Havarikommissionen
Accident Investigation Board Denmark

FINAL REPORT

Accident

11-9-2014

involving

DIAMOND DA40

N39SE

Certain report data are generated via the EC common aviation database

FOREWORD

This report reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this report for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

TABLE OF SYNOPSIS

FINAL REPORT

General

File number:	HCLJ510-2014-278
UTC date:	11-9-2014
UTC time:	16:00
Occurrence class:	Accident
Location:	Near Kulusuk (BGKK) in Greenland
GPS position	65° 33'34.02"N 37° 5'17.34"W
Injury level:	Fatal

Aircraft

Aircraft registration:	N39SE
Aircraft make/model:	DIAMOND DA40
Current flight rules:	Visual Flight Rules (VFR)
Operation type:	General Aviation Ferry/positioning
Flight phase:	Approach
Aircraft category:	Fixed wing Airplane
Last departure point:	Iceland BIKF (KEF): Keflavik
Planned destination:	Greenland (Denmark) BGKK (KUS): Kulusuk
Aircraft damage:	Destroyed
Engine make/model:	LYCOMING 360 FAMILY

SYNOPSIS

Notification

All times in this report are UTC.

The Aviation Unit of the Danish Accident Investigation Board (AIB) was notified of the accident by the Area Control Centre at Copenhagen Airport, Kastrup on 11-9-2014 at 20:00 hours (hrs).

The European Aviation Safety Agency (EASA), the Directorate-General for Mobility and Transport (DG MOVE), the National Transportation Safety Board (NTSB), the Austrian Civil Aviation Safety Investigation Authority (FUS), and the Danish Transport Authority (DTA) were notified on 11-9-2014.

Summary

During a VFR approach in instrument meteorological conditions (IMC), the aircraft impacted high mountainous terrain.

The aircraft was most likely exposed to a controlled flight into terrain (CFIT).

The pilot suffered fatal injuries.

The aircraft was destroyed.

The accident occurred in daylight and under IMC.

The safety investigation did not result in recommendations being made.

1 FACTUAL INFORMATION

1.1 History of the flight

As part of a ferry flight from Europe to the United States (US) the accident flight was a VFR ferry flight from Keflavik (BIKF) in Iceland to Kulusuk (BGKK) in Greenland.

The pilot filed a VFR air traffic control (ATC) flight plan via GIMLI, 65N 30W, VAXAN, Kulusuk locator DA (377 KHz) and BGKK. The filed destination alternate aerodrome was Nuuk airport (BGGH).

Before the flight, the pilot received weather forecasts for BGKK and BGGH by the handling agent.

At 12:32 hrs, the aircraft departed BIKF towards the planned destination BGKK. The estimated enroute time was 3 hours and 15 minutes.

After departure, the pilot contacted Keflavik approach on 119.800 MHz and reported 1800 feet climbing to 4500 feet under VFR.

At 14:26 hrs, and relayed by a high level flying aircraft, the pilot reported to Gulunes radio (Iceland) that the aircraft passed 30° W at 4500 feet and estimated to be at VAXAN at 15:22 hrs.

At 15:29 hrs, the pilot reported to Sondrestrom flight information center (FIC) that the aircraft entered the Greenlandic flight information region (FIR).

At 15:50 hrs, the pilot reported to Kulusuk aerodrome flight information service (AFIS) (118.100 MHz) that the aircraft was 15 nautical miles (nm) from BGKK, inbound to the locator DA, and estimated to be on ground at 16:00 hours. Kulusuk AFIS informed the pilot about the present weather conditions:

- Wind 110° magnetic, 25 knots
- Visibility 10 kilometers
- Light rain
- Scattered at 1100 feet
- Overcast at 1800 feet
- Temperature 6° and dew point 3°
- QNH 990 hPa

The pilot read back the QNH of 990 hPa.

Kulusuk AFIS advised the pilot to report base to runway 11, which the pilot read back.

Between 16:00 and 16:10 hrs, Kulusuk AFIS called the aircraft several times without receiving any response.

At 16:13 hrs, Kulusuk AFIS called Sondrestrom rescue coordination centre (RCC) and declared an alert phase (ALERFA).

At 17:00 hrs, a helicopter - requested from a nearby settlement (Tasiilsaq) - started searching for the aircraft. After approximately 15 minutes of search and due to adverse weather conditions (poor visibility), the helicopter had to return to BGKK.

In the following days, an extensive search for the aircraft was organized, but due to low clouds and fog, the search mission was continuously interrupted.

Due to the poor weather and no signals from the aircraft emergency locator transmitter (ELT), the aircraft was not located until 17-9-2014 at 10:31 hrs.

The aircraft wreckage was located on a steep mountain side at an altitude of approximately 2050 feet mean sea level (MSL) and 3 nm southeast of BGKK.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	1		
Serious			
Minor / None			

1.3 Damage to aircraft

The aircraft was destroyed

1.4 Other damage

There was no other damage

1.5 Personnel information

1.5.1 General

On the accident site, the pilot's US commercial pilot license (CPL) was recovered.

During previous ferry flights, the pilot had achieved experience with flying to BGKK.

1.5.2 License and medical certificate

The pilot, male, 34 years, was the holder of an US airline transport pilot license (ATPL) and a US CPL containing the ratings "airplane single and multiengine land". The CPL rating "multiengine land" was limited to VFR only.

According to the US Federal Aviation Administration (FAA), the pilot's instrument rating was valid at the time of the accident.

The valid medical certificate was a second-class certificate.

1.5.3 Flying experience

The pilot had accumulated a total of approximately 7700 flight hours, which included 600 flight hours under instrument flight rules (IFR).

1.6 Aircraft information

1.6.1 General

The DIAMOND 40 was a 4 seat low wing cantilever monoplane made of composite materials. It had a fixed tricycle landing gear and a T-tail.

