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AIRCRAFT SERIOUS INCIDENT REPORT

Law on Aircraft Accident Investigation, No. 35/2004

Emergency situation due to near fuel starvation

M-01310/AIG-13

N96VF
Beechcraft Corporation, G36
West-northwest of Keflavik, Iceland
September 27th, 2010

1. Factual Information

Location and time	
Location:	West-northwest of Keflavik, Iceland
Date:	27. september 2010
Time[1]:	23:20

Aircraft	
Type:	Hawker Beechcraft Corporation G36
Type of registration:	Corporate
Registration:	N96VF
Year of manufacture:	2008
Serial number:	E-3826
CoA[2]:	Valid
Engines:	One, 300 horsepower Continental IO-550B, piston

Other information	
Persons on board:	Two
Injuries:	None
Damage to aircraft:	None
Short description:	Emergency situation due to near fuel starvation
Weather:	984 hPa low pressure area with up to 50 knots headwind
Flight conditions:	Instrument Meteorological Conditions (IMC)
Flight rules:	Instrument Flight Rules (IFR)
Type of flight:	Ferry flight

Pilot 1		
Age and sex:	64 years old, male	
License:	Airlines Transport Pilot	
Ratings:	CFI, CFII, MAI, AGI	
Medical Certificate:	Medical 1st class, valid	
Flight experience:	Total:	5000 hours
	Total on this type:	26 hours
	Last 90 days:	200 hours
	Last 24 hours:	10 hours and 12 minutes

[1] All times in the report are UTC and where applicable local times are shown in ( ).

[2] Certificate of Airworthiness

Pilot 2 / owner of airplane		
Age and sex:	45 years old, male	
License:	Private Pilot; SEP – Land	
Ratings:	IR	
Medical Certificate:	Medical 2nd class, valid	
Flight experience:	Total:	253 hours
	Total on this type:	26 hours
	Last 90 days:	26 hours
	Last 24 hours:	10 hours and 12 minutes

History of the flight

N96VF, a Beechcraft G36, was being ferry flown from North America to Europe. On board was an experienced pilot, as well as the owner of the airplane, who was also a pilot. When in Sondrestrom, Greenland, they intended to make a fuel stop in Kulusuk, Greenland, but due to the late departure from Sondrestrom the airport at Kulusuk would be closed by the time N96VF arrived there. They therefore decided to proceed directly to Reykjavik, Iceland. At 18:39:34 on September 27th 2010, the pilots contacted ATC and filed a flight plan to Reykjavik Airport (BIRK). The flight plan was for FL150 and a six hour flying time. Figure 1 shows the planned flight route between Sondrestrom (BGSF) and Reykjavik (BIRK), overflying Kulusuk (BGKK).

Figure 1: Planned flight route

The pilots contacted ATC again 3 minutes before departure, to change their destination airport from BIRK (Reykjavik) to BIKF (Keflavik). According to the pilots, they estimated to land in Keflavik in six hours, around 00:45 the next morning.

The airplane departed Sondrestrom Airport in Greenland (BGSF) at 18:45 hrs on the 27th of September 2010 for a flight to Keflavik Airport, Iceland (BIKF).

Halfway into the flight it became evident that the winds were less favourable than the 18:00 UTC forecast at FL 100 and FL 180 had predicted. Those were the forecasts that the pilots had in their possession prior to the flight. At this time, when at FL[3] 130, the winds increased from 15 knots headwind to 45 knots headwind in only 15 minutes. The pilots[4] contacted Iceland Radio at 21:40 for an update on the weather on their route to BIKF. The pilots asked Iceland Radio how the winds were at lower flight levels, and were told that the winds were less at lower altitudes and with a 30° variation, instead of direct headwinds. They then descended to FL 120, but still the airplane incurred the same heavy headwind and ice began to build up on the airplane. The pilots then returned the airplane to FL 130. At this time the headwind at FL 130 was up to 50 knots. About 10 minutes later the pilots contacted Iceland Radio again and asked for updated weather information. Iceland Radio informed them that the heavy headwind was now at all flight levels, up to FL 180. They then decided to descend to a lower level (FL 100) to see if the wind conditions were more favourable there, as well as to remove any build-up ice on the airplane. They discovered that the wind conditions were not more favourable at this flight level. The ice did however melt when the airplane reached this lower level.

