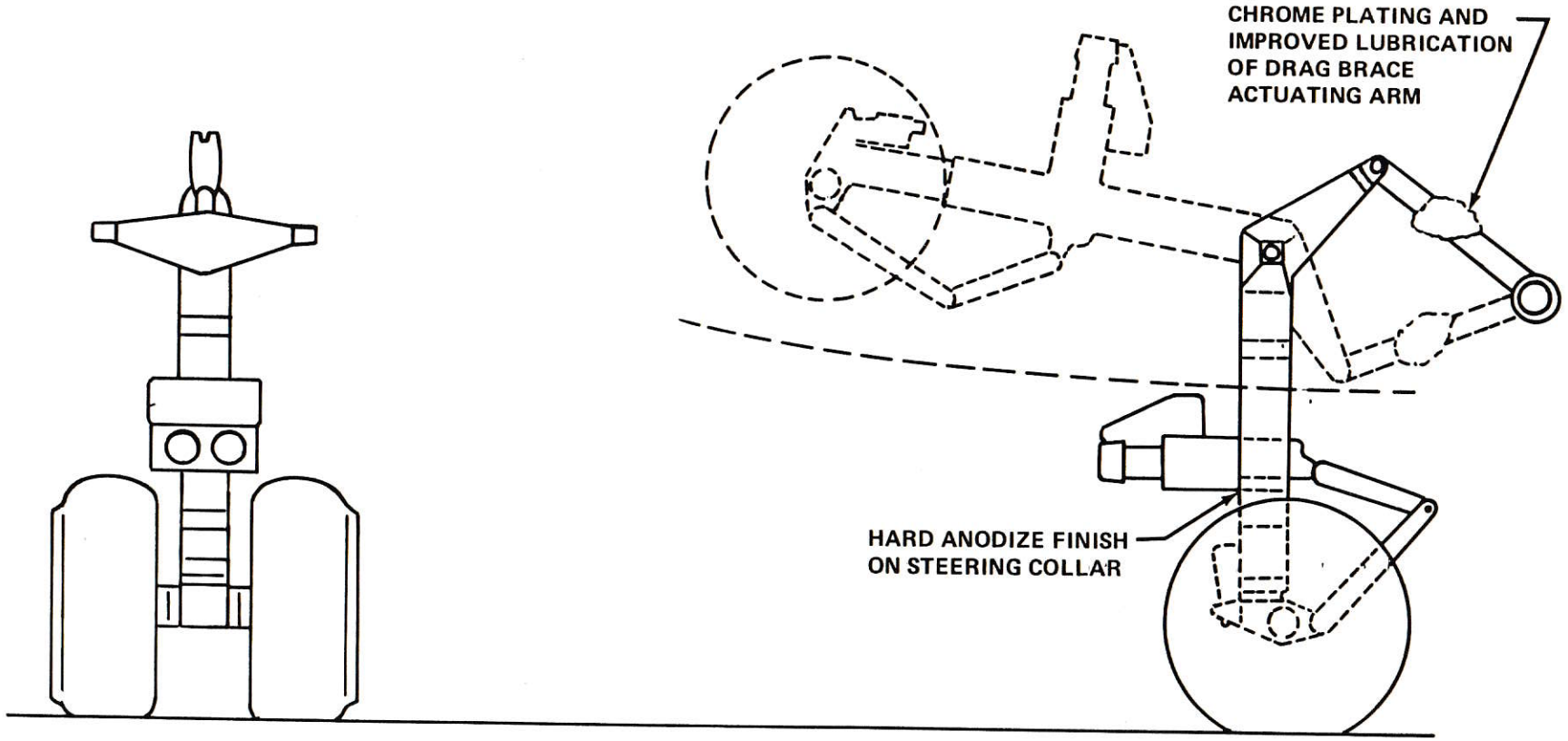


Figure 24.

Intergranular corrosion of the nose landing gear steering collar, at the bushing-to-collar interface, has occurred in service. In April 1969, a coat of epoxy primer was added to the steering collar at the bearing faying surface to eliminate corrosion. Airplanes delivered after mid-1972 have been further improved by changing the steering collar forging material from 7079-T6 to the highly corrosion-resistant 7075-T73, and a hard anodize coating has been added to the steering collar at the bearing faying surface. Figure 25 illustrates the corrosion area and the improvements being incorporated.

