

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-73V, G-EZJK	
No & Type of Engines:	2 CFM56-7B20 turbofan engines	
Year of Manufacture:	2002	
Date & Time (UTC):	12 January 2009 at 1545 hrs	
Location:	West of Norwich, Norfolk	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - 2
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	43 years	
Commander's Flying Experience:	10,716 hours (of which 7,719 were on type) Last 90 days - 56 hours Last 28 days - 9 hours	
Information Source:	AAIB Field Investigation	

The investigation

The Air Accidents Investigation Branch (AAIB) was informed of the serious incident involving this aircraft at 1630 hrs on 12 January 2009 and an investigation was commenced immediately under the provisions of the *Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996*. In accordance with established international arrangements, the National Transportation Safety Board (NTSB) of the USA,

representing the State of Design and Manufacture of the aircraft, appointed an Accredited Representative to participate in the investigation. The investigation is also being fully supported by all parties involved.

This is a preliminary report detailing the facts of the incident; no analysis has been attempted.

This bulletin contains facts which have been determined up to the time of issue. This information is published to inform the aviation industry and the public of the general circumstances of accidents and must necessarily be regarded as tentative and subject to alteration or correction if additional evidence becomes available.

The investigations in this bulletin have been carried out in accordance with The Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996, Annex 13 to the ICAO Convention on International Civil Aviation and EU Directive 94/56/EC.

The sole objective of the investigation of an accident or incident under these Regulations shall be the prevention of accidents and incidents. It shall not be the purpose of such an investigation to apportion blame or liability.

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History of the flight

The operator was intending to complete a combined maintenance check and customer demonstration flight on the aircraft, which was at the end of its lease and had just undergone maintenance, prior to it being handed over to another operator. The customer demonstration flight, designed to confirm the aircraft's serviceability, was loosely based on the Boeing new aircraft delivery test schedule and comprised a series of checks agreed between the existing operator and the aircraft owner.

The commander of the incident flight had, the previous month, flown the aircraft to Southend for maintenance. During that flight he carried out the 'demonstration flight schedule' in order to identify any defects. He returned to Southend on 12 January 2009 to collect the aircraft for a further check flight and discussed with the crew chief from the maintenance provider, who had been responsible for the aircraft during the check, the work that had been carried out; he recalled being told that an adjustment to the elevator balance tab setting had been made. For the forthcoming test flight, the commander was given extracts from the Aircraft Maintenance Manual (AMM) to assist him in conducting an in-flight elevator power-off test and to identify any asymmetrical flight control forces; both were required as part of the maintenance procedures. Prior to departure he checked the aircraft's technical log and confirmed that arrangements had been made with ATC for the flight to be conducted in the East Anglia Military Training Area (MTA). The commander and co-pilot, a first officer from the operator, were to be accompanied on the flight by a representative of the aircraft owner and a representative of the airline due to take delivery of the aircraft. No problems were identified during the pre-flight preparation and the aircraft departed at 1400 hrs with the commander as the handling pilot.

After take off, the aircraft climbed to FL410. Various checks were conducted during the climb and with the aircraft level at FL410. After about 45 minutes the aircraft descended to FL150, during which more checks were conducted. On reaching FL150 an APU bleed check was performed and the aircraft then configured to perform a flight control manual reversion check. This required the aircraft to be flown at FL150, at 250 kt IAS with the fuel balanced, the AUTOPILOT and AUTOTHURST selected OFF, the STAB TRIM MAIN ELEC and AUTOPILOT switches set to CUTOUT and the aircraft in trim. The 'customer demonstration flight schedule' also required SPOILER A and B switches to be selected OFF. All these checks were conducted using the operator's 'customer demonstration flight schedule' and not the maintenance manual extracts as the guiding reference.

Before the manual reversion check commenced, the individual hydraulic systems were isolated by placing the FLT CONTROL switches A and B to the OFF position individually and reinstating in turn enabling the flight controls to be checked for normal operation on a single hydraulic system. Operation was confirmed as satisfactory on both systems. Then, with the commander having released the controls, the co-pilot selected FLT CONTROL switches A and B to the OFF position, removing all hydraulic assistance from the primary flying controls. As he did so the aircraft suddenly pitched nose down. The commander pulled back on the control column with considerable force but was unable to prevent the aircraft from maintaining a nose down pitch attitude of -2.81° and descending at up to 3,100 fpm. The commander, therefore, decided to abandon the check but did not wish to re-engage the hydraulics whilst applying significant backpressure to the controls.