Manufacturer:	Diamond Aircraft Industries GmbH
Type:	DA 40
Year of manufacture:	2003
Serial number:	40299
Aircraft approval:	IFR flight operations
Airworthiness certificate:	Valid until 30-11-2015
Maximum take-off mass:	1150 kilos (kg)
Engine:	Textron Lycoming IO-360 M1A, S/N. L-30951-51A
Propeller:	MTV-12-B/180-17 three- blade constant speed
Wing fuel tanks:	Total 40 U. S. Gallon (USG) usable (aluminium tanks)
Fuel transfer system (ferry kit):	None
Anti-icing / De-icing systems:	None
Avionic:	Onboard global positioning system (GPS) navigation system (GNS) GNS 530 COM/NAV/ILS/moving-map GPS (no terrain information) GNS 430 COM/NAV/ILS/moving-map GPS (no terrain information)
Autopilot:	Dual axis with altitude preselect
ELT:	ACK E-01 ELT 121, 5 MHz and 243 MHz

1.6.2 Maintenance records

Latest annual engine inspection:	20-9-2013 at time since new (TSN) 671.1 hrs
Next annual engine inspection:	30-9-2014 at TSN 771.1 hrs
Latest annual airframe inspection:	20-9-2013 at TSN 671.1 hrs
Next annual airframe inspection:	30-9-2014 at TSN 771.1 hrs

1.6.3 Mass and balance

At impact, the aircraft broke up followed by a post-crash fire. The AIB believes that not all onboard baggage was salvaged.

For that reason, the AIB has not been able to reconstruct the actual mass and balance of the aircraft at the time of the accident.

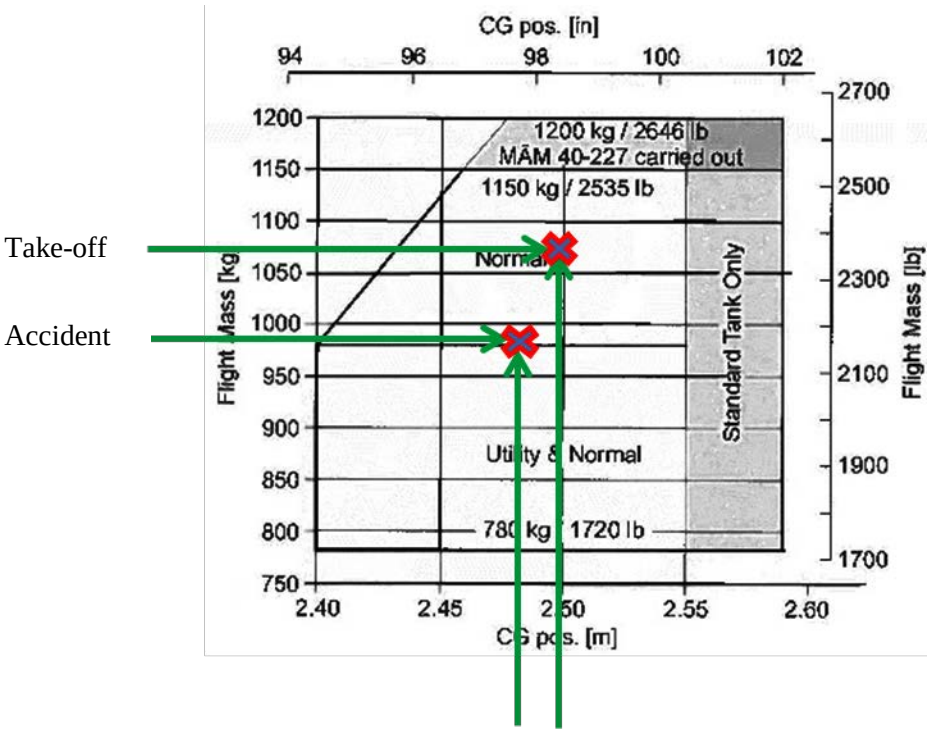
Theoretical reconstruction of the aircraft mass and balance

Subject	Mass (kg)	Arm (meter (m))	Moment (kg/m)
Empty mass	735.0 kg	2.39	1756.65
Front seats (pilot & two fuel cans)	116.0 kg	2.30	266.80
Rear seats (six fuel cans)	94.0 kg	3.25	305.50
Standard baggage compartment	15.0 kg	3.65	54.75
Zero fuel mass	960.0 kg	*2.48*	2383.7
Take-off fuel	109.0 kg	2.63	286.67
Actual take-off mass	1069.0 kg	2.50	2670.37
Estimated mass at impact	988.0 kg	*2.49*	2457.34

The forward flight center of gravity (CG) limit was 2.400 (m), and the aft flight CG limit was 2.558 (m).

For readability, the mass and balance figures in italic in the reconstruction are rounded off numbers.

1.6.4 Mass and balance chart



1.6.5 Picture of N39SE

1.6.6 Fuel uplift

The total amount of fuel (AVGAS 100LL) uplifted at BIKF before departure was 67.5 USG. The wing fuel tanks were filled up, and the rest of the fuel was divided into eight red plastic cans (20 litres each), which were placed in the cabin.

