Serious Incident

Aircraft Type and Registration:	Boeing 737-800, 9H-QBD	
No & Type of Engines:	2 CFM56-7B turbofan engines	
Year of Manufacture:	2015	
Date & Time (UTC):	3 October 2025 at 1913 hrs	
Location:	Manchester Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - 171
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None reported	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	33 years	
Commander's Flying Experience:	6,272 hours (of which 5,889 were on type) Last 90 days - 154 hours Last 28 days - 52 hours	
Information Source:	AAIB Field Investigation	

Synopsis

9H-QBD was on a scheduled flight from Pisa International Airport to Glasgow Prestwick Airport on a day when significant winds had been forecast. The crew took extra fuel to allow for possible delays and diversions due to the weather. Following two windshear escape manoeuvres that transitioned into go-arounds at Prestwick, the crew requested a diversion to Manchester Airport, but the request was not accepted and the aircraft diverted to Edinburgh Airport. Following a further windshear escape manoeuvre at Edinburgh, the crew declared an emergency and diverted to Manchester where they landed with a fuel quantity significantly below the final reserve fuel.

Following this serious incident, Manchester Airport reiterated to stakeholders its policy of accepting diversion requests if the airport has the capacity to receive the aircraft and that the decision on accepting the diversion does not rest with the handling agent.

History of the flight

9H-QBD was scheduled for a flight from Pisa International Airport in Italy, to Prestwick Airport near Glasgow in the United Kingdom. Over the scheduled arrival time, Storm Amy was due to pass through Scotland and Northern England, bringing strong to gale force winds, several weather fronts and prolonged rainfall. The previous day the operator had issued a storm pack including four safety bulletins to remind pilots about the potential impact of the forecast weather. This was followed up on the day with an additional email reminder of guidance on weather disruption and conservative fuel planning including uplifting fuel for the furthest alternate and adding commander's discretionary fuel.

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The crew reported 45 minutes before departure and were aware of the potential for weather disruption in Scotland and Northern England. They conducted their own flight planning at home individually, prior to reporting for duty. On arrival at Pisa, both pilots compared their individual planning and they broadly agreed. The amount of additional fuel taken was influenced by the anticipated need to use the shorter of the two runways at Prestwick because the crosswind forecast for the longer runway was outside the aircraft's limits. The pilots stated that they agreed on using Manchester Airport as their alternate because it had more favourable weather conditions than the operator-planned alternate of Glasgow Airport.

The flight was due to depart at 1415 hrs but was delayed until 1528 hrs, with the commander as the pilot flying for this outbound sector, and the flight to Prestwick was initially uneventful. Weather data for Manchester, Prestwick, Glasgow and Edinburgh airports were collected in ample time, and the pilots discussed the weather conditions and the windshear escape procedure as part of their arrival briefing.

There were no delays at Prestwick, and the aircraft was vectored for the approach to Runway 20. The surface wind conditions were passed as 240° at 29 kt gusting 45 kt with both pilots commenting on the turbulence as they began the approach. At 1,200 ft aal the autopilot and autothrottle were disconnected due to the fluctuating airspeed. On passing 300 ft aal the airspeed was beginning to decay and the commander increased thrust to compensate. The rate of airspeed decay continued and on approaching 264 ft aal a windshear warning was triggered with two-tone siren and a "WINDSHEAR, WINDSHEAR, WINDSHEAR" voice message. The windshear escape manoeuvre[1] was executed and, on passing between 600 and 700 ft aal, the aircraft exited the conditions. The commander transitioned to a standard go-around, followed the missed approach procedure, and joined the hold at Turnberry (TRN) VOR at 6,000 ft.

The pilots reviewed their fuel situation and decided to wait in the hold to see if an aircraft of the same type currently on approach experienced any windshear. The pilots discussed the windshear event, obtained the updated weather for Manchester and noted that another windshear escape manoeuvre would necessitate a diversion in accordance with company policy. The other aircraft landed and reported a loss in airspeed on short finals of 25 kt at 500 ft. Another approach to Prestwick was requested and ATC were informed that "IN CASE OF MISSED APPROACH AGAIN, WE GO STRAIGHTFORWARD TO MANCHESTER".

During the second approach, the pilots reported that the conditions felt less turbulent than before. The autopilot and autothrottle were again disconnected at approximately 1,200 ft aal, and airspeed fluctuations were reported as being less than the previous approach. The instant wind at this time was passed as 230° at 34 kt gusting 46 kt. Around 50 ft aal, another windshear warning was triggered, and the commander executed the windshear escape manoeuvre. When out of windshear conditions they transitioned to a standard go-around, completed the '*After Take-off*' checklist, climbed to 6,000 ft and were instructed to go back to TRN to hold.

Footnote

[1] See section, *Windshear escape manoeuvre.*

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During the routing to the hold, ATC stated that Manchester was unable to accept their diversion request, but no explanation was given as to why the request had been refused. The pilots obtained the weather for Edinburgh Airport via ATC which reported strong winds but no windshear, although there had been some aircraft go-arounds earlier. The nearest alternative airport was Glasgow Airport, which was reporting in the ATIS that aircraft had experienced windshear on finals. Based on this information the pilots requested a diversion to Edinburgh, this request was made six minutes after they were told by ATC that Manchester had refused to accept the diversion.

It took a further five minutes for their request to divert to Edinburgh to be accepted. During that time the pilots discussed declaring a "FUEL MINIMUM" or a "MAYDAY" to go to Manchester. However, they agreed that their current fuel state did not meet the criteria written in the company operations manual to declare an emergency[2]. They discussed their concern that they might receive a windshear warning at Edinburgh, and they also discussed the windshear warnings, wondering whether they had been spurious.

They departed the hold, climbed to FL150 and routed toward Edinburgh. During this transit the pilots were becoming more concerned about the fuel, but there was no discussion of a plan should they have to go around at Edinburgh, and they did not inform ATC of their fuel situation (there was no requirement to do so). They reported that due to the high workload they decided not to tell the company about the diversion until they were on the ground.

