Air Accidents Investigation Branch

AAIB Bulletin 9/2022

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(ALL TIMES IN THIS BULLETIN ARE UTC)

AAIB Field Investigation Reports

A Field Investigation is an independent investigation in which AAIB investigators collect, record and analyse evidence.

The process may include, attending the scene of the accident or serious incident; interviewing witnesses; reviewing documents, procedures and practices; examining aircraft wreckage or components; and analysing recorded data.

The investigation, which can take a number of months to complete, will conclude with a published report.

SERIOUS INCIDENT

Aircraft Type and Registration:	Airbus A350-1041, G-XWBC
No & Type of Engines:	2 Rolls-Royce Trent XWB-97 turbofan engines
Year of Manufacture:	2019 (Serial no: 362)
Date & Time (UTC):	2 January 2022 at 1430 hrs
Location:	London Heathrow Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 12 Passengers - 326
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to aircraft skin, toilet waste panel and tailstrike sensor
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	17,305 hours (of which 652 were on type) Last 90 days - 141 hours Last 28 days - 48 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was approaching Runway 27L at London Heathrow airport at the end of a flight from Dubai. During the flare for landing the aircraft "floated" and the crew believed it would not land within the runway Touchdown Zone (TDZ). A go-around was initiated from low height and speed; the subsequent pitch rate applied caused the aircraft to reach a nose-up attitude sufficient to cause a tailstrike. The aircraft subsequently landed safely and there were no injuries.

History of the flight

The aircraft was operating a commercial passenger flight from Dubai International Airport to London Heathrow Airport. The flight crew had completed a rest period in Dubai and both reported that they felt normally rested for the start of the duty. The crew were given wake up calls at 0330 hrs and their duty commenced at 0430 hrs. The departure preparations were entirely routine, and the only entry in the aircraft technical log related to a flight deck touch screen on the commander's side. The aircraft departed Dubai at 0620 hrs.

The flight to Heathrow was uneventful and the crew briefed an approach to Runway 27L. The forecast weather indicated the possibility of gusts up to 30 kt and the crew discussed the implications of this during their briefing approximately one hour before landing. The wind was within limits[1] for the co-pilot to act as PF for the landing and that was accepted as the plan. Due to the blustery conditions the crew calculated the landing performance for both Flap 3 and Flap Full. Both are approved landing configurations, but Flap 3 is preferable in gusty conditions. The runway surface was wet and so, in accordance with the operator's SOPs, the crew assumed medium to poor braking action and no reverse thrust for landing distance calculations. The aircraft is equipped with a Brake to Vacate (BTV) autobrake system, which allows the crew to select a desired exit from the runway and then automatically varies the braking force to achieve that exit. In this case the crew selected the N6 exit (Figure 1) from Runway 27L.

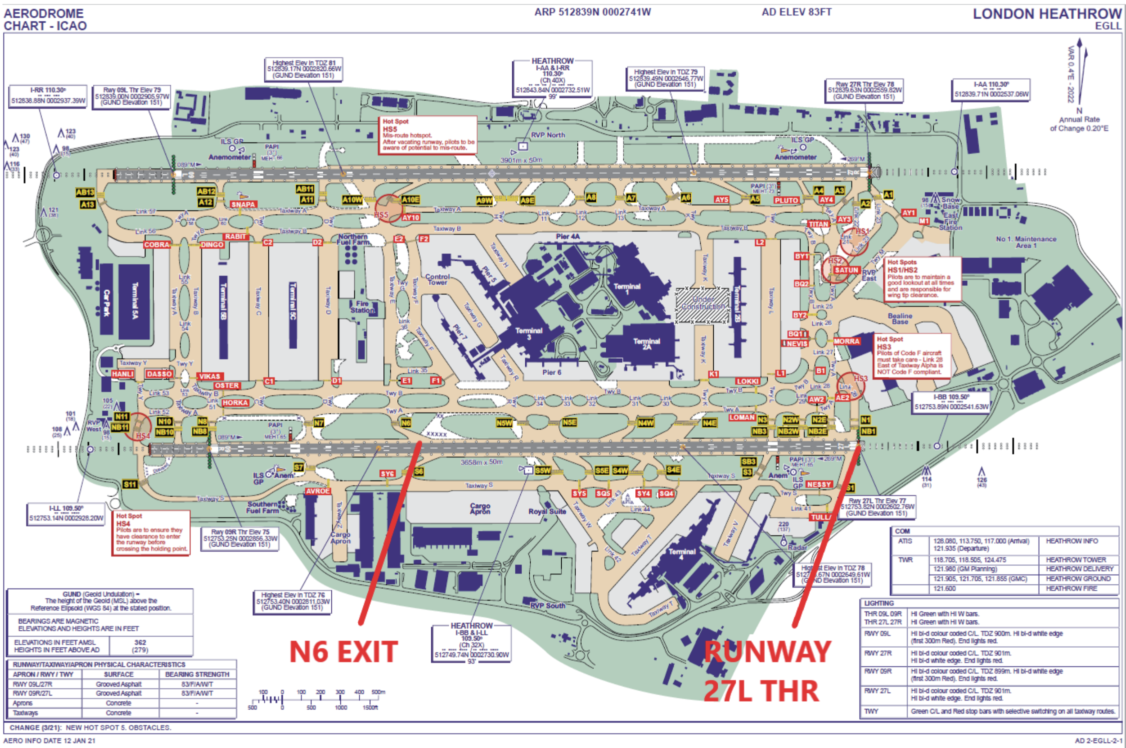

Figure 1

London Heathrow Airport Chart

The operator uses a monitored approach philosophy in which the PM for landing acts as PF for the initial stages of the approach and then hands control to the other pilot for the final approach and landing. Accordingly, the commander was PF for the initial stages of the approach.

The crew accepted a shorter arrival routing from ATC, which meant the aircraft was higher than intended with respect to the vertical path. The commander used speedbrakes to increase the descent rate, and the aircraft was in its landing configuration by 2,000 ft agl. The co-pilot took over the PF role at approximately 1,000 ft agl.

Footnote

[1] The operator's crosswind limit for a landing by the co-pilot is 26 kt.

There was another aircraft landing ahead, also planning to vacate at N6, so the co-pilot elected to continue the ILS approach to Runway 27L with the autopilot engaged until that aircraft cleared the runway. The co-pilot disengaged the autopilot at approximately 400 ft agl to conduct a manual landing. The co-pilot stated that he had to make a few corrections to the flight path as a result of the wind conditions but that the approach felt normal. The ATIS reported the wind as 210 at 11 kt gusting 22 kt.

The co-pilot manually reduced thrust at approximately 50 ft agl and then flared the aircraft for touchdown. He described the flare as a “check” in pitch and then holding the attitude. The aircraft’s radio altimeter audio callout sounded at 5 ft, after which the flight crew described the aircraft as “floating”. The radio altimeter height increased to 9 ft and then decreased to 5 ft where there was a second 5 ft audio call. The commander considered that after the prolonged flare the aircraft would land beyond the runway TDZ. The operator has a Safe Landing Policy which directs a go-around should the crew foresee a landing outside the TDZ, and so the commander called “go-around”.

The co-pilot initiated the go-around, selected Take Off Go-Around (TOGA) on the thrust levers and applied a pitch up demand on his control column, briefly reaching full aft control movement. Engine response from idle to go-around thrust takes several seconds and with the low energy state the aircraft briefly touched down. As it did so the pitch attitude was increasing in response to the co-pilot’s control inputs and reached a maximum of 15° nose up. The pilots described the touchdown as firm, but not so severe that it would have constituted a heavy landing. The commander felt the initial pitch was greater than warranted, but stated that by the time he could have reacted the co-pilot was already taking corrective action. With the aircraft on the ground the aural configuration warning sounded as a result of TOGA thrust being selected with a landing flap setting.

The aircraft then became airborne and climbed away in a normal go-around. The crew retracted the landing gear and reduced the flap setting to FLAP 1 to keep airspeed low and reduce the ground track for the circuit to land. As the aircraft passed 400 ft agl the Electronic Centralised Aircraft Monitor (ECAM) displayed a TAILSTRIKE warning. The warning is inhibited at lower heights. ATC informed the crew, by RTF, that they had observed a tailstrike. The crew completed the ECAM actions for a tailstrike and then the after takeoff checklist. The crew discussed the situation and decided to continue with an approach to Runway 27R, as Runway 27L was temporarily out of use for an inspection after the tailstrike. The co-pilot continued as PF while the aircraft positioned on approach and the commander took control for the landing. After landing the airport RFFS conducted an external inspection for damage and the aircraft then taxied to a parking stand and shut down.

Accident damage

An initial damage assessment found two areas of skin damage on the aircraft tail lower fuselage, one each end of the toilet waste panel aft of the tailstrike sensor. While the rearmost skin damage area was assessed as surface finish damage, the forward area appeared to have penetrated through the paint, copper mesh lightning protection layer and up to five carbon fibre reinforced plastic layers.

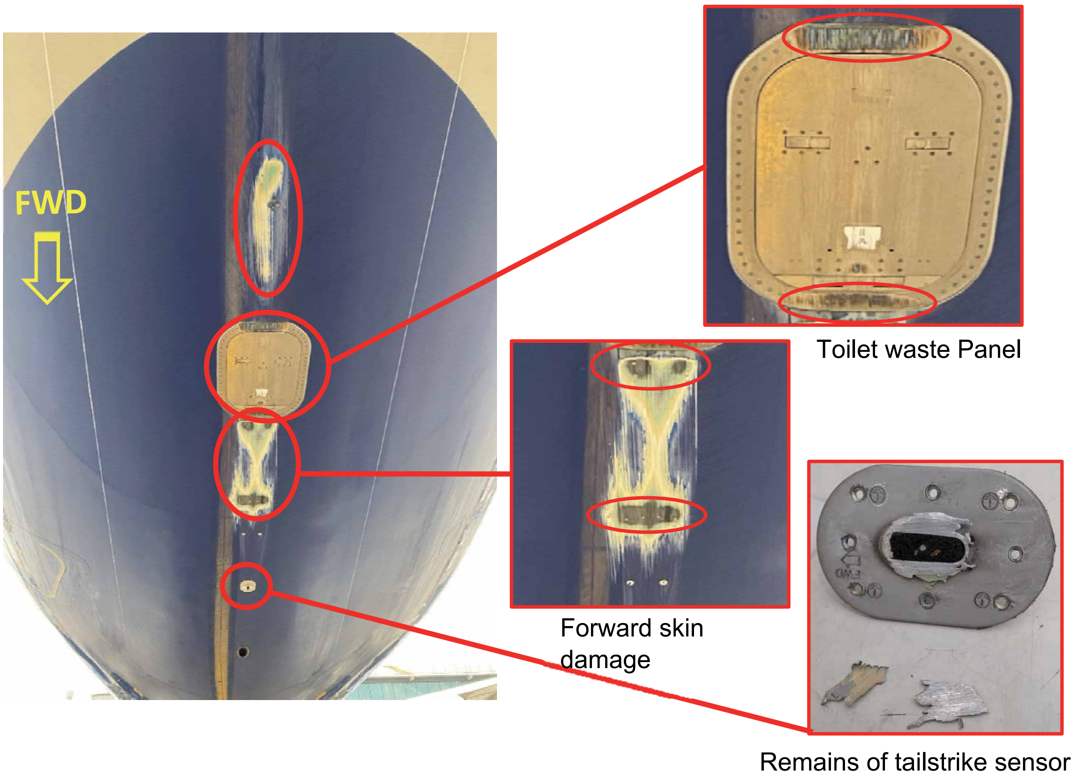

Figure 2

Rear lower fuselage damage to skin, toilet waste panel and tailstrike sensor

The leading and trailing edges and rivets on the toilet waste panel were also abraded by the runway surface, although the damage to the panel was believed to be repairable during the initial damage assessment.

