

3. Conclusions

Findings

- (i) The aircraft had been maintained to an approved maintenance schedule and its documentation was in order.
- (ii) The crew were properly licenced and adequately experienced to carry out the flight.
- (iii) Pitch control was lost following the in-flight separation of the right hand stabilizer and elevator, which occurred shortly after the extension of 50° flap.
- (iv) The stabilizer variable incidence screw jack actuator fractured in the stabilizer separation sequence allowing the left hand stabilizer to travel to the fully nose up position under aerodynamic loads thereby increasing the aircraft rate of pitch, nose down.
- (v) The right hand stabilizer rear spar top chord had failed prior to the accident flight as a result of long term fatigue damage. The fatigue crack had existed for about 7,200 flights, of which approximately 6,750 flights were made when the aircraft was on the US register.
- (vi) Following the failure of the stabilizer rear spar top chord the structure could not sustain the flight loads imposed upon it long enough to enable the failure to be detected by the then existing inspection schedule. It cannot, therefore be classified as failsafe.
- (vii) Insufficient consideration had been given at the design and certification stage to the stress distribution in the horizontal stabilizer spar structure following a top chord failure in the region outboard of the closure rib.
- (viii) The replacement of the horizontal stabilizer light alloy top skin by stainless steel significantly altered the stiffness distribution of the structure, creating the high fastener loadings which led, ultimately, to the fatigue failure in the rear spar top chord in G-BEBP.
- (ix) Neither the inspections detailed in the approved maintenance schedule nor those recommended by the manufacturer were adequate to detect partial cracks in the horizontal stabiliser rear spar top chord, but would probably have been adequate for the detection of a completely fractured top chord.
- (x) The inspections required by the Dan-Air UK CAA approved maintenance schedule in respect of the stabilizer rear spar top chord were less specific than those recommended by the manufacturer.
- (xi) No fatigue tests were carried out on the 707-300 series horizontal stabilizer structure prior to USA or UK certification. Neither at the time of certification nor at the time of writing were such repeated load tests required by either US or UK legislation for structures declared to be failsafe.
- (xii) A post accident survey of the 707-300 fleet, world-wide, revealed a total of 38 aircraft with fatigue cracks present in the stabilizer rear spar top chord. Of this number four stabilizers required chord replacement.

- (xiii) Post accident flight tests revealed that deployment of speed brakes during the landing roll produced an horizontal stabilizer load condition spectrum which was significantly different to that used in the original design.

Cause

The accident was caused by a loss of pitch control following the in-flight separation of the right hand horizontal stabilizer and elevator as a result of a combination of metal fatigue and inadequate failsafe design in the rear spar structure. Shortcomings in design assessment, certification and inspection procedures were contributory factors.