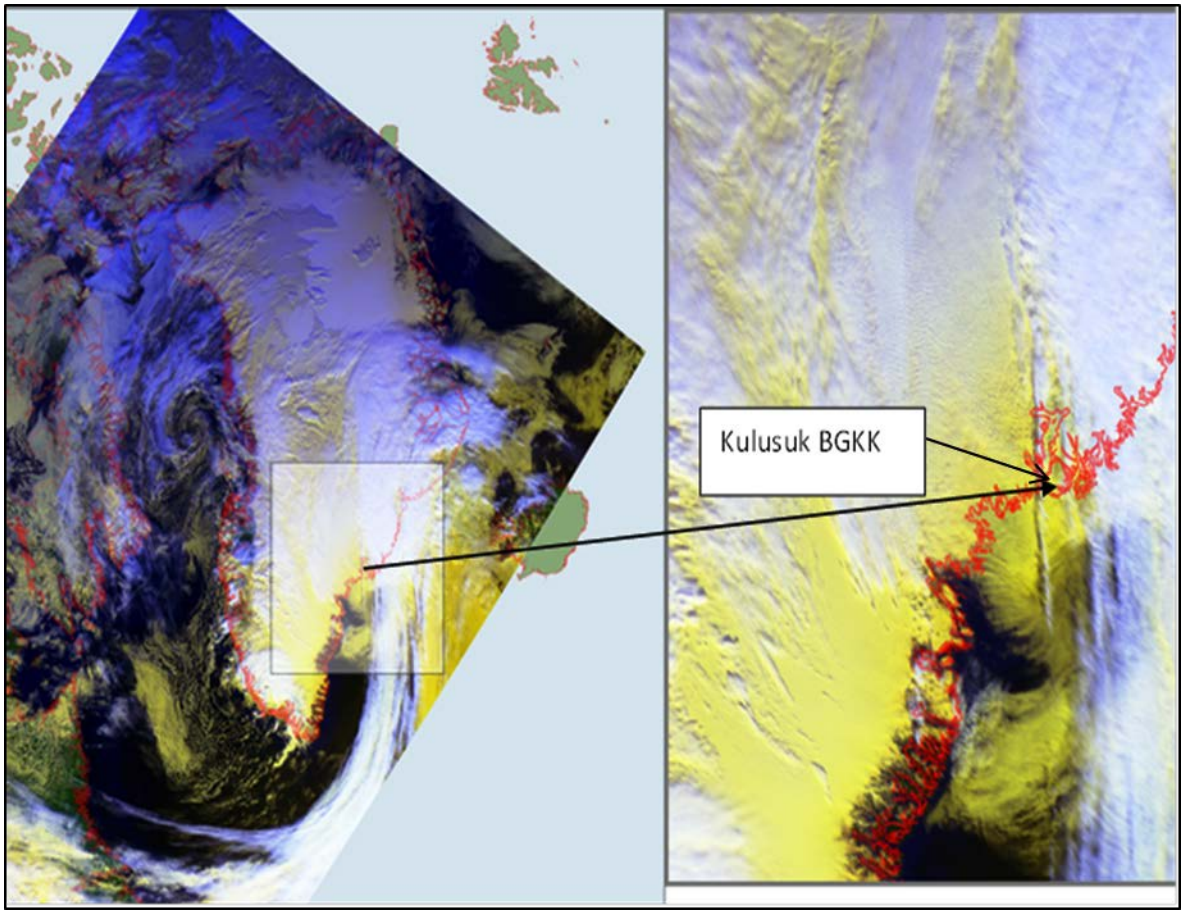
Two cans were placed in the right hand front passenger seat, and six cans were placed in the aft passenger seats.

The total capacity of the eight plastic cans was 160 litres.

The fuel contained in the plastic cans was unusable during flight.

