INCIDENT

Aircraft Type and Registration:	Boeing 737-76N, 5N-MJI
No & Type of Engines:	2 CFM56-7 turbofan engines
Year of Manufacture:	2001
Date & Time (UTC):	21 November 2010 at 0855 hrs
Location:	Southend Airport, Essex
Type of Flight:	Commercial Air Transport (non-revenue)
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:	43 years
Commander's Flying Experience:	5,100 hours (of which 3,500 were on type) Last 90 days - 90 hours Last 28 days - 65 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The crew had programmed the aircraft's Flight Management Computer (FMC) for a maximum thrust takeoff from Runway 24 at Southend Airport. As the aircraft taxied out, ATC changed the runway in use to Runway 06. The FMC was re-programmed but an incorrect 'assumed' temperature was entered, resulting in too great a thrust reduction for the runway length available. Although the aircraft became airborne before the end of the runway, had the takeoff been rejected just before V_1 there would have been insufficient runway remaining within which to stop.

History of the flight

The aircraft had been undergoing maintenance with an organisation based at Southend Airport and was to be repositioned back to the operator's base at Lagos Airport, Nigeria. The crew comprised two captains, one of whom was designated as the aircraft commander and the other, the co-pilot, as pilot flying (PF).

The co-pilot arrived at the airport first and commenced the flight planning, using the documentation provided. This included an Airport Analysis Table for Southend Airport. Unable to locate this table, the co-pilot used the Quick Reference Handbook (QRH), Performance Dispatch section, and the prevailing meteorological conditions to calculate the takeoff speeds using maximum thrust, in accordance with the operator's Standard Operating Procedures (SOPs).

The commander arrived approximately 90 minutes after the co-pilot, due to transport problems, and was informed by the maintenance staff that the aircraft and documentation were ready. At this point the flight was running some two hours late. The commander joined the co-pilot onboard the aircraft, where the latter had programmed the FMC with the relevant weights and speeds and was in the process of entering the flight planned route, including the departure runway, Runway 24. Whilst this was being done, the commander carried out the external pre-flight inspection before rejoining the co-pilot on the flight deck. The two captains reviewed the FMC programmed data, in accordance with the operator's SOPs, and confirmed that it was correct. The aircraft engines were then started and the crew received clearance to taxi. The weather at the time was: surface wind 360°/ 05 kt, CAVOK, temperature 7°C, dew point 5°C and QNH 1010 mb. The runway was dry.

While the aircraft was taxiing for a departure from Runway 24, ATC changed the runway in use. The aircraft was cleared to Runway 06 via Taxiway Charlie and the commander taxied the aircraft as instructed. He also took over the radio calls, because the co-pilot was having difficulties with his external communications. The runway change necessitated a reprogramming of the FMC. This was carried out with some urgency by the co-pilot, who called out the data as it was entered. Reprogramming the FMC with the new runway deleted the previously entered performance data, thus allowing an 'assumed' temperature to be entered, for a reduced thrust takeoff[1], should it be required. When entering the 'assumed' temperature for the new runway, the co-pilot entered a temperature in the region of 50°C[2]. The crew normally operated from longer runways, mainly in Africa, where such an 'assumed' temperature was appropriate. The aircraft was configured for a takeoff with the flaps at 5°, engine bleeds ON and anti-ice OFF. The engines were rated at 24K (24,000 lbs) maximum thrust.

The aircraft backtracked and lined up on Runway 06 and the crew were cleared for takeoff. However, instead of backtracking the full length of Runway 06, they lined up at the displaced threshold, which was 600 ft from the start of the runway. The co-pilot was given control and, following the pre-takeoff checks, the thrust levers were advanced and the autothrottle was engaged.

As the aircraft accelerated along the runway, the commander recalled thinking, at about 100 kt, that the acceleration was slow and calling for maximum thrust, which he thought the co-pilot applied. At the V_R speed of 133 kt the rotation was initiated and the aircraft lifted off, climbing away on the programmed departure route.

Airport information

Southend Airport has a single runway, orientated 06/24. Runway 06 is 5,264 ft in length and 121 ft wide, with an asphalt surface and friction course. There is an arrester bank some 85 ft beyond the end of the paved surface and a main railway line 145 ft beyond that. Further on there are housing estates. The Take Off Run Available (TORA) is published as 4,785 ft.