When the airplane had two hours flying time remaining to Keflavik, it became apparent that the fuel on board might not be sufficient to complete the flight. According to the onboard fuel management computer, the fuel remaining after landing at Keflavik would be three USG[5] (11.4 litres). By then it was too late to turn back to Greenland and the pilots informed Iceland Radio that they were low on fuel and requested priority for direct landing at BIKF. This triggered the emergency response plan at Keflavik Airport and a helicopter from the Icelandic Coast Guard was sent to escort N96VF.

At 01:33 UTC N96VF landed safely at Keflavik Airport, after 6 hours and 48 minutes of flight. After landing (including taxiing) the remaining usable fuel was measured and turned out to be one USG in each of the airplane´s two fuel tanks.

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[3] Flight Level

[4] According to a report from the pilots, they were both operating the radio

[5] US Gallon

Meteorological information

According to the pilots, they received the 18:00 UTC wind forecast for September 27th 2010, for their route from Greenland to Iceland. From the forecast they determined the wind to be favourable for the flight and estimated that the airplane should therefore have sufficient fuel to complete the flight to Iceland. The owner of the airplane also stated that they leaned the fuel mixture as much as possible[6] during the whole flight, to save fuel. Due to time constraints as the airport in Sondrestrom was closing, the pilots did not request the next wind forecast for the flight, which was the 00:00 UTC forecast for the 28th of September 2010.

Aids to navigation

The airplane was equipped with Garmin GIA 63W NAV/COM/GPS system. According to the owner of the airplane, the system gave the pilots the necessary data to re-evaluate the situation when the headwind strength increased past the predicted strength. According to the pilots, the system showed when the airplane had two hours flying time remaining to Keflavik that the fuel on board might not be sufficient to complete the flight.

[6] All the cylinders had to be replaced shortly after this flight, due to wear, which can be caused by too weak fuel mixture

2. Analysis and Conclusion

Weather

From the 18:00 UTC wind forecasts that the pilots had in their possession, they should have anticipated steadily increasing cross wind along the way with increasing headwind component over the Denmark Strait. Halfway into the flight, after 3 hour flight time, the headwind increased to 50 knots. As calculated in Appendix A, this was 27 knots more than the maximum forecasted headwind at the planned FL150 at 18:00 UTC. By comparison, as also calculated in Appendix A, this was 16 knots more than the maximum forecasted headwind at the planned FL150 at 00:00 UTC.

Low pressure areas are common between Greenland and Iceland, while high pressure areas are common over the Greenland glacier. The nature of the weather on the western shores of Greenland and on the Greenland glacier is therefore often significantly different from the weather over the Denmark Strait between Greenland and Iceland. Due to the nature of the low pressure systems in the northern hemisphere, low pressure systems can generate a considerable headwind when flying from Greenland to Iceland, across the Denmark Strait.

Flight operation

The pilots had planned the flight at FL 150. During the flight they descended to FL 130 in order to minimize their oxygen use and also changed their altitude on several occasions trying to locate more favourable winds.

According to Pilot 2 the airplane had engaged in slower than normal flight. When he leaned the fuel mixture, the airplane adopted a nose high attitude. Pilot 2 did not detect this change of flight configuration when it occurred. When the pilots later tried to understand why they were low on fuel Pilot 1 noticed this flight configuration and enriched the mixture (about 10%) and gained (about 30%) ground speed. According to the pilots, they do not know how long they had been operating the airplane under slower than normal flight, but believe that the increased wind, darkness and fatigue affected their ability to detect the situation.

The IAAIB performed calculations shown in Appendix B to estimate the reserve fuel the airplane should have had based on the 18:00 UTC forecast used, as well as the reserve fuel the airplane should have had based on the 00:00 UTC forecast.

