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ATSB TRANSPORT SAFETY REPORT
Aviation External Investigation AE-2009-045
Final

Engineering examination

Fractured main landing gear axle

Gippsland Aeronautics GA-8 Airvan - VH-BFS

21 June 2009

Abstract

During a flight on 21 June 2009, a Gippsland Aeronautics GA-8 Airvan aircraft, registered VH-BFS, sustained a fracture of the right main landing gear axle assembly, resulting in separation and loss of the wheel and brake calliper. To assist their investigation of the occurrence, the Civil Aviation Safety Authority (CASA) requested the assistance of the Australian Transport Safety Bureau (ATSB) in the metallurgical examination of the fractured landing gear leg. While the examination provided some information on the nature and location of the failure, the amount of material abraded and lost from the fracture surface (as a result of landing on the fractured leg), precluded a full determination of the fracture mechanism.

FACTUAL INFORMATION

Introduction

On 21 June 2009, while travelling from Harvey Bay and during descent to Fraser Island, Qld, a Gippsland Aeronautics GA-8 Airvan sustained a fracture of the right main landing gear axle assembly, resulting in separation of the wheel and brake calliper. The aircraft was diverted to Maryborough, Queensland, where it landed safely on the remaining portion of the axle.

As part of their investigation of the occurrence, the Civil Aviation Safety Authority (CASA) requested the assistance of the Australian

Transport Safety Bureau (ATSB) in the metallurgical examination of the fractured landing gear leg. Subsequently, a damaged component, identified as the leg attach sleeve from the right main landing gear assembly, was received by the ATSB's Technical Analysis Branch.

Scope of the examination

The requested examination was limited to a metallurgical examination of the leg attach sleeve.

Leg attach sleeve

The main landing gear assembly was as shown in Figure 1, with the axle assembly highlighted in yellow. The axle assembly is shown in Figure 2 and has the leg attach sleeve highlighted. According to drawings received from the aircraft manufacturer, the leg attach sleeve was manufactured from 4130 steel to MIL-S-6758, and fillet welded to the axle. A doubler was also welded to the underside of the joint as shown.

Figure 3 shows the leg attach sleeve as removed from the aircraft. Much of the underside of the sleeve (and fracture surface) was ground away as a result of the aircraft landing on the fractured axle stub. The remaining fracture was evident extending through the welded elbow joint between the sleeve and axle. A section of fillet weld was present on the fracture surface (Figure 4). The associated fracture surface morphology was typical of ductile overload, with no evidence of prior or progressive cracking noted.

Figure 1: Main landing gear, with axle assembly highlighted

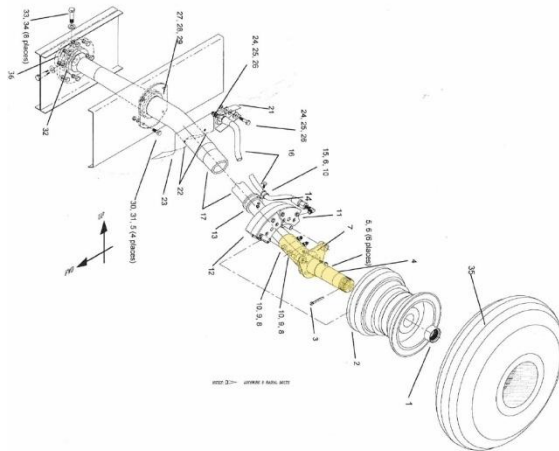


Figure 2: Axle assembly. Below the dotted line represents the portion of the leg attach sleeve ground away during landing.

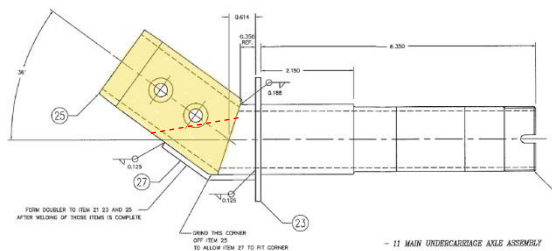


Figure 3: Leg Attach Sleeve



Figure 4: Remaining portion of weld



A metallographically-prepared and etched cross section taken through the sleeve, normal to the fracture surface, presented an equiaxed ferrite/pearlite microstructure (Figure 5). The average Vickers hardness of the steel was measured at 205 HV₂₀. Both the microstructure and hardness were consistent with 4130 steel in the normalised condition and on inquiry, the aircraft manufacturer confirmed that the axle assemblies were subject to a post-weld, normalising heat-treatment during production. There were no microstructural defects or anomalies observed in any of the examined sections.

Figure 5: Steel microstructure (2% nital etch)



COMMENTS

As a result of gross abrasion sustained during the aircraft landing, the amount of material lost from the leg attach fracture surfaces (including the doubler from the underside of the axle assembly) precluded an accurate determination of the failure mechanism.

Considering the assembly design, the fillet weld would likely have been the region of highest stress in the axle assembly and therefore, in the absence of material or manufacturing defects, it is probable that the fracture would have originated and progressed through the weld along its full path.

The onset of failure under low nominal stress conditions, that is, during flight, suggested a progressive or fatigue-type mechanism, rather than a gross transient overload event. However, there was no evidence of fatigue on the remaining fracture surface.

Future increased examination vigilance and possible enhanced inspections of the leg attach sleeve welds of other GA8 aircraft is suggested in view of the nature of the failure sustained.