

**No:** 6/91

**Ref:** EW/C91/2/2

**Category:** 1a

**Aircraft Type and Registration:** Boeing 737-300, G-TEAB

**No & Type of Engines:** 2 CFM 56-3-B2 turbofan engines

**Year of Manufacture:** 1988

**Date & Time (UTC):** 23 February 1991 at about 1902 hrs and at 2150 hrs

**Location:** Faro, Portugal and Sutton Coldfield, West Midlands

**Type of Flight:** Public Transport

**Persons on Board:** Crew - 6                      Passengers - 112

**Injuries:** Crew - None                      Passengers - None

**Nature of Damage:** Damage to right hand main landing gear fairings and to inboard right hand flap assembly, body fairing and seal plate

**Commander's Licence:** Airline Transport Pilot's Licence

**Commander's Age:** 51 years

**Commander's Flying Experience:** 9,500 hours (of which 4,500 were on type)

**Information Source:** AAIB Field Investigation

During approach to runway 15 at Birmingham Airport, the right main landing gear leg inner fairing fell from the aircraft and struck the roof of a house in Sutton Coldfield under the approach path. Three days earlier, on the 20th February 1991, the aircraft had undergone a P6 check at the maintenance organisation's facility at Manchester. During the check, the body fairing (see photograph) adjacent to the right inboard flap had been removed and subsequently re-fitted. This item is in close proximity to the flap seal plate and to the inboard, or lower, main landing gear leg fairing and is fitted on spigots to ensure rapid and accurate location on assembly, without any requirement for subsequent functional checks. Following completion of the check, the aircraft flew four sectors without incident, including the outbound flight from Birmingham to Faro on the 23rd of February.

Prior to departure for the return flight from Faro for Birmingham, three separate external inspections had been performed because the co-pilot was being "line-checked". Both he and the commander had carried out individual checks followed, as there was some time to spare, by a mutual and very detailed inspection. No fault was identified with either the landing gear or the flaps.

The flight took off at 1900 hrs but when the landing gear was retracted after take-off the gear warning light indicated that the right main landing gear had not locked in the "up" position. As there had been no accompanying yaw or vibrations, the commander assumed this to have been caused by a faulty sensor and elected to continue with the "after take-off" procedures. Following retraction of the flaps, the aircraft was accelerated to 210 kt and the landing gear was recycled, and on this occasion the required 'up-and-locked' indication was achieved. There were no further anomalous indications during the remainder of the flight and the aircraft landed at Birmingham at 2151 hrs without further event. However, after the engines had been shut down, the ground engineer reported to the commander that the right main landing gear oleo fairings were damaged, the lower one was missing, and that there was some damage to the right hand trailing-edge flaps. The Police confirmed that the missing landing gear fairing had struck a house in Sutton Coldfield, under the approach path, and had caused moderate damage to the roof before falling to the ground.

Following temporary repairs, the aircraft was cleared for a (non-revenue) positioning flight to Manchester. Detailed inspection of the aircraft showed that the lower, inboard, oleo fairing had detached from the aircraft following failure of the mid fairing. The right body fairing had displaced forward of its correct position and was 'hung' on the forward end of one of its mounting spigots, with its diaphragm structure distorted and prevented from moving aft by the spigot. It also showed evidence of contact with the landing gear inboard fairing. The inboard fairing was partly delaminated and showed evidence of compressive damage, in a fore-and-aft direction, and whilst some of this was clearly caused by adjacent aircraft structure, some was probably due to ground impact. Near the aft end of the body fairing, some damage was found at the stainless steel rubbing strip which had come away from the fairing structure. This was local to an area where the seal plate comes into close proximity with the body fairing, and there was corresponding damage to the leading edge of the seal plate. Small amounts of material from the seal plate were found between the composite structure of the fairing and the stainless steel plate. There was also some impact damage to the outboard, or upper, oleo fairing and to the flap assembly in the vicinity of the right main landing gear.

Discussions with the UK Civil Aviation Authority and with Boeing indicated that, on a number of occasions, interference between the oleo fairings and the body fairings had occurred as a result of misalignment or movement whilst in service. Also, there were cases on record of the flap seal plate having interfered with the body fairing. There was no instance found on record where the body fairing had moved forward after installation. Two possibilities were examined: firstly that contact between the oleo fairing and body fairing had been the initial problem; and secondly, that this occurrence had been the result of interference between the seal plate and the body fairing. The first possibility was discounted because there was no evidence that the mid-fairing had moved against the oleo, nor was there any significant distortion of the inner fairing, and any likely partial failure of these items would

probably have been noted by the crew before departure. Further, this sequence would not have accounted for the forward displacement of the body fairing. The maintenance organisation stated that it had been difficult to remove this fairing after the incident due to the distortion impeding access to the securing nut and split pin, and pointed out that fitting it in the position found would have been equally difficult, and would have resulted in damage during the next gear retraction. The second possibility was supported by the evidence of damage to the seal plate and the body fairing, which appeared to have jammed together. Previous cases where this has happened have involved cracking around the seal plate fasteners and the subsequent interference has resulted in loss of the seal plate in flight. In this case, the seal plate had a more substantial attachment to the mid flap.

There were three features of the design which, while acceptable in themselves, were identified as having contributed to this incident. The first was the normal working clearance between the seal plate and the body fairing. This is specified in the Maintenance Manual as 0.06 inches (1.5mm), +0.19/-0.06 inches (+5/-1.5 mm). These limits allow the seal plate to contact the body fairing. To accommodate this, the latter is fitted with a stainless steel plate to facilitate rubbing contact. The Maintenance Manual calls for checking of the seal plate clearance after assembly of the flaps or following adjustment of the mounting spigots for the body fairing, but not after re-fitting of the fairing when no adjustment has been required. The second feature is the facility to remove and re-fit the body fairing routinely with only minimal checks. Even though the fairing is extremely close to the seal plate and to the inner oleo fairing, it can be re-fitted with only minimal checks because it is mounted on spigots which accurately control its location. The Maintenance Manual calls for checks on the gaps at the forward and inboard edges of the fairing after fitting, but does not call for inspection of the clearance between the outboard face of the fairing and the seal plate. The third feature of the design is the provision of a chamfer on the body fairing at the location where the seal plate first makes contact with it during flap retraction. When the clearances are correct there is usually no contact with the chamfer, but if the seal plate makes initial contact inboard of its intended position, it is eased over the edge of the body fairing by the chamfer. The chamfer includes the edge of the stainless steel rubbing plate and therefore the leading edge of the seal plate must pass over the interface between the two materials, but has the potential to separate them and jam itself between them.

As a result of the investigation the maintenance organisation has introduced a visual check of the seal plate gap and alignment following routine re-fitting of the body fairing. The AAIB has made a Safety Recommendation to the CAA which would introduce a similar check to the Maintenance Manual.



Impact damage to outboard oleo fairing

Body fairing forward of correct position

Damage to stainless steel rubbing strip

Flap

Damage to leading edge of seal plate

Middle oleo fairing (Inner oleo fairing detached)

Evidence of interference between body fairing and detached inner oleo fairing

FWD →

BOEING 737 G-TEAB  
Right Main Landing Gear shown