The Edinburgh ATIS gave a surface wind of 240° at 34 kt gusting 46 kt and the aircraft was set-up for an approach to Runway 24. On transfer to Edinburgh Approach, they asked if any landing aircraft had experienced windshear and were told that nothing had been reported. The pilots commenced their third approach. Again, the autopilot and autothrottle were disconnected at approximately 1,200 ft aal and on passing 745 ft aal another windshear warning was triggered. The crew performed the windshear escape manoeuvre, transitioned into a go-around, after which ATC vectored the aircraft to the north in anticipation of a second approach.

The pilots were increasingly concerned about the decreasing fuel situation and seemed convinced that they would get another windshear warning at Edinburgh. They noted they had 2,100 kg of fuel remaining and that the diversion fuel required for Manchester was 2,800 kg (to land with the final reserve fuel of 1,101 kg)[3]. The commander decided to divert to Manchester and the Flight Management Computer (FMC) predicted that this would result in the aircraft arriving in the airport overhead with between 500 and 700 kg of fuel. The co-pilot programmed the approach at Manchester Airport into the FMC, after which the FMC predicted the landing fuel would be 300 kg, significantly below the final reserve fuel. This was noted by the crew and prompted the declaration of a "MAYDAY MAYDAY MAYDAY FUEL" to ATC and a request for an immediate diversion to Manchester.

Footnote

[2] See section, *In-flight fuel management*, Figure 5.
[3] Final reserve fuel is discussed in the later section, *Fuel planning*.

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ATC cleared the aircraft to route direct to point ROSUN and to climb to FL230. The commander reported that the predicted fuel on arrival was between 900 and 1,000 kg once the routing and flight level had been entered into the FMC. He also commented that the predicted arrival fuel decreased during the climb and cruise en route to Manchester.

There was no further discussion by the pilots about the expected fuel remaining on arrival at Manchester except that they realised they would not have enough fuel for another go-around. There was no consideration of using a closer alternative such as Newcastle Airport. In the cruise, the left main fuel tank amber LOW FUEL QUANTITY TANK 1[4] alert illuminated. Although noted by the pilots, they did not action the *'Low - Fuel Quantity'* checklist. The commander commented that this was because the reason for the low fuel quantity was clear. They noted a fuel imbalance of 100 kg, with the left main fuel tank lower, and completed the fuel balancing procedure. This was then followed by an amber LOW FUEL QUANTITY TANK 2 alert for the right main fuel tank.

Manchester ATC cleared the aircraft direct to a 10 nm final for Runway 23R. The aircraft landed at 1952 hrs with 363 kg total fuel remaining and taxied to stand. The total flight time from the first go-around at Prestwick to landing at Manchester was 1 hour 45 minutes.

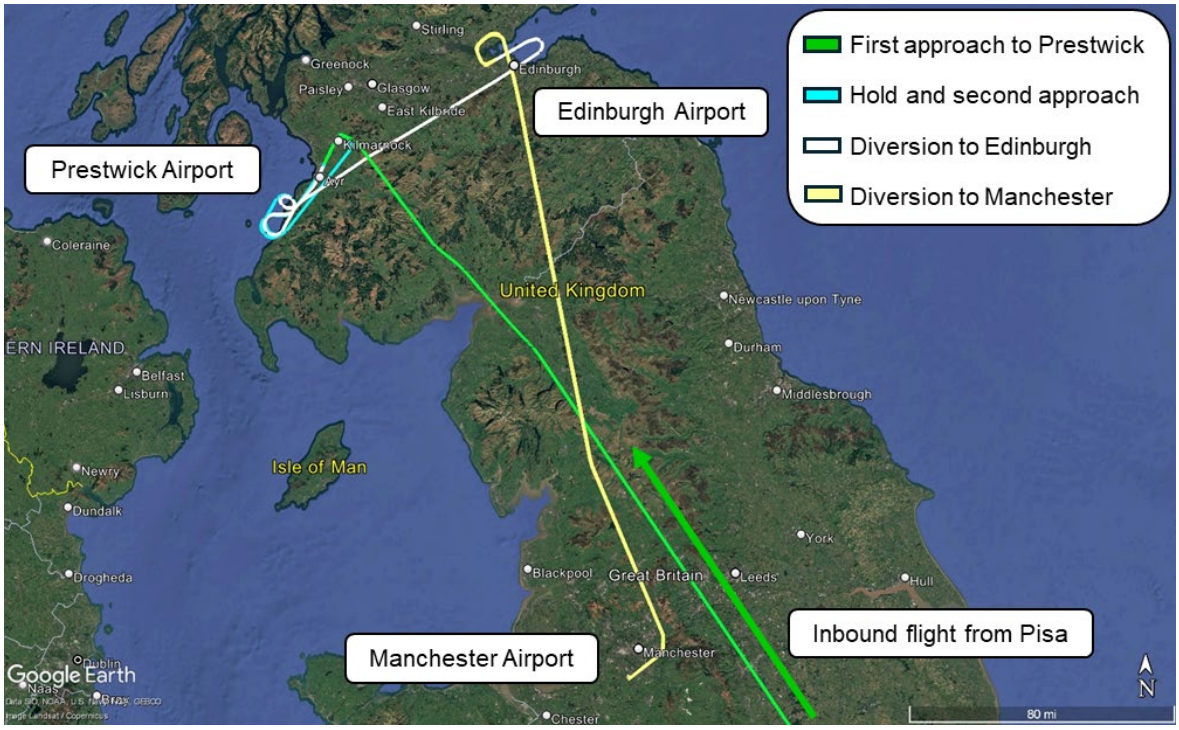


Figure 1

Diversion routing – total time 1 hour 45 minutes

Footnote

[4] Low fuel quantity is triggered when the tank reaches 1,000 lb (454 kg).

