

Serious Incident

Aircraft Type and Registration:	Boeing 737-301, G-JMCU	
No & Type of Engines:	2 CFM 56-3B2 turbofan engines	
Year of Manufacture:	1986 (Serial no: 23513)	
Date & Time (UTC):	6 March 2023 at 2236 hrs	
Location:	Aberdeen Airport	
Type of Flight:	Commercial Air Transport (Cargo)	
Persons on Board:	Crew – 2	Passengers – None
Injuries:	Crew – None	Passengers – N/A
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	44 years	
Commander's Flying Experience:	7,502 hours (of which 2,569 were on type) Last 90 days – 39 hours Last 28 days – 9 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

The aircraft departed Aberdeen Airport with FLAP 1 set instead of the planned FLAP 5 used in the takeoff performance calculations. The crew noticed the incorrect flap setting after takeoff, whilst attempting to retract the flaps in the normal sequence. Calculations performed afterwards indicated that on this occasion the aircraft's performance on takeoff was adequate with FLAP 1 set. However, it is not safe to take off without confirming that flap is set correctly, because the aircraft may not achieve the required performance.

History of the flight

The aircraft departed Aberdeen Airport on a cargo flight to East Midlands Airport. The copilot was undergoing differences training for Boeing 737-300 series, having recently completed line training on the Boeing 737 NG. He had previously flown the ATR 72. The commander was PM and the co-pilot was PF.

It was snowing in Aberdeen and the aircraft was de-iced on stand. This required Supplementary Procedures (SP) 16¹ to be actioned by the pilots, which changed the point during the pre-departure preparation when the flaps were set. The taxi route from Stand 9 to Runway 34 was short and included a 90° turn to enter the runway. The weather conditions

Footnote

¹ Boeing 737 Flight Crew Operating Manual - Supplementary Procedures Chapter SP Adverse Weather Section 16.

worsened after pushback, with heavy snow and reduced visibility. The commander stated that he taxied very slowly and was mindful of the threat of a taxiway excursion given the environmental conditions.

During the taxi the remaining checklist items were completed, which included the co-pilot setting takeoff flap. The commander called for 'FLAP 5' to be set and the co-pilot confirmed this was complete. The commander recalled visually checking during line-up that the green light on the flap position indicator was illuminated, which confirmed the flap lever was no longer at zero.

The pilots carried out an engine fan blade ice shedding procedure on the runway before taking off. After departure, the co-pilot called for flaps to be retracted to 'FLAP 1' and the commander realised the lever was already in the flap 1 detent. The pilots maintained the configuration until accelerating to the normal speed for flap retraction to the clean configuration.

During the cruise the pilots carried out performance calculations for a flap 1 takeoff, which revealed that the speeds were similar to those calculated for FLAP 5, and concluded that the error had not had an adverse effect on the safety of the aircraft.

Recorded information

A 25-hour Flight Data Recorder (FDR) and a 2-hour Cockpit Voice Recorder (CVR) were fitted to the aircraft.

Cockpit Voice Recordings

The CVR installed in the aircraft combines all crew channels into a single recorded channel to provide at least 2 hours of cockpit recording, in addition to recording these separately for at least the last 30 minutes of operation.

CVR recordings of the occurrence had been overwritten by recordings of the subsequent flight, though the pilots discussed the event during the cruise on this subsequent flight. The content of the discussion corroborated information provided to the AAIB by the commander.

CVR quality

The recordings on CVR channel 2 had a notably lower volume than the other channels, making some of the audio recorded to this channel unintelligible. The investigation did not determine the reason for this lower volume.

Noise was also present on input channels 1-3 which was not present on the area microphone channel. Spectral analysis determined that this was due to interference from a 400 Hz tone, indicating interference from the aircraft's AC electrical system.

As a result of previous investigations encountering CVRs and FDRs which had not recorded data as expected, the UK Civil Aviation Authority published recommendations for continued

airworthiness of CVRs in Chapter 12 of CAP 731², intended to ensure appropriate signal levels and intelligibility of CVR recordings. The AAIB notified the operator of the CVR recording quality issues and referred to this guidance. The operator shared these findings with its Continuing Airworthiness Management Organisation (CAMO) and subsequently shared documents with the AAIB indicating that the issues had been rectified.