As designed, the tailstrike sensor had fractured on impact (Figure 2).

Recorded information

G-XWBC was fitted with a solid-state Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR); both of which were downloaded by the AAIB and recorded the whole event.

The CVR confirmed the crew accounts of the event, and the FDR data was used to produce Figure 3, covering G-XWBC's approach from 100 ft radio altitude until initiation of the go-around during which the tailstrike occurred. The numbered points at the top of Figure 3 represent the approximate position on Runway 27L of the corresponding events shown on the graph.

Prior to point 1, as G-XWBC descended below 100 ft radio altitude, the approach was stable with a pitch attitude of between 2° and 3° nose up, a descent rate of approximately 800 ft/min and with airspeed reducing towards 150 kt. At point 1, at approximately 55 ft above the runway, the aircraft was flared for landing and shortly afterwards the thrust levers closed to idle.

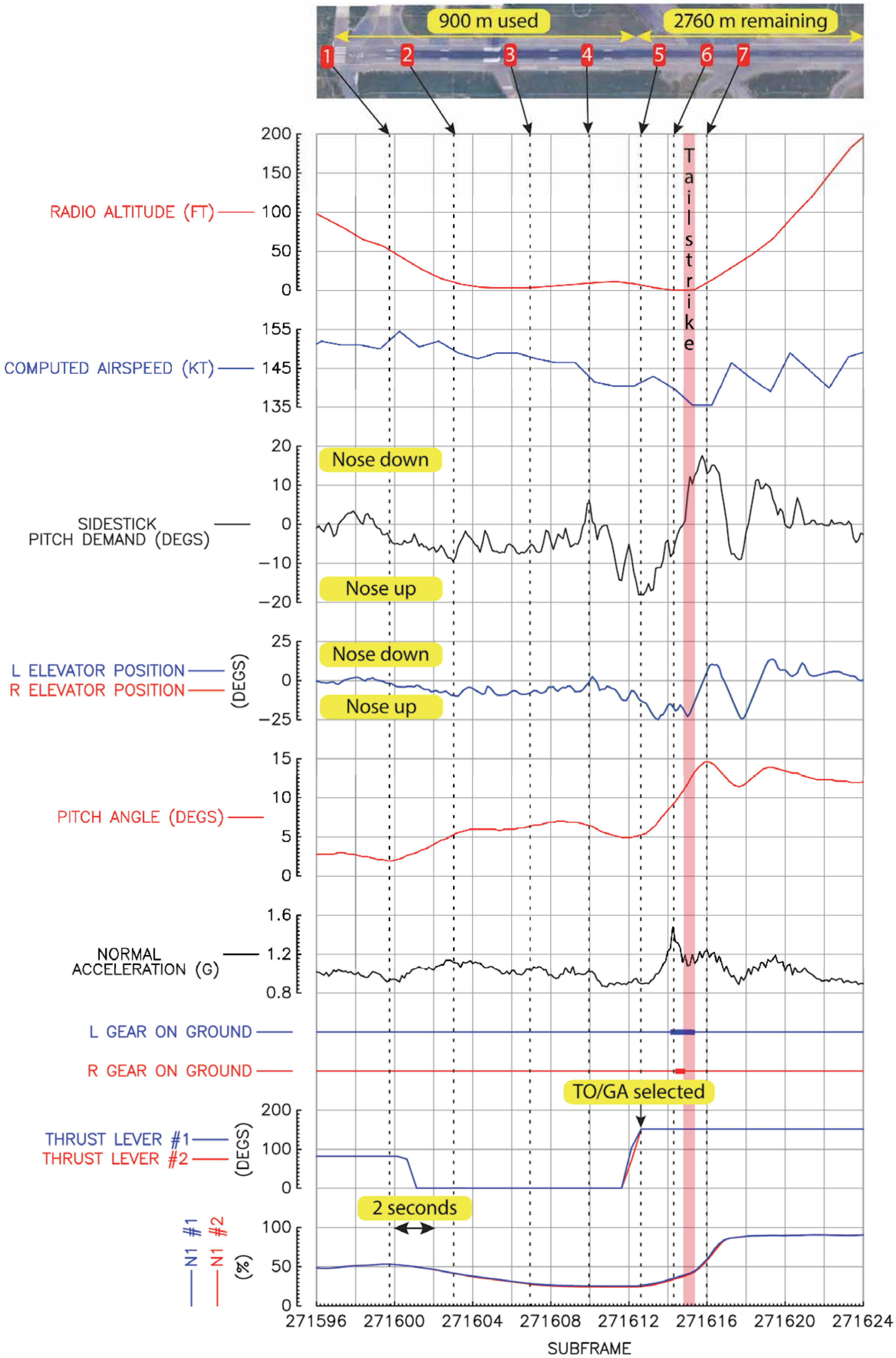

Figure 3

G-XWBC's descent from 100 ft radio altitude and the initial part of the go-around

Over the next three seconds, as G-XWBC descended through 10 ft, progressively more nose-up sidestick was applied, reaching 3/5 of maximum sidestick deflection at point 2. In response, G-XWBC's pitch attitude increased and then stabilised at around 6° nose-up, and the aircraft 'floated' 5 ft above the runway but did not touchdown.

Four seconds later, at point 3, G-XWBC began to climb and the pitch attitude increased slightly. At point 4, a sharp nose-down sidestick input (of approximately 1/3 of maximum deflection) was made. The sharpness of this input is seen in the distinct reduction of normal acceleration at point 4.

G-XWBC then descended, the pitch attitude reduced towards 5° nose up, and an increasing amount of nose-up sidestick was applied which reached full travel. In response, the elevators reached 4/5 of their full nose-up travel. At point 5, having used 900 m of runway and with the aircraft at the end of the TDZ, a go-around was initiated and the thrust levers were moved to the TOGA detent. At this point, 2,760 m of runway remained ahead of the aircraft.

The nose-up sidestick command was then reduced, although it was still maintained in the nose up sense, and the pitch attitude, which had risen rapidly because of the large elevator deflections, approached 10º nose up. At the same time, G-XWBC's airspeed had substantially decreased and, before the engines had time to significantly spool up, the aircraft briefly touched down at point 6.

Between points 6 and 7, as G-XWBC became airborne again, the airspeed reached a minimum of 135 kt and the tailstrike occurred. Although nose-down sidestick inputs were made, G-XWBC's pitch attitude continued to increase before the elevators moved to reduce the pitch attitude. A maximum pitch attitude of 16° nose-up was recorded at point 7.

After point 7, following a large nose-up sidestick demand the flight path began to stabilise.

Aircraft information

G-XWBC is an Airbus A350-1000 configured for passenger operations and is 73.79 m long. The Flight Crew Operating Manual gives the following information with regard to tail clearance warnings:

> *'"Pitch-Pitch" aural alert is triggered if the pitch attitude, monitored by the flight controls, reaches a given limit. This aural alert is only available in manual landings when the aircraft height is lower than 50 ft RA. In addition, a tailstrike pitch limit also appears on the PFD at landing below 400 ft RA.'*

The audio warning is triggered when the pitch attitude is expected to exceed 9° nose-up. The system uses a predictive phase advance term to calculate the pitch attitude one second into the future.

The tailstrike pitch limit in the Primary Flight Display (PFD) (Figure 4) is displayed at fixed pitch value, which corresponds to the pitch limit on the ground with the main landing gear compressed plus an additional margin. The illustration from the Flight Crew Training Manual

(FCTM) shows the pitch limit for an A350-900. The incident aircraft was an A350-1000, which is longer, and therefore the PFD indication would be positioned at 8.6° nose-up. The indication disappears when the groundspeed falls below 50 kt, or 4 seconds after a go-around is initiated.

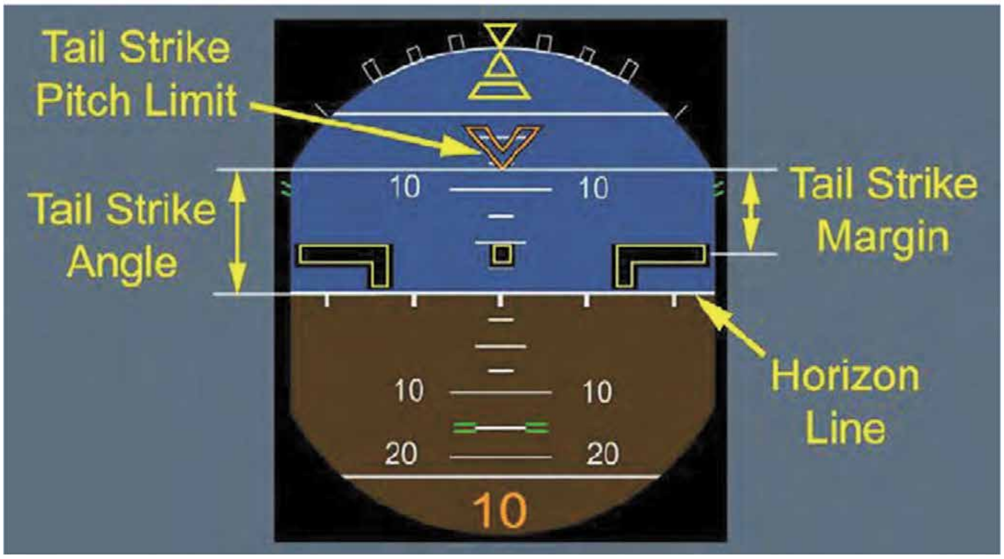

Figure 4
PFD Tailstrike Pitch Limit

The aircraft is equipped with a Runway Overrun Warning/Runway Overrun Protection (ROW/ROP) system. The ROW and ROP functions alert the flight crew if a potential runway overrun is detected at landing. The ROW function is operative until the aircraft is on the ground and the ROP function becomes active. The system uses the following definition for on ground:

'The nose landing gear is on ground, or

The ground spoilers are extended for 5 seconds.'

The ROW/ROP system monitors the computed landing distance and predicts a potential landing runway overrun in flight and during rollout. If the landing runway is too short the system will:

- '*Trigger the applicable aural and visual alerts (ROW and ROP)*
- *Automatically order maximum braking, when the autobrake system is selected to medium or if the BTV is active.'*

With regard to the limits on the tailstrike warnings and the limitations on when they are active the manufacturer gave the following information:

'The "Pitch-Pitch" alert is designed to avoid excessive pitch attitude during the landing phase. It is available during manual landing below 50ft RA.

