SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-8K5, G-TAWG	
No & Type of Engines:	2 CFM56-7B27E turbofan engines	
Year of Manufacture:	2012 (Serial no: 37266)	
Date & Time (UTC):	21 July 2020 at 0500 hrs	
Location:	Birmingham Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - 187
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	41 years	
Commander's Flying Experience:	10,262 hours (of which 2,615 were on type) Last 90 days - 16 hours Last 28 days - 13 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and information from the operator	

Synopsis

The operator had suspended operations for several months due to Covid-19 restrictions, and prior to the incident flight the reservation system from which the load sheet was produced had been upgraded. There was a fault in the system which, when a female passenger checked in for the flight and used or was given the title 'Miss', caused the system checked her in as a child. The system allocated them a child's standard weight of 35 kg as opposed to the correct female standard weight of 69 kg. Consequently, with 38 females checked in incorrectly and misidentified as children, the G-TAWG takeoff mass from the load sheet was 1,244 kg below the actual mass of the aircraft.

Following this serious incident, the operator introduced a daily check to ensure adult females were referred to as Ms on the relevant documentation, with a secondary check by Operations staff against passenger loads. A more formal system of checks was introduced on 24 July 2020.

History of the flight

General

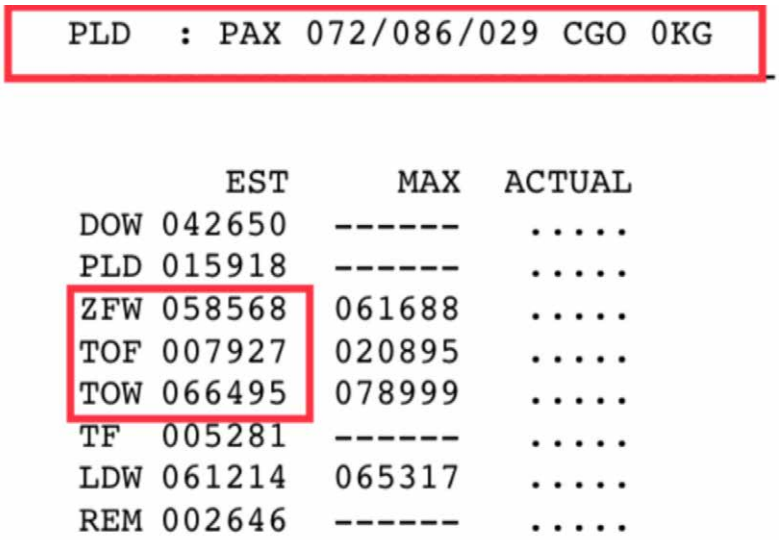
The operator was the UK associated regional arm of a large European company, with a number of operating bases at major and regional airports within the UK. On 10 July 2020, three adult females were checked in for a flight as children. The reason was identified

as the use of the title 'Miss', which the system interpreted as a child and not as an adult, equivalent to a weight difference of 34 kg. Action was taken to correct the problem, and the situation was monitored. On 21 July 2020, three flights by three different aircraft from the same operator departed from the UK with inaccurate load sheets caused by the same issue. G-TAWG was the first of the three to take off, at 0500 hrs from Birmingham International Airport.

The flight crew had two documents available to them: the flight plan showing the route and planning information with predicted takeoff weight; and a load sheet providing the actual weight and distribution of the passengers, including additional weight such as cargo, from which aircraft performance was calculated. Procedures for how these documents were used were set out in the airline's Operations Manual.

The incident flight

The aircraft was to depart on a scheduled flight from Birmingham International Airport to Palma de Mallorca airport (PMI), Spain. The weather at 0450 hrs, 10 minutes before departure, was wind calm, CAVOK, OAT 8°C, dew point 6°C and QNH 1026 hPa. As part of the prestart procedure, the flight crew reviewed the flight plan, which gave an expected takeoff weight (TOW) of 66,495 kg (Figure 1), and the load sheet, which gave a TOW of 64,889 kg (Figure 2). They noticed that there was a discrepancy, with the load sheet showing 1,606 kg less than the flight plan. They noted that the number of children shown on the load sheet was higher than expected, at 65, compared to the 29 which were expected on the flight plan. The commander recalled thinking that the number was high but plausible; he had experienced changing loads on the run-up to the temporary grounding[1] as passengers cancelled and altered trips at short notice.