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Meteorology

A deep area of low pressure was sitting to the west of Scotland, named by the Met Office as Storm Amy. It was the first named storm of the season and was forecast to bring destructive winds. By 1800 hrs the low pressure had deepened to 952 hPa and was centred near Cape Wrath (Figure 2).

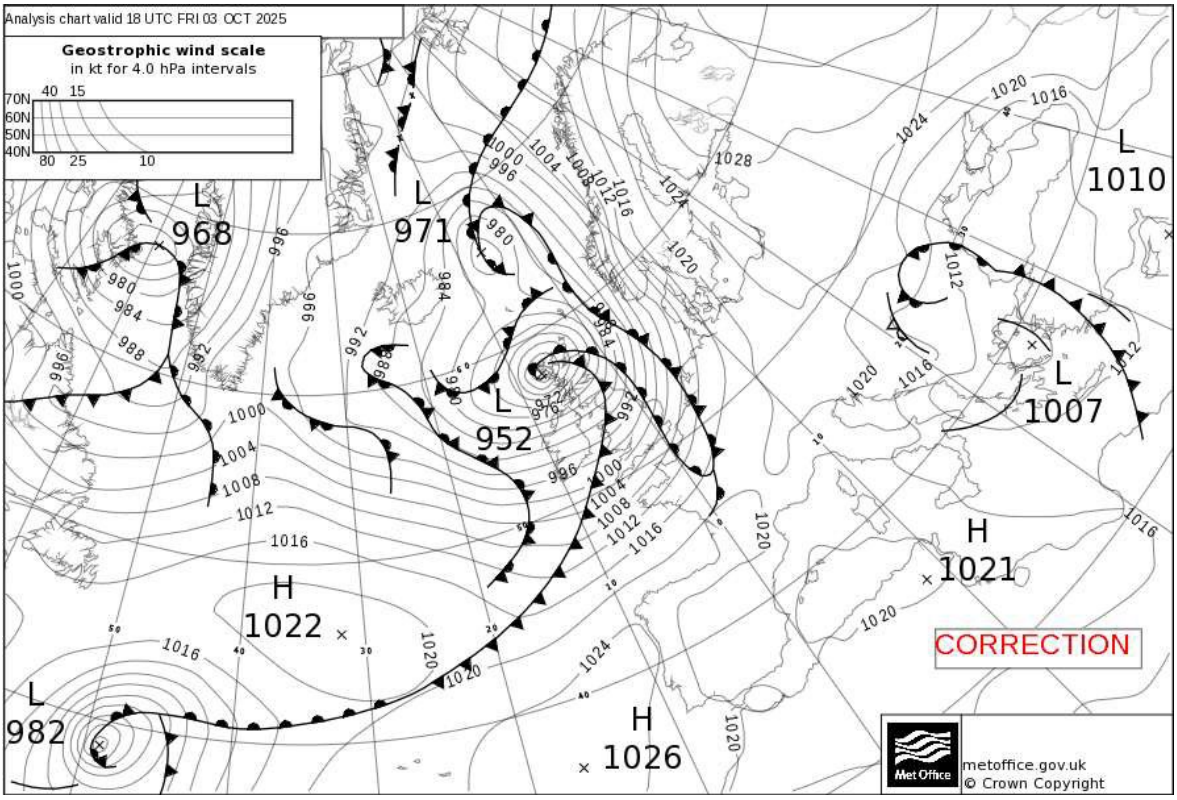


Figure 2

Surface analysis chart valid 1800 UTC on 3 October 2025

The forecast weather for Prestwick at the expected time of arrival showed a strong south-westerly wind of 25 kt and gusts of 40 kt, with a 30% probability of an increase to 30 kt with gusts of 50 kt. A maximum gust of 56 kt was recorded at 1620 hrs and 1950 hrs.

The forecast wind at Glasgow over the period was the same as Prestwick, with a maximum gust of 55 kt reported at 1750 hrs. Edinburgh, which is further east, also forecast strong south-westerly winds, 28 kt and gusts of 48 kt. Edinburgh experienced a maximum gust of 54 kt at 1820 hrs.

Further south, the forecast winds were better, with Manchester giving a southerly wind of 25 kt gusting to 38 kt, reducing in strength as it veered south-westerly of 18 kt gusting 28 kt. Manchester experienced a maximum gust of 37 kt at 1920 hrs.

Newcastle Airport was one of the alternate airports included in the pilot's briefing pack. Forecast weather for the airport was not available in the pack, but at the time the aircraft diverted to Manchester, the wind at Newcastle was from 290° at 22 kt.

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Flight Preparation

The operator uses a flight planning system that generates a routing based on a variety of criteria to ensure the most efficient Operational Flight Plan (OFP) is generated. The routing is then sent to Eurocontrol for validation prior to a full briefing pack being released to the pilots' Electronic Flight Bags (EFBs) in advance of the flight. The briefing pack contains the OFP, ATC Flight Plan, dispatch information, weather and NOTAMs. The briefing pack was released to the crew at 0724 hrs on the day of the flight and consisted of 57 pages, which the pilots reviewed at their respective homes before reporting for duty.

Fuel planning and management

The operator uses an approved standard fuel scheme for fuel planning and in-flight re-planning. The pre-flight requirement for departure fuel is the sum of taxi fuel, trip fuel, an additional 5% contingency for unforeseen factors, diversion fuel to a destination alternate airport and 30 minutes of final reserve fuel (Figure 3). Extra fuel can be included to account for operational constraints or delays, such as ATC. In addition, the commander has the discretion to upload additional fuel, and crews were encouraged to do so in the email sent by the operator the day before.

