THE DANISH
ACCIDENT INVESTIGATION BOARD
The Aviation Unit

FINAL REPORT

HCLJ510-2012-155

Accident to Learjet 24D
Registration D-CMMM
Bornholm/Roenne Airport, (EKRN), Denmark
15 September 2012

= PREFACE=

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

In accordance with the provisions of EU Regulation No 996/2010, 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 contents

FINAL REPORT

HCLJ510-2012-155	**Accident**		
Aircraft:	Learjet 24D	Registration:	D-CMMM
Engines:	2 - GE CJ610-6	Flight:	Private, IFR
Crew:	1 - seriously injured	Passenger:	1 - seriously injured
Place:	Near Bornholm/Roenne Airport (EKRN)	Date and time:	15.9.2012 at 11:39 UTC

All times in this report are UTC.

SYNOPSIS

The Aviation Unit of the Danish Accident Investigation Board (AIB DK) was notified of the accident by the Area Control Centre at Copenhagen Airport, Kastrup (EKCH) on 15.9.2012 at 11:47 hrs.

The International Civil Aviation Organization (ICAO), the Bundesstelle für Flugunfalluntersuchung (BFU), the Transportation Safety Board of Canada (TSB), the National Transportation Safety Board (NTSB), the European Aviation Safety Agency (EASA) and the European Commission (DG Move) were notified on 15.9.2012 at 21:41 hrs. The BFU appointed an accredited representative to the investigation.

Parallel to this safety investigation, a judicial investigation was instituted (rf. regulation (EU) No 996/2010 of the European parliament and of the council).

The accident occurred in daylight and under visual meteorological conditions (VMC).

The pilot and the passenger were seriously injured, and the aircraft was destroyed.

Conclusion

Inadequate en route fuel management resulted in fuel starvation of both engines, while the aircraft was flying at low altitude and the airspeed was decreasing.

The dual engine flame out and the subsequent aircraft speed control led to an unrecoverable stall and consequently caused the accident.

FACTUAL INFORMATION

History of flight

The accident occurred during a private IFR flight from Strausberg Airport (EDAY), Germany, to Bornholm Airport (EKRN), Denmark. Before the flight, an ATS flight plan was filed. See appendix 1.

Before takeoff at EDAY, the aircraft was refueled with 200 liters of jet fuel. According to the ATS flight plan, the pilot stated the total endurance to be 01:30 hrs and the Estimated Elapsed Time (EET) to be 00:30

hrs. The pilot informed the AIB DK that the estimated total endurance before takeoff at EDAY was approximately 01:00 hrs.

The aircraft departed EDAY at 10:58.

Enroute, the pilot observed a low fuel quantity warning light. Otherwise, the flight was uneventful until the approach to EKRN.

At 11:32:00 hrs and at a distance of approximately18 nm southwest of EKRN, the pilot cancelled the IFR flight plan and continued VFR for a visual approach to runway 29. See appendix 2 – marking A.

While descending inbound EKRN, the airspeed was decreasing. See appendix 3 and appendix 4.

At 11:37:08 hrs, the pilot reported to Roenne Tower that the aircraft was turning final for runway 29. The aircraft was cleared to land. The wind conditions were reported to be 280° 19 knots maximum 29 knots. See appendix 5 - marking B.

The aircraft was configured for landing (the landing gear was down and the flaps extended to 40°).

On a left base to runway 29, both engines suffered from fuel starvation.

At 11:39:18 hrs, the pilot three times declared an emergency. See appendix 5 - marking C.

The aircraft entered a stall and impacted terrain in a field of sweet corn. See appendix 5 - marking D.

A search and rescue mission was immediately initiated.

Personal information

On board the aircraft in the pilot's personal belongings, the AIB DK found 2 Airline Transport Pilot Licenses (ATPL) issued by the US Federal Aviation Administration (FAA). The 2 US ATPL licenses had the same FAA license number but the names of the license holders were different. The names of the license holders were inconsistent with the pilot's Iranian identity.

The BFU informed the AIB DK that the pilot was neither in possession of a valid German pilot license nor a German validation of an US license, which was required to operate a German registered aircraft.

The NTSB informed the AIB DK that the pilot was not in possession of a valid US pilot license.

It has not been possible for the AIB DK to determine whether or not the pilot was in possession of valid pilot license issued by another state.

It has not been possible for the AIB DK to obtain information on the pilot's training background and flying experience.