Flight Data Recordings

The flight parameters recorded by the FDR indicated a normal takeoff from Aberdeen. The takeoff was compared to four previous takeoffs recorded on the FDR which operated under similar conditions from Aberdeen, where FLAP 5 was used for takeoff. The rate of acceleration, pitch attitude during the initial climb, and rate of climb for the FLAP 1 takeoff were similar to the values recorded from the previous FLAP 5 departures.

Aircraft information

Takeoff flap position

The normal *'Before Taxi procedure'*³ states the commander will call "FLAPS ___" as required for takeoff. In response, the co-pilot should select the flap setting stated by the commander and verify that the LE FLAPS EXT green light is illuminated. The LE FLAPS EXT light is illuminated when the flap position is greater than zero.

SP 16 states:

"If taxi route is through ice, snow, slush, or standing water in low temperatures or if precipitation is falling with temperatures below freezing, taxi out with the flaps up. Taxiing with the flaps extended subjects the flaps and flap drives to contamination. Leading edge devices are also susceptible to slush accumulations."

The co-pilot had recently converted from the ATR 72 aircraft and had not completed any flap 1 departures in the Boeing 737. The ATR 72 has three flap settings, flaps UP, flap 15 and flap 30. The normal selection for takeoff is flap 15 which requires the flap lever to be moved from zero into the first available detent.

The most common takeoff flap selection on the Boeing 737 family is flap 5, requiring the flap lever to be moved into the third detent, which was the configuration on which the performance data had been calculated during this event. On a 737-400 aircraft a flap 1 takeoff is not permitted.

Footnote

² CAP 731 - *Approval, Operational Serviceability and Readout of Flight Data Recorder Systems and Cockpit Voice Recorders*, available at <http://publicapps.caa.co.uk/docs/33/CAP731.PDF> [accessed January 2024].

³ Boeing 737 Flight Crew Operating Manual – Normal Procedures – Amplified Procedures.

Takeoff configuration warning

The Flight Crew Operating Manual⁴ states:

“Takeoff configuration warning is armed when the airplane is on the ground and either or both forward thrust levers are advanced for takeoff. An intermittent warning horn sounds if:

- *for the 737-300, trailing edge flaps are not in the flaps 1 through 15 takeoff range*
- *for the 737-400, trailing edge flaps are not in the flaps 5 through 15 takeoff range”*

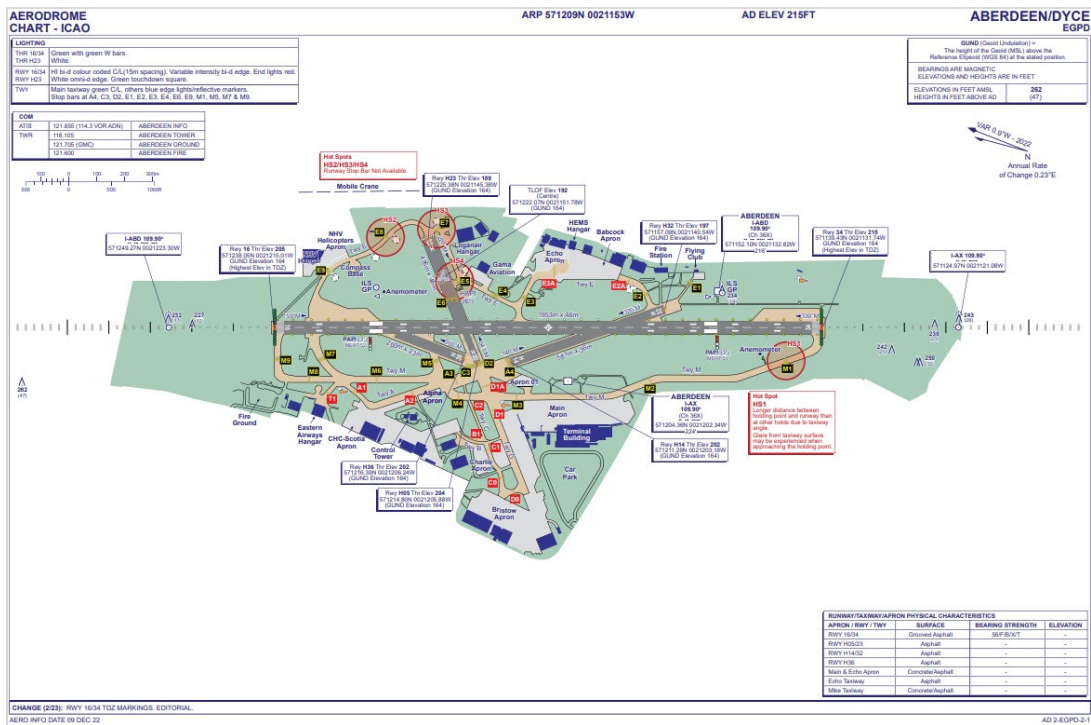
There are seven 737-400 aircraft and three 737-300 aircraft in the operator’s fleet.