It is triggered when the pitch is expected to become greater than 9°. The audio warning includes a phase advance term, which amounts to the pitch angle one second in the future. This phase advance is tuned to, on one hand, allow sufficient time for the pilot to correct his sidestick input, and on the other hand not to be intrusive.

This balance works well when the pitch rate is low, as is the case during landing.

During a go-around, this compromise is no longer achievable. The pitch rate is quite high, and the predicted pitch angle tends to be overestimated. This would result in spurious audio warnings that might prevent the crew from achieving the rotation rates necessary for a go-around. There is also the fact that with high pitch rates, it is impossible to give the crew sufficient time to allow them to react.

It was therefore decided to inhibit the Pitch-Pitch audio warning during a go-around.

In parallel, during landing below 400 ft, an orange chevron on the PFD indicates the maximum pitch attitude to avoid a tailstrike, at a fixed value (8,6°) corresponding to the pitch limit with the main landing gear compressed.

Upon go-around initiation, the chevron remains displayed only until the aircraft is above 10 ft RA.

It has to be noted that on A350, with the AP off, the FD pitch bar disappears below 50 ft RA.

Then, when the go-around is initiated by pushing the thrust levers in TOGA notch, the FD pitch bar is displayed again, in SRS (Speed Reference System) mode.

In the initial phase, the SRS guidance targets 12.5° as pitch target, but, as long as the tailstrike pitch limit (chevron) is displayed on PFD (i.e. as long as the aircraft is below 10ft RA), the FD pitch bar is limited by the chevron (i.e below 8.6° on the PFD pitch scale).

The FD guidance does not include any other tailstrike protection.'

Aircraft examination

After a detailed damage assessment by the operator's maintenance team, it was confirmed that the area aft of the toilet waste panel only required restoration of the surface finish. An ultrasonic Non-Destructive Test inspection of the toilet waste panel cut-out found no signs of delamination. Composite damage assessments were completed of the airframe stringers located around the areas of external damage, but no further damage was found. The abraded external fuselage skin areas were examined and again no delamination of the carbon composite layers was present.

Inspection of the external skin area forward of the toilet waste panel found the painted surface, copper mesh layer and up to three composite layers had been worn away in small patches (Figure 5). The damage was within the capability of the operator's aircraft structures maintenance team to repair. The toilet waste panel was damaged beyond repair because the abraded leading and trailing edges had thinned the material and compromised the strength of the panel. Three vent pipes positioned along the rear of the fuselage had also been bent and abraded as the aircraft tail struck the ground and had to be replaced (Figure 6).

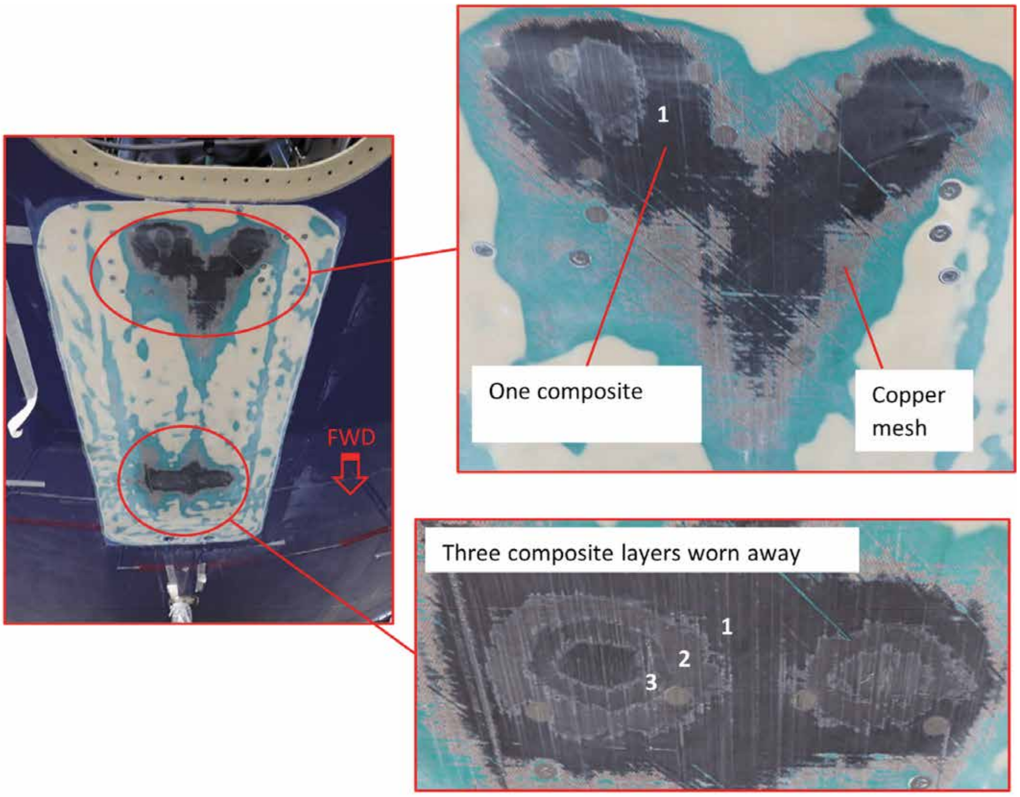

Figure 5
Damaged skin composite layers

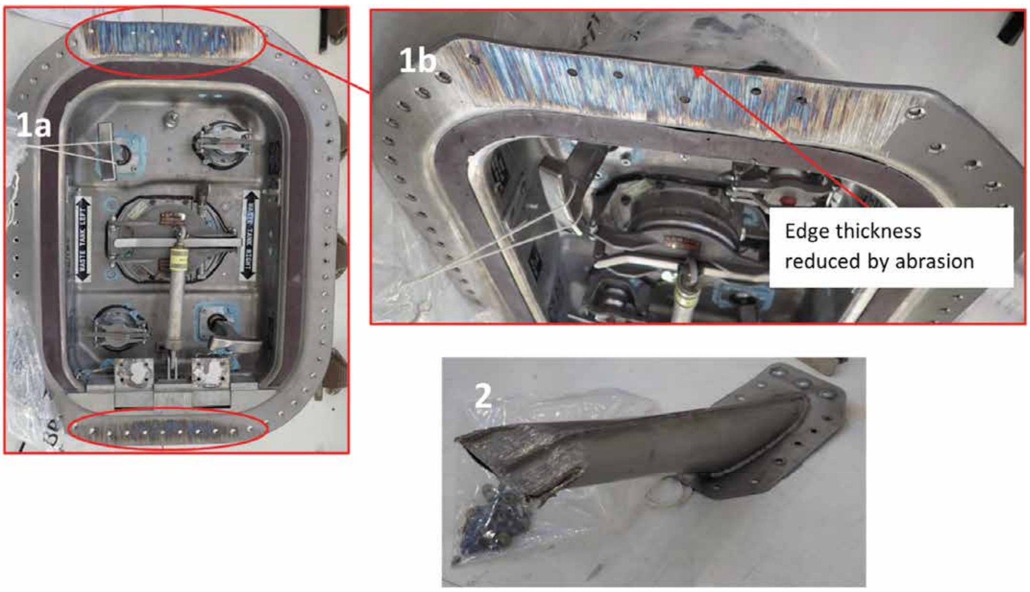

Figure 6
Toilet waste panel (1a) damaged beyond repair (1b) and damaged vent pipe (2)

Tailstrike indication system

The primary component of the tailstrike indicator system is the tailstrike sensor which is designed to fracture when the aircraft's tail hits the ground. There are two wires inside the sensor (Figure 7) to allow for a fault condition should one of the wires become open circuit. In this state no tailstrike alert is displayed and the fault is added to the post flight report by the Centralised Maintenance System and included in a maintenance check.

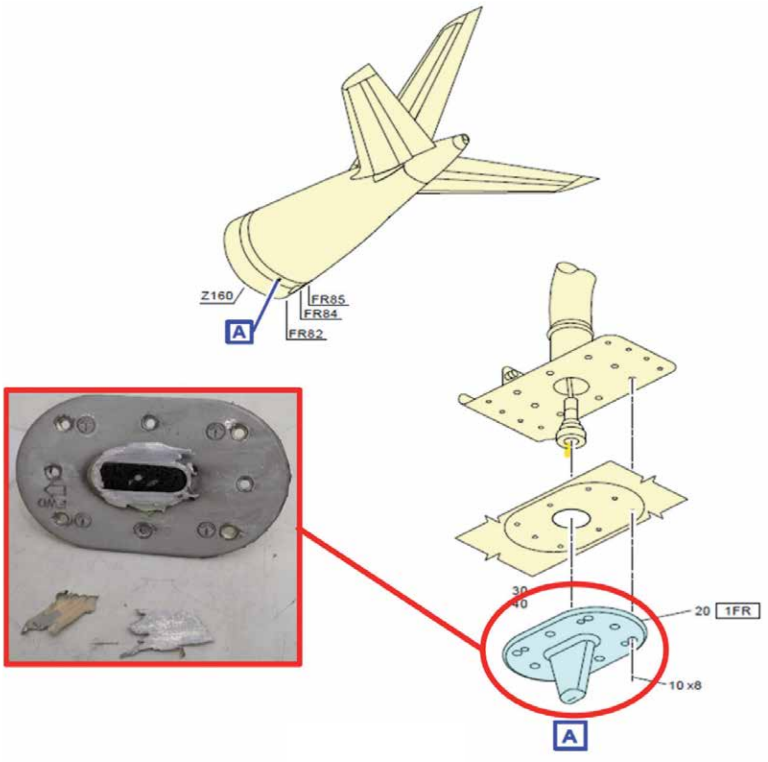

Figure 7
Tail strike sensor location

When a tailstrike does occur, the two wires in the sensor are damaged and become open circuit from their normally grounded (GND) state. The change of signal state is detected by the Common Remote Data Concentrators which change the format of the data and transmits it to the Flight Warning System (FWS) via the Avionics Full Duplex Switched Ethernet (AFDX). The FWS shows a warning on the ECAM Warning Display providing the aircraft is in the appropriate flight phase, landing or taking off. A single chime is also produced from the flight deck loudspeakers. On the cockpit glare shield and panels 411VU and 412VU, MASTER CAUT push buttons are also illuminated (Figure 8). Other than an ECAM message, the system warnings are inhibited when TOGA is selected during landing.