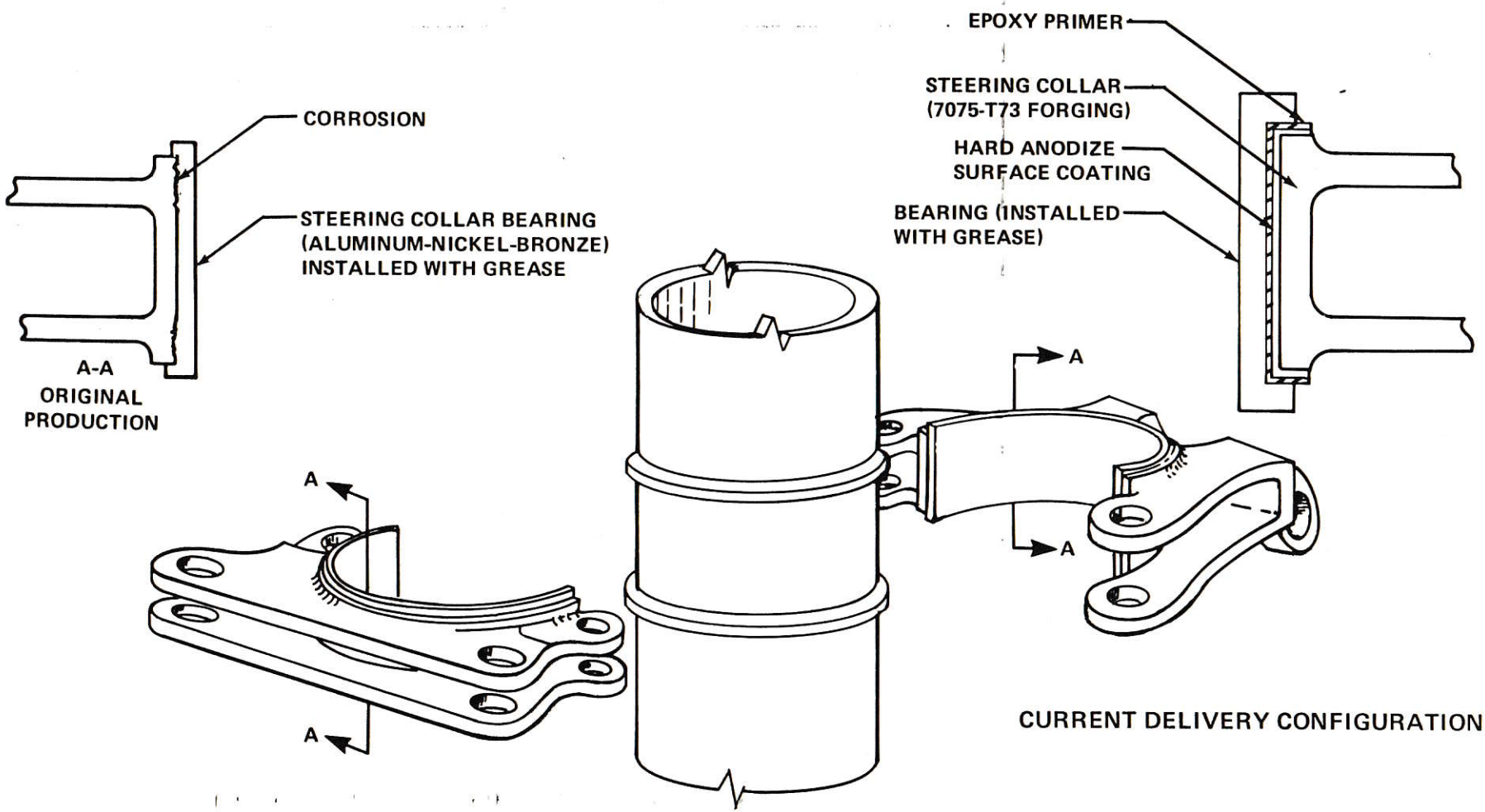


Figure 25.

Pitting corrosion of the nose landing gear drag brace actuating arm shaft, at bearing surfaces and in splines, occurred on some airplanes delivered prior to February 1971. Airplanes delivered since that time incorporate the following changes, which are illustrated in Figure 26:

- Elimination of dry film lubricant from actuating arm shaft and splines
- Chrome plate actuating arm shaft and thrust face
- Cadmium plate splines and actuating arm shaft
- Addition of grooves and holes to bushings to provide positive grease flow to shaft and splines