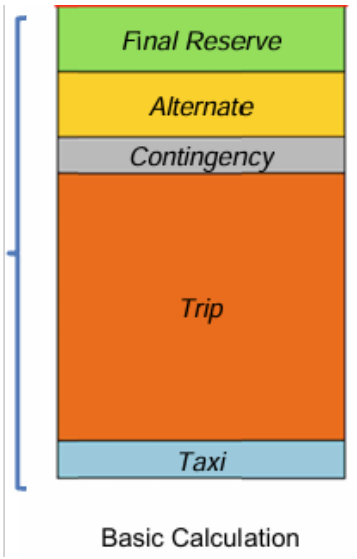


Figure 3

Pre-flight fuel requirement

The flight planning system selects a destination alternate airport from a company-approved list taking into consideration the forecast weather minima, available approach aids and relevant aerodrome NOTAMs. Having passed the flight planning suitability check, up to four alternates are displayed for crew information. Each alternative is numbered in order of company preference but crews may select any of these alternates. This allows the commander to select a different alternate without having to ask for a revised OFP.

At the initial planning stage, Glasgow was the destination alternate (ALTN) with a fuel requirement of 991 kg, giving an OFP Block Fuel of 9,563 kg (Figure 4). Having reviewed

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the weather, the pilots agreed to use Manchester as the ALTN with a fuel requirement of 1,606 kg (an additional 615 kg of fuel). The commander decided to load another 1,322 kg of fuel to give a total of 1,937 kg of discretionary fuel (PIC DISCR) and a total fuel of 11,500 kg. The 1,322 kg of additional fuel would provide approximately 33 minutes of additional flight time (based on an average trip fuel burn of 2,433 kg/hr).

FUEL (BIAS P01.0)	ARPT	FUEL (KGS)	TIME (HHMM)
TRIP FUEL		6896	0250
CONT 5%		345	0009
ALTN	GLA	991	0022
FINRES		1101	0030
PLANNED T/OFF FUEL		9333	0351
ATC		35	0001
T/OFF FUEL		9368	0351
TAXI		195	0015
BLOCK		9563	0351
PIC DISCR		1937	
TOTAL FUEL		11500	

Figure 4

OFP fuel plan

ATC Flight Plan

The operator's Operations Manual did not require the pilots to inform the operations centre that they were changing the commercial alternate to Manchester. Consequently, the destination alternate on the flight plan remained as Glasgow. The pilots reported that changing a destination alternate would require a telephone call to the operations centre and the OFP to be re-issued, which could take up to 15 minutes. However, as they had the required fuel, routing and level information this was not necessary.

All flight plan information is available to ATC, but during a flight any abnormal events are driven by the pilot's intentions. This requires clear communication between the pilot and ATC, who will coordinate any requests. Alternate airfields are not sent a copy of the flight plan and so any diversion request must be coordinated through ATC; nominating an airfield as an alternate on a flight plan does not ensure acceptance.

In-flight fuel management

In-flight fuel management procedures ensure fuel consumption is monitored at regular intervals and compared to planned fuel consumption to maintain safety margins. The aim is to ensure that the aircraft lands at an aerodrome with at least final reserve fuel.

The operator's Operations Manual states:

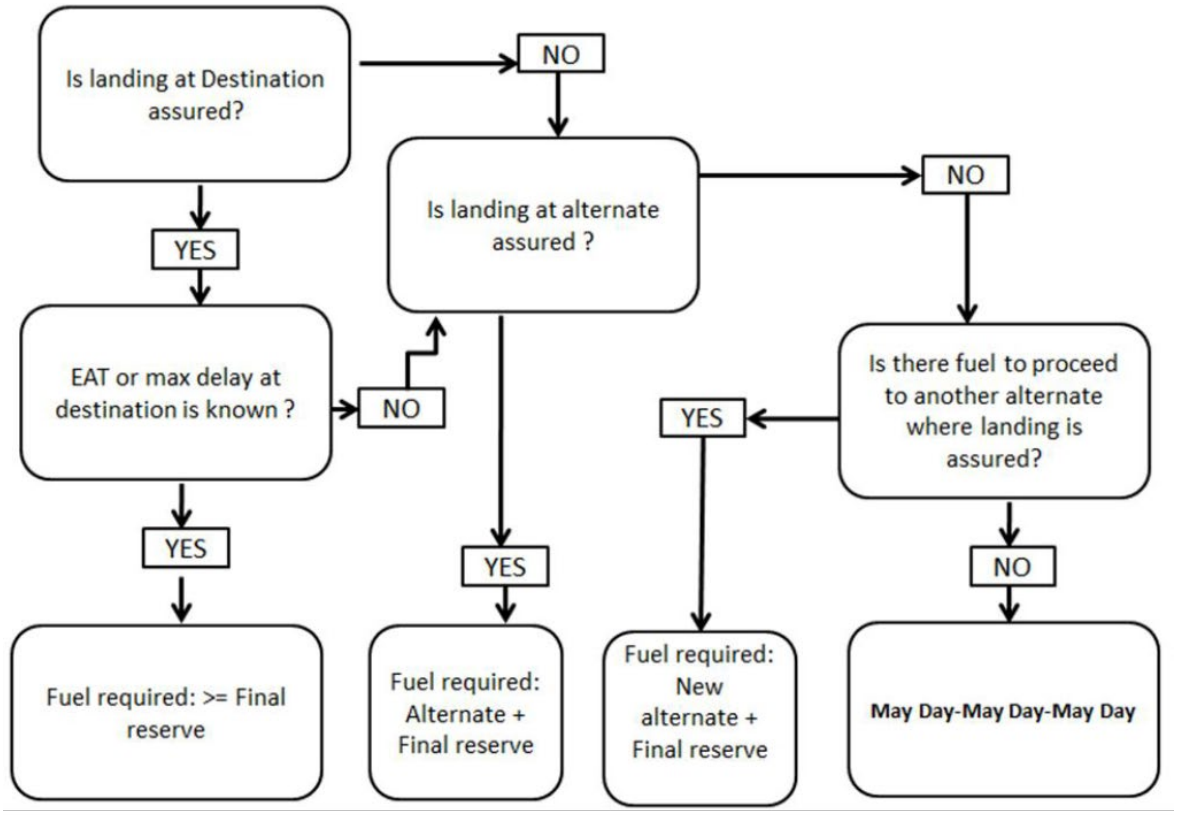
> *'The objective of the Final Reserve Fuel (FRF) protection is to ensure that a safe landing is made at any aerodrome when unforeseen circumstances may not allow [the crew] to safely complete the flight as originally planned. The*

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commander should always consider first planning a safe landing option and estimating whether this landing can be performed with more than the FRF. When this estimation indicates that the FRF can no longer be protected, then a fuel emergency should be declared and any landing option explored … including deviating from rules, operational procedures, and methods in the interest of safety'.