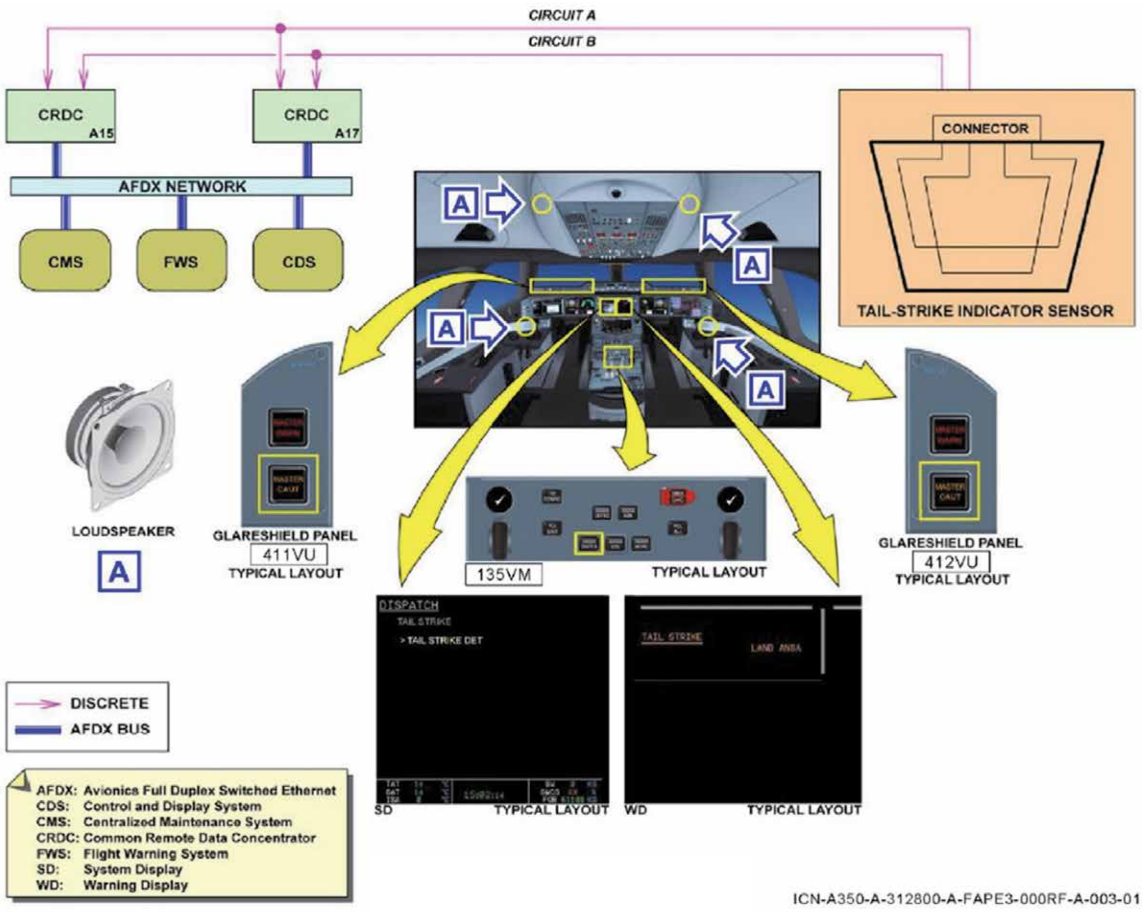

Figure 8

Tail strike system diagram

Meteorology

The weather report at 1420 hrs gave the wind as 210° at 13 kt. There was a report of cumulonimbus cloud indicating shower conditions in the vicinity of the airport and therefore an increased likelihood of gusts.

An amended weather forecast had been issued for Heathrow at 1256 hrs. That indicated a wind of 230° at 12 kt, with temporary periods of wind from 220° at 20 kt with gusts to 30 kt, associated with heavy showers of rain and cumulonimbus cloud.

Airfield information

Heathrow Airport lies approximately 14 miles to the west of central London. It has two parallel runways, and Runway 27L, where the incident occurred, has a Landing Distance Available of 3,658 m. TDZs are marked by pairs of stripes symmetrically placed on the two sides of a runway centreline. The number of pairs depends on the runway length, with one pair for runways that are shorter than 900 m and six if the length is 2,400 m or more. The aiming point marking coincides with one of these pairs and is noticeably wider (Figure 9). The TDZ on Runway 27L has six pairs of stripes and is 900 m long.

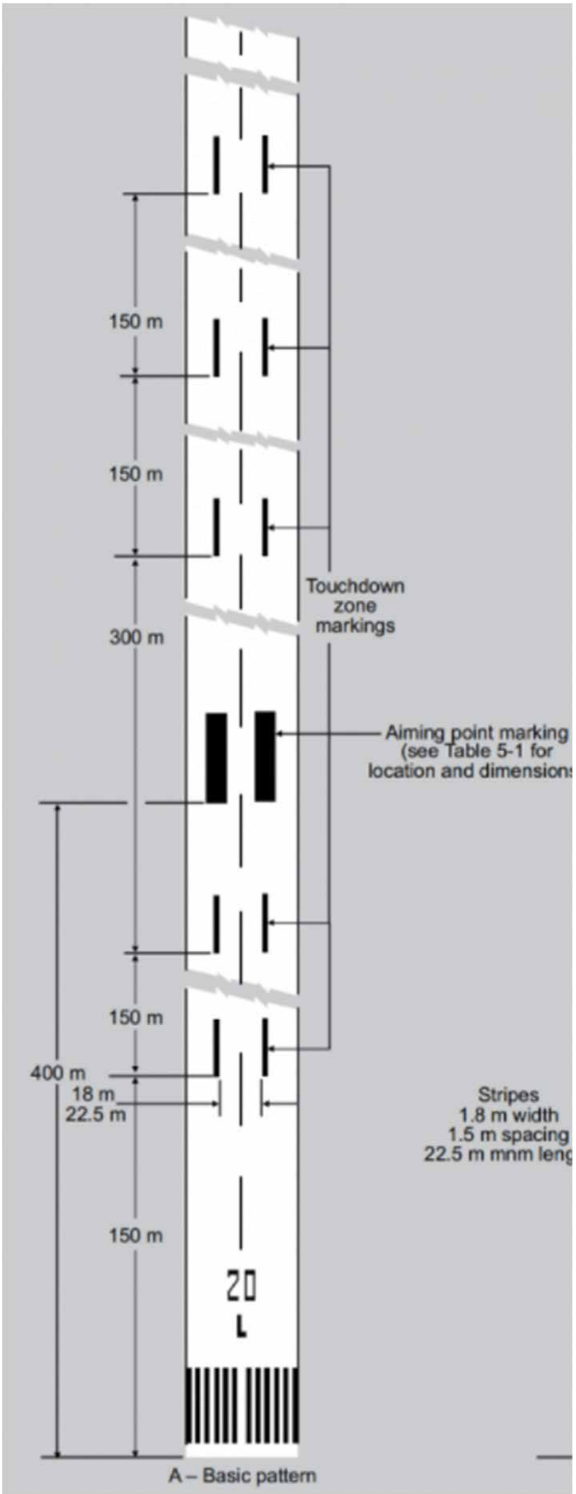

Figure 9

Example of Runway TDZ Markings

Organisational information

The FCTM contains guidance for the flare (Figure 10), and states that the flare height would normally be approximately 40 ft agl.

FLARE AND TOUCHDOWN

PITCH CONTROL

In stabilized conditions, the flare height is around 40 ft. This height varies due to the operational conditions that directly affect the rate of descent.

[...]

In order to assess the rate of descent during the flare and the aircraft position vs. the ground, look well ahead of the aircraft. Do not allow the aircraft to float or do not attempt to extend the flare by increasing pitch attitude in order to achieve a perfect smooth touchdown. A prolonged float increases both the landing distance and the risk of tail strike.

Figure 10

FCTM Flare Guidance

In order to create a robust defence against runway excursions on landing, the operator has defined *'Safe Touchdown Criteria'* in its operations Manual Part A (OMA), which include:

- *'Main Gear Touchdown within the TDZ (See Note 1, 2).*
- *Main Gear Touchdown and trajectory within runway edge is guaranteed.*
- *Normal Runway contact within the aircraft geometric landing limits.*

  Note 1: If the aircraft is still airborne at the end of the TDZ, or it is obvious that the landing will not be within the TDZ, a rejected landing shall be initiated. The crew need not wait until the aircraft physically touches down to perform the rejected landing.

  If the Safe Touchdown Criteria are not achieved, PM will use the following call:

- *"go-around".'*

If a landing is made beyond the TDZ then it would be recorded as an event by the operator's Flight Data Monitoring programme. The operator's expectation is that a crew who land beyond the TDZ would file an Air Safety Report. If such an event is recorded, the operator stated that it would be investigated with the crew to understand the event and give guidance to prevent recurrence. The operator's A350 fleet operates to runways with landing distance as short as 2,400 m.

In the case of a go-around being initiated close to the ground, the operator's FCTM contains the following advice:

'If the flight crew performs a go-around near the ground, they should take into account the following:

- *The PF should avoid excessive rotation rate, in order to prevent a tailstrike.*
- *A temporary landing gear contact with the runway is acceptable.'*

Analysis

Although the wind conditions at Heathrow were gusty, they were within limits for the approach. The approach was flown with the APs engaged until approximately 400 ft agl and then manually. The flare was initiated at 50 ft agl with the pitch attitude raised to 7° nose-up. This caused the rate of descent to reduce to 0 ft/min and so the aircraft floated along the runway. The thrust levers were retarded at 30 ft agl and the airspeed decreased with a concomitant reduction in lift. The aircraft then started to descend once more.

As the commander felt the aircraft would land beyond the TDZ, he directed a go-around in accordance with the operator's policy. TOGA was selected on the thrust levers and, simultaneously, the co-pilot briefly applied full nose-up pitch control before partially reducing the command. This caused a pitch-up rate of approximately 3°/s. The aircraft touched down, and as the pitch attitude reached 9° nose-up the tail struck the ground.

The go-around was initiated before touchdown but as the engine thrust had been reduced to idle it took some seconds to develop go-around thrust. The airspeed had reduced significantly below approach speed and so the aircraft lacked the performance to gain height immediately and the touchdown resulted. This possibility is recognised in the FCTM which gives guidance for handling the aircraft in such circumstances.

From the point at which the go-around was initiated, 2,760 m of runway remained ahead of the aircraft, which would have been sufficient distance for the aircraft to land and safely decelerate. In these circumstances, it is unlikely that the control inputs that led to the significant pitch up would have been made and the aircraft might not have been damaged. However, landing would have been against the operator's policy – common across all its fleets – to reject a landing if a touchdown beyond the defined TDZ is anticipated. The policy is applicable to a wide range of aircraft and airports, including many with restrictive runway lengths. The operator's view was that a single policy ensures simplicity, avoids ambiguity, and includes a consideration that runway excursions represent a greater hazard than go-arounds.

Conclusion

A go-around was initiated from low height and low speed. The aircraft had insufficient energy to climb immediately and so touched down during the go-around process. The pitch rate induced by the co-pilot caused the aircraft to reach a nose up attitude sufficient to cause a tailstrike as the aircraft touched down.

Published: 18 August 2022.

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-8K5, G-FDZF
No & Type of Engines:	2 CFM56-7B27/3 turbofan engines
Year of Manufacture:	2008 (Serial no: 35138)
Date & Time (UTC):	11 September 2021 at 1240 hrs
Location:	Aberdeen Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 67
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	15,490 hours (of which 1,524 were on type) Last 90 days - 67 hours Last 28 days - 62 hours
Information Source:	AAIB Field Investigation

Synopsis

At 1341 hrs on 13 September 2021, the AAIB was informed that a serious incident had occurred to a Boeing 737-800, registration G-FDZF, during a go-around at Aberdeen Airport on 11 September 2021.