Recorded data

Analysis of the recorded flight data showed that the aircraft taxied onto Runway 06 and backtracked, with

Footnote

[1] Reduced takeoff thrust (ATM) is a takeoff thrust level less than the full rated takeoff thrust. Reduced takeoff thrust is achieved by selecting an 'assumed' temperature higher than the actual ambient temperature. When using ATM, the takeoff thrust setting is not considered a takeoff operating limit since minimum control speeds (VMCG and VMCA) are based on full rated takeoff thrust. At any time during takeoff, thrust levers may be advanced to the full rated takeoff thrust.

Footnote

[2] The programmed temperature was not recorded on the FDR or other memory storage.

the flaps set at 5° and the autothrottle armed. The aircraft lined up at the displaced threshold of Runway 06 and held for two minutes and 10 seconds whilst the before takeoff checklist and crew actions were completed. The wind was from 360° at less than 5 kt, with an OAT of 6°C.

Before brake release, the thrust levers were advanced to give 80.9% and 81.9% N_1 on the left and right engines, respectively. The brakes were then released and the autothrottle was engaged, accelerating the engines to the reduced thrust takeoff setting. Within the first 500 ft of the aircraft's takeoff roll, the left and right engines increased to 86.0% and 86.1% N_1, respectively. As the takeoff roll continued, the respective N_1 values increased further to 86.1% and 86.6%, where they stabilised. The PF commenced the rotation at V_R and, as the aircraft accelerated through the V_2 speed of 140 kt, it became airborne, passing through the 35 ft screen height after travelling 4,317 ft from point of brake release.

The aircraft crossed the threshold of Runway 24 at a height of 150 ft, with the landing gear retracting. A positive climb gradient of 21% had been achieved, with a rate of climb of 2,590 fpm.

Aircraft performance

The aircraft manufacturer was provided with the airport and meteorological information and asked to review the aircraft performance, using an (incorrect) 'assumed' temperature of 50°C.

The results indicated that, had the crew elected to abandon the takeoff just before V_1, there would have been insufficient runway remaining in which to stop. Using maximum braking and maximum reverse thrust, the aircraft would have required a further 656 ft of runway surface beyond that available. It was calculated that the aircraft would have overrun the end of the runway at approximately 60 kt.

Had the aircraft suffered an engine failure one second before V_1, and the takeoff had been continued, it would not have been airborne before the runway end. Conversely, had the engine failed one second after V_1, the aircraft would have lifted off before reaching the end of the runway surface. The manufacturer noted the performance requirement to achieve a 35 ft screen height by the end of the runway. This would not have been possible in the event of an engine failure at these stages.

It was concluded that the maximum 'assumed' temperature for Runway 06 in the ambient conditions should have been 29°C.

Safety action

Following the incident, the operator introduced four safety actions. These were:

- The crew received a structured training package in order to return them to line flying operations.
- Performance and Mass Balance calculations and takeoff and landing exercises in and out of Southend Airport, and other similar maintenance bases used by the operator, will be incorporated into the operator's biannual simulator recurrent training cycle for all their Boeing 737 pilots.
- Operations into and out of Southend Airport, and other similar airfields, will be limited to daylight operations only, so that the perception of speed is not impaired as it would be at night or in low visibility.

- The company Operations Control Centre will include 'Special Briefings' for unusual and limiting airfields, such as Southend, accompanied by a Route and Airfield checklist. The briefing should serve to remind pilots of the need and circumstances under which a full thrust takeoff is required.

Discussion

The crew considered that they were under time pressure to depart as soon as possible, due to the delay caused by the commander's transport problems. Despite this, they had correctly carried out the flight planning and performance calculations for the departure from Runway 24. Neither crew member was familiar with the airport, so the commander, who was taxiing the aircraft and carrying out the radio communication, was concentrating on ensuring he complied with the taxi clearance. When the runway change was given, the co-pilot carried out the re-programming of the FMC. Although he called out the data he was entering, neither crew member noticed that an incorrect 'assumed' temperature had been entered, as opposed to the maximum thrust setting.

By commencing the takeoff roll from the displaced threshold, the runway TORA was effectively reduced by 600 ft. The commander, recognising the slower than expected acceleration, called for maximum thrust but, although he thought it had been applied, the recorded engine parameters did not support this.

Both pilots were qualified aircraft commanders and there appears to have been an element of mutual confidence in the other pilot's ability to perform his task correctly. The adherence to SOPs, when the FMC was programmed for a departure from Runway 24, broke down when it was re-programmed for a departure from Runway 06.

Whilst the aircraft became airborne and achieved the screen height by the end of the runway, with both engines operating, the manufacturer considered that, had an engine failed at or close to V_1, the aircraft may not have stopped, if the takeoff had been rejected, or become airborne by the end of the runway if the takeoff had been continued.

In view of the safety actions taken by the operator after this incident, no Safety Recommendation is considered necessary.