The term MINIMUM FUEL is used to inform ATC that all planned aerodrome options have been reduced to a specific aerodrome of intended landing. Any change to the existing clearance may result in landing with less than planned final reserve fuel. It is not an emergency but an indication to ATC that one is possible should there be any delays.

The operator produced a flow chart to assist pilots with their in-flight decision making (Figure 5).



Note: To consider a landing to be "assured", the Commander shall take account of all operational considerations including any forecast deterioration in the weather and plausible single failures of ground and/or airborne facilities e.g. CAT II/III to CAT I.

Figure 5

Operator's fuel decision flow chart

Table 1 shows the fuel remaining on 9H-QBD at key points of the flight, along with the minimum fuel required at those points.

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Stage of Flight	Fuel Remaining	Minimum Required	Difference
Approaches at Prestwick			
Start of first approach	4,725 kg	Manchester (1,606 kg) + Final Reserve Fuel (1,101 kg) Minimum 2,707 kg	2,018 kg
First go-around	4,608 kg		1,901 kg
Depart TRN Hold for second approach	3,800 kg		1,093 kg
Second go-around	3,515 kg		808 kg
Diversion to Edinburgh			
Depart TRN on diversion	2,900 kg	Edinburgh (1,067 kg) + Final Reserve Fuel (1,101 kg) Minimum 2,168 kg	732 kg
Commence third approach	2,253 kg	Final Reserve Fuel Minimum 1,101 kg	1,152 kg
Third go-around	2,164 kg		1,063 kg
Diversion to Manchester			
Departing Edinburgh "MAYDAY MAYDAY MAYDAY FUEL"	2,036 kg	Manchester (1,700 kg estimated by crew) + Final Reserve Fuel (1,101 kg) Minimum 2,800 kg estimated by crew	-764 kg Estimated landing fuel 336 kg

Table 1

Fuel on board and fuel required during the flight

After entering the TRN Hold following the first windshear escape manoeuvre, the pilots reviewed the fuel and re-iterated that their minimum fuel required for Manchester was 2,800 kg. They agreed that they had sufficient fuel for another approach but would wait for feedback from the aircraft on approach, and that another go-around would result in a diversion.

On entering the TRN Hold following the second go-around, the pilots amended the minimum fuel to 2,200 kg for a diversion to Edinburgh. In the five minutes between making the decision to divert and the diversion being accepted, the crew discussed a diversion to Manchester and expressed concern about what they would do following a further go-around due to windshear at Edinburgh. They knew that Manchester would accept a new request if they declared a MAYDAY for low fuel but believed their fuel state did not justify such a declaration. They agreed, however, that they would declare a fuel emergency should they be forced to go around at Edinburgh.

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When they were en route to Edinburgh, the commander stated that the minimum fuel was now the final reserve fuel of 1,101 kg. He stated that 1,400 kg would be used to declare minimum fuel.

Following the third windshear escape manoeuvre, the pilots estimated the fuel required to divert to Manchester was 2,800 kg, which would have resulted in the aircraft landing with the final reserve fuel. The fuel remaining at the time was 2,100 kg, which suggested that a diversion to Manchester would lead to the aircraft landing with 400 kg (although the crew estimated it would be between 500 and 700 kg).

Information from the crew

Following the windshear escape manoeuvre at Edinburgh, the pilots were concerned that they might encounter windshear for a second time if they made another approach and they would either have to land despite the windshear warning to remain above final reserve fuel or go around again. If they went around, they would be committed to making a third approach because low fuel would prevent them from diverting anywhere else. They considered that diverting to Manchester, even landing below final reserve fuel, was preferable because it was the safest option, given the favourable wind conditions meant they were highly unlikely to have to go around yet again. The crew found the transit to Manchester stressful, given the low fuel situation, and considered they had a high workload. They were focused on preparing for the approach and monitoring the wind conditions and, once en route, did not consider returning to Edinburgh or diverting to a closer alternate airport such as Newcastle Airport.

Information from the operator

The operator commented that there was a period of time after the crew had asked to divert to Edinburgh but before they received clearance to do so. During this time, the crew's concern that they may have to go around at Edinburgh could have been interpreted as meaning a landing at Edinburgh might not be assured due to a risk of windshear. If so, this would have allowed an emergency to be declared under the operator's procedures.

Weather related missed approaches

The operator's Operations Manual Part A, *Weather Related Missed Approaches*, states:

> *'If a missed approach has been executed for meteorological reasons, another approach shall only be commenced if the Commander has reason to believe that a second approach will lead to a successful landing'; and*
>
> *'It is not permitted to conduct a third approach following two abandoned approaches due to windshear'.*

Diversion request

In the UK AIP, Manchester Airport regulations state, *'All operators are advised that before planning Manchester as an alternate, they are required to have ground handling available at the airport'*. Manchester is a regular destination of the operator of 9H-QBD and so ground handling was available.

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Manchester's diversion policy states:

> *'Aircraft diverts will be accepted if there is capacity on the ground, including the spaces available through the Manchester Airport Excess Parking Plan. Declared emergencies & medical diversions will always be accepted'.*

At 1822 hrs, the pilot notified Prestwick ATC that their intention was to divert to Manchester in the event of a go-around from the second approach. At 1829 hrs Manchester ATC received the request and called Airfield Control for a decision.

