## 1. Applicability

All Piper PA28 series aeroplanes and PA32, PA34, and PA44 series aeroplanes which share common methods and materials of wing trailing edge flap construction to those used in the PA28 series.

## 2. Purpose

To alert operators and maintainers to potential severe undetected corrosion in the flap and flap attachment structure and to direct attention to the Piper Service Manual inspection recommendations.

## 3. Background

CASA continues to receive reports of corrosion defects in PA28 flap structure describing severe corrosion, missing sections of nose ribs, corroded spars and missing rivets. It may be possible for an internal inspection to find evidence to remove the flap from service. However, in every case, the full extent of the damage was only revealed when the flap structure was dismantled.

### Flap Nose Skins Ribs and Spars

Wing flap nose ribs PN 62328-00 and PN 62328-01 are frequently found badly corroded in the enclosed flap leading edge area. In one case, removal of the leading edge revealed heavy corrosion in all six nose ribs, three of which had separated from the spar. The aluminium spar had been completely corroded through where attached to the steel centre hinge bracket (Figure1).

Figure 1. Typical flap nose rib and spar corrosion The steel hinge arm has been removed.

While periodic inspections of the internal flap structure using borescopes etc. can detect corrosion, the true extent of any damage can only be fully appreciated when the skin is removed (Figure 2).

Figure 2. Removed flap skin showing extensive flap nose skin corrosion.

In one case, all ribs in one flap had parted from the attachment brackets and the trailing skin rib situated under and on the outer end of the strengthened walkway portion of the flap had corroded away to virtually nothing.

An external inspection would not have likely detected the missing rivets and corrosion shown in Figure 3.

Figure 3. Missing rivets and rib corrosion.

### Wing Flap Hanger Brackets

The aluminium wing flap attachment hinge/hanger brackets have been found to contain severe exfoliation corrosion on the exposed surface of the bracket (inside the wing), accompanied by missing rivet head/tails due to corrosion (Figure 4).

Figure 4. Corroded section of flap hanger bracket.

This intergranular corrosion weakens the strength of the bracket. When a corroded flap hanger bracket is detected, the wing structure underneath the bracket could also be expected to be damaged from corrosion (Figure 5).

Figure 5. Corroded wing structure under the flap hanger bracket.

The Piper Maintenance Manual and Progressive Inspection Manuals for the PA28, PA32, PA34 and PA44 provide specific instructions to address this problem and typically state at Section 53-30-00 of the Maintenance Manual:

*Para A. Each 200 Hours*
*For airplanes with wing flap(s) which have accumulated ten (10) years time-in-service,conduct the following special inspection each 200 hours: Inspect the interior of the wing flap for evidence of dissimilar metal corrosion where aluminum sheet metal is in contact with steel flap brackets. Use a bore scope or other suitable tool. Installation of a new wing flap will relieve this inspection requirement until such time as the replacement wing flap reaches ten (10) years time-in-service.*

(**FAA SAIB CE-11-10** (5 January 2011) also refers)

Unfortunately, in many cases the manufacturer has not provided access panels which could be used to gain access for an internal inspection of the flap structure.

## 4. Discussion

While all metal aircraft will suffer from corrosion issues as they age, each aircraft will exhibit unique deterioration characteristics according to the materials and methods of construction used as well as the environment in which the aircraft is stored, operated and maintained over its life.

The onset and rate of corrosion will be more rapid where a ‘bare’ metal-to-metal aluminium structure i.e. assembled without primer, is operated in a saline environment without being regularly washed with fresh water. Similarly, an aircraft that is stored outside, particularly over grass and not carefully maintained will be especially susceptible to corrosion damage.

Even structures assembled with coatings such as zinc chromate primer, aluminium cladding and paint will eventually succumb to corrosion as these coating protections will steadily deteriorate and eventually become exhausted as they are consumed while providing the desired corrosion protection.

The rate of deterioration is particularly high where materials such as lead and steel are joined directly to aluminium. It follows that extensive and destructive dissimilar metal corrosion can be expected where the steel flap attachment brackets contact the bare metal aluminium spars and internal nose ribs of PA28 aircraft.

### Corrosion Inhibiting Compounds (CIC)

As the presence of moisture is required for corrosion to form, a typical response by some operators and maintainers has been to apply some form of moisture displacing spray-on coating or corrosion inhibiting compound (CIC) to the structure. Such action has had some unfortunate results.

CASA sponsored research has shown:

*"..that the use of CICs on structural joints that rely on friction/clamp up force and which are primarily in shear, such as aircraft lap joints, may experience a reduction in fatigue life due to the ingress of CICs on the faying surface of the joint".*

(Reference: Jaya I, G. Clark / C H. Wang. 'MANAGEMENT OF STRUCTURAL SAFETY RISKS ARISING FROM CORROSION MANAGEMENT PROGRAMS' RMIT University Melbourne, Australia March 2012). Significant elements of this paper are summarised in CASA General Advice AWB 02-042 'The Use of Corrosion Inhibiting Compounds and Effects on Aircraft Structural Joints'.

If approved CICs are used appropriately they can offer substantial benefits in protecting aircraft structure. However, caution should be exercised to ensure that they are appropriate (for example MIL-C-81309A, MIL-C-23411 or MIL-C-16173) and applied in accordance with the aircraft manufacturer's instructions or approved data.

## 5. Recommendations

CASA strongly recommends that operators and maintainers:

1. Conduct detailed inspections of the external and particularly the internal structure of the wing trailing edge flaps and attachment fittings for corrosion, missing rivets and other defects.

2. Such inspections should be completed at the frequencies detailed in the aircrafts' approved maintenance program or at the periods stated in the Piper maintenance data.

3. Where the manufacturer does not provide access for an adequate internal inspection of the flap structure, consider CASR Part 21M engineering approval for the installation of access holes / panels, as required.

4. Consider CASA AWB 02-042 'The Use of moisture Corrosion Inhibiting Compounds and Effects on Aircraft Structural Joints'.

5. Replace or repair corroded structure in accordance with approved data.

6. Monitor aircraft manufacturer's publications for additional guidance including prevention and rectification actions.

## 6. Reporting

Defects describing internal and external corrosion and other defects in wing trailing edge flaps and attaching structure of the aeroplanes identified in the Airworthiness Bulletin should be submitted to CASA via the defect reporting system.

## 7. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link e-mail address:

AirworthinessBulletin@casa.gov.au

or in writing, to:

Airworthiness and Engineering Standards Branch
Standards Division
Civil Aviation Safety Authority
GPO Box 2005, Canberra, ACT, 2601