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PLD  : PAX 072/086/029 CGO 0KG

        EST      MAX   ACTUAL
DOW 042650   ------    .....
PLD 015918   ------    .....
ZFW 058568   061688    .....
TOF 007927   020895    .....
TOW 066495   078999    .....
TF  005281   ------    .....
LDW 061214   065317    .....
REM 002646   ------    .....
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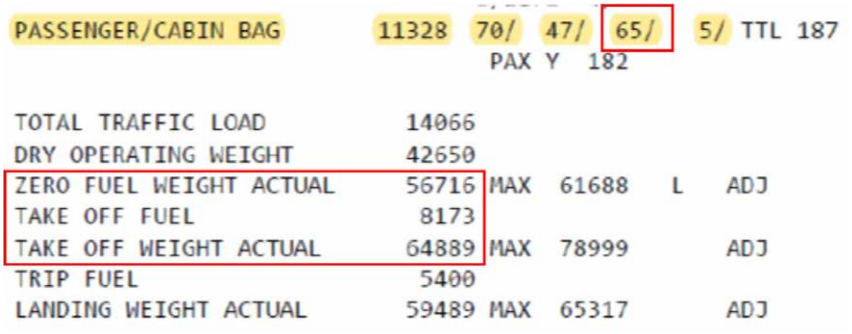
Figure 1

Flight plan weights and passengers

Footnote

[1] As a result of the imposition of Covid-19 restrictions.



PASSENGER/CABIN BAG	11328	70/	47/	65/	5/	TTL 187
		PAX Y	182			
TOTAL TRAFFIC LOAD	14066					
DRY OPERATING WEIGHT	42650					
ZERO FUEL WEIGHT ACTUAL	56716	MAX	61688	L	ADJ	
TAKE OFF FUEL	8173					
TAKE OFF WEIGHT ACTUAL	64889	MAX	78999		ADJ	
TRIP FUEL	5400					
LANDING WEIGHT ACTUAL	59489	MAX	65317		ADJ	

Figure 2

Load sheet weights and passengers

He remarked that variances between actual and expected Zero Fuel Weight (ZFW)[2] were not uncommon. A further issue with the load sheet on the flight was the baggage load, which had been calculated as 35 bags at a standard mass of 16 kg, and 150 bags whose actual masses averaged 14.5 kg per bag. This was an unusual occurrence, but the use of actual masses was permitted by the Operations Manual. The commander also took care to check the load sheet taxi fuel was correct, as he had noticed a discrepancy with the flight plan statistical taxi fuel[3]. After a brief discussion, the flight crew decided that they were content with the load sheet, the actual bag weights being very close to standard and the new ZFW being understood as a function of the differing passenger load.

The flight crew followed the normal procedure to calculate takeoff performance independently using the Boeing Onboard Performance Tool (OPT). With a light and variable wind, they elected to use a 5 kt tailwind with the load sheet data to compute takeoff performance. Nothing unusual was noticed by the crew on departure and the flight continued normally to the destination.

Subsequent use of the actual takeoff weight for performance calculations showed that all departure airspeeds should have been one knot greater than those used on the incident flight, and the thrust required should have been 88.9% N_1 compared to the 88.3% N_1 set on the incident flight. The screen displays from the Boeing OPT are shown in Figure 3, with the incorrect load sheet takeoff weight on the left and the correct takeoff weight on the right. The resulting one knot difference in takeoff speeds (V_1, V_2 and V_R) can be seen in the bottom right of each screenshot, and the different takeoff thrusts on the bottom left.

A calculation was carried out for the actual TOW and environmental conditions, using a calm wind rather than assuming a 5 knot tailwind. The result showed that a thrust of 88.2% N_1 would have been required to meet regulatory requirements.

The crew procedure for performance planning is set out at Figure 4.

Footnote

[2] The Zero Fuel Weight is the weight of the aircraft fully loaded with crew, passengers, bags and freight with only the weight of the fuel to be added.

[3] Statistical taxi fuel is a statistical prediction of the fuel expected to be used for taxiing based on previous departures.