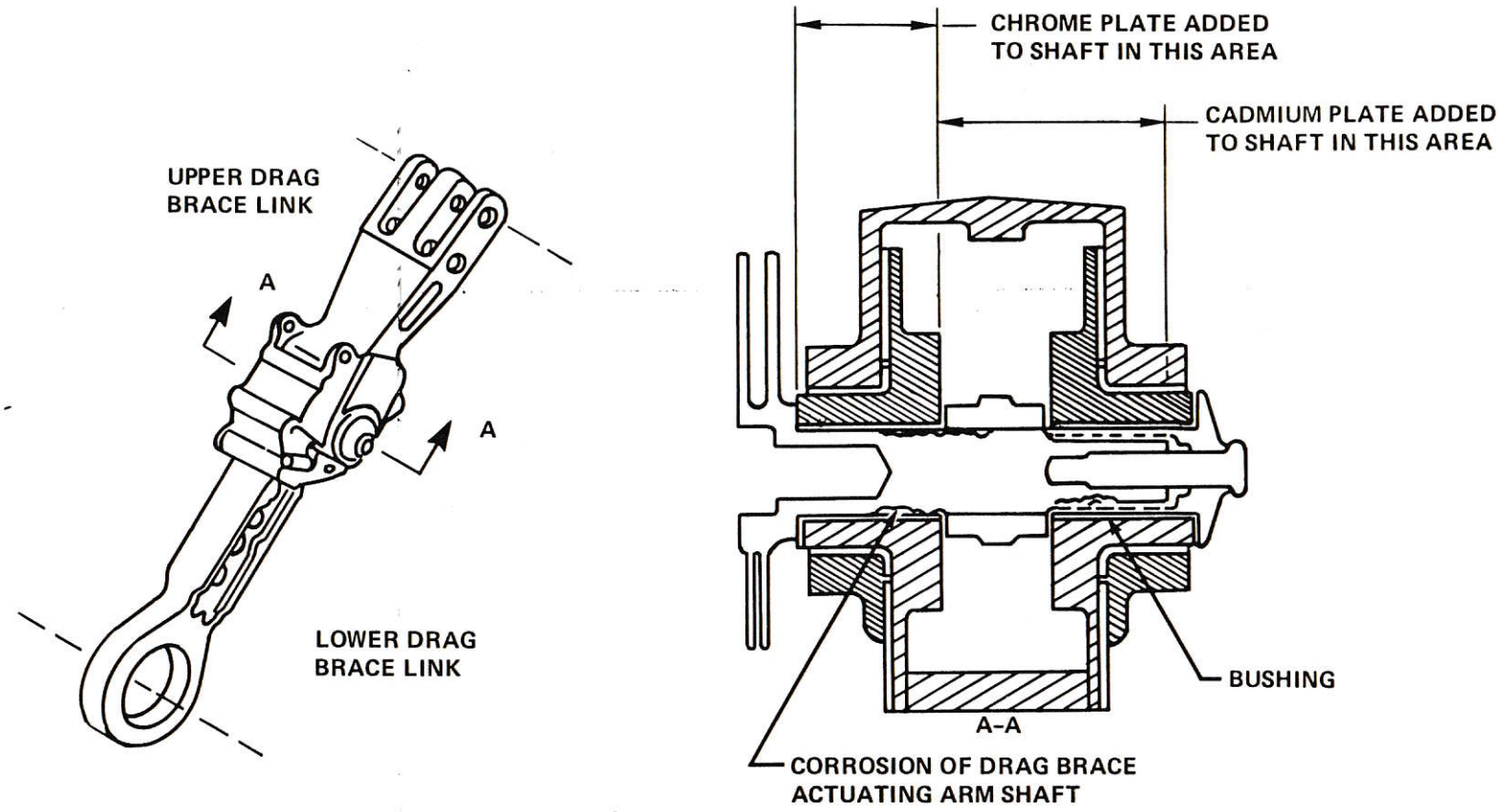


Figure 26.