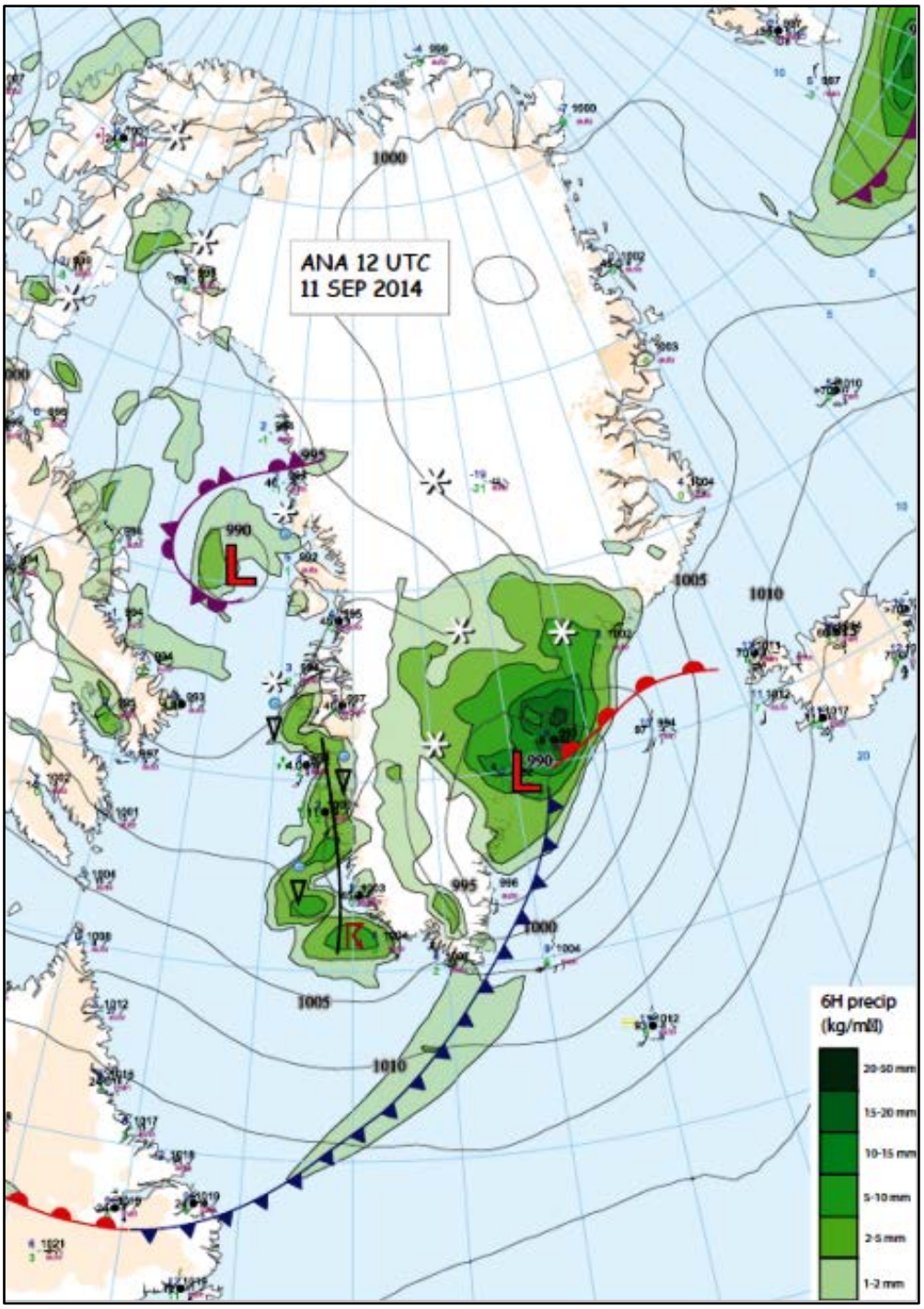
1.7 Meteorological information

1.7.1 Satellite image

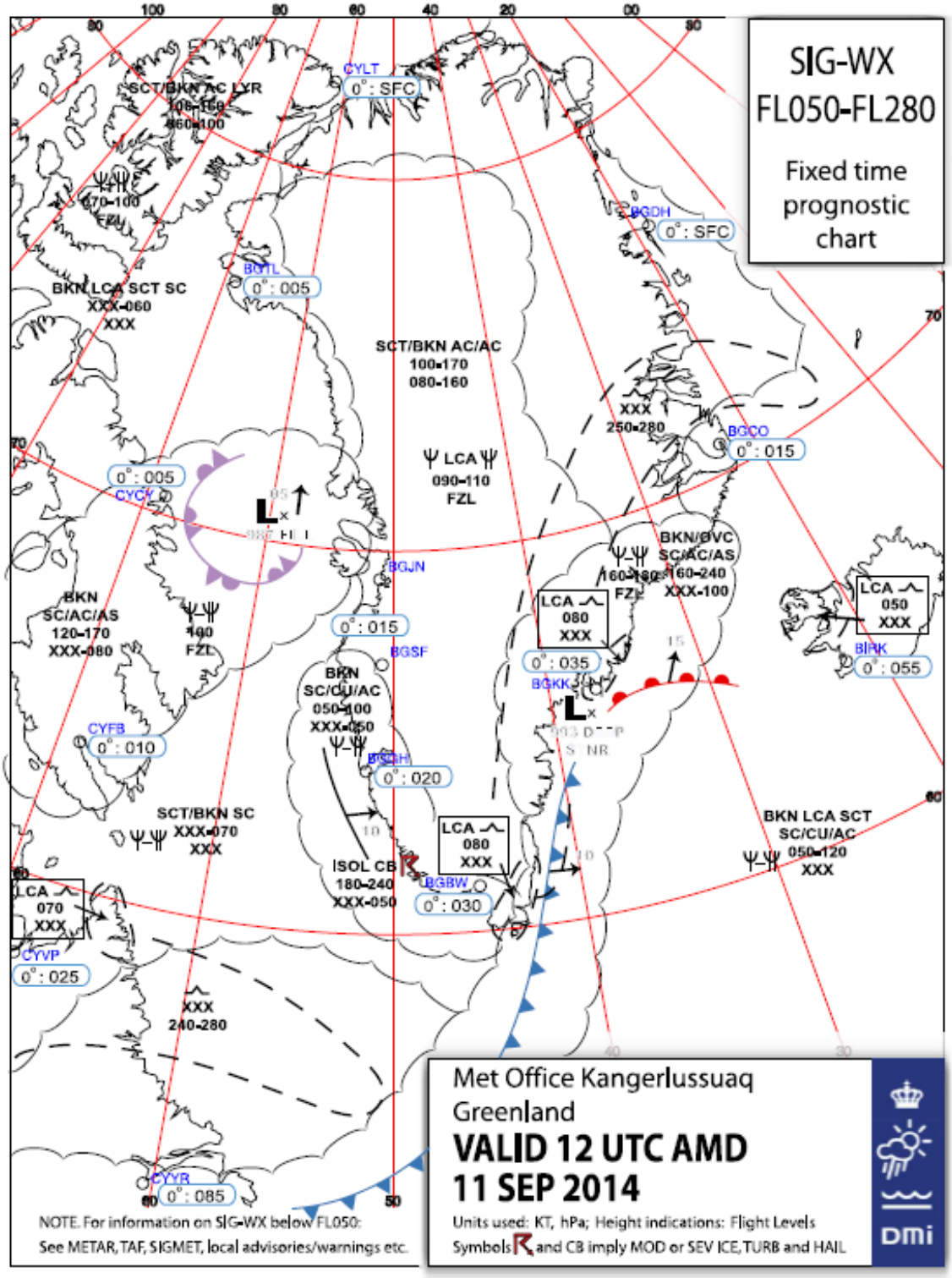


1.7.2 Analysis - central forecasting office

Kangerlussuaq (BGSF) valid on 11-9-2014



1.7.3 Significant weather chart



Due to a thunderstorm warning in the south-western part of Greenland, the above chart was issued as an amendment. The warning was not applicable for BGKK.

1.7.4 Weather information

The pilot was a registered user of an internet-based weather service.

The day before the accident flight and in order to download wind and temperature charts, the pilot logged in 6 times to the internet-based weather service.

According to the Icelandic meteorological offices, no telephone calls regarding aviation weather conditions between Iceland and Greenland had been received in the time period from 10-9-2014 until 11-9-2014.

Before the flight, the pilot had not been in contact with the Danish Meteorological Institute (DMI).

1.7.5 Analysis and aftercast

Due to lack of weather observations of the enroute weather conditions, the aftercast was mostly reconstructed by the use of satellites, radiosonde information from BIKF and Ammasalik, and common knowledge of the typical enroute weather conditions.

A deep low pressure system was moving from the southwest to the northeast through Denmark Strait and moving very close to the Greenlandic east coast. At the time of the accident, the low pressure system was still located south of Kulusuk.

In the area above Denmark Strait between Iceland and Greenland, a current of a warm air mass moved towards the south.