During the manually flown go-around, which was initiated at 2,250 ft amsl, the aircraft initially climbed, but just before it reached the cleared altitude of 3,000 ft amsl it began to descend. It descended to 1,780 ft amsl (1,565 ft agl) with a peak rate of descent of 3,100 fpm, and accelerated to an airspeed of 286 kt (the selected airspeed was 200 kt) before the crew corrected the flightpath. The aircraft descended for a total of 57 seconds before the climb was re-established. It is likely that the crew allowed the aircraft to descend unnoticed having become overloaded by the high workload during the go-around.

As a result of this serious incident, Aberdeen ATC changed its procedures for aircraft being broken off from the approach, and the aircraft manufacturer issued guidance to pilots about the behaviour of the Autopilot and Flight Director System (AFDS) and autothrottle during go-arounds. The aircraft operator informed all its pilots about the event; included extensive go-around training in its training cycle; and completed a full review on pilot recency, which introduced additional restrictions to manage pilots through periods of reduced flying.

History of the flight

The crew of G-FDZF had operated a passenger flight from Newcastle International Airport to Palma de Majorca Airport before operating the incident flight from Palma to Aberdeen Airport. The aircraft departed Palma at 1047 hrs with 67 passengers and 6 crew on board. At 1230 hrs the flight crew established contact with Aberdeen Radar for a radar vectored CAT I ILS approach to Runway 34 at Aberdeen. At 1235 hrs, as the aircraft was descending through 5,100 ft amsl, the crew were informed by ATC that there was a possibility that they may have to discontinue the approach, in which case they should expect a climb straight ahead to 3,000 ft amsl. This was because a search and rescue helicopter, which was currently on the ground at the airport, would take priority once airborne.

The crew established the aircraft on the localiser and glideslope at 3,000 ft amsl with the aircraft configured with the landing gear down and flap 15. A single autopilot was engaged, as was the autothrottle. At 2,600 ft amsl the aircraft was instructed by the radar controller to break off the approach, climb to 3,000 ft amsl and turn left onto a heading of 270°. Twelve seconds later the autopilot was disengaged and the autothrottle, which remained engaged, increased engine thrust to 97% N_1. After another six seconds, at 2,250 ft amsl, the aircraft began to climb towards the cleared altitude and started a left turn towards the assigned heading. As the aircraft, which was being manually flown, approached 3,000 ft amsl, it began to descend. Further heading instructions were passed by ATC whilst the aircraft descended, with it reaching a minimum altitude of 1,780 ft, corresponding to 1,565 ft agl, before a climb was re-established. The descent rate peaked at 3,100 ft/min as the aircraft passed 2,160 ft amsl.

The tower controller noted on the radar repeater in the visual control room that the aircraft was descending unexpectedly and contacted the radar controller to advise him. This prompted the radar controller to contact the crew, instructing them to climb to 3,000 ft amsl. This call came just as the crew began to pitch the aircraft back into a climb. During the recovery the aircraft speed reached 286 KIAS[1], whereas the speed the crew had selected was 200 KIAS. As the aircraft passed through 3,000 ft amsl the crew re-engaged the autopilot and the flight path stabilised. The entire event occurred with the aircraft in IMC.

The aircraft was then given a further climb, before being radar vectored for another approach to Runway 34 where it landed without further incident.

Figure 1 shows the aircraft's flightpath during the event.

Footnote

1 Aberdeen Control Zone/Area is Class D airspace, and the speed limit is therefore 250 KIAS below FL100 as described in the UK Aeronautical Publications (AIP) Part 2 – En-Route (ENR), Section 1.4, Paragraph 2.4.

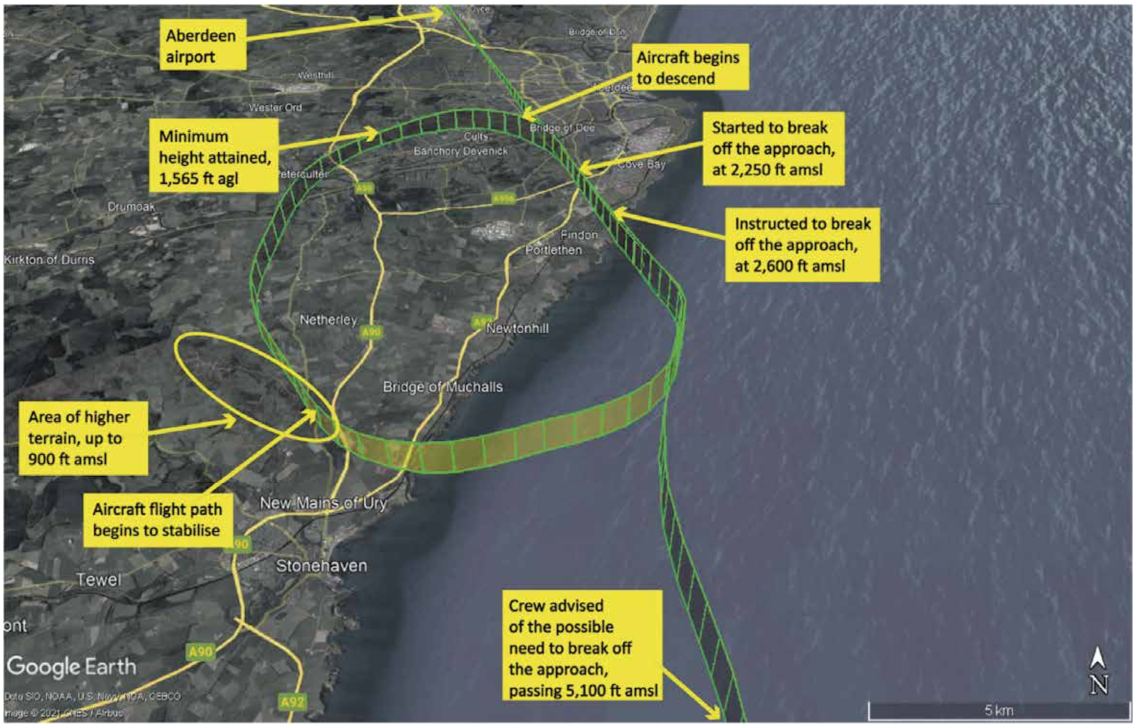

Figure 1

G-FDZF's flightpath into Aberdeen and the unintended descent

Recorded data

The aircraft's Cockpit Voice Recorder had been overwritten because the aircraft remained in service before the AAIB was notified and began an investigation into the event. However, the data from the operator's flight data monitoring (FDM) provider was available, as well as radar and R/T recordings from Aberdeen. Figure 2 shows a summary of the FDM data for the approach and the subsequent unintended descent. The four shaded areas are described below. Each square on the x-axis represents 10 seconds.

Area A shows the flightpath from when the crew responded to the ATC instruction to break off the approach and shows the disconnection of the autopilot, whilst the autothrottle remained engaged. It shows that the thrust increased automatically towards 97% N_1, the landing gear was retracted, and the aircraft's pitch attitude increased. The aircraft climbed and turned left towards a heading of 270°. The data shows a strong correlation between the engine power setting and changes in the pitch of the aircraft, noting that the flap setting did not change, and that no manual pitch trim inputs are recorded in Area A.

Area B shows that as the aircraft, which was being manually flown, approached the selected altitude of 3,000 ft, the autothrottle reduced the engine power setting and the pitch of the aircraft decreased as the flight director began to command the level-off. As the aircraft passed 2,850 ft amsl, the flaps were retracted from flap 15 to flap 5, and after reaching 2,930 ft amsl the aircraft began to descend. G-FDZF then briefly levelled at 2,650 ft amsl and the flaps were further retracted from Flap 5 to Flap 1. Four seconds later, the flaps were fully retracted and G-FDZF again started to descend.

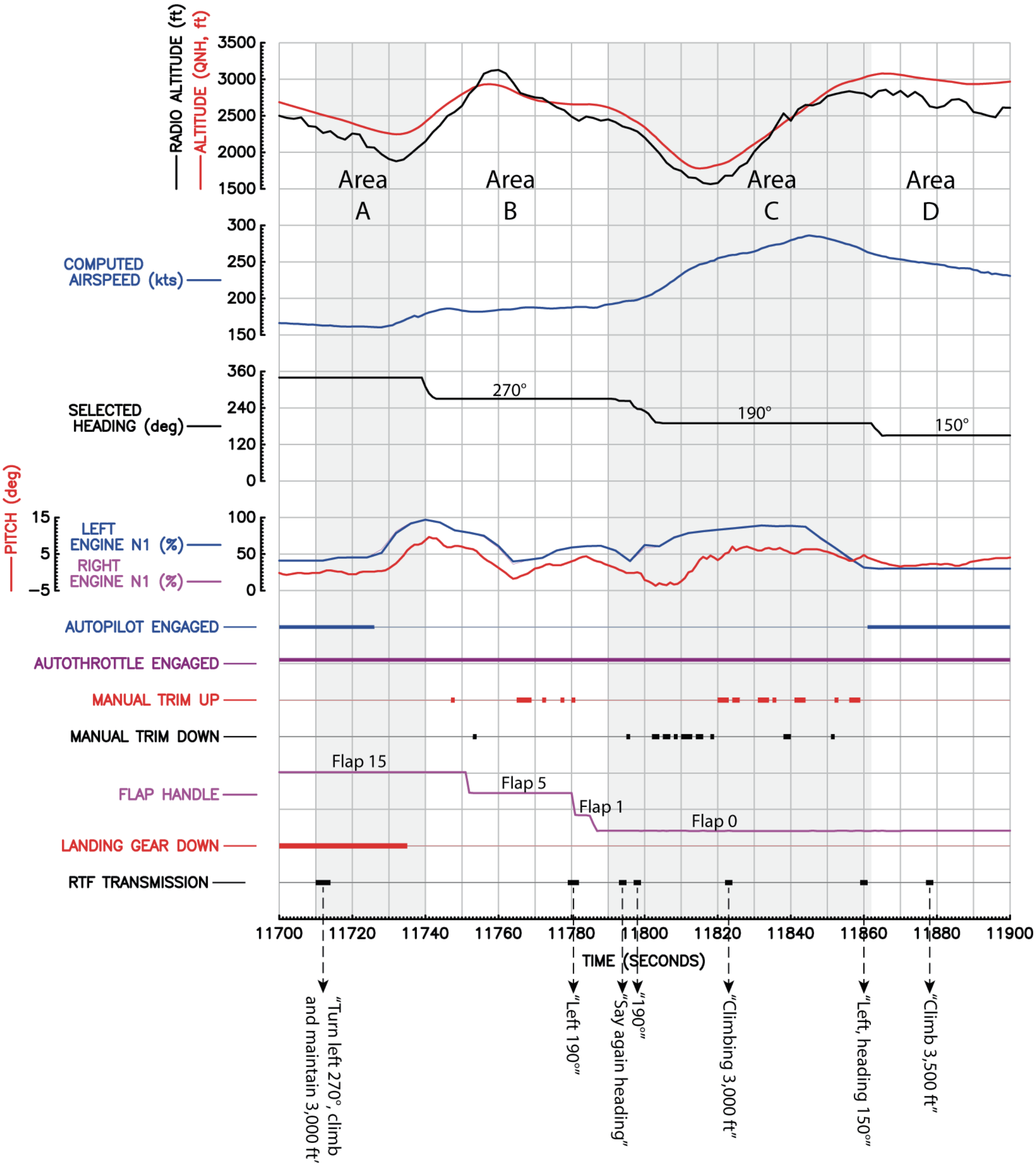

Figure 2

Flight data for the approach and subsequent unintended descent

Area C shows several radio transmissions from the aircraft, as the crew responded to new headings assigned by ATC, and the lowest altitude reached by the aircraft before a climb was re-established. The climb was initiated at about the same time as the crew replied to ATC's instruction to climb, with the peak airspeed of 286 kt recorded in the climb.