Aircraft information

1. Aircraft documentation and maintenance

The BFU informed the AIB DK that the certificate of aircraft registration was cancelled in 2009. Later on in the investigation, the BFU corrected this information. On February 2nd , 2012 and due to a missing airworthiness certificate, the Luftfahrt-Bundesamt (CAA - Germany) revoked the certificate of aircraft registration.

The latest valid airworthiness certificate was issued on the 8th of March 2004 and expired on the 31st of March 2005.

At the time of the accident, the aircraft was not recorded to be maintained by a JAR 145 maintenance organization, a maintenance program or a Continuing Airworthiness Management Organization (CAMO).

2. Fuel system

The aircraft had five tanks; two wing tanks, two wingtip tanks and one fuselage tank.

The engines were supplied with fuel from the wing tanks only. In order to use the fuel from the fuselage tank, the fuel had to be transferred into the wing tanks.

See appendix 6 (extract from the FAA approved Learjet 24D airplane flight manual).

3. Low fuel quantity warning light (extract from the FAA approved Learjet 24D airplane flight manual)

"The LOW FUEL warning light in the readout panel is actuated by a float switch in either left or right wing tank when the level in that particular tank decreases to approximately 450 pounds of fuel."

4. Minimum flight crew

According to the FAA approved Learjet 24D airplane flight manual, the minimum flight crew should consist of a pilot and a copilot.

5. Mass at the time of the accident

Due to the lack of valid aircraft mass and balance documentation, the AIB DK has calculated an estimated mass of 8370 lbs (3804 kg) at the time of the accident. The calculated mass is based on generic mass data (aircraft and persons on board) and estimated fuel on board at the time of the accident.

Meteorological information

1. Aftercast

Visibility:	20-50km
Clouds:	Scattered clouds about 2000 feet og broken clouds about 5000 feet
Icing:	Light to moderate but only in a thin layer between approximately 5500 to 7000 feet
Turbulence:	Light to moderate mechanical turbulence near the surface
Wind at 2000 feet:	280 ° and 30 knots
Windshear:	No windshear of significance