1.7.6 Enroute aftercast

Precipitation:	Local light rain/drizzle
Visibility:	5-10 kilometer or more
Clouds:	Overcast (ovc) stratocumulus (sc), base 2000-3500 feet, top 5000-7000 feet. Local base of sc in 1200-2000 feet
Icing:	Light/moderate in clouds above freezing level. Risk of severe icing conditions during prolonged flights in clouds
Wind at surface:	South east to southwest 15-25 knots
Wind/temp at 5000 feet:	210/35-45 knots / plus 1° Celsius (C) - plus 8° C
Wind/temp at 10000 feet:	210/50 knots / 0° C – minus 4° C

1.7.7 Aftercast BGKK area

Precipitation:	Rain/drizzle. Above 1500 feet msl risk of sleet and above 2500 feet risk of snow
Visibility:	6 - 10 kilometers. In snow precipitation 1000 - 3000 meters.
Clouds:	Scattered (sct) broken (bkn) 1000-1200 feet. Bkn/ovc 1800-2000 feet. In general, solid ovc 2000-20000 feet.
Freezing level:	2500-3000 feet.
Icing:	Light to moderate icing in clouds. There was risk of severe icing during prolonged flights in clouds above 2500 feet.
Turbulent:	Moderate, possible risk of severe turbulence beneath mountains below approximately 6000 feet. Risk of heavy up draught or down draught conditions near mountain-sides at low level flying.
Surface wind:	080°- 90°, 22-25 knots, gusting to 30-35 knots.
Wind at 2000 feet:	040°- 080°, 30-40 knots.
Windshear conditions:	Occasional windshear, but only in areas of turbulent air around the mountains.

1.7.8 Available weather information

Terminal aerodrome forecast (TAF) - BGKK

bgkk 111013z 1110/1119 08022kt 9999 -ra ovc020 tempo 1110/1115 08025g35kt 7000 ra bkn 005 becmg 1115/1118 08012kt tempo 1115/1119 7000 ra bkn008=

bgkk 111200z 1112/1119 08028g40kt 9999 -ra ovc020 tempo 1112/1116 08025kt 7000 ra bkn008 becmg 1116/1118 08012kt tempo 1116/1119 7000 ra bkn 010

bgkk 111200z 1112/1121 08028g38kt 9999 -ra ovc020 tempo 1112/1116 08025kt 7000 ra bkn 008 becmg 1116/1118 08012kt tempo 1116/1121 7000 ra bkn010

bgkk 111500z 1115/1124 10015kt 9999 -ra ovc020 tempo 1115/1118 08025g35kt 7000 ra bkn008 tempo 1118/1122 7000 ra bkn010 becmg 1122/1124 30025g40kt nsw bkn090

Meteorological terminal aviation routine weather report (METAR) - BGKK

bgkk 110950z auto 07024g36kt 9999ndv -ra bkn014/// 05/02 q0996=

bgkk SPECI 111001z 08024g34kt 9999 ra ovc017 05/02 q0995 rmk 8sc=

bgkk 111050z 08025g36kt 7000 ra ovc017 04/02q0994 rmk 8sc=

bgkk 111150z 09029g40 9999 -ra ovc017 04/01 q0993 rmk 8sc=

bgkk 111250z 09025kt 9999 -ra ovc019 04/02 q0992 rmk 8sc=

bgkk 111350z 10021kt 9999 -ra ovc019 05/02 q0991 rmk 8sc=

bgkk 111450z 09022g32kt 9999 -ra ovc019 05/04 q0990 rmk 8sc

bgkk 111550z 08024kt 9999 -ra sct011 ovc018 05/03 q0990 rmk 8sc=

bgkk 111650z 08020kt 9999 -ra sct011 ovc019 05/04 q0989=

bgkk 111750z 09021kt 9999 -ra sct005 ovc017 05/04 q988 rmk 3st 8sc

1.8 Aids to navigation

1.8.1 Kulusuk locator

DA RWY 11 377 KHZ H24 64 34 12.5N 037 12 25.5W Coverage 40 nm

At the time of the accident, the locator was serviceable.

1.9 Communication

Recordings of the radiotelephone communications were obtained.

The recordings were of good quality and useful to the investigation.

According to the AFIS operator, the pilot's radio communication was calm and relaxed and gave no impression of problems with neither the aircraft nor the flight operation.

1.10 Aerodrome information

1.10.1 Kulusuk Airport: BGKK

Position (Airport):	65 34 25N 037 07 25W
Elevation:	117 feet
Magnetic variation:	25°W (January 2009)
Designation:	Kulusuk traffic information zone (TIZ)
Airspace classification:	G
Air traffic service (ATS):	Kulusuk AFIS
Runway:	11 and 29
Dimensions - surface:	1199 x 30 meters - gravel

No radar coverage was established in the area

1.10.2 Visual approach chart

See appendix 5.1.

1.10.3 Instrument approach chart

See appendix 5.2.

1.11 Flight recorders

Flight recorders were neither installed nor required.

1.12 Wreckage and impact information

1.12.1 General

The aircraft impacted near the top of a high mountainous terrain at an altitude of approximately 2050 feet msl and approximately 3 nm southeast of BGKK.

The GPS position was 65° 33'34.02"N 37° 5'17.34"W.

Wreckage and aircraft debris covered an area of approximately 240 meter from east to west.

The damage to the wreckage indicated that the aircraft impacted with almost wings level and with a high airspeed.

The wreckage trail - see appendix 5.3.

1.12.2 Post-crash fire

Most of the aircraft composite material was consumed by a post-crash fire.

1.12.3 Tail section

The aft part of the tail and the tail fin was partly intact and located approximately 25 meters west of the impact area. The tail fin was partly damaged by the post-crash fire.

1.12.4 Control levers

The control pedestal was damaged.

The throttle lever was observed to be forward of mid position, the mixture lever in rich and the propeller lever in fine pitch position.

The fuel tank selector was in the left hand tank position.

1.12.5 Fuel tanks and fuel plastic cans

Both wing fuel tanks punctured at impact and were partly colored by heat of the post-crash fire.

The onboard fuel cans punctured at impact and together with the remaining fuel of the wing tanks, the fuel ignited at the accident site.

A few small parts of the fuel plastic cans were identified at the accident site.

1.12.6 Fire wall / instrument panel

Approximately 200 meters west of the impact area, some parts of the engine fire wall and the instrument panel were located.

All flight instruments were heavily damaged.

It was not possible to extract any readings from the flight instruments.

1.12.7 GPS

The aircraft was equipped with a Garmin GNS 430 and a Garmin GNS 530, and both were recovered from the accident site.

Due to excess impact damage, it has not been possible to extract any information from the GNS units.

1.12.8 Engine start switch

The engine start switch was observed to be in position “both”, and part of the start key was in the engine start switch.

1.12.9 Engine

The engine was located approximately 230 meters west of the impact area.