Area D shows the autopilot re-engagement and the flight path of the aircraft beginning to stabilise.

The FDM data also showed that the Terrain Awareness and Warning System did not activate during G-FDZF's unintended descent.

Somatogravic illusion

Because aircraft can accelerate and decelerate at much greater rates than our bodies evolved to detect, our perception of an aircraft attitude can be erroneous. If an aircraft rapidly accelerates it can, especially in the absence of visual cues, create a false sensation of being in an increasingly nose-up attitude. If the pilot reacts by pushing on the controls to reduce the pitch of the aircraft, it can lead to a descent, which, if the aircraft is close to the ground, can be extremely dangerous. A deceleration can give the sense of a nose-down attitude change. This is known as the somatogravic illusion. There are many examples of pilots being affected by this illusion including during takeoffs and go-arounds where the aircraft's pitch and speed are changing rapidly, especially if external visual references are limited such as at night or in IMC.[2]

In this event, the rapid acceleration in IMC on application of full go-around thrust may have been perceived by the flight crew as the aircraft abruptly pitching up. Therefore, the FDM data was analysed to see if the control column force sensors, which sense the magnitude and direction of the force applied to either control column, recorded any nose-down inputs during this phase of the flight (Area A of Figure 2).

This analysis showed that nose-down, or push, forces were recorded by the control column sensors but that these forces did not adversely affect G-FDZF's climb during the initial part of the go-around. Because a substantial amount of thrust had been applied in the preceding seconds and there were no manual pitch trim inputs, these forces most likely indicate that the aircraft was out of trim.

As G-FDZF accelerated during the unintended descent (Area C of Figure 2), the FDM data was also analysed for this region. This showed that no abnormal nose-down forces were recorded.

Aircraft information

Autopilot and flight director

The automatic flight control system consists of the AFDS and the autothrottle. The AFDS and the autothrottle are controlled through the Mode Control Panel and the flight management computer. The AFDS and autothrottle status are displayed to both pilots through Flight Mode Annunciators at the top of the primary flight displays.

Footnote

[2] Recent examples in large commercial aircraft and helicopters include:
Accident to B767-300 N1217A, 2019 https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR2002.pdf [accessed August 2022].
Accident to B737-800 A6-FDN, 2016 https://mak-iac.org/upload/iblock/3d1/report_a6-fdn_eng.pdf [accessed August 2022].
Accident to AW139 G-LBAL, 2014 https://assets.publishing.service.gov.uk/ [accessed August 2022].
media/56162ac0e5274a625100000f/Agusta_Westland_AW139_G-LBAL_10-15.pdf [accessed August 2022].

The flight director displays command bars on the primary flight display as long as a pitch and/or roll mode is selected on the AFDS. The relevant bar will not appear if no mode is engaged. The flight director can be operated with or without the autopilot and autothrottle.

B737-800 Go-around mode

The Boeing 737-800 is a dual autopilot, Category 3 approach capable aircraft. Normal procedures, as outlined by the manufacturer, require the use of a single autopilot on an ILS approach unless the intention is to conduct a CAT II or III approach and landing. Automatic go-arounds are only available from a dual autopilot approach. The AFDS go-around mode is engaged by pressing the Takeoff/Go-around (TO/GA) switches. Pressing either of the switches when the engagement criteria are met will disconnect the single autopilot (if connected) and place the flight directors in go-around mode. The aut othrottle (if engaged) will move to go-around thrust, and the flight directors will then command 15º nose-up pitch. Below 2,000 ft radio altitude, one press of a TO/GA switch will cause the autothrottle (if engaged) to advance to a power setting for a climb rate between 1,000 and 2,000 ft/min. With two presses of a switch, the autothrottle (if engaged) will advance to the full go-around N_1 limit. Above 2,000 ft radio altitude, one press of a TO/GA switch commands thrust to the full go-around N_1 limit.

The commander recalls pressing the switches only once when commencing the go-around, and at this point the aircraft was above 2,000 ft radio altitude. At the time of this serious incident the Flight Crew Operating Manual described autothrottle behaviour following one or two presses of the TO/GA switch below 2,000 ft radio altitude but did not describe the different behaviour above 2,000 ft. The single press leading to the movement of the thrust to the full go-around limit was unexpected by the crew.

Autopilot altitude modes

The AFDS can capture and hold a pre-selected altitude. These modes are altitude acquire (ALT ACQ) and altitude hold (ALT HOLD). When the AFDS is engaged in TO/GA mode, the pitch mode will change to ALT ACQ when approaching the altitude selected on the mode control panel. ALT HOLD commands pitch to hold the selected altitude. Successful engagement of ALT HOLD requires the altitude difference between the selected altitude and the aircraft's actual altitude to be less than 60 ft and the aircraft's rate of climb to be less than 5 ft/s, or 300 ft/min. As G-FDZF climbed towards the selected altitude of 3,000 ft, ALT ACQ mode was entered automatically. The aircraft reached a maximum altitude of 2,930 ft amsl and, although the rate of climb was less than 300 ft/min, the aircraft did not come within 60 ft of the selected altitude for ALT HOLD to engage. The AFDS therefore remained in ALT ACQ as the aircraft began to descend away from the selected altitude.

Simulator trial

During the investigation the AAIB used a Boeing 737-800 simulator to examine the characteristics of the aircraft in conditions like that experienced by the crew of G-FDZF.

The Boeing 737 family has underslung engines and is therefore susceptible to a pitch/ power couple. If power is increased, the tendency of the aircraft is to pitch up, and it tends to pitch down when power is reduced. This pitch/power couple is strong, especially with large changes in power at slower speeds. Selecting TO/GA for a go-around at approach speed requires the pilot to apply a forward force on the control column until the aircraft is trimmed in order to fly the aircraft at the required pitch for the go-around. Once the aircraft is trimmed for the go-around, further adjustment is then required as power is reduced from Go-Around thrust for the level-off at the selected altitude.

Changing the lift profile of the wings by altering the flap setting also requires a change in the trim of the aircraft to maintain the selected pitch attitude. Retracting the flaps causes a pitch down, which is most acute when the flaps move from Flap 5 to Flap 1 and from Flap 1 to Flap up.

Both these requirements are common to many other aircraft types and are very familiar to crews that operate the Boeing 737. They are well practised, generally presenting no issues to crews when manually flying the aircraft.

Aircraft performance

The press of the TO/GA switches is not recorded on FDM data, but the associated disconnection of the single engaged autopilot, which occurs momentarily afterwards, is recorded. In the data from G-FDZF this coincided with the autothrottle mode changing to N_1, which indicates that the thrust was being commanded towards the full Go-Around thrust limit. Had the autothrottle been commanding the reduced thrust for the 1,000 – 2,000 ft/min rate of climb, the mode would have been Go-Around.

Meteorology

Low pressure was centred to the northeast of the UK, with a cold front running across the far north of, and turning down the east coast of, Scotland. There were thick layers of cloud across northeast Scotland associated with the frontal system. There was some convective activity along the North Sea coast to the east of Aberdeen.

The crew reported that throughout the arrival, initial approach and go-around they were in IMC.

Airfield ATC information

Aberdeen has three runways and the main runway, which is orientated 160°/340°, is used for fixed wing movements. The airport has intensive large helicopter activity associated with the North Sea oil and gas industry.

During the period of COVID 19, the airport movements were not significantly reduced due to the ongoing support for the oil and gas industry. For some parts of the period, Aberdeen was the busiest airport within the UK by movement numbers. This meant that the ATC staff at Aberdeen were working with a more usual workload than many other controllers around the country and had no significant periods away from work due to the pandemic.

Aberdeen has its own approach radar control station, which is situated at the airport together with the visual control tower. The approach controller is responsible for positioning the aircraft onto the final approach and the aircraft is then handed over to the tower controller. The approach controller and tower controller communicate with regards to movements and sequencing. In the case of G-FDZF, the tower controller was aware of the possibility that a search and rescue helicopter would require priority. The tower controller notified the approach controller who informed the crew that there was a possibility that they would be broken off the approach as a result. The tower controller also has a screen which displays the approach radar picture and information.

Approach controller

The approach controller instructed the pilots to break off the approach when the aircraft was just below 3,000 ft amsl, which was the go-around altitude. The controller considered that it was reasonable for the crew to complete a turn to the left and climb back to 3,000 ft amsl. The intention was to reposition the aircraft for a further approach with the minimum of delay. The controller felt that, had the aircraft been significantly lower, it would have been more appropriate to instruct the crew to conduct a standard missed approach, which was to continue straight ahead, climbing to 3,000 ft amsl.

The approach controller, having instructed the crew of G-FDZF to break off the approach and having seen the aircraft Mode C return approach 3,000 ft, was engaged with two recent departures that required some action and did not detect the subsequent descent. The tower controller noted that the aircraft began to descend and contacted the approach controller. The approach controller then instructed the crew of G-FDZF to climb to 3,000 ft amsl. This call coincided with the aircraft beginning to climb again from its minimum altitude.

ATC safety nets

Aberdeen radar data processor is equipped with 'safety nets', which are not required by regulation but are functions intended to increase safety, and two of these are related to terrain clearance. Neither alert activated for G-FDZF. The first is a decent rate monitor, introduced after a fatal North Sea helicopter accident, that alerts the controller when an aircraft has a rate of descent of 2,500 ft/min or greater when below 3,000 ft amsl in controlled airspace. The second is a minimum safe altitude warning that provides an alert if the aircraft descends, or is predicted to descend, below a height of 500 ft above the terrain model, which represents terrain and obstacles. This warning has two levels of alert, with a stage 1 alert if the aircraft is predicted to breach 500 ft within 23 seconds, and a stage 2 alert if a breach is predicted within 15 seconds. An exclusion area exists around the extended centreline of the main runway to prevent an alert being generated by every aircraft on approach, although G-FDZF was outside this area as it reached the point of minimum altitude.

The FDM data from G-FDZF indicated that the aircraft had a descent rate of more than 2,500 ft/min for approximately nine seconds, which should have triggered the descent rate monitor alert. However, because the radar data processor rounds successive aircraft altitude responses to the nearest 100 ft and radar responses occur some six seconds apart, it is likely that the derived vertical speed did not exceed the alerting threshold due to the lack of granularity in the processed data.