The IAAIB concludes that the requirements of ICAO Annex 6 part 2.2.3.6, regarding 45 minutes reserve fuel at normal cruising altitude, while also taking into account an alternate aerodrome (BIRK) during flight planning, was met while using the 18:00 UTC forecast for 27th of September 2010, as it yielded 1 hour and 2 minutes fuel reserve. On the other hand using the 00:00 UTC forecast for 28th of September 2010 it was not met.

Aircraft

After the incident an inspection was performed on the airplane. No malfunction was found in the airplane that could have led to this serious incident.

Human factor

Detailed analysis of the 18:00 UTC wind forecast would have revealed that the winds during the flight were not as favourable as the pilots had judged.

Due to time constraints as the airport in Sondrestrom was closing, the pilots did not request the 00:00 UTC wind forecast. According to the pilots they only had 45 minutes to refuel the airplane, make a new flight plan and to take off, or face a 1200 USD overtime fee by the Sondrestrom airport. The pilots therefore divided the work, where one (Pilot 2) gathered the weather information while the other (Pilot 1) prepared the IFR flight plan. Pilot 1 filed the IFR flight plan in the name of Pilot 2. According to Pilot 2, he however believed Pilot 1 to be the commander of the flight.

According to Pilot 2 the reason for continuing with the flight to Iceland was:

- The fear to be stuck in Sondrestrom as they had been in Iqualuit for 2 days, and the will to escape that meteorological system and continue the travel.

- The desire to maintain a fast speed ferry, allowing them to meet the return trip to the United States for one of the pilots, so as to avoid time and cost associated with changing a flight, plus rescheduling professional obligations for both pilots.

The IAAIB believes the hasty departure from Sondrestrom, in addition to the above, as the airport was closing, affected the pilots' judgement and preparation.

The IAAIB also believes that if the pilots had made proper flight planning they would have discovered that it was not safe to continue their flight directly to Iceland in the evening.

Survivability

During the investigation the Icelandic AAIB considered the possibility that the pilot of N96VF could have been offered to land at the Rif Airstrip (BIRF) at Snaefellsnes Peninsula.

The distance between Sondrestrom (BGSF) and Rif (BIRF) is 666 NM. Landing at Rif would have shortened the flight up to 53 NM compared to Keflavik (BIKF) where the airplane landed.

According to the Icelandic AIP the airstrip at Rif is equipped with runway lights that can be turned on by request. According to ISAVIA (ATC) this possibility was not considered and the pilot did not request it, as he was not aware of this airstrip.

Findings

- Haste when preparing the flight
- The pilots used the 18:00 UTC wind forecast and not the later 00:00 UTC wind forecast which would have been more valid for the second half of the flight
- The pilots underestimated the headwind in the second part of the flight
- The pilots changed their destination from Reykjavik (BIRK) to Keflavik (BIKF), three minutes prior to departure from Sondrestrom

- The pilots flew most of the flight at FL 130 instead of the planned FL 150
- The pilots engaged in slower than normal flight, consuming increased fuel per the distance travelled
- The pilots changed their altitude on numerous occasions during the flight, when searching for lesser headwind and to remove any build-up ice on the airplane
- Extra fuel was consumed when the airplane increased its altitude after each decent
- The pilots requested priority due to low fuel when 2 flight hours remained to BIKF
- Two gallons were left in the fuel tanks after landing at BIKF
- Using the 18:00 UTC wind forecast on 27th of September 2010 meets the fuel reserves requirements of ICAO Annex 6 part 2.2.3.6
- Using the 00:00 UTC wind forecast on 28th of September 2010 does not meet the fuel reserves requirements of ICAO Annex 6 part 2.2.3.6

Causes

- Haste when leaving Sondrestrom
- Poor flight planning

3. Safety recommendations

The IAAIB recommends to ISAVIA that:

1. This serious incident should be introduced to Air Traffic Controllers during recurrent training so they will be more aware of airports and airstrips that can be used in emergency situations.

2. The possibility of including information on such airports and airstrips to the appropriate checklists and emergency plans be considered.

3. The option of installing equipment at Rif Airstrip to enable pilots to turn the runway lights on by radio transmission be considered.

The IAAIB recommends to ICAA that:

1. A dialog be opened with the Danish CAA (on behalf of Greenland) and the Canadian CAA, to discuss ferry flights across the North Atlantic Ocean to increase information for ferry flight pilots.