The propeller and half part of the propeller hub were missing. The other half part of the propeller hub was still in place at the propeller shaft. Around the broken part of the propeller hub there was a clear sign of torsion failure.

A bundle of cobber wires from the damaged alternator twisted around the front of the engine, indicating that the damaged alternator rotated at impact.

The engine contained a little amount of engine oil. The oil was clean and the colour was light brown.

No other damages than impact damages were revealed.

1.12.10 Artificial horizon

The artificial horizon was located approximately 240 meters west of the impact area

The artificial horizon was damaged and unreadable.

1.12.11 Flight planning documentation

The AIB did not find or salvage any aeronautical charts or flight planning information on the accident site.

1.13 Medical and pathological information

Due to the impact forces and the post-crash fire, it was not possible to perform an autopsy of the pilot.

1.14 Fire

The aircraft was partially consumed by a heavy post-crash fire.

The onboard plastic cans containing 160 litres of fuel intensified the post-crash fire.

1.15 Survival aspects

Due to the impact forces and the post-crash fire, the accident was not survivable.

1.16 Tests and research

None

1.17 Additional information

1.17.1 ATC flight plan

The filed ATC flight plan was a VFR flight plan.

The ATC filed cruising altitude was 4500 feet. When the aircraft passed 30° west, the pilot reported the cruising altitude to be 4500 feet.

After passage of 30° west and until the time of the accident, the pilot did not report any further altitude information.

1.17.2 Destination alternate aerodrome

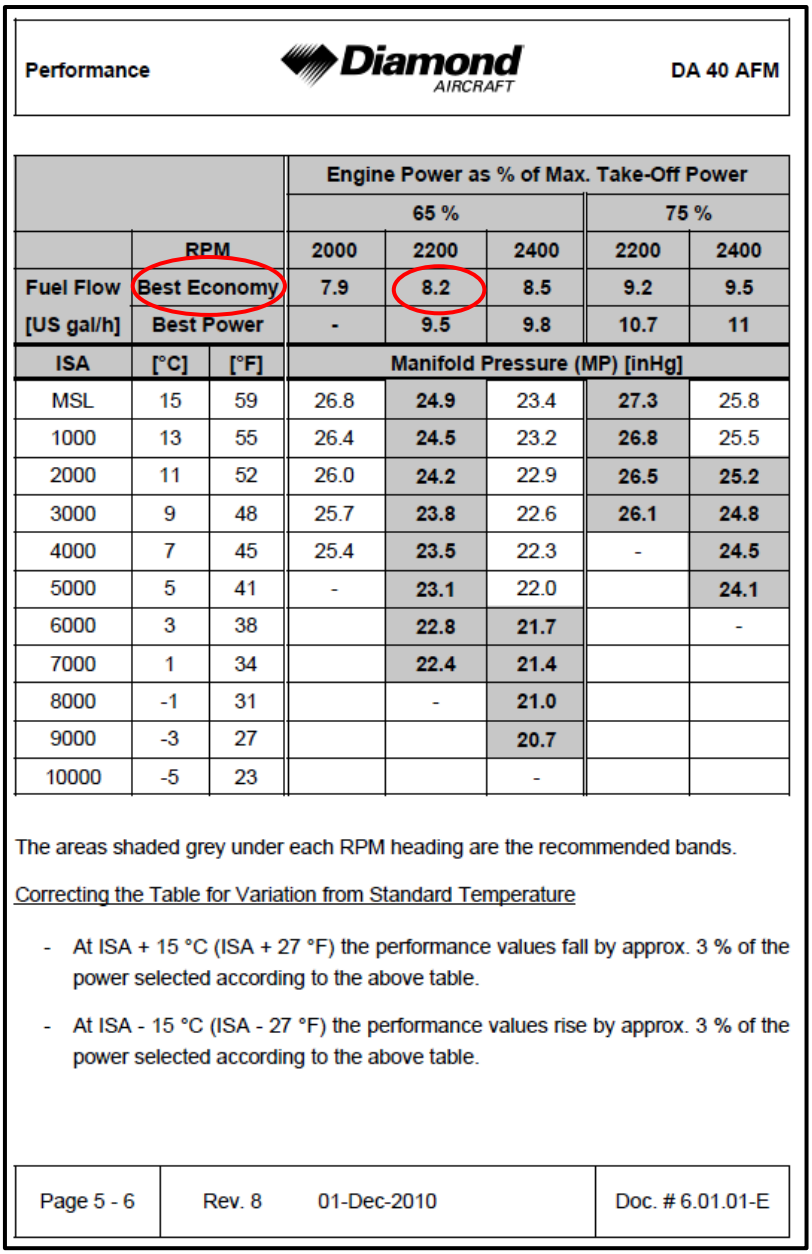
The filed destination alternate aerodrome was BGGH.

A destination alternate aerodrome was not required for VFR pre-flight planning.

<u>Performance data:</u>

- Total endurance (best economy / 65 % engine power): Approximately 4:55 hours
- Total flight distance from BGKK to BGGH: Approximately 381 nm

- Total flight time from BGKK to BGGH (no wind): Approximately 2:58 hours



Performance — Diamond AIRCRAFT — DA 40 AFM

			Engine Power as % of Max. Take-Off Power				
			65 %			75 %	
	RPM		2000	2200	2400	2200	2400
Fuel Flow	Best Economy		7.9	8.2	8.5	9.2	9.5
[US gal/h]	Best Power		-	9.5	9.8	10.7	11
ISA	[°C]	[°F]	Manifold Pressure (MP) [inHg]				
MSL	15	59	26.8	**24.9**	23.4	**27.3**	25.8
1000	13	55	26.4	**24.5**	23.2	**26.8**	25.5
2000	11	52	26.0	**24.2**	22.9	**26.5**	**25.2**
3000	9	48	25.7	**23.8**	22.6	**26.1**	**24.8**
4000	7	45	25.4	**23.5**	22.3	-	**24.5**
5000	5	41	-	**23.1**	22.0		**24.1**
6000	3	38		**22.8**	**21.7**		-
7000	1	34		**22.4**	**21.4**		
8000	-1	31		-	**21.0**		
9000	-3	27			**20.7**		
10000	-5	23			-		

The areas shaded grey under each RPM heading are the recommended bands.