The diversion policy states:

> *'Upon receipt of a divert request from ATC, Airfield Control will assess the stand capacity. If parking space is available, the request should be accepted. Airfield Control will notify:*
>
> *Airport Operations Duty Manager*
> *Manchester Airport Control Hub (MACH)*
> *Nominated Ground Handling Agent*
>
> *Whilst MAN/EGCC will notify Ground Handling Agents of any expected diversions, the decision to accept a request for an inbound diversion will always be made by MAN Airfield Operations on grounds of flight safety and aerodrome ground capacity.'*

At 1834 hrs, Airfield Control called ATC stating the handling agent was unable to accept the diversion. Prestwick were told the diversion could not be accepted, but the reason of a lack of handling capacity was not passed. The refusal was subsequently relayed to the pilots at 1837 hrs, after the second missed approach.

The Manchester Airport Excess Parking Plan was not in force on the day, although they had accepted 19 diversions due to Storm Amy. The handling agent for the operator stated it was their policy to accept diverting aircraft from this operator, but there was no record of the communications between Airfield Control and the handling agent. Therefore, it was not established how the decision was made to refuse the diversion.

Following this incident Manchester Airport reviewed its procedures and restated that diversions will be accepted by Airfield Control if there is parking space available. Handling agents would be notified but would not be involved in the decision-making process. Manchester reiterated that to use Manchester as an alternative airport an operator must have a handling agent.

Enhanced Ground Proximity Warning Systems (EGPWS)

The aircraft was fitted with an EGPWS that incorporated several detection modes including windshear alerting (Mode7). This function was designed to provide detection of windshear by monitoring aircraft parameters for indications of energy-loss conditions.

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Mode 7 windshear alerting is active during flight phases where windshear is known to present the greatest hazard:

- Takeoff: From rotation until the aircraft passes 1,500 ft agl.
- Approach: From 1,500 ft down to 10 ft agl.
- Missed approach: Until climbing through 1,500 ft agl.

A Windshear Warning is generated when the system detects severe performance-degrading shear, including decreasing headwind, increasing tailwind, or a strong downdraft. When detected, a red WINDSHEAR message is displayed on the Primary Flight Displays and there is an aural WINDSHEAR warning. The warning envelope is dynamically adjusted based on aircraft climb performance, flightpath angle, variations from normal approach speeds, and fluctuations in static air temperature, which are characteristic of microburst encounters.

Windshear escape manoeuvre

If a windshear warning is received, pilots must execute a manually flown windshear escape manoeuvre, which is designed to transition the aircraft into a maximum rate climb to clear the windshear conditions. It differs from a normal go-around in that it requires maximum thrust, not go-around thrust, landing gear and flap configurations are not changed, and the aircraft pitch attitude is controlled for maximum climb performance rather than go-around performance. Once the aircraft is clear of windshear, the aircraft is recovered to a normal climb configuration.

Recorded information

The aircraft was fitted with an FDR and CVR, both of which were successfully downloaded at the AAIB. The EGPWS was also recovered, which recorded parameters associated with the windshear warnings. In addition, RTF recordings were provided by Prestwick, Edinburgh and Manchester Airports. All data sources were combined to create a timeline of events.

Just before taxiing to the runway in Pisa, the combined fuel from the left, centre and right fuel tanks was 11,671 kg. Takeoff commenced at 1528 hrs with the centre tank fuel being used first on an uneventful flight to Prestwick.

The CVR recorded the last 2 hours 11 minutes of operation and commenced recording at 1752 hrs, during the descent to Prestwick at FL161. Some of the crew discussions were in Italian which was translated with the assistance of an Accredited Representative from the Agenzia Nazionale per la Sicurezza del Volo (ANSV) of Italy.

ATC cleared the aircraft to land at Prestwick Airport Runway 20, passing the wind conditions of 250° at 29 kt. The controller continued to pass the instant wind conditions as the aircraft continued the approach, the last of which was 250° at 40 kt. At 1806:27 hrs when 0.7 nm from the runway threshold at 215 ft agl, a windshear warning was recorded on the CVR and FDR and the flight crew performed a go-around. At the time, recorded fuel quantity was approximately 4,608 kg[5] (Figure 6).

Footnote

[5] Fuel quantity is recorded every 64 seconds.

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The aircraft carried out the windshear escape manoeuvre that transitioned into a go-around, during which flight crew discussions included fuel, the possibility of a diversion to Manchester, and that another of the operator's aircraft was on the approach to Prestwick.

