No: 2/92 **Ref: EW/C91/10/1** **Category: 1a**

Aircraft Type and Registration:	Boeing 737-230, D-ABHU	
No & Type of Engines:	2 JT8D-15 turbofan engines	
Year of Manufacture:	1981	
Date & Time (UTC):	5 October 1991 at 1013 hrs	
Location:	London Heathrow Airport	
Type of Flight:	Public Transport	
Persons on Board:	Crew - 6	Passengers - 88
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Nose dome detached from No. 2 engine	
Commander's Licence:	German Airline Transport Pilot's Licence	
Commander's Age:	39 years	
Commander's Flying Experience:	6,000 hours (of which 803 were on type)	
Information Source:	AAIB Field Investigation	

The aircraft was scheduled for a flight from Heathrow to Hanover. After 92 bags, weighing 1344 kg were loaded into the forward hold, the door was closed and checked. At 1908 hrs, with the first officer as handling pilot, the aircraft departed, from runway 27L, on a Brookmans Park 3G Standard Instrument Departure. At 2 nm DME from the London VOR, the aircraft was at 1,500 feet with flap 1° and take-off power set; the pitch attitude was between 15° and 18° and the IAS was about 162 kt. At this point, the crew heard a series of bangs which appeared to come from the No. 2 engine and the first officer noticed that the master caution 'DOORS' was illuminated. The No. 2 throttle was retarded to idle and the engine parameters appeared to be normal. An attempt was made to increase the power, but the banging restarted. Following reports of flames from the back of the engine, it was shut down. ATC was informed and the departure controller gave the aircraft a heading of 070°, climbing to 3,000 feet. A handover to approach control was arranged and the airfield was put on Full Emergency at 1912 hrs. Radar vectors were given to a 10 nm final for runway 27R and the aircraft landed, with the first officer still handling, at 1921 hrs. The runway was cleared and communication was established with the emergency services which were in attendance. The commander was informed that there was no sign of fire in the No. 2 engine and that the forward cargo door was partially open. The aircraft was taxied to the stand and shut down. Initial post flight inspection revealed that the nose dome and its

retaining bolts were missing from the No. 2 engine although there were no obvious signs of it having been ingested.

The forward hold baggage restraint was still in place and a subsequent check ascertained that nothing was missing. A check of the runway and the majority of the area immediately under the initial flight path failed to locate the nose dome and no object was found which could have come from the aircraft.

Examination of the forward cargo door

The forward and aft cargo doors on the Boeing 737 aircraft open inwards and are hinged at the top. A balance spring and cable assembly counter the weight of the door such that it hangs partially open when not locked closed or latched fully open during loading. The door can be unlocked using the normal external handle or an internal handle, presumably supplied for use by anyone accidentally trapped in the cargo bay. Exerting a downward pull on the inner handle rotates the two locking rollers out of engagement with their stop fittings without movement of the outer handle (see diagram). A spring, Part no. 69-67541-1 (superseded by 69-76131-1) returns the inner handle to the locked position when it is released.

When inspected by AAIB, the forward cargo bay had been emptied but the operator advised that the load of passenger baggage had been found completely intact, including some paperwork which had been loose in the bay. The door itself operated normally and had been functioned several times. Again, the operator advised that the door had originally been found with the external handle in the "locked" position but with the locking rollers unlocked (note: this situation would occur if the internal handle had been used to open the door).

A rigging and door indication check revealed no abnormalities but, when the internal trim was removed, it was found that the spring, whose part number is quoted above, was missing. This meant that the inner handle could be actuated using only very light finger pressure. There was no sign of the spring and it appeared that it had not been fitted. The last time this area had been accessed for maintenance was reported to be January 1991.

A query to the Boeing Company elicited the reply that they had knowledge of three incidents in which a lower cargo door had been found unlatched after landing. In two of these cases the subject spring was found to have broken and in the third it was found to be missing. The two cases of spring breakage involved both the earlier and later standard of spring type. Boeing Service Activities Report 90-05 described these incidents and advised that the spring installation was being reviewed. The Report also emphasised that the door could not open in flight with the aircraft pressurised but, if

unlocked, could open on landing or taxiing. In fact, the procedure used by this operator meant that the cabin was slightly pressurised on the ground after engine start.