Correcting the Table for Variation from Standard Temperature

- At ISA + 15 °C (ISA + 27 °F) the performance values fall by approx. 3 % of the power selected according to the above table.
- At ISA - 15 °C (ISA - 27 °F) the performance values rise by approx. 3 % of the power selected according to the above table.

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1.18 Useful or effective investigation techniques

None

2 ANALYSIS

2.1 General

Due to the break up, when the aircraft impacted the mountain, and the post-crash fire, operational and technical documentation and flight instrument information were lost, which to some point hampered the AIB investigation.

However, in the opinion of the AIB the license and the qualifications held by the pilot and the technical status of the aircraft including mass and balance had no influence on the sequence of events.

Because it was not possible to perform an autopsy of the pilot, the AIB cannot rule out a scenario of inflight pilot incapacitation. But the AIB finds that the sequence of events narrows the probability of pilot incapacitation.

2.2 Weather conditions

Taking into consideration the available weather information at the estimated time of arrival at BGKK, the weather conditions appeared to be IMC down to 1800 feet, which - if flying above - required instrument flying.

2.3 The approach

The last two waypoints in the filed ATC VFR flight plan were the waypoint VAXAN and the locator DA. The AIB finds it probable that similar waypoints were loaded into the two onboard GNS units.

At first radio contact with Kulusuk AFIS, the pilot reported to be 15 nm from BGKK and inbound to the locator DA.

The flight track from the waypoint VAXAN towards the locator DA passed overhead the accident site.

In the opinion of the AIB, the VFR approach was most likely supported by use of the two onboard GNS units as primary navigation aids.

In general, the GNS 530 and the GNS 430 were capable of presenting exact aircraft positions. However, the GNS 530 and the GNS 430 did neither contain nor presented terrain information.

For that reason and if not supported by other terrain information, the accuracy of lateral guidance during the VFR approach might mentally have overshadowed the lack of vertical guidance (terrain information).

The AIB believes that flying in IMC during the VFR approach without appropriate vertical guidance (terrain information) most likely led to a CFIT accident.

2.4 Decision making

The aircraft was approved for IFR flight operations, the pilot held a valid instrument rating, and an instrument procedure was available at BGKK.

It has not been possible for the AIB to reveal why the pilot filed a VFR ATC flight plan and not an IFR ATC flight plan, and why the pilot during the approach mentally failed to include the above-mentioned available resources in his mental risk assessment and decision making process.

However, a combination of flying under IMC during the VFR approach and a knowledge of no other alternatives (destination aerodrome alternates were beyond the endurance range of the aircraft) than landing at BGKK might have provoked target fascination.

3 CONCLUSIONS

3.1 Findings

1. The pilot was properly licensed and held a valid instrument rating
2. The aircraft was approved for IFR flight operations
3. The pilot filed a VFR ATC flight plan from BIRK to BGKK with the destination alternate aerodrome BGGH
4. The filed destination alternate aerodrome was not within the endurance range of the aircraft
5. A destination alternate aerodrome was not required for VFR pre-flight planning
6. The technical status of the aircraft including mass and balance had no influence on the sequence of events
7. During previous ferry flights, the pilot had achieved experience with flying to BGKK
8. Before the flight, the pilot received weather forecasts available for BGKK and BGGH
9. The observed weather conditions in the area of BGKK was equivalent to the forecasted weather conditions
10. The pilot’s radio communication was calm and relaxed and gave no impression of problems with neither the aircraft nor the flight operation
11. The pilot did not report any technical issues
12. The flight track from the waypoint VAXAN towards the locator DA passed overhead the accident site
13. The pilot commenced in IMC a VFR approach
14. An instrument procedure was available at BGKK
15. There was no distress call from the pilot
16. At the time of the accident, the engine produced power
17. The aircraft impacted with almost wings level and with a high airspeed

18. It was not possible to perform an autopsy of the pilot

3.2 Factor

1. The pilot commenced in IMC a VFR approach

3.3 Summary

During a VFR approach in IMC, the aircraft impacted high mountainous terrain.

The aircraft was most likely exposed to a controlled flight into terrain (CFIT).

The pilot suffered fatal injuries.

The aircraft was destroyed.

The accident occurred in daylight and under IMC.

4 SAFETY RECOMMENDATIONS

The safety investigation has not resulted in recommendations being made.