ADDITIONAL CORROSION PREVENTATIVE MEASURES

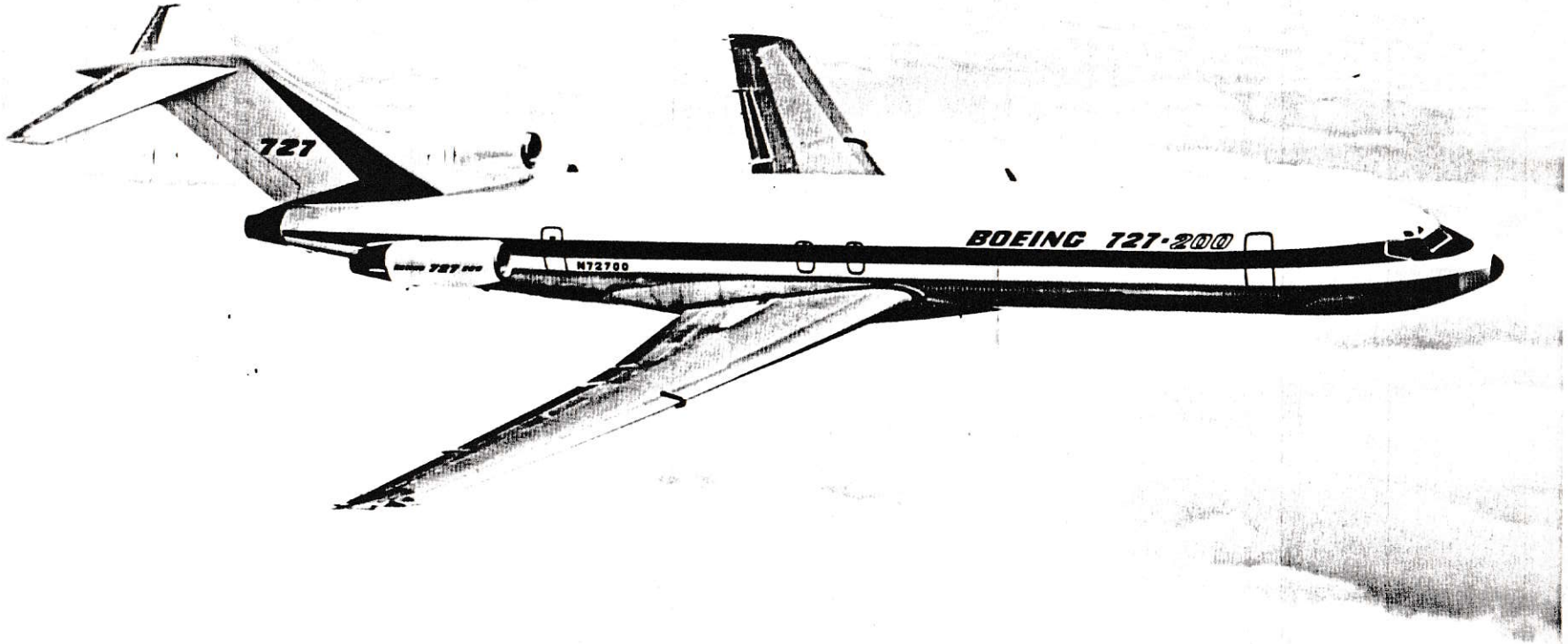
The following corrosion preventative measures will be incorporated on airplanes delivered in early 1973 in addition to those specific changes detailed in previous pages of this document.

- BMS 5-10 (structural cold setting bond) adhesive is eliminated
- Nonaluminum fasteners in airplane unpainted exterior areas are cadmium-plated corrosion-resistant steel
- Insulation blankets are restrained from contacting skin in bilge area
- All structure in the integral fuel tank is finished with fuel-resistant primer (BMS 10-20)
- Corrosion-inhibiting adhesive primer (CIAP) is used on all metal bonded assemblies
- Positive moisture drainage to body bilge drain valves is assured
- Thin gage (0.020 and less) clad aluminum is painted
- Corrosion-resistant honeycomb core (BMS 4-4F) is used
- Nonaluminum fasteners in primary structure composing the airplane exterior surfaces are installed with underhead sealant or primer

- Structure immediately under the toilets, galleys, and entryways is painted with Corogard.
- An improved aerodynamic sealant compound exhibiting superior resistance to weathering and shrinkage is utilized.
- All magnesium parts receive a minimum of two coats of primer on each faying surface in addition to faying surface seal where in contact with dissimilar metal. Magnesium parts located on the airplane exterior receive an additional two coats of enamel paint.
- Silver loaded epoxy adhesive is removed from static discharger installation.
- Upper and lower wing splice joints at the side of the body are painted with Corogard.
- LPS-3 moisture-displacing organic inhibitor is applied during airplane manufacture.

Application of LPS-3 moisture-displacing organic inhibitor during airplane manufacture has become part of the Boeing corrosion-prevention program. This compound is applied in inaccessible areas of the fuselage, wing, empennage, and landing gear that would require djsassembly or removal for LPS-3 application during service.

THE BOEING CORROSION PREVENTION PROGRAM FOR THE 727 HAS BEEN A MAJOR FACTOR IN ESTABLISHING THE 727 AS BOEING'S MOST SUCCESSFUL MODEL, WITH OVER 1000 AIRPLANES SOLD. THE 727, LIKE BOEING MODELS 707, 737, AND 747, IS CONTINUALLY UPDATED TO REFLECT THE COMBINED EXPERIENCE GAINED AND NEW TECHNOLOGY DEVELOPED IN ALL PROGRAMS, WHICH ENSURES A STRUCTURALLY SUPERIOR PRODUCT.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BOEING 727-200
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