

**INCIDENT**

<b>Aircraft Type and Registration:</b>	Jetstream 3102, G-LOGR
<b>No &amp; Type of Engines:</b>	2 Garrett TPE 331-1OUG-513H turboprop engines
<b>Year of Manufacture:</b>	1984
<b>Date &amp; Time (UTC):</b>	17 February 1994 at 1020 hrs
<b>Location:</b>	7 nm north east of Glasgow Airport, Scotland
<b>Type of Flight:</b>	Public Transport
<b>Persons on Board:</b>	Crew - 3                      Passengers - 7
<b>Injuries:</b>	Crew - None                      Passengers - None
<b>Nature of Damage:</b>	Right landing gear door detached
<b>Commander's Licence:</b>	Airline Transport Pilot's Licence
<b>Commander's Age:</b>	34 years
<b>Commander's Flying Experience:</b>	6,112 hours (of which 891 were on type) Last 90 days - 196 hours Last 28 days - 57 hours
<b>Information Source:</b>	Aircraft Accident Report Form submitted by the pilot and metallurgical examination

The aircraft was on approach to Glasgow Airport when, as the gear was lowered, a very slight vibration was felt for 5 to 10 seconds. The approach and landing were completed normally and after shutdown it was noticed that the right main landing gear door was missing.

The door had detached through failures at its hinge brackets. The failure at the rear hinge appeared to be recent but that in the forward hinge bracket showed signs of discoloration which indicated that there had been a pre-existing crack. The recovered halves of both brackets and the door operating rod were sent to the AAIB and examined by a materials and non-destructive testing (NDT) specialist. The rear hinge bracket and the operating rod had failed in bending overload but fatigue cracking was confirmed in the forward hinge bracket. Fatigue had initiated from multiple origins across the width of the concave surface of a curved section of the bracket. It was estimated that the life of the fractured hinge was of the order of  $1 \times 10^5$  cycles from initiation to final fracture. Initiation at one end of the crack appeared to be associated with a score on the side of the bracket. However, although the scratch may

have influenced fatigue initiation at that locality, other fatigue cracks were found running across the concave surface parallel to the main rupture crack. This, and the existence of multiple origins, indicated a general over stressing condition. Metallographic examination of some of the adjacent cracks revealed that all were associated with intergranular corrosion and some with machining abuse. Paint protection was present only at the hinge lug and evidence at the paint run-out showed that this had been overpainted at least twice. When the fracture face was examined under ultraviolet light, fluorescence was seen on an inner part of the fatigue surface where fatigue progression had been most rapid. On the outer section compacted debris and fretage products were present on the surface.

Tests showed that the aluminium alloy of the bracket conformed to the required British Standard Specification L168. A replacement bracket in titanium alloy is available. These aluminium hinge assemblies (Part No 137213B401) are subject to repetitive CAA mandatory inspections under Alert Service Bulletin 32-A-JA840318. In summary, the bulletin requires checks on the door assemblies for distortion, damage, security, correct rigging and clearances and describes required NDT checks on the operating rod and the hinge brackets using a fluorescent dye penetrant. The bulletin requires reprotection with lanolin resin on the surfaces from which paint has been removed.

The specialist concluded that failure had occurred due to a high stress, corrosion fatigue mechanism and that, at the time of the last fluorescent penetrant inspection, a crack had existed across the width of the bracket's concave surface and along approximately 0.13 inch of the adjacent side face. He commented that very thorough cleaning is required prior to fluorescent penetrant inspection and that lanolin is very difficult to remove from inside tight cracks, requiring repeated hot vapour degreasing followed by hot alkaline degreasing, boiling water washing and oven drying. Noting that paint must be removed from the components initially, he also remarked that it is important to remember that cracks can retain an aggressive paint stripper, that such strippers can be acidic and that oxidising acids quench the fluorescence in penetrants containing fluorescein.

The operator reported that there was evidence that there had been fouling between the door and the main gear leg which could have loaded up the bracket.