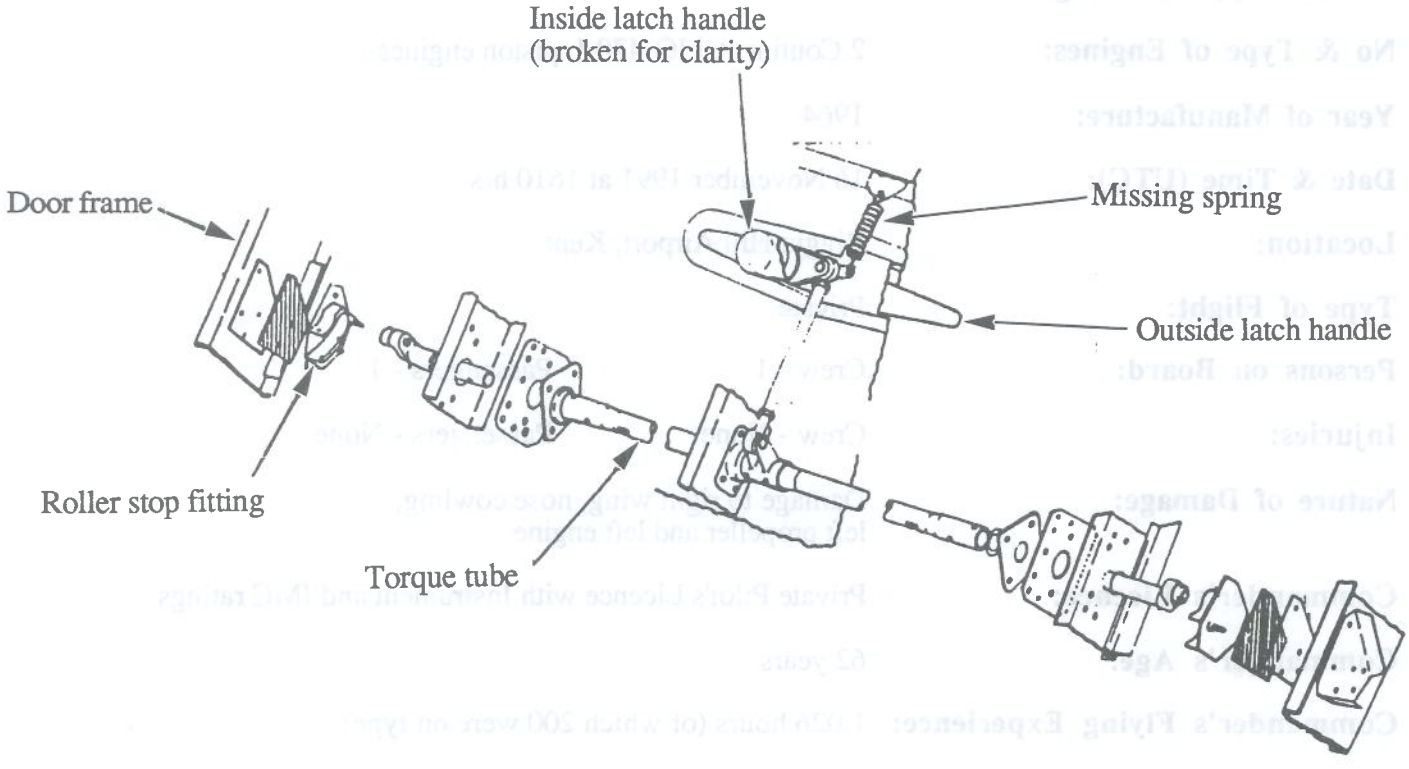
Thus it appeared that buffetting of the airframe due to the engine surges had caused the door to become unlocked and gave the crew the warning caption in the cockpit. It was unlikely that the door had actually opened until after the aircraft had landed. The reason why this latent defect in the door mechanism had not manifested itself earlier, perhaps after a firm landing, remains unclear.

Examination of the No. 2 engine

The engine and its intake cowl were completely free of any sign of contact with the missing nose dome. The latter had been attached to the accessory gearbox cover by four studs threaded into the cover casting. All four studs had pulled out of the casting, stripping the threads - presumably these remained with the dome itself which was not recovered.

A subsequent detailed examination of the engine at the operator's overhaul facility revealed no defects apart from the missing dome nor any consequential damage from its departure. Interrogation of the CAA's occurrence database revealed only one previous case of nose dome detachment occurring to a British Boeing 737-200 in 1988. This case did, however, bear considerable similarity to the D-ABHU incident inasmuch as detachment caused the engine to surge but occasioned only minor damage to the fan blades. The dome was found lying in the intake and from this it was determined that the studs had been overtightened in the magnesium alloy accessory gearbox cover causing three out of the four threads to strip. The remaining stud remained in its thread but had broken the attachment flange of the cover. The sequence was believed to have commenced with progressive failure of the threads in the cover following which the dome slewed across the intake causing the engine to surge.

Some information regarding an incident in March 1991 involving engine surge on a Boeing 737 was provided by Boeing. In this case, too, the dome was found in the intake having stripped a number of threads in the gearbox cover. A further event occurred in October 1991 when another Boeing 737 abandoned its take-off run following a series of engine surges. Upon inspection, the nose dome was found lying in the intake and there was apparently evidence that the attachment studs had been overtorqued.



D-ABHU forward cargo door latching mechanism showing location of missing spring.