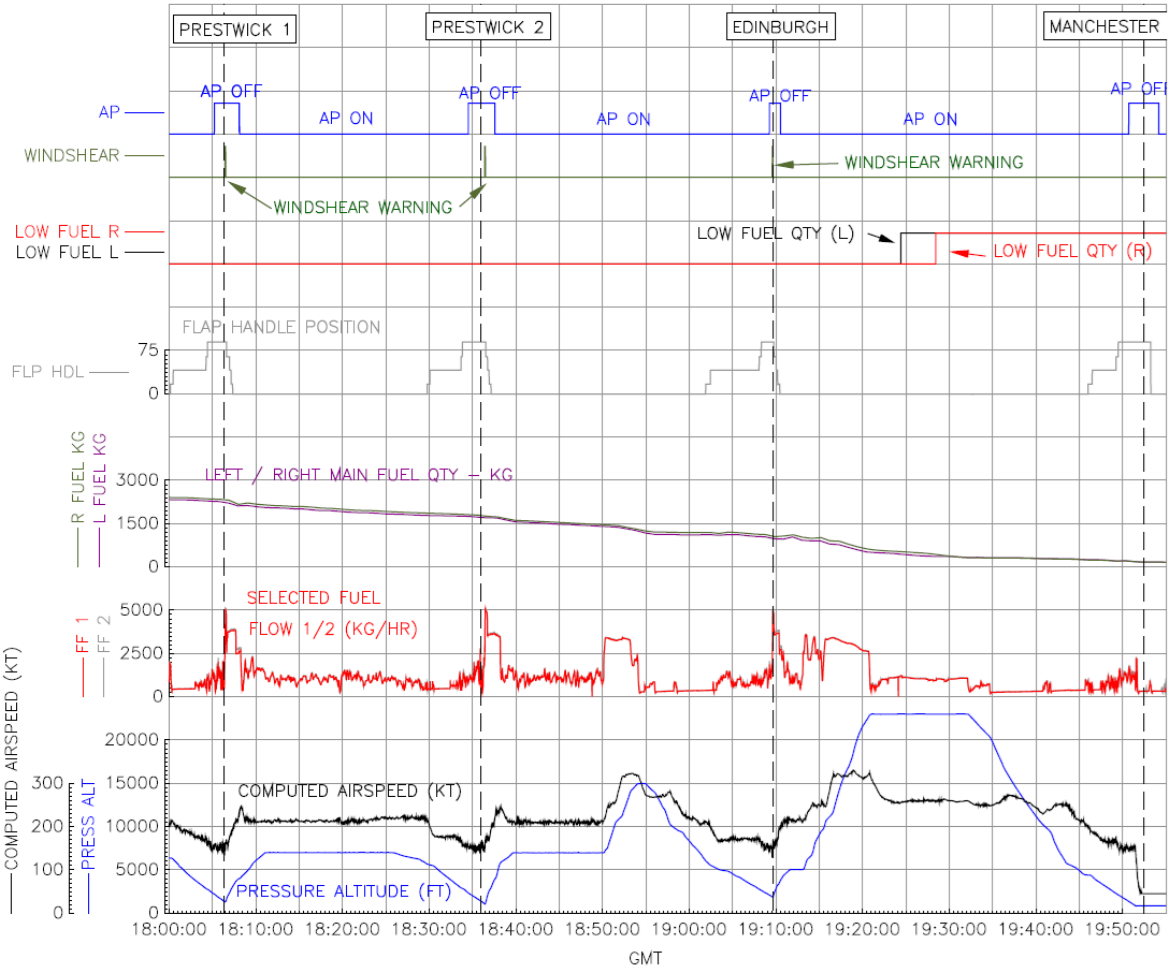


Figure 6

9H-QBD Flight Data for the four approaches

While in the hold, at 1817:28 hrs, the crew requested the Manchester weather report from ATC. After the operator's other aircraft successfully landed, at 1821:58 hrs, a second approach to Prestwick was requested and with the crew stating to ATC that "IN CASE OF MISSED APPROACH AGAIN, WE GO STRAIGHTFORWARD TO MANCHESTER".

During the second approach to Prestwick, at 1836:25 and 50 ft agl, a second Windshear Warning was triggered and a go-around was performed. At the time, recorded total fuel quantity was 3,515 kg. During the climb, ATC advised that "…MANCHESTER IS UNABLE TO ACCEPT YOU…" and asked for their intentions. The aircraft entered the hold again, during which the flight crew asked for the Glasgow and Edinburgh weather report and whether aircraft were landing at these destinations. The ATIS received from Glasgow included reports of windshear, and at 1843:26 hrs, the crew stated "REQUEST IMMEDIATELY TO DIVERT TO EDINBURGH". This was approved at 1848:53 hrs and the aircraft began tracking towards Edinburgh.

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The flight continued and, at 1908:26 hrs, the aircraft was cleared to land on Runway 24 at Edinburgh Airport. At 1909:36 hrs, the FDR and CVR recorded a third Windshear Warning at 2.43 nm from the runway, at 745 ft agl. A windshear escape manoeuvre was performed, and Edinburgh ATC instructed the crew to turn onto 320° and to climb to 4,000 ft. At the time, recorded fuel quantity was 2,164 kg.

During the climb, the crew discussed fuel again and that another approach may lead to another Windshear Warning. They discussed the remaining fuel, which was 2,100 kg, and estimates of landing with between 500 and 700 kg of fuel if they diverted to Manchester Airport.

As the aircraft reached 4,000 ft, ATC instructed them to change frequency to Edinburgh Radar, who instructed them to turn right for vectors for an ILS approach back to Runway 24. The crew then discussed an ILS approach to Manchester Airport during which likely remaining fuel was discussed. The co-pilot commented that the predicted fuel on arrival at Manchester was "0.3" (i.e. 300 kg) and it was decided that they should declare a MAYDAY.

At 1912:34, the commander stated to ATC:

> "WE HAD ANOTHER WINDSHEAR ALSO HERE, SO WE HAVE ER MAYDAY MAYDAY MAYDAY FUEL [CALLSIGN]".

Edinburgh ATC acknowledged the MAYDAY and instructed the crew to descend to 3,000 ft. The commander replied stating that:

> "AH BUT WE ARE AFRAID THAT WE GET ANOTHER WINDSHEAR HERE WE WE WOULD LIKE TO DIVERT IMMEDIATELY TO MANCHESTER, IT WAS DENIED BEFORE".

ATC acknowledged this and instructed them to climb to 6,000 ft on a heading of 180°.

The flight then continued towards Manchester Airport, climbing to FL230. During the flight, at 1924:26 hrs, the FDR recorded the LOW FUEL QUANTITY TANK 1 alert. The crew acknowledged this and also discussed that the fuel estimate continued to decrease (although it is unknown from what amount). They also acknowledged a fuel imbalance of 100 kg, with the FDR data recording 523 kg of fuel in the right tank and 404 kg in the left tank. Over approximately three minutes, the recorded fuel became balanced and the crew acknowledged that the fuel balancing was completed[6].

At 1928:28 hrs a LOW FUEL QUANTITY TANK 2 alert was recorded and the flight then continued, landing at Manchester at 1951:30 hrs. At the point of touchdown there was 363 kg total fuel remaining. The aircraft taxied to stand and, just prior to engine shutdown, the final fuel quantity recorded on the FDR was 240 kg.

Footnote

[6] Fuel quantity is recorded every 64 seconds.

