

No: 11/86

Ref: 1a

Aircraft type and registration: HS 748 Series 2A-245 G-BFLL

No & Type of engines: 2 Rolls Royce Dart RDA7 turbo props, Mk 534-2

Year of Manufacture: 1968

Date and time (UTC): 18 June 1986

Location: In flight between Dublin and Newcastle

Type of flight: Scheduled

Persons on board: Crew — 2 Passengers — N/K

Injuries: Crew — None Passengers — None

Nature of damage: Loss of section of right elevator outboard of outer hinge

Commander's Licence: Air Transport Pilot's Licence

Commander's Age: 48 years

Commander's Total Flying Experience: 8245 hours

Information Source: Aircraft manufacturer and operator in conjunction with AIB.

History of the flight

The aircraft was nearing the end of a flight from Dublin to Newcastle and was established on the localiser for runway 07, approximately 20 nautical miles out. As it passed through flight level 065, at a speed of approximately 200 knots, the pilot was easing forward on the control column when a sharp buffet was felt coincident with a slight nose pitch up. With no further abnormal events occurring, the aircraft continued normally and performed an unremarkable landing, the crew attributing the event to local clear air turbulence although conditions had been generally stable throughout the flight.

The post-flight check of the aircraft revealed the section of the right elevator outboard of the outer hinge to be missing, a section some 2 feet in length and that part of the elevator containing mass balance weights.

Both elevators were removed from the aircraft and subjected to detailed examination, the failed item at the manufacturer's plant and its partner at the operator's base at Manchester. The missing section was not recovered.

Aircraft history

G-BFLL, constructors No.1658, was built in 1968 and delivered new to an airline in Colombia.

In 1978 at a total time of 15,179 hours and 17,477 landings the aircraft was brought back to the UK since when it has been operated by one airline, its total time having increased to 26,537 hours and 31,417 landings at the time of the failure. The aircraft records show that both elevators had been fitted to this aircraft since new and that some damage had occurred to the elevator in question in a ground incident whilst in service in Colombia. The cause, extent and date of this damage was not positively identified from these records.

Elevator examination, reference Figure 1

A detailed inspection and strip examination of the failed elevator revealed that a chordwise failure had occurred at station 187" and that the fracture of the upper and lower areas of the aileron spar, nesting angles, and finger plates were all associated with high cycle fatigue.

Bruising and fretting damage had occurred over relatively large areas of the fracture surfaces and local structure, indicating that the crack had been developing for some time. It quickly became apparent that the failure had occurred in the region of a poor quality repair that did not conform to the manufacturer's repair manual. Over-long blind or "pop" type rivets had been used to secure a skin insert and three rivets used to secure the inboard hinge rib (and its respective trailing edge rib) to the spar were missing. However, it was evident that at some time these rivets had been installed and a portion of one blind rivet which was recovered from this area showed evidence of fatigue. In addition, the hinge rib had been assembled onto the spar on a relatively thick bed of sealant which had not extruded from the joint as the rivets were installed, indicating an imprecise fit of these components after the repair.

Once the individual parts of the elevator adjacent to the failure were separated it became apparent that the horizontal flanges, both of the spar and nesting angles, were slightly rippled over a distance of several inches in from the failure. These ripples could not be readily explained as resulting from the elevator tip detachment and were strongly suggestive of a compression instability effect.

As part of a subsequent fleet inspection an elevator from a similar model HS748, TJ-CCV, was discovered which had suffered damage believed to be similar to that which occurred on G-BFLL. A photograph of the damage is shown as Figure 2. On examination, similar rippling was present on the upper and lower spar flanges over a similar distance, with a small crack present in the top surface spar nesting angle, close to the failure section position on G-BFLL. The manufacturer considered it probable that in both cases, after the spars were distorted, they were straightened and re-used leaving residual deformation of the flanges. Both these spars were identified as being of original manufacture.