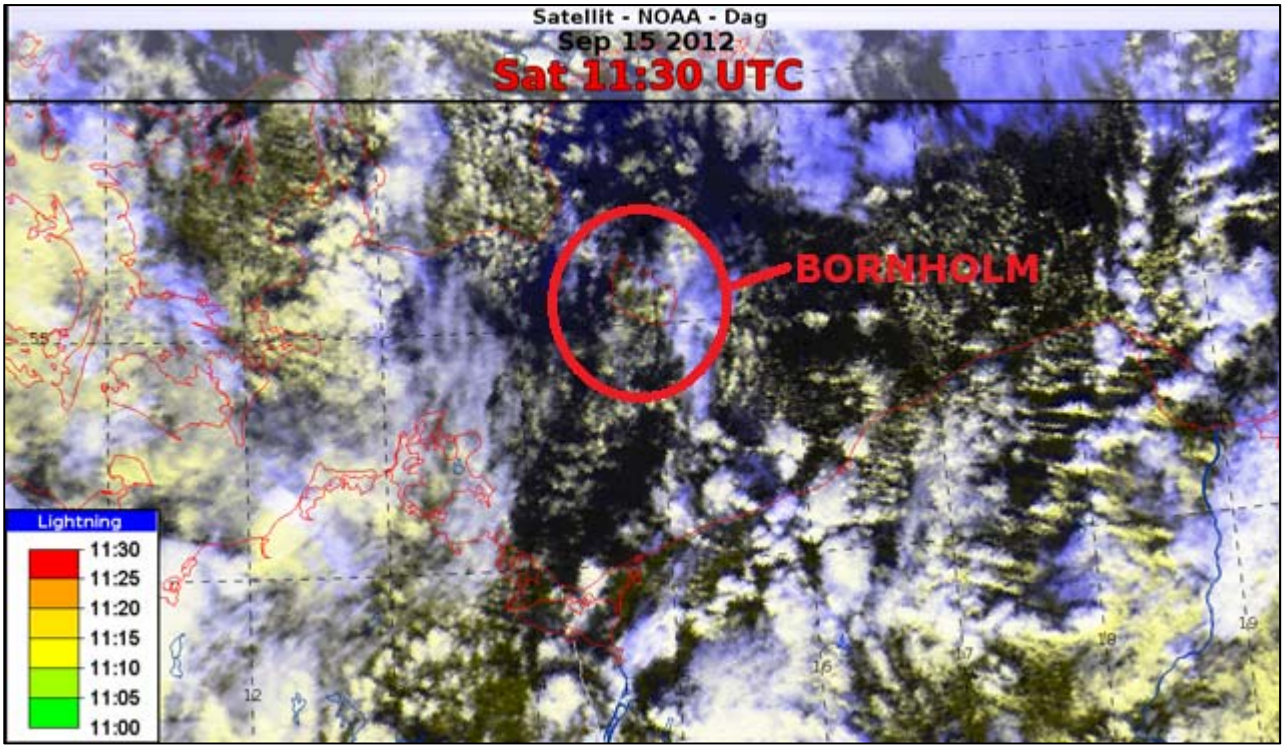
2. METAR

150850 METAR	ekrn 150850z auto 28017kt 9999ndv bkn017/// 15/11 q1007=
150920 METAR	ekrn 150920z auto 28018kt 9999ndv bkn017/// 15/10 q1007=
150950 METAR	ekrn 150950z auto 28017g27kt 9999ndv bkn017/// 15/10 q1007=
151020 METAR	ekrn 151020z auto 28017kt 9999ndv bkn020/// 16/10 q1007=
151050 METAR	ekrn 151050z auto 27017kt 9999ndv bkn022/// bkn024/// 15/10 q1007=
151120 METAR	ekrn 151120z auto 27017g27kt 9999ndv bkn022/// 16/10 q1008=
151150 METAR	ekrn 151150z auto 28018kt 9999ndv sct023/// bkn047/// bkn093/// 16/10 q1008=
151220 METAR	ekrn 151220z auto 28018kt 9999ndv bkn022/// 16/10 q1008=

3. TAF

150500 TAF-FC	ekrn 150540z 1506/1515 28018kt 9999 sct025 tempo 1506/1510 28020g32kt -shra bkn012 bkn020cb tempo 1510/1515 28022g35kt=
150800 TAF-FC	ekrn 150840z 1509/1518 28018kt 9999 sct025 tempo 1509/1510 28020g32kt -shra bkn012 bkn020cb tempo 1510/1517 28022g35kt=
151100 TAF-FC	ekrn 151140z 1512/1518 28018kt 9999 sct025=

4. Satellite photo at 1130 hrs



5. Wind at EKRN

CreationTime	2 Min Avg Dir	2 Min Avg Speed	10 Min Var Low	10 Min Var High	10 Min Gust Min	10 Min Gust Max	X-Wind	T-Wind	MX-Wind
2012-09-15 11:39:54	280	18			10	29	05	H17	13
2012-09-15 11:39:44	280	18			10	29	04	H17	13
2012-09-15 11:39:34	280	17			10	29	04	H17	13
2012-09-15 11:39:24	280	17			10	29	04	H16	13
2012-09-15 11:39:14	280	17			10	29	04	H16	13
2012-09-15 11:39:04	280	17			10	29	04	H16	13

Aerodrome information

1. General (extract from the AIP Denmark)

EKRN ARP PSN: 55 03 47.76N 014 45 34.41E

ELEV: 52 FT

RWY: Runway 11/29 - 2002 X 45 M

2. NOTAM

No NOTAM was issued for EKRN that was of any relevance to the sequence of events.

3. Rescue and fire fighting services (extract from the AIP Denmark)

6. Rescue and Fire Fighting Services			
1. AD category for fire fighting	CAT 5 and boats available for scheduled traffic MON - FRI 0600 - 2145 (0500 - 2045) SAT 0600 - 1500 (0500 - 1400) SUN 0800 - 2145 (0700 - 2045) For other traffic PPR, submitted not later than 1 HR before flight	2. Rescue equipment:	-
		3. Capability for removal of disabled aircraft:	-
4. Remarks: By PN submitted not later than 13 UTC the day before the flight, rescue and fire fighting service CAT 6/CAT 7 may be requested against a special fee.			