Regarding the minimum safe altitude warning, although the aircraft descended to 1,800 ft amsl, the terrain at that point was 250 ft amsl, and the aircraft did not reach the point of being within 23 seconds of breaching 750 ft amsl, which would have been required to trigger a stage 1 minimum safe altitude alert.

National guidance

The CAA produces guidance for the provision of air traffic services in the form of CAP 493[3], *The Manual of Air Traffic Services Part 1,* (MATS Part 1). The manual describes when controllers should instruct an aircraft to perform a missed approach and states that:

> *Missed approach instructions shall include the level to which the aircraft is to climb and, if necessary, heading instructions to keep the aircraft within the missed approach area.*

In the case of Aberdeen there was no requirement to issue a heading as the standard missed approach, which takes aircraft straight ahead on runway heading, would have kept the aircraft within the missed approach area.

Local guidance

Each ATC unit produces a MATS Part 2 specific to that particular unit. The MATS Part 2 for Aberdeen at the time of the incident did not specify that the controllers should instruct the crew to conduct a standard missed approach, nor did it give any guidance to the controller regarding the possible high workload of the pilots.

ATC Investigation

Aberdeen ATC investigated the incident which included confirming that their radar data processor terrain alerts were functioning as designed. As a result of this investigation, they made some changes, through a supplementary instruction to MATS Part 2, which included introducing a procedure for aircraft being broken off an approach within the Final Approach Fix to only be instructed to conduct a standard missed approach (unless there are over-riding safety considerations, or the crew have already been issued with alternative instructions). Headings may be allocated once the aircraft is level at the missed approach altitude.

Aircraft crew

Crew recency

The crew of G-FDZF differed in their recency levels but both had experienced significant periods without flying in the preceding 18 months. The commander had flown 10 flights during the previous month. For the co-pilot, this was only his fourth flight in nearly 11 months, having completed two training flights seven days before the day of this incident. Both pilots had completed numerous simulator sessions during the 18-month period to gain or retain recency or to complete their annual recurrent check.

Footnote

[3] CAA MATS Part1 https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=11137 [accessed August 2022].

Airlines faced significant challenges to keep crews current in the two years leading up to this event. Whilst there are legal requirements for crews to complete three takeoffs and landings within 90 days, there are no regulatory requirements laid out for crews to have operated the aircraft, especially on commercial flights. Operators had to adapt and develop their own programmes to ensure that crews were prepared and competent to fly, often after significant periods away from the aircraft.

Simulators were used not just for the takeoff and landing requirements but also to try and maintain crew skill levels when operating in both normal and emergency situations. The challenge was, and is, to try and represent the real world of flying in a simulated environment. It can be difficult to replicate moments of high crew workload caused by the effects of ATC instructions and background communications, the presence of other aircraft in the area, poor weather and other operational pressures. The safety benefits of simulator training are well established. However, the real-world environment creates different demands on crews, and it is possible that this event illustrates that lack of recent exposure to the real-world environment can erode crews' capacity to deal effectively with those challenges. Regulators were concerned that pilots returning to the flight deck following extended periods without flying could be at risk of performing below their normal standard during their first few flights.

Missed approaches in large commercial air transport

Data provided from UK airports suggested that the overall go-around rate for commercial operations pre-pandemic was in the region of three per 1,000 arrivals. This figure illustrates that go-arounds are a relatively rare event for a pilot as well as for the ATC controller. A pilot flying for the operator of G-FDZF might have completed 250 flights per year at pre-covid levels and therefore might have expected to perform a go-around in flight once a year. With the decrease in flying during the pandemic, many pilots may have not encountered a go-around in flight for several years.

Whilst operators, including that of G-FDZF, regularly practise go-arounds in the simulator, these are most regularly for licence qualification and are therefore often flown from a single engine approach or for qualification of the crews for low visibility operations. In low visibility operations both autopilots would be engaged and an autopilot-coupled go-around would generally be available. The operator had a program to ensure that the crews practised two engine go-arounds in the simulator, but these go-arounds were often performed from close to minimum descent altitude and not from an altitude close to the missed approach altitude.

The AAIB has investigated other go-around incidents which have similarities to G-FDZF[4], and the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) recently published a report into a similar incident at Paris Orly Airport[5].

Footnote

4 Report into the serious incidents involving G-THOF, https://www.gov.uk/aaib-reports/aar-3-2009-boeing-737-3q8-g-thof-23-september-2007 [accessed November 2021], and I-NEOT, https://www.gov.uk/aaib-reports/aaib-investigation-to-boeing-737-86n-i-neot [accessed November 2021].

5 https://www.bea.aero/en/investigation-reports/notified-events/detail/serious-incident-to-the-boeing-737-registered-7t-vjm-operated-by-air-algerie-on-06-12-2019-at-paris-orly/ [accessed November 2021].

Analysis

The aircraft descended from close to 3,000 ft amsl for 57 seconds before a climb was re-established, and this represented a significant deviation from the crew's expected flightpath. The rate of descent peaked at 3,100 ft/min before the aircraft began to climb having descended to 1,565 ft agl, significantly reducing the aircraft's separation from terrain. During the descent and subsequent recovery, there was an uncommanded and undesirable increase in airspeed to 286 kt that was not corrected in a timely manner.

Having pressed the TO/GA switches once for the go-around, the crew expected the engaged autothrottle to select power for a climb rate of between 1,000 – 2,000 ft/min. However, the aircraft was above 2,000 ft radio altitude and as a result, unexpected by the crew, the power advanced towards the full Go-Around N_1. With the underslung engines, and at an approach speed for the flap selected, this large increase in power meant that the aircraft pitched up significantly and climbed towards the selected altitude of 3,000 ft amsl very rapidly. The autothrottle remained engaged, and as the aircraft approached the level-off it reduced the thrust towards that required to maintain the selected speed in level flight. The reduction in thrust caused the aircraft pitch attitude to reduce, and this was exacerbated by trim changes due to the retraction of the flaps from Flap 15 to Flap 5. The aircraft then began a descent, and since it had not reached the criteria for ALT HOLD, the AFDS remained in ALT ACQ. The retraction of the flaps from Flap 5 to Flap 1, and then from Flap 1 to Flap up during the descent also further decreased the pitch attitude. As the aircraft was descending, the speed increased despite the selected speed remaining at 200 kt.

The crew were assigned several heading changes both before and during the aircraft descent. These instructions placed an additional burden on a crew that was already working hard. The heading instructions had to be acknowledged and actioned by the co-pilot, which could have distracted him from his monitoring tasks. The commander, who was manually flying, had to manoeuvre the aircraft in roll during a very dynamic period in pitch control.

Although the crew seemed unaware of the descent for a significant period, there remained further barriers to a continued descent that might have alerted them to the situation. These were the aircraft's Terrain Avoidance and Warning System and the ATC radar system alerts. In this instance, the ATC radar system alert that was supposed to warn of an aircraft with a rapid rate of descent failed to recognise that G-FDZF'S descent rate exceeded 2,500 ft/min for a total of approximately nine seconds. This barrier, therefore, did not function as expected. However, the crew became aware of the descent and began to correct it at the same time as the tower controller noticed their descent on the radar repeater in the tower - both the crew and ATC therefore acted to correct the flight path as soon as it was noticed.

The investigation looked at the possibility that the crew were affected by a somatogravic illusion as the aircraft accelerated, but although this could not be completely dismissed, an analysis of the FDM data showed it was unlikely. Any nose-down force on the controls during the initial part of the go-around was most likely due to the aircraft being out of trim, with the large increase in thrust causing a pitch up that the commander countered by pushing forward on the control column. There were no abnormal nose-down forces on the controls during the subsequent acceleration during the descent.

The COVID 19 pandemic led to most pilots flying significantly less than normal. This presented challenges to operators and crews in remaining current and maintaining skill levels to levels equivalent to when the flying intensity was greater. These same challenges applied also to those providing a service to the aircraft, such as ATC. The operator of G-FDZF had a plan for both aspects of the lack of flying. The simulator program was designed not just to maintain crews' legal currency requirements, but also to allow them to maintain their skills in both the normal and emergency phases of flight. Whilst simulators provide an excellent environment for practising operations, they do have some limitations in reflecting real-world experience.

Two engine go-arounds in day-to-day flight operations are rare. With a go-around rate around three per 1,000 flights in the UK, the average crew from the operator might have expected to experience one a year when flying at the pre-pandemic rate. Regular practise in the simulator is usually conducted from the approach minimums for regulatory compliance, either single engine or with an autopilot-coupled go-around available. Go-arounds from higher altitudes on the approach are less regularly practised. It is unlikely that either crew member had conducted a go-around in the aircraft in the previous two years.

Whilst the go-around should have presented little problem to the experienced crew, the combination of less than average flying in the recent period (and very little flying in the case of the co-pilot), the unexpected large increase in thrust and the changes in heading given by ATC probably combined to overload the crew. Subsequently, they were unable to retain their situation awareness. The changes in thrust generated corresponding changes in the pitch of the aircraft, which together with the pitch changes generated as the crew changed the flap configuration were not dealt with through manually trimming the aircraft. The pitch of the aircraft was not managed effectively by the commander and the aircraft began to descend.

Conclusion

The crew of G-FDZF were instructed to go-around by ATC. After initially climbing towards the miss approach altitude, the aircraft began to descend. The descent continued for 57 seconds reaching a minimum of 1,565 ft agl before the aircraft was recovered to a climb. A combination of an unexpected large increase in thrust when the go-around was initiated, instructions from ATC to fly a heading, a lack of manual pitch trimming, and the changes in the flap configuration, caused the crew to become overloaded, allowing the aircraft to descend unnoticed for a significant period. Both pilots had experienced significant periods away from flying the aircraft type during the pandemic.

Safety actions

The aircraft operator completed an investigation into the serious incident, and took the following safety action:

> An extensive review of pilot recency related safety events was conducted, and additional company restrictions were introduced to safely manage pilots through a period of reduced flying.

Pilots of the Boeing 737 were informed that above 2,000 ft radio altitude a push of the TO/GA switches will provide full go-around thrust.

The operator's non-Boeing 737 pilot community was notified of the incident.

Go-around training would be included in the next recurrent simulator cycle to address the issues raised in this serious incident. The training objectives would be to increase the knowledge of the AFDS system in GA mode, increase exposure to two engine go-around events to reduce possible startle effects, and to encourage the use of appropriate pilot competences including threat and error management. The package would include a total of at least six go-around scenarios to be flown by the crew, including one above 2,000 ft radio altitude so crews would experience the thrust increasing to full go-around thrust.

Details of the serious incident were shared with other operators through the CAA Flight Operations Liaison Group.

Aberdeen ATC conducted an investigation into the serious incident and subsequently took the following safety action:

Changes were introduced through a supplementary instruction to MATS Part 2, which included introducing a procedure for aircraft being broken off an approach within the Final Approach Fix to only be instructed to conduct a standard missed approach (unless there are over-riding safety considerations, or the crew have already been issued with alternative instructions). Headings would only be allocated once the aircraft is level at the missed approach altitude.