The commander stated that, should the aircraft pitch up or down uncontrollably during a manual reversion check, he had been trained to roll the aircraft to unload the pressure on the elevator and release the controls before reinstating the hydraulics. The commander therefore, rolled the aircraft left 91.2° and believes he released the controls before calling for the co-pilot to re-engage the FLT CONTROL switches. The recording from the Cockpit Voice Recording (CVR) indicated that at this point there was confusion between the two pilots. This resulted in the commander thinking that hydraulic power had been restored to the flight controls although there is no evidence that the FLT CONTROL switches had been moved from the OFF position.

The commander rolled the wings level and attempted to arrest the rate of descent which had increased considerably, peaking at 21,000 fpm; the aircraft had pitched 30° nose down after the aircraft had been rolled to the left. The control forces remained high but the commander considered this to be due to the aircraft's speed, which both pilots observed to be indicating above 440 kt. He retarded the thrust levers and selected the speed brakes, however, the spoilers had been switched OFF as part of the test procedure.

The commander continued to maintain backpressure on the controls and made a PAN call to ATC. The aircraft eventually recovered from the dive at about 5,600 ft, having entered a layer of cloud. The pilots reviewed the situation and selected the FLT CONTROL switches, which had remained OFF throughout the flight excursion, to the ON position. The control forces returned to normal.

As a result of the incident the check flight was abandoned and the aircraft returned to Southend. Suspecting possible structural damage, the commander kept the speed below 250 kt and configured the aircraft for landing early during the approach. The aircraft appeared to operate normally and landed without further incident at 1606 hrs.

Weight and Centre of Gravity

The aircraft's take off weight was 47,633 kg and MACTOW 20.6%. The centre of gravity remained within limits throughout the flight.

Guidance Material

The Boeing 737-700 AMM extract given to the crew referred to recovery techniques to be used in the event of a pitch upset being encountered during the manual reversion test. These are also published in the Boeing 737-700 Quick Reference Handbook (QRH) and call for the possible use of bank to recover from a 'pitch-up upset' event. In the 'pitch-down upset' case the QRH advises rolling the wings level.

In April 2006 the CAA published a Check Flight Handbook containing guidance to pilots and flight test engineers approved to conduct CAA flight check schedules on UK registered aircraft. This guidance is only intended to be used as a supplement to briefings given by the CAA when conducting their published schedules. Section 3, Tech 2, Part 10 covers flying control checks and states:

'It might be possible to put some bank on the aircraft to turn a large pitch up or pitch down into a turn manoeuvre before re-powering the system. This might prevent an unusually high or low pitch manoeuvre developing.'

Engineering investigation

The aircraft was reaching the end of its lease contract with the operator and had been removed from the operating fleet for a maintenance input to comply with hand-back contractual requirements. The maintenance arrangement was specific to the operator's aircraft 'hand-back' activities and was sub-contracted to a third

party maintenance provider by the operator's established line and base maintenance provider. It also included a complex structure of 'sub-contracted' management and oversight responsibilities involving a number of additional third party companies.

During the ferry flight to deliver the aircraft to the maintenance provider, the operator had flown a 'shakedown' test using the same customer 'demonstration flight test schedule' to identify any existing defects, allowing rectification work to be completed during the maintenance input. This 'shakedown' flight included the manual reversion test to assess the trim of the aircraft. This involved switching off both hydraulic systems powering the aircraft flight controls and assessing the amount of manual stabiliser trim wheel adjustment required to balance the aircraft in level flight. The results of this test identified that the aircraft was within, but very close to, the approved maintenance manual limits. Following the flight, the commander verbally requested that this be addressed during the subsequent maintenance input, but elected not to enter it in the tech log, as the level of stabiliser trim required during the test had been within limits. The absence of a formal post-flight debrief and formal written record resulted in the balance tabs, attached to the elevators of the aircraft,

being adjusted in the opposite sense to that identified as necessary by the flight test. The aircraft was therefore significantly out of trim during the post-maintenance test flight, and it was that which initiated the pitch-down incident during the manual reversion test.

The investigation is continuing and a final report will be published by the AAIB.

Safety Actions

- The operator suspended further check flights until it had carried out a review of maintenance procedures, check pilot procedures and flight check schedules
- The CAA are reviewing Section 3, Tech 2, Part 10 of its Check Flight Handbook to ensure the specific guidance related to flying control checks is not open to misinterpretation.
- The CAA intend to publish an Airworthiness Communication (AIRCOM) addressing the issues relating to the co-ordination between operators and maintenance organisations surrounding the conduct of maintenance check flights.