The IAAIB recommends to pilots that:

1. They ensure during flight planning that the requirements of ICAO Annex 6 part 2.2.3.6 are met.

Reykjavik, April 19th, 2013

Aircraft Accident Investigation Board of Iceland

Appendix A – Headwind estimated at FL150

Figure 2 shows the North Atlantic wind forecast at FL100 at 18:00 UTC on the 27th of September 2010.

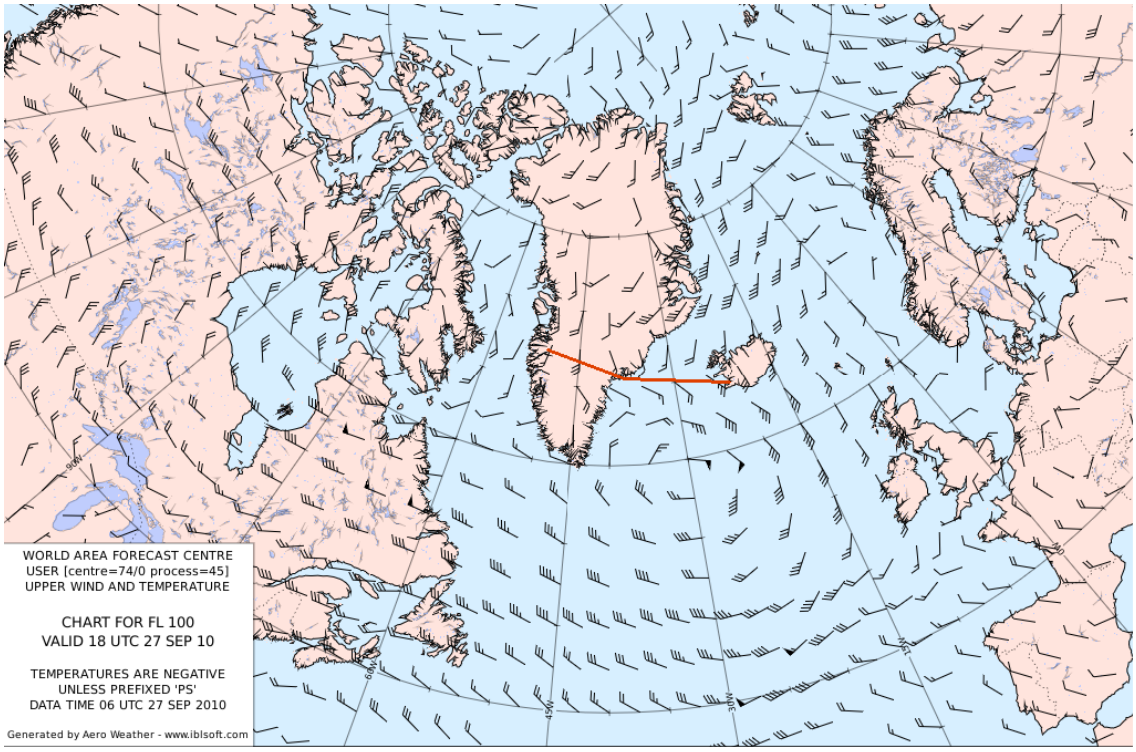


Figure 2: North Atlantic wind forecast at FL100 for 18:00 UTC on September 27th 2010

The maximum headwind from Figure 2 is estimated as follows:

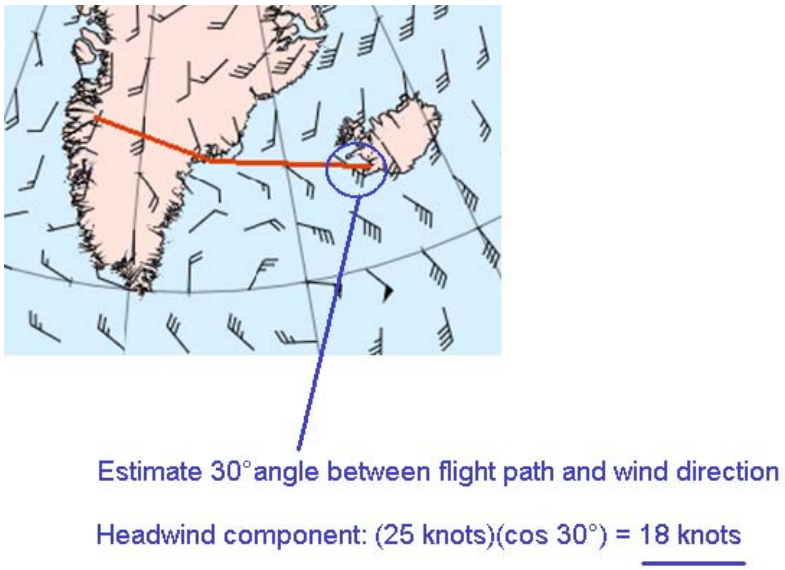


Figure 3 shows North Atlantic wind forecast at FL180 at 18:00 UTC on the 27th of September 2010.

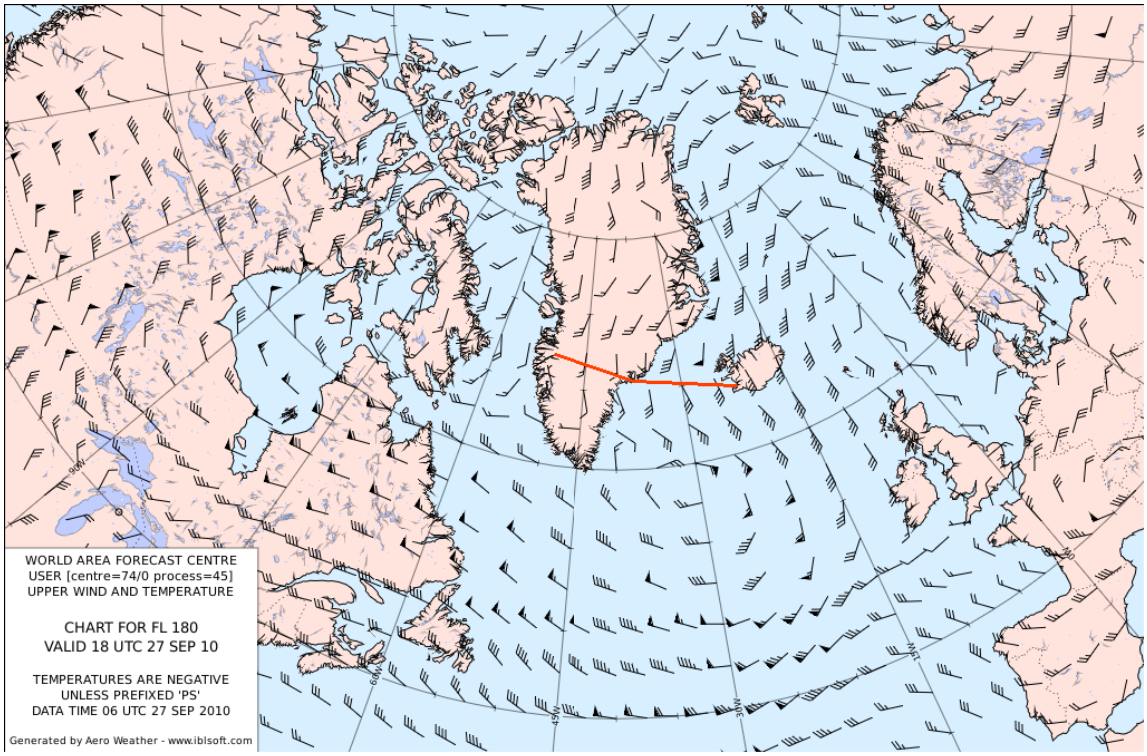


Figure 3: North Atlantic wind forecast at FL180 for 18:00 UTC on September 27th 2010

The maximum headwind from Figure 2 is estimated as follows:

Estimate 50° angle between flight path and wind direction

Headwind component: (40 knots)(cos 50°) = 26 knots

The flight plan was for FL150, so the estimated headwind at FL150 at 18:00 UTC, is:

$$18\ knots + \left(\frac{5}{8}\right)(26\ knots - 18\ knots) = \textbf{23 knots}$$

After the headwind rose to 50 knots, the maximum headwind at the planned FL150 per the 18:00 UTC forecast was therefore underestimated by:

50 knots – 23 knots = **27 knots**

Figure 4 shows the North Atlantic wind forecast at FL100 at 00:00 UTC on the 28th of September 2010.