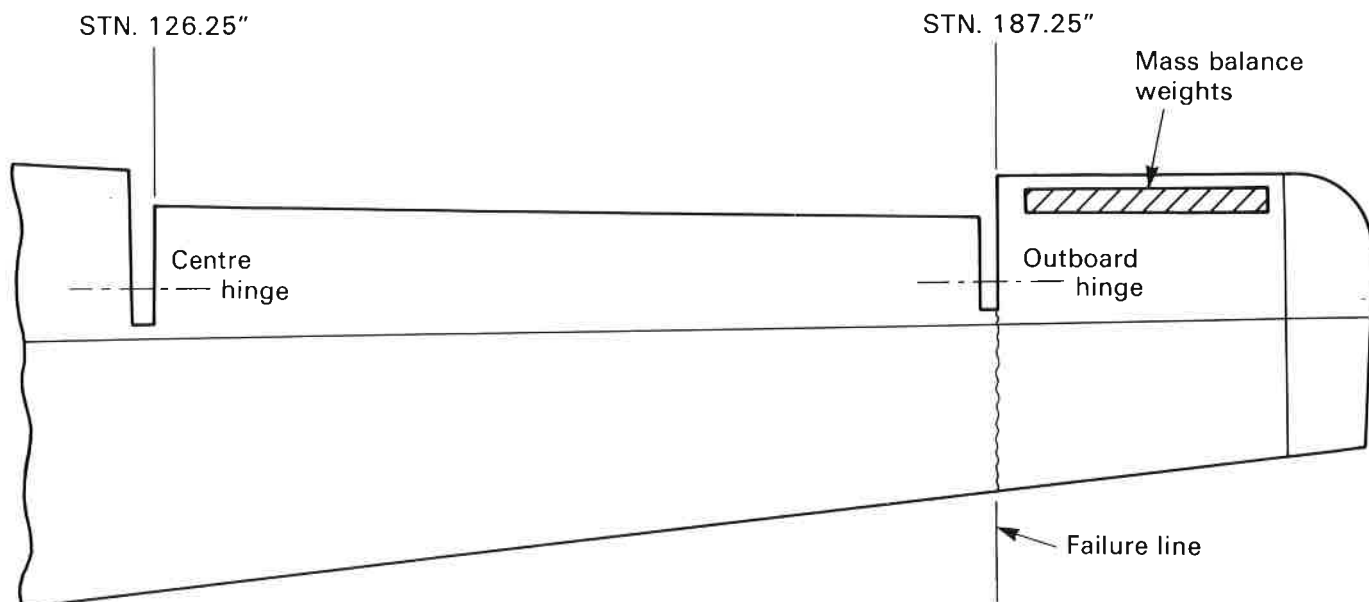
It was recorded that TJ-CCV had accomplished 3,700 hours and 4,600 landings since the repair.

As part of a more general inspection of HS748 elevators a secondary problem was identified. Several of those examined had cracks developing in the outer hinge cut out region of the finger plate, including the left elevator from G-BFLL. Attachment of the inner hinge rib to the spar of this item, which was of original build standard, had been effected by the use of blind rivets, one of which was missing and with the remaining two loose. The original manufacturer's production drawings for the elevator, call for solid rivets to be used in this area. However, the solid rivets were changed for Avdel blind rivets after the seventh aircraft. All elevators, so far examined, that show these cracks were constructed with blind rivets in this area.

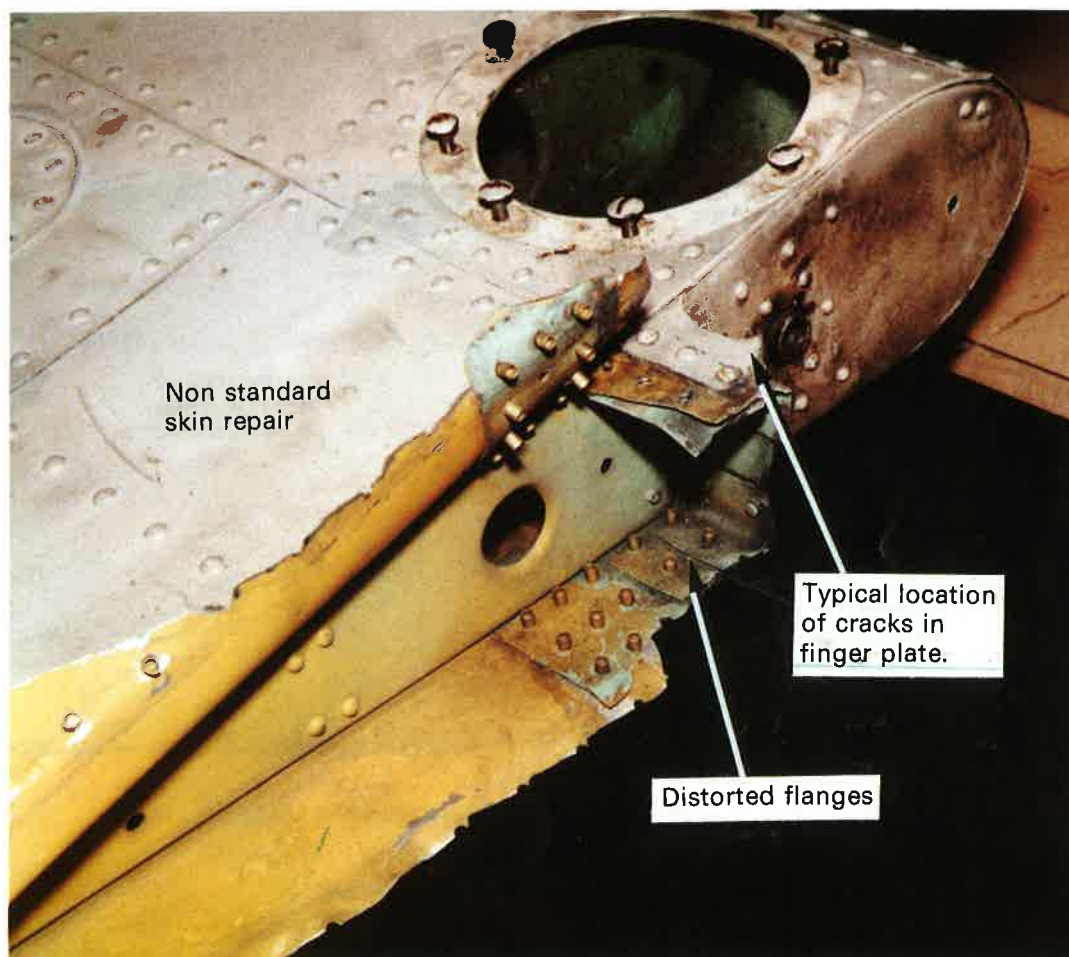
G-BFLL had flown 3,202 hours since a major inspection and 355 hours since the most recent inspection when the elevator and tabs skinning were due for a visual examination.