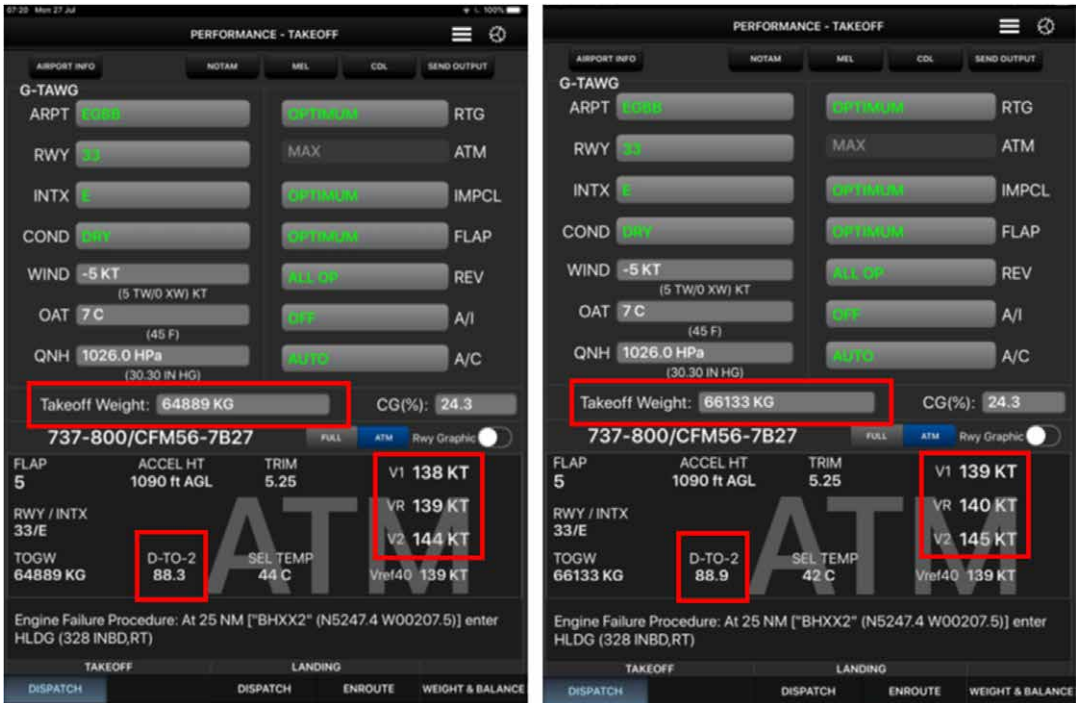


Figure 3

Boeing Onboard Planning Tool performance data

Table 2.2.6(1)

Captain	First Officer
Both pilots shall verify the loadsheet independently.	
Callout:	
• Actual ZFW	Verify against planned ZFW on OFP. Enter actual ZFW in CDU PERF INIT page. Call out PERF INIT GW minus taxi fuel as gross error check against loadsheet TOW.
• Actual TOW (check for gross error)	Verify against planned TOW on OFP.
• CRZ CG (use MACTOW or MACZFW whichever is lower). Verify CDU entries.	Enter CRZ CG on CDU PERF INIT page. Execute entries.
• MACTOW. Verify MACTOW entry	Enter MACTOW on TAKEOFF REF page 1/2.
All weights should be called out rounded up to the next higher 0.1T.	
For OPT calculation, agree airport, runway, takeoff weight, thrust, configuration and other assumptions. Complete takeoff calculation independently using the latest airport information.	

Figure 4

Performance planning procedure

The Ground Operations Manual sets out the actions to be taken should any last-minute changes (LMC) above a certain value be made to the payload (Figure 5).

3.4 Last Minute Changes

If any last minute change occurs after the completion of the loadsheet, (mass and balance documentation), this must be brought to the attention of the commander and the last minute change must be entered on the loadsheet (mass and balance documentation).

If the total LMC exceeds the values shown in this table below, a new mass and balance document must be prepared.

Aircraft Type	LMC Exceeds
B737	500 kg (Including fuel)

Figure 5

Last-minute change weight limit

Airline IT system

Part of the operator's IT system was an integrated check-in system, which was undergoing an upgrade as part of a wider system upgrade for the airline industry.