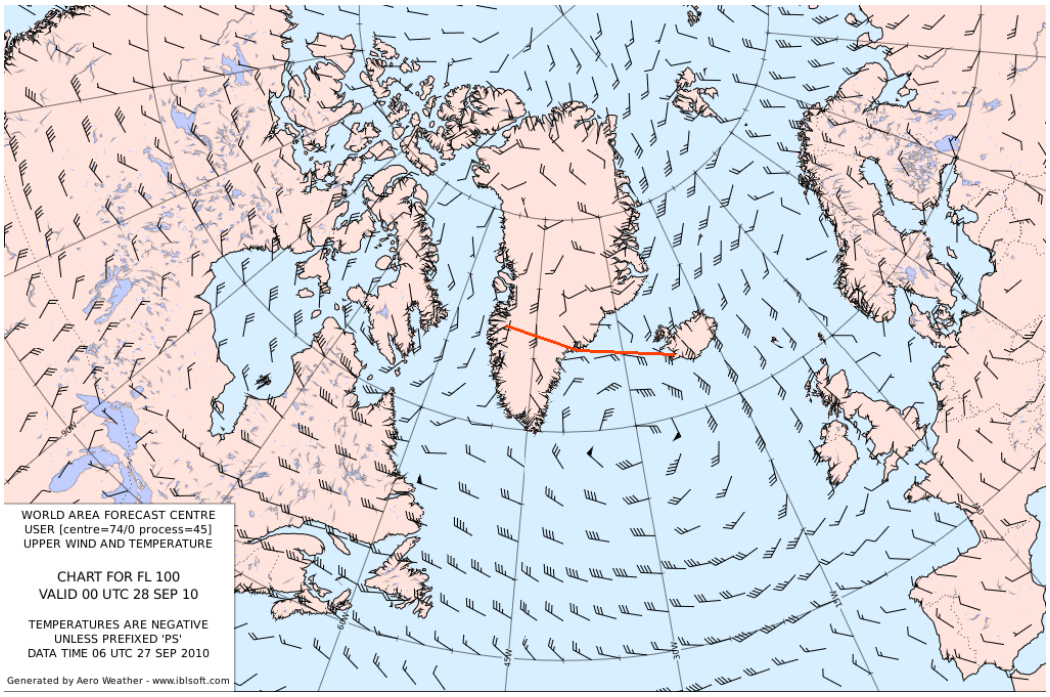


Figure 4: North Atlantic wind forecast at FL100 for 00:00 UTC on September 28th 2010

The maximum headwind from Figure 4 is estimated as follows:

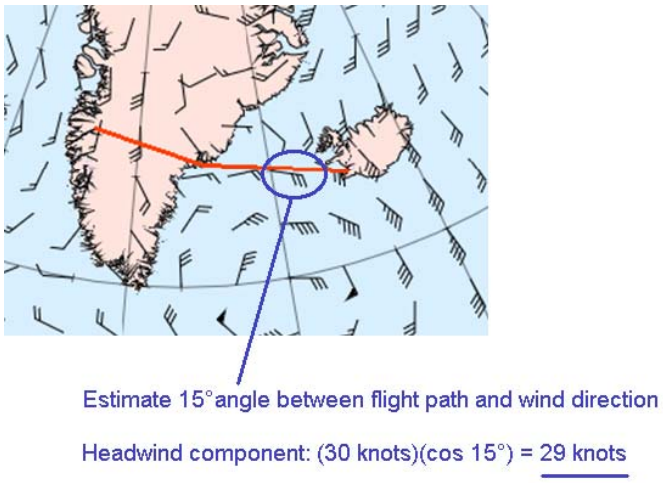


Figure 5 shows the North Atlantic wind forecast at FL180 at 00:00 UTC on the 28th of September 2010.