Meteorology

The weather at Aberdeen Airport at the time of the departure was reported to have been temporary moderate snow showers with a reduction in visibility to 2,000 m. The cloud base was at 1,000 ft and the temperature was 0°C. There was a reported visibility of 800 m during taxi.

Aerodrome information

Aberdeen’s Runway 16/34 is the only runway suitable for fixed wing aircraft operations and has a published TORA of 1,953 m.



Footnote

⁴ Boeing 737 Flight Crew Operating Manual - Warning Systems Chapter 15 System description Section 20.

Personnel

Both pilots held valid licences and their medicals were in date.

Operator response

In response to the event, the operator conducted a review of the 737 *'Before-Takeoff'* checklist. Following this review, a Flight Staff Notice was published to advise crews of the following change to 737 OMB and the *'Before-Takeoff'* checklist in order to mitigate the threat of incorrect flap settings for takeoff:

Boeing 737 Normal Checklist	
BEFORE TAKE-OFF (F/O)	
<u>Previously:</u>	
Flaps.....	_ GREEN LIGHT (Captain)
<u>Amended response:</u>	
Flaps.....	_ PLANNED, _ INDICATED, GREEN LIGHT (Captain)

Analysis

The poor weather conditions introduced several distractions on the flight deck before departure. The application of the SP 16 procedure put the pilots out of their normal sequence for setting takeoff flap. The task of taxiing in reduced visibility on a narrow taxiway would have taken more mental capacity than normal, and was likely exacerbated by the time pressure introduced by the worsening environmental conditions. It is possible the co-pilot reverted to the motor memory of selecting one flap detent, which was correct on the ATR 72 he had recently flown.

The commander visually confirmed the LE FLAP EXT light was illuminated once lined up on the runway, but did not confirm the actual position of the flaps on the indicator. Flap 1 is an allowable takeoff setting for a Boeing 737-300 and would not result in any further annunciations. There was therefore nothing to alert the pilots to the incorrect flap setting other than to check it themselves.

In this event, completing the takeoff with flap 1 did not have any effect on the safe conduct of the flight. In other circumstances where the takeoff performance was limited, such as an increased aircraft weight, reduced runway length or less favourable environmental conditions, there may have been a greater risk to the safety of the aircraft.

Conclusion

An incorrect flap selection was made and not detected before takeoff. A combination of poor weather conditions and time pressure may have influenced the pilot's performance. It is necessary to check the actual flap position set, because the green configuration light indicates only that flap more than zero is set.

Safety actions

In response to this event, the operator amended the 'Before Takeoff' checklist to include the planned and indicating flap setting to be verbalised. They issued a 'Flying Staff Notice' to highlight the potential risk of flap mis-selections. The notice drew particular attention to those recently converted from the ATR of the risk of 'reverting to type' and moving the lever to the first gate (FLAP 1), rather than the second or third as required for FLAP 5 and FLAP 15 departures.