Boeing 737-46B, G-OBMN, 23 June 1997

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Aircraft Type and Registration:	Boeing 737-46B, G-OBMN
No & Type of Engines:	2 CMF56-3C1 turbofan engines
Year of Manufacture:	1989
Date & Time (UTC):	23 June 1997 at 1708 hrs
Location:	Mahon Airport, Menorca, Spain
Type of Flight:	Public Transport
Persons on Board:	Crew - 6 - Passengers - 179
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Skin damage on the underside of the rear fuselage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	17,010 hours (of which 5,150 were on type)
	Last 90 days - 185 hours
	Last 28 days - 61 hours
First Officer's Flying Experience:	8,153 hours (of which 2,840 were on type)
	Last 90 days - 128 hours
	Last 28 days - 49 hours
Information Source:	AAIB Field Investigation

History of the Flight

The flight was planned to operate a flight from London (Stansted)to Mahon, Spain, before returning to Luton. The aircraft wasserviceable prior to departure and carried 179 passengers, whichrepresents a full passenger load. Because of the cost of fuelat the destination it was normal to carry surplus fuel from Stanstedin order to reduce the amount required during the refuel at Mahon.

Therefore, the limiting weight considered for the departure fromStansted was the maximum landing weight at Mahon. Thus with atake-off weight of 61,724 kg and a projected fuel burn of 5,566kg the planned landing weight was 56,158 kg, which was 87 kg belowthe maximum authorised landing weight of 56,245 kg. However,whilst the planned arrival fuel was 6,484 kg the recorded arrivalfuel was 6,680 kg; the aircraft thus arrived with 196 kgmore fuel than planned which resulted in the aircraft being 109 kgabove the maximum authorised landing weight when shutting downat Mahon. Whilst not significant in itself this did ensure thatthe aircraft was at a high mass for the approach and landing.

The weather obtained by the crew for the arrival at Mahon includeda surface wind of 230_/10 kt, variable between 190_ and 270_,visibility in excess of 10 km, scattered cloud with a base of2,000 feet, the surface temperature was 24_C and the QNHwas 1016 mb. Runway 19 was the runway in use. It has a HighIntensity Approach Lighting System with the PAPIs set at 3_ andis 7,710 feet long. The crew elected to fly the VOR/DME approachfor Runway 19 with the commander as the handling pilot; Flap 30was the planned landing flap setting. When both crew memberscould clearly see the runway and the approach lights the commanderreverted to a visual approach and he deselected the auto-pilotat an estimated altitude of 1,200 feet at which point the aircraftwas in the landing configuration with the gear down and the flapsset to 30. At this stage the crew estimated that the aircraftwas a little high on the glide path but by 600 feet the aircraftwas stabilised on the correct visual approach path. The referencelanding speed for the weight and configuration was 143 KIAS andthe crew planned to fly the approach 5 kt above this speed inaccordance with both their Standard Operating Procedures and guidanceprovided in the Boeing Flight Training Manual; their approachspeed was therefore 148 KIAS. The crew considered the approachand subsequent landing to be entirely satisfactory although theywere aware that the attitude indicator reached approximately 10_during the flare which, whilst slightly prolonged, led to a softtouchdown. Although the crew were not concerned that they mayhave scraped the tail during the landing the commander did inspectthe tail bumper during his walk round at Mahon and saw no indicationsof damage. There were no comments from either the cabin crewor the passengers suggesting that the tail of the aircraft mayhave contacted the ground.

Flight Recorders

The Flight Data Recorder, a Sundstrand UFDR was replayed at theAAIB; Figure 1 shows an extract from the FDR for the approachfrom about 2,000 feet and the subsequent landing at Mahon. At1,600 feet the power was reduced to Flight Idle, the initialrate of descent was 1400 feet/minute with an airspeed of between160 and 170 kt CAS. Below 500 feet the rate of descent reducedto 600 feet/minute, and the power was increased at around200 feet, to 50% N1. The airspeed was 150 kt.

At 50 feet the elevator angle began to increase to 16° NoseUp initially, and the pitch angle increased to 8.4°. Theaircraft touched down at 137 kt, the pitch attitude increasedafter touchdown to a maximum 9.66°, remaining at about 9.5°for three seconds. The body pitch angle for runway contact atzero roll given in the flying manual is 9.5°. The maximumelevator angle was 19.1° as the pitch attitude began to reduce. The touchdown was gentle with a maximum normal acceleration of1.24g. The subsequent landing at Luton was normal.

Examination of aircraft

The aircraft had sustained skin damage over Frame Stations 887,907 and 927, on the underside of the rear fuselage. In addition,the tip of the aft galley drain mast had been lightly scraped. It was apparent that the tail bumper, located aft of the damagedarea, had not contacted the runway.

Ultrasonic test equipment showed that the skin on Frames 887 and927 had been abraded to the extent that the thickness was reducedfrom a nominal 0.063 inches to a minimum of 0.046 inches. A joinbetween two adjacent skin panels occurred at Frame 907; this wasachieved by means of an internal butt strap, with the edges ofboth skin panels being attached to the frame flange through thebutt strap. The forward panel had been abraded through its fullthickness at one point, thus exposing part of the butt strap. The fact that the latter had not been worn through meant thataircraft pressurisation had not been affected.

The damaged areas were all repaired in accordance with the aircraftStructural Repair Manual, and involved fitting temporary patchesintended to last for 3,000 landings.

It was noted that when a piece of string was held taut betweenthe tail bumper and the bottom of a main landing gear wheel (thussimulating the ground plane with the aircraft at a high pitchangle), it cleared the damaged area of the fuselage by approximately3 inches. This suggested that only this amount of additionaloleo compression/tyre sidewall deflection was needed to bringthe lower fuselage, rather than the tail bumper, into contactwith the ground. The pressures in the tyres and oleos were foundto be normal, and the DFDR data showed that the landing at Mahonwas not hard.

Regarding the positioning of the tail bumper on this type of aircraft,the manufacturer stated "... the function of the unit wasto protect the horizontal stabiliser jack screw assembly fromdamage which could be sustained due to an over rotation immediatelyafter lift-off (*ie with the oleos at maximum extension).* ..Apparently there has been some misunderstanding concerningthe function of this device in that it is really only a "protector"of the jackscrew assembly. We have initiated a change to the737400 Maintenance Manual to clarify this point".

Summary

The rear fuselage contact with the runway during landing appearsto be the result of a combination of factors. The aircraft flewthe approach at a weight close to the maximum authorised landingweight in variable wind conditions. At 1,200 feet the aircraftwas high on the approach and the 30 flap setting was maintained;the maximum drag flap of 40 was not selected. The pilot maintainedthe engine power at flight idle, until around 200 feet, in orderto regain the required flight path at the correct speed and then,when engine power was increased, only 50% N1 was applied. Furthermore,the flare was initiated at 50 feet, as evidenced by the increasingelevator angle and this elevator input was maintained after touchdown.

The Boeing 737 Flight Crew Training Manual states that duringthe flare and touchdown " *Initiate the flare when themain gear is approximately 15 feet above the runway by increasingpitch attitude approximately 3_..*" The same manual alsoexplains that " *The usual causes for an aft fuselage contactwith the runway during landing are: early (high) flare, earlythrust reduction, low airspeed or rapid speed reduction duringflare, prolonged flare or holding the aircraft off the runwayin an attempt to achieve a soft landing and /or applying excessivenose up elevator after touchdown to control derotation*".