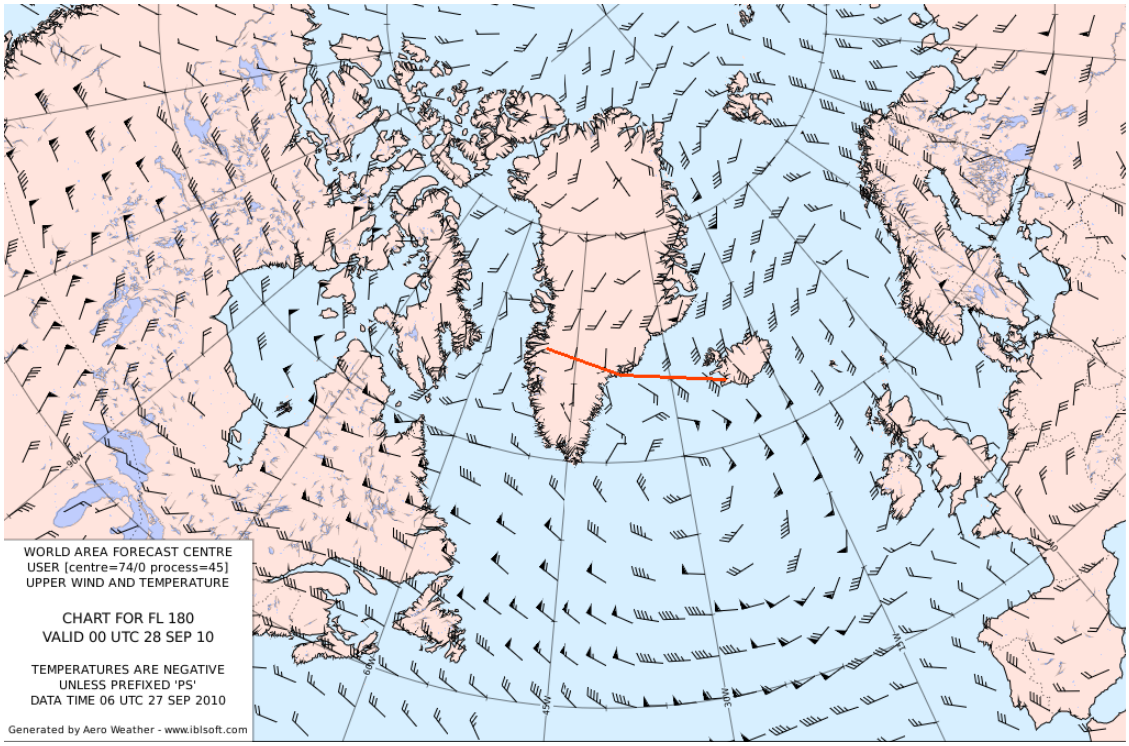
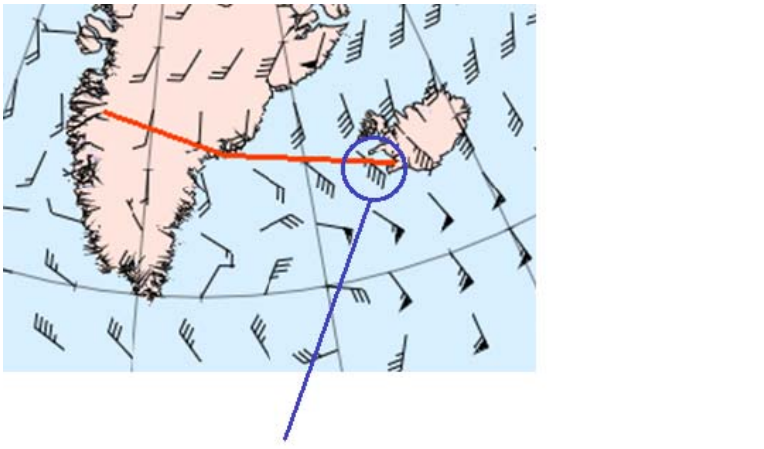


Figure 5: North Atlantic wind forecast at FL180 for 00:00 UTC on September 28th 2010

