Aviation Safety Investigation Report 199805758

British Aerospace Plc
BAe 146

30 December 1998

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Aviation Safety Investigation Report

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Occurrence Number:	199805758	**Occurrence Type:**	Incident
Location:	Brisbane, Aerodrome		
State:	QLD	**Inv Category:**	4
Date:	Wednesday 30 December 1998		
Time:	1550 hours	**Time Zone**	EST
Highest Injury Level:	None		

Aircraft Manufacturer:	British Aerospace Plc		
Aircraft Model:	BAe 146-200		
Aircraft Registration:	VH-NJQ	**Serial Number:**	E2072
Type of Operation:	Air Transport Domestic High Capacity Passenger Scheduled		
Damage to Aircraft:	Minor		
Departure Point:	Proserpine Qld		
Departure Time:	1410 EST		
Destination:	Brisbane Qld		

Approved for Release: Wednesday, November 29, 2000

FACTUAL INFORMATION

The BAe 146 aircraft was being operated on a routine passenger flight from Proserpine to Brisbane. When the crew selected full flap during the approach to Brisbane, they noticed an aerodynamic vibration through the airframe which was associated with a tendency for the aircraft to roll to the right. The crew were able to control the roll and continued the approach for an uneventful landing.

Examination of the aircraft revealed that about 600 mm of the forward edge of the bonded and riveted upper surface panel for the right wing flap had partially separated. The failure occurred at about the mid-span position and 38 rivets were found to be either damaged or missing. The panel had a chordwise crack approximately 25 mm long, at the outboard end of the separated section. At rest, the edge of the panel protruded above the leading edge surface by about 10 mm. Preliminary assessment indicated that the rivets had failed progressively over an extended period.

The maintenance documentation for the aircraft showed that the flap was fitted to the aircraft during original manufacture and had accumulated a total of 25,642 cycles and 25,203 hours time in service.

The aircraft had undergone a heavy maintenance "C" check on 19 December 1998, 11 days prior to the incident. Approximately 35 loose or cracked rivets on the outboard section of the flap were replaced at that time.

Examination of the remainder of the flap revealed exfoliation corrosion in the faces of the track link bearing lugs at four locations. Specialist advice was that "the corrosion appears to be substantial and will require removal of the links and bearings at these locations, with treatment, rectification and/or lug bracket replacement as required".

The manufacturer's system of maintenance specified a "walk around check" at 2,000 hour intervals, with an "external visual inspection" at 4,000 hour intervals which coincided with the "C" check.

A section of the failed flap panel approximately 540 mm long by 150 mm wide, containing 25 rivet holes including the part containing the crack, was removed from the panel and forwarded for specialist metallurgical examination. Once disassembled it was found that the crack consisted of fatigue fractures emanating from opposite sides of a rivet hole. The fractures had initiated at the hole to countersink transition. The crack then grew under span-wise tension loads. These loads developed progressively after a number of rivets had separated, allowing a part of the panel to lift when subjected to aerodynamic loads. The upward movement of the panel then translated into span-wise tension at the crack location. The examination also found that the mating surfaces of the aluminium sheet panel and flap structure had a thin coat of a light brown coloured sealant applied. It was found that this sealant had penetrated into some rivet holes and countersinks.

The specialist metallugical examination concluded that failure of the riveted joint was precipitated by the presence of the sealant between the joint mating faces. The ATSB was advised that all significant repairs to the flap structure were normally only conducted at the factory. However, under certain circumstances the manufacturer may approve repairs on a one-off basis.

The manufacturer was approached for information relating to the use of the sealant to determine if it was introduced during manufacture or during a subsequent repair action. Despite numerous approaches, no information was received.

The specialist metallurgical report further advised that a fundamental requirement for any effective structural joint is that the clamping force must be high enough to prevent slip and wear of the joined parts and that it must remain stable over the life of the joint. Because the sealant is inherently less stiff than the panel, and the stiffness of the flap structure or the rivet may change over time, the sealant may be expelled from the joint. This would result in a reduction or a loss of the clamping force. Consequently, the joined parts would be allowed to move relative to one another when subjected to service loads. Any movement within a joint would then subject the rivets to higher than normal loads, and progressively wear them to the point of failure. Once one rivet failed, the load it carried would be transferred to the other rivets, triggering a progressive failure of the joint.

It is possible that the sealant may have been introduced after flap manufacture, during an in-service repair. However, no relevant information was available.

SAFETY ACTION

As a result of this incident, and concerns about the effectiveness of certain aspects of the "C" check heavy maintenance inspection, the operator raised two Technical Service Instructions (TSIs). The first called for an immediate fleet inspection to report loose rivets. This fleet inspection revealed that 3 other aircraft of the operators fleet were affected. One of these aircraft required the replacement of between 20 and 30 "working rivets" on both flaps in the same position as for VH-NJQ.

The second TSI required a once only inspection, with the flap removed at the next heavy maintenance visit, to facilitate an in-depth inspection of the carriage links and attachment bolts.

In reply to concerns raised by the ATSB during the investigation, the Civil Aviation Safety Authority conducted an investigation into the circumstances leading to the flap failure and to assess any possible breakdown in the operator's system of maintenance. The subsequent CASA report stated in part, "investigation revealed there were no special circumstances that led to the flap failure so soon after repair work in the area. The BAe Structural Task Group for Ageing Aircraft have indicated that the flap is a weak area; with corrosion and exfoliation a problem". The report further advised that the manufacturer's corrosion prevention control program will address the deficiencies in the system of maintenance.

At the time of finalising this investigation, no further reports of flap failure, similar to this occurrence, had been reported to the Bureau.