Wreckage and impact information

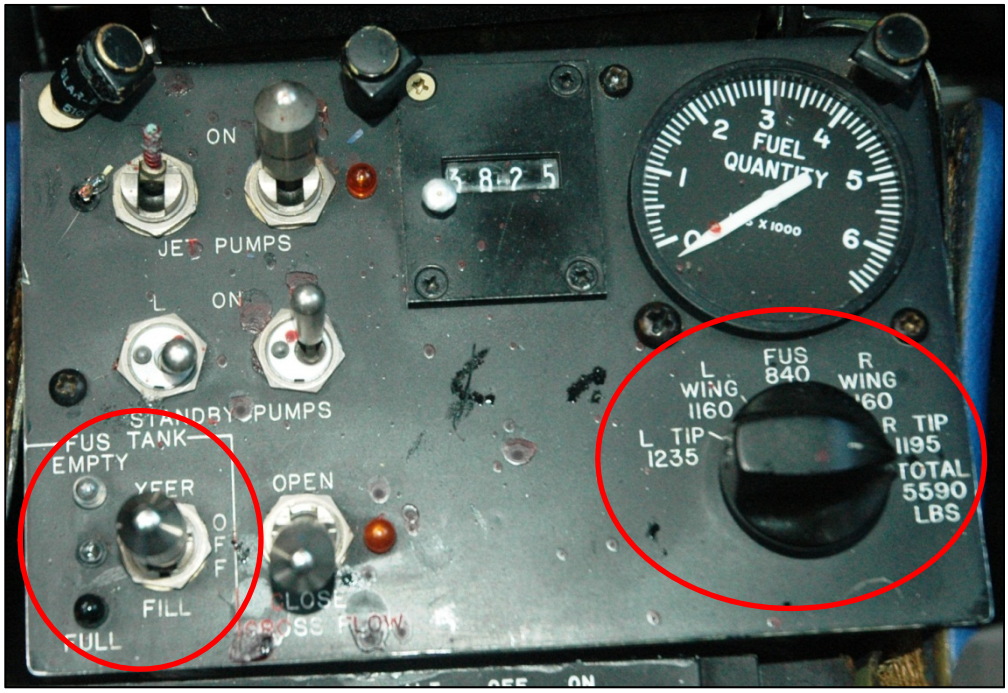
1. Impact

The aircraft impacted terrain (a field of sweet corn) at 55 03 19.21 N 14 47 15.63 E (1040 meters east of the threshold to runway 29) in a wings-level attitude. The height of the sweet corn crop was approximately 3 meters.

The wreckage trail track had a direction of approximately 300 degrees magnetic. The wreckage and the wreckage trail pattern observed were consistent with a low forward airspeed and a steep descent (stall). The wreckage trail was approximately 19 meters long by 16 meters wide.

At impact, the main landing gear struts went through the upper wing skin. Both the main and the nose landing gear separated from the aircraft. The fuselage and the wings were severely damaged. Both engine mounts were bent and broken.

2. Fuselage tank switch and fuel quantity selector switch



3. Airspeed indictor at the left instrument panel

The speed bug setting was 110 knots, which was equivalent to the speed bug setting at the right instrument panel.

4. Starter/generator switches (toggle switches)

The right starter/generator switch was found in start position.

Survival aspects

1. A combination of interviews with firefighting and medical personnel and AIB DK investigations led to the conclusion that at the time of impact, the pilot did wear hip belt but not shoulder hardness and the passenger did wear hip belt and shoulder hardness.

The pilot's hip belt (see below) was cut by the firefighting services personnel. The two shoulder hardness straps were not attached to the hip belt locking mechanism.

2. Search and rescue

Rescue and firefighting services were at place (scheduled traffic to EKRN).

At 13:39:46 hrs, the firefighting services were cleared to enter the runway in order to search for the aircraft in the eastern part of the airport area. The exact position of the accident site (within or outside the airport security fence) was unknown.

At 13:42:12 hrs, the firefighting services located the accident site to be outside the airport security fence in a nearby field of sweet corn. The firefighting services requested the TWR to open the eastern security gate. The TWR did not have remote access to open that specific gate.

Airport security rules restricted the number of keys available for the airport security gates. The officer on duty should daily sign for a security gate key and store it in one of the airport emergency vehicles.

A security gate key was not available. Since there was no sign of fire, the firefighting services decided to return to the airport terminal and drive to the accident site via the highway along the airport area.

The firefighting services arrived at the accident site at 13:46:00 hrs.

The pilot and the passenger were pinned in the cockpit and it took approximately 1:05 hrs to get the pilot and the passenger out of the cockpit.

20 minutes later, a rescue helicopter with the pilot and passenger onboard departed EKRN with destination Copenhagen University Hospital.

3. Preventive actions

As a consequence of this accident, security gate keys were placed in all airport emergency vehicles.

Technical investigation

1. Engine - general

Debris of sweet corn crop was found in both engine air intakes. There were no damages to the inlet guide vanes and the first stage compressor disks. The second stage compressor disk of both engines had low rotor speed damages.