5 APPENDICES

5.1 Visual approach chart
5.2 Instrument approach chart
5.3 Wreckage trail

5.1 Visual approach chart

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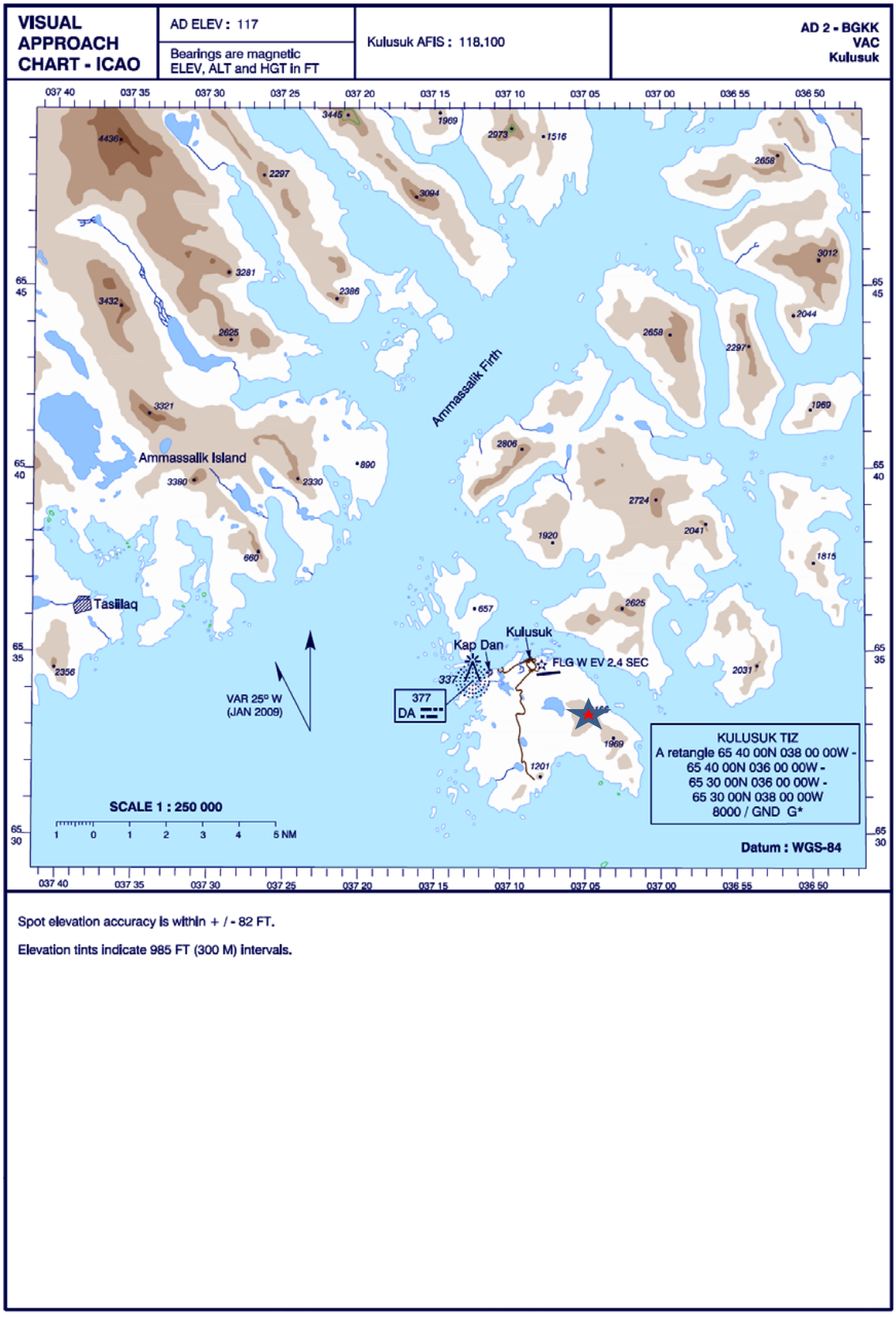
Accident site



5.2 Instrument approach chart

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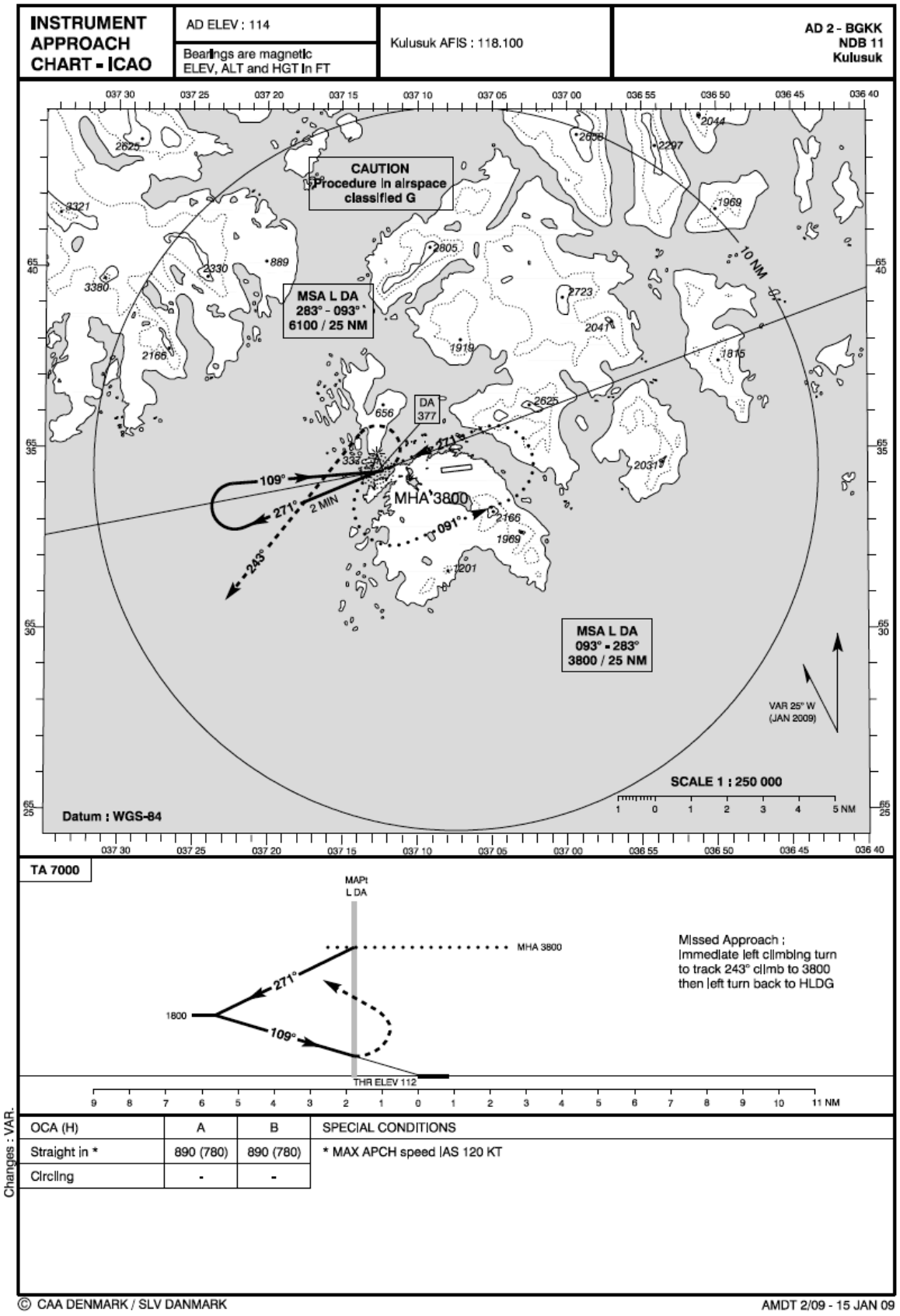

5.3 Wreckage trail

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