The aircraft manufacturer took safety action in relation to the aircraft Flight Crew Operations Manual:

Clarification was introduced relating to the first push of the TO/GA switches at or above 2,000 ft radio altitude, with the Flight Crew Operations Manual amended to read:

> *'If pushed at or above 2,000 ft RA (or below 15,500 ft if both RA's have failed) with glideslope engaged or the flaps down:* [autothrottle] *(if armed) engages in N1 mode and advances thrust towards the full go-around limit. The* [autothrottle] *Engaged Mode annunciation on the FMA indicates N1.'*

Published: 18 August 2022.

AAIB Correspondence Reports

These are reports on accidents and incidents which were not subject to a Field Investigation.

They are wholly, or largely, based on information provided by the aircraft commander in an Aircraft Accident Report Form (AARF) and in some cases additional information from other sources.

The accuracy of the information provided cannot be assured.

Accident

Aircraft Type and Registration:	Piper PA-23-250, N13987
No & Type of Engines:	2 Lycoming TIO-540-C4B5 piston engines
Year of Manufacture:	1971 (Serial no: 27-4605)
Date & Time (UTC):	23 June 2022 at 1435 hrs
Location:	Auguste George Airport, British Virgin Islands
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Right main landing gear collapsed, propeller and flap damage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	8,000 hours (of which 3,000 were on type) Last 90 days - 80 hours Last 28 days - 30 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further AAIB enquiries

The pilot reported that the landing was normal, but the right main landing gear collapsed rearwards as the aircraft slowed during the rollout. The pilot was uninjured.

Investigation by the aircraft operator's maintenance agency identified that the right main landing gear drag bolt had broken. Similar failures have occurred on other PA-23 type aircraft, and the manufacturer issued Service Bulletin 1299 in January 2017 to periodically check (and replace) the bolts. The FAA issued Special Airworthiness Information Bulletin (SAIB) CE-17-08 in February 2017 recommending that operators comply with the manufacturer's bulletin. They did not consider the failure to be an unsafe condition, so an Airworthiness Directive was not issued.

The aircraft operator told the AAIB that they periodically checked the bolts in accordance with the manufacturer's recommendations, but no anomalies had been found. After the accident, they said that they will replace the drag bolts on all their PA-23 aircraft.

ACCIDENT

Aircraft Type and Registration:	Tecnam P92-EM Echo, G-WHEN
No & Type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	2004 (Serial no: PFA 318-13679)
Date & Time (UTC):	29 May 2022 at 1315 hrs
Location:	2.5 miles west of City Airport (Manchester Barton)
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Minor)
Nature of Damage:	Substantial
Commander's Licence:	Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	1,509 hours (of which 16 were on type) Last 90 days - 6 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft had taken off uneventfully from Runway 26L and at around 750 ft agl and approximately two miles from the airport the engine lost power. The engine did not respond to the pilot's throttle commands, and the engine speed dropped to idle. The pilot recalled checking that both fuel tanks were selected, and that the carburettor heat, the fuel pump and both magnetos were all set to ON.

He selected a field for a forced landing, however the aircraft flipped over when the nosewheel contacted the soft ground. The pilot sustained serious injuries in the accident.

After the accident the engine was ran satisfactorily on a test bench. The cause of the power loss could not be determined.

AAIB Record-Only Investigations

This section provides details of accidents and incidents which were not subject to a Field or full Correspondence Investigation.

They are wholly, or largely, based on information provided by the aircraft commander at the time of reporting and in some cases additional information from other sources.

The accuracy of the information provided cannot be assured.

Record-only UAS investigations reviewed: June - July 2022

21 Apr 2022 **Parrot Anafi** East Kilbride, South Lanarkshire
At the end of a flight the UAS displayed a FLIGHT CONDITIONS warning. As the remote pilot brought the UA into land it flew erratically, not responding to the pilot commands, and became lodged in a tree. On recovery of the UA one of the propellers was found to be missing.

23 May 2022 **Yuneec H520** Cardiff
The UA was destroyed when a gust of wind caused it to strike a wall and then fall to the ground.

25 May 2022 **DJI Mavic Pro 2** Holborn, London
The UA became uncontrollable in turbulent winds, and subsequently struck a wall.

5 Jun 2022 **DJI M300RTK** Offshore Windfarm
During a survey flight, the UA struck a wind turbine and fell to the ground.

8 Jun 2022 **Mavic 2 Enterprise Advanced** Southampton Water
Following a hand launch from a vessel, control of the UA was lost. It fell into the water and was not recovered.

12 Jun 2022 **DJI Mavic II Pro** Shoeburyness, Essex
The UA was filming at a charity event. Approximately 160 m from the remote pilot the UA struck a bird causing damage to the propellers. The UA flipped upside down and landed uncontrolled on a roof.

14 Jun 2022 **MA Multiplex Glider Solius** Sheffield, South Yorkshire
The remote pilot lost sight of the model aircraft when it flew into low cloud. The aircraft was not found.

29 Jul 2022 **MA Model Aircraft** Colney, Hertfordshire
Following a loss of control link, the model aircraft flew away and dropped to the ground beyond a line of trees.

30 Jul 2022 **MA Viper Pro** Felthorpe, Norfolk
The control link to the model aircraft was lost and it flew into trees.

31 Jul 2022 **MA Red-5 GPS Hawk** Tudeley, Kent
The control link to the model aircraft was lost. It flew away and descended into a field.

Miscellaneous

This section contains Addenda, Corrections and a list of the ten most recent Aircraft Accident ('Formal') Reports published by the AAIB.

The complete reports can be downloaded from the AAIB website (www.aaib.gov.uk).

TEN MOST RECENTLY PUBLISHED FORMAL REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

1/2015 Airbus A319-131, G-EUOE
London Heathrow Airport
on 24 May 2013.

Published July 2015.

2/2015 Boeing B787-8, ET-AOP
London Heathrow Airport
on 12 July 2013.

Published August 2015.

3/2015 Eurocopter (Deutschland) EC135 T2+, G-SPAO
Glasgow City Centre, Scotland
on 29 November 2013.

Published October 2015.

1/2016 AS332 L2 Super Puma, G-WNSB
on approach to Sumburgh Airport
on 23 August 2013.

Published March 2016.

2/2016 Saab 2000, G-LGNO
approximately 7 nm east of Sumburgh Airport, Shetland
on 15 December 2014.

Published September 2016.

1/2017 Hawker Hunter T7, G-BXFI
near Shoreham Airport
on 22 August 2015.

Published March 2017.

1/2018 Sikorsky S-92A, G-WNSR
West Franklin wellhead platform, North Sea
on 28 December 2016.

Published March 2018.

2/2018 Boeing 737-86J, C-FWGH
Belfast International Airport
on 21 July 2017.

Published November 2018.

1/2020 Piper PA-46-310P Malibu, N264DB
22 nm north-north-west of Guernsey
on 21 January 2019.

Published March 2020.

1/2021 Airbus A321-211, G-POWN
London Gatwick Airport
on 26 February 2020.

Published May 2021.

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GLOSSARY OF ABBREVIATIONS

aal	above airfield level
ACAS	Airborne Collision Avoidance System
ACARS	Automatic Communications And Reporting System
ADF	Automatic Direction Finding equipment
AFIS(O)	Aerodrome Flight Information Service (Officer)
agl	above ground level
AIC	Aeronautical Information Circular
amsl	above mean sea level
AOM	Aerodrome Operating Minima
APU	Auxiliary Power Unit
ASI	airspeed indicator
ATC(C)(O)	Air Traffic Control (Centre)(Officer)
ATIS	Automatic Terminal Information Service
ATPL	Airline Transport Pilot's Licence
BMAA	British Microlight Aircraft Association
BGA	British Gliding Association
BBAC	British Balloon and Airship Club
BHPA	British Hang Gliding & Paragliding Association
CAA	Civil Aviation Authority
CAVOK	Ceiling And Visibility OK (for VFR flight)
CAS	calibrated airspeed
cc	cubic centimetres
CG	Centre of Gravity
cm	centimetre(s)
CPL	Commercial Pilot's Licence
°C,F,M,T	Celsius, Fahrenheit, magnetic, true
CVR	Cockpit Voice Recorder
DME	Distance Measuring Equipment
EAS	equivalent airspeed
EASA	European Union Aviation Safety Agency
ECAM	Electronic Centralised Aircraft Monitoring
EGPWS	Enhanced GPWS
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
EPR	Engine Pressure Ratio
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
FAA	Federal Aviation Administration (USA)
FDR	Flight Data Recorder
FIR	Flight Information Region
FL	Flight Level
ft	feet
ft/min	feet per minute
g	acceleration due to Earth's gravity
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
hrs	hours (clock time as in 1200 hrs)
HP	high pressure
hPa	hectopascal (equivalent unit to mb)
IAS	indicated airspeed
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IP	Intermediate Pressure
IR	Instrument Rating
ISA	International Standard Atmosphere
kg	kilogram(s)
KCAS	knots calibrated airspeed
KIAS	knots indicated airspeed
KTAS	knots true airspeed
km	kilometre(s)
kt	knot(s)
lb	pound(s)
LP	low pressure
LAA	Light Aircraft Association
LDA	Landing Distance Available
LPC	Licence Proficiency Check
m	metre(s)
mb	millibar(s)
MDA	Minimum Descent Altitude
METAR	a timed aerodrome meteorological report
min	minutes
mm	millimetre(s)
mph	miles per hour
MTWA	Maximum Total Weight Authorised
N	Newtons
N_R	Main rotor rotation speed (rotorcraft)
N_g	Gas generator rotation speed (rotorcraft)
N_1	engine fan or LP compressor speed
NDB	Non-Directional radio Beacon
nm	nautical mile(s)
NOTAM	Notice to Airmen
OAT	Outside Air Temperature
OPC	Operator Proficiency Check
PAPI	Precision Approach Path Indicator
PF	Pilot Flying
PIC	Pilot in Command
PM	Pilot Monitoring
POH	Pilot's Operating Handbook
PPL	Private Pilot's Licence
psi	pounds per square inch
QFE	altimeter pressure setting to indicate height above aerodrome
QNH	altimeter pressure setting to indicate elevation amsl
RA	Resolution Advisory
RFFS	Rescue and Fire Fighting Service
rpm	revolutions per minute
RTF	radiotelephony
RVR	Runway Visual Range
SAR	Search and Rescue
SB	Service Bulletin
SSR	Secondary Surveillance Radar
TA	Traffic Advisory
TAF	Terminal Aerodrome Forecast
TAS	true airspeed
TAWS	Terrain Awareness and Warning System
TCAS	Traffic Collision Avoidance System
TODA	Takeoff Distance Available
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
USG	US gallons
UTC	Co-ordinated Universal Time (GMT)
V	Volt(s)
V_1	Takeoff decision speed
V_2	Takeoff safety speed
V_R	Rotation speed
V_{REF}	Reference airspeed (approach)
V_{NE}	Never Exceed airspeed
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional radio Range

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