Engine oil level of both engines was checked without remarks.

Both engine combustion and turbine sections were examined by boroscope. No damages were observed. The compressors and turbines had free movement when turning.

2. Engine - fuel supply

The low pressure fuel filter bowls in the fuselage aft compartment were removed and drained. Both fuel filters were clean. The left engine fuel filter bowl was ¾ full and the right engine fuel filter bowl was ½ full. The fuel filter bowls were expected to be full provided fuel from the wing tanks fed the engines.

The low pressure fuel supply lines of both engines were disconnected at the inlet of the fuel control unit (FCU). There were no signs of fuel, which would have been expected provided fuel from the wing tanks fed the engines.

The high pressure fuel filter bowls were removed and drained. Both fuel filters were clean. Both fuel filter bowls revealed lack of fuel. The right bowl was observed to be empty. The fuel filter bowls were expected to be full provided fuel from the wing tanks fed the engines.

Both wing tip tanks were structurally damaged. When recovering the aircraft, leakages from the wing tip tanks were observed. After approximately 2 – 3 liters of fuel had leaked, the wing tip tanks were empty.

The fuel sump drains of both wing tanks were removed with no sign of fuel.

After recovering the aircraft to hangar facilities, a quantity of 160 liters of fuel was drained from the fuselage tank. The fuel transfer valve and the fuel cross flow valve were found in closed position, which was consistent with the position of the fuselage tank transfer toggle switch (off). If selected to transfer both the fuel cross flow valve and the fuel transfer valve open and allow fuel from the fuselage tank to the wing tanks.

The red pin indicators on the left and the right engine main shut off valves were observed to be in open position, which allowed fuel to the engines.

The conclusion of the overall technical investigation was fuel starvation.

Operational investigation

1. GPS readout

On the basis on the downloaded GPS groundspeed (GS) data, the AIB DK calculated estimated indicated air speeds (IAS) during the final stage of the flight (base turn to runway 29).

The assumptions underlying the calculations were:

- An average wind on approach of 280° and 25 knots
- IAS equal to true air speed (TAS)
- Estimated GPS course changes (magnetic track) during the base turn to runway 29
- Linear interpolation of GPS GS and calculated IAS

See appendix 3 and appendix 7.

2. D-CMMM flights in 2012

The flight plan database of the European Organization for the Safety of Air Navigation (Eurocontrol) contained the following information on flights performed by D-CMMM in 2012:

- 7.4.2012 EDAY-LFSB
- 7.4.2012 LFSB-LEPA
- 9.4.2012 LEPA-LOWS
- 9.4.2012 LOWS-EDAY
- 2.6.2012 EDAY-ESMS
- 2.6.2012 ESMS-EDAY
- 28.7.2012 EDAY-EKCH
- 28.7.2012 EKCH-EDAY
- 28.8.2012 EDAY-EKRN
- 28.8.2012 EKRN-EDAY
- 14.9.2012 EDAY-EDAY
- 15.9.2012 EDAY-EKRN

3. Stall warning system (extract from the Learjet 24D approved flight manual)

Due to the lack of valid aircraft documentation, the AIB DK by its investigation assumed that the aircraft was equipped with the Century III Retrofit Kit.

“Aircraft with Century III Retrofit Kit

The stall warning system consists of a stall warning vane on each side of the nose (8 and 29, figure 1-2), a "shaker" assembly on each control column, a normal accelerometer, two altitude switches, six flap position switches, two angle-of-attack indicators, stall warning lights, and a stall warning computer. During flight, the stall warning transducers are supplied with a constant voltage. As aircraft angle of attack increases

the transducer output voltage decreases. The transducer signal, along with altitude and flap position information, is fed into the computer, which sums all of the signals to give an instantaneous measure of aircraft proximity to stall. When the altitude switch closes (above approximately 22, 500 feet) shaker actuation speed increases approximately 15 knots and the pusher actuation speed is approximately 15 knots above stall condition. When the aircraft angle of attack increases such that speed is 7% above stall speed the computer energizes the control column shakers. The shakers produce a low-frequency, high-amplitude buffet signal through the control column to the crew. If the pending stall condition continues until the aircraft speed reaches one knot (seven knots with flaps up) above stall speed, the computer will command a nose down attitude to the pitch servo. The amount of force applied in the nose-down direction is 80 pounds at the control wheel. The force is applied to the control column in a pumping motion until the angle of attack decreases below the stall point. The accelerometer limits the pusher force to approximately 1/2 g unless both stall warning vanes are in a stall condition."