The structural repair manual for the aircraft is being reviewed by the manufacturer with reference to the adequacy of flying control surfaces repair instructions. In addition the secondary problem is being dealt with by the issue of service bulletins, one mandatory, relating to increased frequency of inspections and improvements which take into account the in-service experience of the aircraft type.

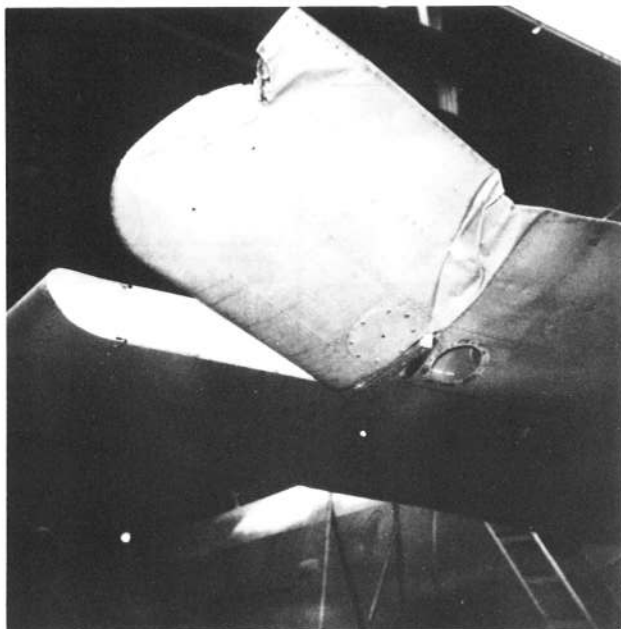
FIGURE 1



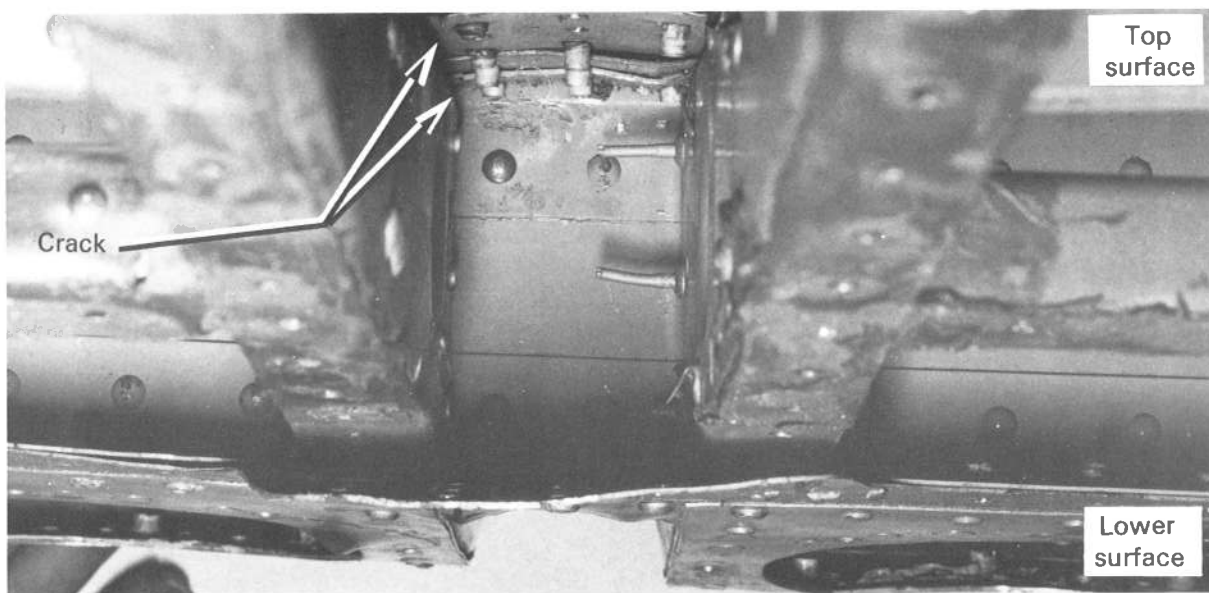
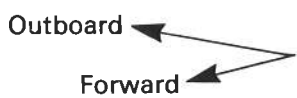
Configuration of outboard section of elevator



Elevator failure section details-G-BFLL



Damage to TJ CCV



View of O/B hinge cut out of left elevator from TJ-CCV showing distortion of flanges and crack in nesting angle 3700 hours after repair.