Prior to the upgrade being implemented, users were involved in considering any risks that might occur as part of the upgrade and, during User Acceptance Testing (UAT), the system functioned as expected. In some of the training meetings held in London in February 2020, the different titles for passengers, such as Mr, Mrs and Dr, used by the various markets, had been discussed in relation to standard IATA usage. The relationship between a passenger's title and the standard weight allocated was not discussed. No specific test scenarios looking at passenger titles were examined in the UAT.

On the first flight after the upgraded system was implemented, an adult female passenger was checked in for a flight as a child and was also shown on the load sheet as a child. This was spotted by the flight dispatcher and the operator's systems delivery manager. A check of the flight revealed two other cases where the same error had occurred. No safety or ground operations reports were submitted about this occurrence.

The system programming was not carried out in the UK, and in the country where it was performed the title Miss was used for a child, and Ms for an adult female, hence the error. A manual solution for correcting the problem was quickly identified that involved a team identifying upcoming flights, checking each booking, and changing all adult females with the title 'Miss' to 'Ms', which overcame the problem. Subsequently, this work was shared between two teams, and the process was completed every afternoon and evening for the next day's flights. It was checked again every morning, where possible, before flights departed.

As a further mitigation measure, Ground Operations had requested that the check-in-staff pay particular attention to female passengers and double check that they showed in the system as females and not as children when they presented themselves at the check-in desk or at the gate. This request was sent out electronically to all ground stations. This was initially a recommendation, as it was not prescribed in the Ground Operations Manual.

The upgrade programmers adapted a piece of software, which changed the title of any adult female from Miss to Ms automatically, and this was implemented on 17 July 2020. This adaptation was only capable of changing bookings before check-in. Any passenger bookings with the title Miss already checked in, including online up to 24 hours before departure, would not be amended. On 20 July 2020, the programmer was making enhancements to the program to improve its performance. This should not have stopped the program from working, but as this was a 'fix', it could not be known for sure.

A combination of the teams not working over the weekend and the 'online' check-in being open early on Monday 20 July, 24 hours ahead of the flight, meant the incorrectly allocated passenger weights were not corrected.

Analysis

The incident occurred due to a simple flaw in the programming of the IT system, which was due to the meaning of the title 'Miss' being interpreted by the system as a child and not an adult female. This was because in the country where the system was programmed, Miss is a child and Ms is an adult female. This issue had not been identified as part of the initial risk analysis and did not manifest itself during the trial simulations. For the incident flight, the weight of passengers on the load sheet was below the actual weight of the passengers by 1,244 kg, which was more than the 500 kg LMC weight difference above which a new load sheet should have been produced, had the weight discrepancy been identified.

When the issue was first identified, the operator had instigated Safety Action to prevent an incorrect load sheet being produced and used for aircraft performance planning. However, the work of correcting the adult females wrongly listed as children was handled by teams that were not working over the weekend. Passengers were able to check in online 24 hours before departure, on 20 July 2020. On this day, a software 'fix' was being applied to the system, possibly preventing it from identifying incorrect passenger status before the incident flight on 21 July.

Whilst an incorrect takeoff weight was used for aircraft performance planning, the thrust required for the actual TOW and environmental conditions (88.2% N_1) was marginally less than the thrust used for the takeoff (88.3% N_1). This meant the safe operation of the aircraft was not compromised.

Conclusion

A flaw in the IT system used by the operator to produce the load sheet, meant that an incorrect takeoff weight was passed to the flight crew. As a result, the aircraft departed with a takeoff weight 1,244 kg more than stated on the load sheet. An upgrade of the system producing load sheets was carried out to prevent reoccurrence.

Safety action

Following this serious incident, the operator took action to prevent re-occurrence:

- A member of the Systems team manually checked the flights daily to ensure that the title 'Miss' was amended to 'Ms'.
- A secondary check was instigated with the Operations department against the booked passenger loads.
- A reminder briefing was given to Ground Handling Agents to ask them to be alert at check-in or during boarding for any adult female passengers showing as Miss or a child.
- A formalised procedure for a Customer Care Executive to check bookings was instituted on 24 July 2020.