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During the previous go-arounds at Prestwick and Edinburgh, with the engines at go-around power, recorded fuel flow reached approximately 3,600 kg/hr per engine (120 kg/min for both engines).

EGPWS data

When the EGPWS generates a windshear warning, it stores several parameters once per second for 50 seconds prior to and 50 seconds after the warning. Download of the EGPWS revealed three windshear detections for this flight.

The data was shared with the system manufacturer for comment, and the data included a 'total shear' parameter, which is a calculated measure of the overall windshear. Once this total shear reaches a threshold, a windshear warning is triggered. The manufacturer confirmed that the system was functioning as per design and there were no system failures recorded. The 'total shear' parameter reached the threshold required to trigger the windshear warnings on each occasion.

Aircraft performance

The landing at the destination of Prestwick was expected to be onto Runway 20 rather than the longer Runway 30 due to the crosswind being too great for Runway 30. This limited the landing weight of the aircraft and, therefore, the take-off weight at Pisa. This, in turn, limited the amount of extra contingency fuel that could be carried to allow for the weather.

Analysis

Summary

9H-QBD departed Pisa for Prestwick but diverted to Edinburgh following two windshear escape manoeuvres at Prestwick. A further windshear escape manoeuvre was performed at Edinburgh after which the crew declared a MAYDAY and diverted to Manchester, where they landed with 363 kg, less than the final reserve fuel of 1,100 kg.

Pre-flight planning

Pre-flight preparations and planning were conducted by each pilot at home prior to the flight. The crew had been informed of the potential disruption due to storm Amy through two communications sent the day before and on the morning of the flight. Extra contingency fuel was carried due to the forecast wind at the destination but the amount of additional fuel was limited by the expectation that an approach to the shorter runway at Prestwick would be required. The additional fuel allowed for about one hour of extra endurance at cruise speed.

Decision-making and emergency handling

Following the first windshear escape manoeuvre at Prestwick, the crew elected to enter the hold and wait to see if another aircraft of the same type landed. They held for about 20 minutes and, when the landing was confirmed, began a second approach. This was in accordance with the operator's policy that a second approach should only be flown if a commander has reason to believe it will lead to a successful landing.

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After the second go-around at Prestwick, the crew asked to divert to Manchester because of the operator's policy that a third approach is not permitted following two windshear escape manoeuvres, but the request was refused. Although the reason for the refusal was not established, it appeared to have resulted from a breakdown in communication between units within Manchester Airport. According to the airport and handling agent's policies, the diversion request should have been accepted. The pilots believed that their fuel state did not permit them to declare a fuel emergency, which would have allowed them to go to Manchester. The operator commented that an emergency could have been declared if the crew was concerned that landing at Edinburgh would not have been assured because of windshear. However, the crew based their decision to divert to Edinburgh on a weather report that did not include windshear (although it did report some previous go-arounds) and because Glasgow Airport, although nearer, was experiencing similar weather conditions to Prestwick.

Following the windshear escape manoeuvre at Edinburgh, ATC turned the aircraft north, expecting it to make another approach. The pilots were concerned about the fuel situation but also the possibility of another windshear escape manoeuvre and go-around should they remain at Edinburgh. The Operations Manual states that commanders should only make a second approach following a weather-related go-around if they assess that the second approach will be successful, but the crew appeared concerned that the conditions at Edinburgh did not support such an assessment. Another approach at Edinburgh would have protected final reserve fuel – if it had resulted in a safe landing – but the crew was concerned that if it resulted in another missed approach, they would then be committed to making a third approach in windshear conditions with no option other than to fly through a windshear warning to land.

Prior to declaring the fuel emergency, the pilots had calculated and agreed that they would arrive at Manchester with between 500 and 700 kg of fuel. When they programmed the FMS, however, it predicted arriving at Manchester with 300 kg. Both calculations were below the final reserve fuel of 1,100 kg. The operator's final reserve fuel policy aims to ensure a safe landing when unforeseen circumstances do not permit the flight to be conducted safely as originally planned, and it is likely that three windshear escape manoeuvres and a diversion would be captured by this definition. The policy also requires commanders to consider '*a safe landing option'* that preserves final reserve fuel before exploring *'any landing option'.* The commander considered that if they remained at Edinburgh it could lead to them making an approach with no option other than to fly through any windshear warning to land. In the circumstances, the commander considered a diversion to Manchester to be the safest option even though it would inevitably lead to landing below final reserve fuel.

When the LOW FUEL QUANTITY TANK 1 message was displayed, there was an opportunity to review the decision to divert because Edinburgh, although behind them, was closer than Manchester. In the event, the aircraft continued to Manchester where it landed safely, but it is unlikely that there would have been sufficient fuel available for another go-around. The crew had considered Manchester to be their preferred alternate airport from the outset and it is possible that this influenced their decision-making.

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Manchester Airport Actions

Following this serious incident, Manchester Airport reiterated to stakeholders its policy of accepting diversion requests if the airport has the capacity to receive the aircraft and that the decision on accepting the diversion does not rest with the handling agent.

Conclusion

Following two windshear escape manoeuvres at Prestwick caused by the presence of Storm Amy, the crew of 9H-QBD asked ATC if they could divert to Manchester. Although the airport and handling agent policies at Manchester meant that the diversion should have been accepted, a breakdown of communication within the airport led to it being refused. The aircraft diverted instead to Edinburgh where the crew was required to perform another windshear escape manoeuvre.

The pilots were concerned that if they remained at Edinburgh there was a possibility that their low fuel state and the wind conditions could mean they had no option other than to fly through a windshear warning while on approach. They calculated that if they diverted to Manchester, they would land with between 500 and 700 kg of fuel, and, subsequently, the FMS calculated the expected arrival fuel to be 300 kg. Both calculations meant that the aircraft would land below the final reserve fuel of 1,100 kg, but the commander considered the safest option was to divert to Manchester where the aircraft landed with 363 kg.

Following this serious incident, Manchester reiterated to stakeholders its policy for accepting diverting aircraft.

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