The maximum headwind from Figure 5 is estimated as follows:



The flight plan was for FL150, so the estimated headwind at FL150, is:

$29\ knots + \left(\frac{5}{8}\right)(37\ knots - 29\ knots)$ = **34 knots**

After the headwind rose to 50 knots, the maximum headwind at the planned FL150 per the 00:00 UTC forecast was therefore underestimated by:

50 knots – 34 knots = **16 knots**

Appendix B – Fuel reserves estimated

Backtracking calculations reveal that after the headwind rose to 50 knots halfway into the flight (after about 3 hours of flying) a 27 knots[7] underestimated headwind would reduce the range by about 103 NM[8]. The distance between BGSF and BIKF, where the airplane landed, is about 719 NM. The average groundspeed for the second half of the flight was therefore about 95 knots[9]. The 103 NM reduced range due to the underestimated headwind gives about 1 hour and 5 minutes'[10] overestimated reserves.

The usable fuel in the fuel tanks is 37 USG in each tank, or 74 USG total. At landing 72 USG had already been consumed during the 6.8 hour flight. The average fuel consumption was therefore 10.6 USG/hr[11] during the flight. The two USG left in the fuel tanks would have given maximum extra 11 minutes[12] of flight.

The fuel reserve, while taking into account the 18:00 UTC [on 27th of September] wind forecasts and a final landing at BIKF would therefore have yielded 1 hour and 16 minutes[13] fuel reserve.

The requirements of ICAO Annex 6 part 2.2.3.6 are 45 minutes reserve fuel at normal cruising altitude, while also taking into account an alternate aerodrome. The above calculations are based on BIKF. The closest alternate aerodrome to BIKF is BIRK. The distance between BIKF and BIRK is about 22 NM. At an average groundspeed of 95

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[7] 50 knots – 23 knots = 27 knots

[8] $(6\ hours\ and\ 48\ minutes - 3\ hours)(27\ knots)$ = (3.8 hr)(27 knots) = 103 NM

[9] $\frac{719\ NM/_2}{3.8\ hours}$ = 95 knots

[10] $\frac{103\ NM}{95\ knots}$ = 1.08 hr = 1 hour and 5 minutes

[11] $\frac{72\ USG}{6.8\ hours}$ = 10.6 USG/hr

[12] $\frac{2\ USG}{10.6\ USG/hr}$ = 0.189 hr = 11 minutes

[13] 1 hour and 5 minutes + 11 minutes = 1 hour and 16 minutes

knots, this would have reduced the fuel reserves by 14 minutes[14], down to 1 hour and 2 minutes[15] total fuel reserve.

It is however also re-emphasized that the 18:00 wind forecast revealed that the winds during the flight were in addition not favourable as the pilots had judged when they left Sondrestrom in haste, due to the low pressure area in the Denmark Strait. So, they would incorrectly have estimated an even greater fuel reserve.

With regards to the 00:00 UTC [on 28th of September] wind forecasts, similar backtracking calculations reveal that after the headwind rose to 50 knots, a 16 knots[16] underestimated headwind would reduce the range by about 61 NM[17].

The 61 NM reduced range due to the underestimated headwind gives about 38 minute[18] overestimated reserves. As before, the extra two gallons in the fuel tanks would give maximum extra 11 minutes of flight. Also as before, diversion to BIRK as an alternate aerodrome would reduce the range by 14 minutes.

The total fuel reserve, while taking into account the 00:00 UTC [on 28th of September] wind forecasts and a final landing at BIKF would therefore have yielded 35 minute[19] total fuel reserve.

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[14] $\frac{22\ NM}{95\ knots}$ = 0.23 hr = 14 minutes

[15] 1 hour and 16 minutes – 14 minutes = 1 hour and 2 minutes

[16] 50 knots – 34 knots = 16 knots

[17] $(6\ hours\ and\ 48\ minutes - 3\ hours)(16\ knots)$ = (3.8 hr)(16 knots) = 61 NM

[18] $\frac{61\ NM}{95\ knots}$ = 0.64 hr = 38 minutes

[19] 38 minutes + 11 minutes - 14 minutes = 35 minutes