4. Stall speeds (extract from the Learjet 24D approved flight manual)
Due to the lack of valid aircraft documentation, the AIB DK by its investigation assumed that Softflite, Century III (Learjet wings and wings modification - AMK 83-5) was incorporated.

See appendix 8 (stall speeds).

5. IFR fuel planning (rf. the German CAA)
See appendix 9 (LuftBO - §29 and DV LuftBO - § 33)

Additional information
1. Onboard normal checklist (extract)
"Approach"

1. Circuit Breakers	*IN*
2. Hydraulic & Emergency Air Pressure	*CHECK*
3. Fuel Balance	*CHECK*
4. Landings Speeds & EPR for Go-around	*COMPUTE, BUGS SET*
5. Radio altimeter	*SET*
6. No Smoking/Fasten Seat Belt Sign	*ON*
7. Spoilers	*RETRACT*
8. Flaps	*AS DESIRED*

ANALYSIS

General

The AIB DK investigation was hampered by the lack of valid:

- aircraft documentation on aircraft status
- aircraft maintenance records and documentation
- flight operational documentation
- pilot records and documentation on pilot initial and recurrent training, flight experience, license and medical status.

Consequently, the AIB DK decided to focus solely on the operational sequence of events during the approach to EKRN.

There was a mismatch between the actual aircraft operation and the objective of ensuring flight safety by a regulated aviation system. From a systemic point of view, the AIB DK finds it thought-provoking that a non-registered aircraft was accepted by the regulated aviation system (12 times in 2012).

Though not causal to the accident, the AIB DK considers this finding a flight safety issue, which needs further consideration by EASA.

Flight inbound EKRN

1. Weather

The weather conditions at EKRN did not have influence on the sequence of events.

2. Minimum flight crew

The aircraft was certified for two pilot operations but was operated by a single pilot. Taking the complexity of the aircraft into account, the AIB DK considers this finding to be a neglect of flight safety.

3. Fuel planning

With an estimated total endurance of approximately 01:00 hrs and no stated alternate planning for the IFR flight from EDAY to EKRN, the AIB finds the preflight fuel planning insufficient and inconsistent with the German regulated IFR fuel planning safety barriers.

3. Enroute

A low fuel quantity warning light was presented to the pilot. It has not been possible for the AIB DK to determine how this warning was handled and how the fuel balance (rf. the approach check list) was checked.

However, the AIB DK concludes that usable fuel in the fuselage tank was not transferred into the wing tanks. On approach to EKRN, empty wing tanks led to fuel starvation of both engines.

At a critical moment, it is possible that the fuel quantity selector switch in the total position might mentally have blocked the pilot's perception of the onboard fuel distribution leading to inappropriate fuel management and decision-making.

4. Approach to EKRN

During decent and on initial approach to EKRN, the IAS was reduced and the aircraft was configured for landing.

When established on bug speed (approximately 110 knots IAS), the pilot most likely added power to remain stabilized and both engines suffered from fuel starvation. Pilot handling of the dual engine flame out (possible attempt to restart the right hand engine) caused a gradual speed drop.

The gradual speed drop led to activation of the stall warning system - column shaker (approximately 80 knots IAS equal to 75 knots IAS (stall speed) + 7%)). A further speed drop highly probable caused a commanded nose down attitude to the pitch servo – column pusher (76 knots IAS). The activation of the stall warning system and the pilot emergency call seemed to occur almost simultaneously (rf. appendix 7).

The whole sequence took place at low altitude, which in combination with a stall warning system commanded nose down attitude might have provoked an instinctively opposite reaction by the pilot in order to avoid impacting ground. Conflicting actions (machine versus human) might have pushed the aircraft into a deeper stalled state and finally led to an unrecoverable stall resulting in the aircraft impacting the ground.

Search and rescue

A low forward airspeed combined with the impact in a field of sweet corn reduced the impact forces and made the accident survivable.

Indirectly, airport security rules had an influence on the search and rescue response time, which from a survival aspect point of view was inappropriate. However in this accident, the AIB DK does not consider this finding as crucial in regard to the survival aspects. As a preventive action, security gate keys were placed in all airport emergency vehicles

CONCLUSION

Inadequate en route fuel management resulted in fuel starvation of both engines, while the aircraft was flying at low altitude and the airspeed was decreasing.

The dual engine flame out and the subsequent aircraft speed control led to an unrecoverable stall and consequently caused the accident.

APPENDICES

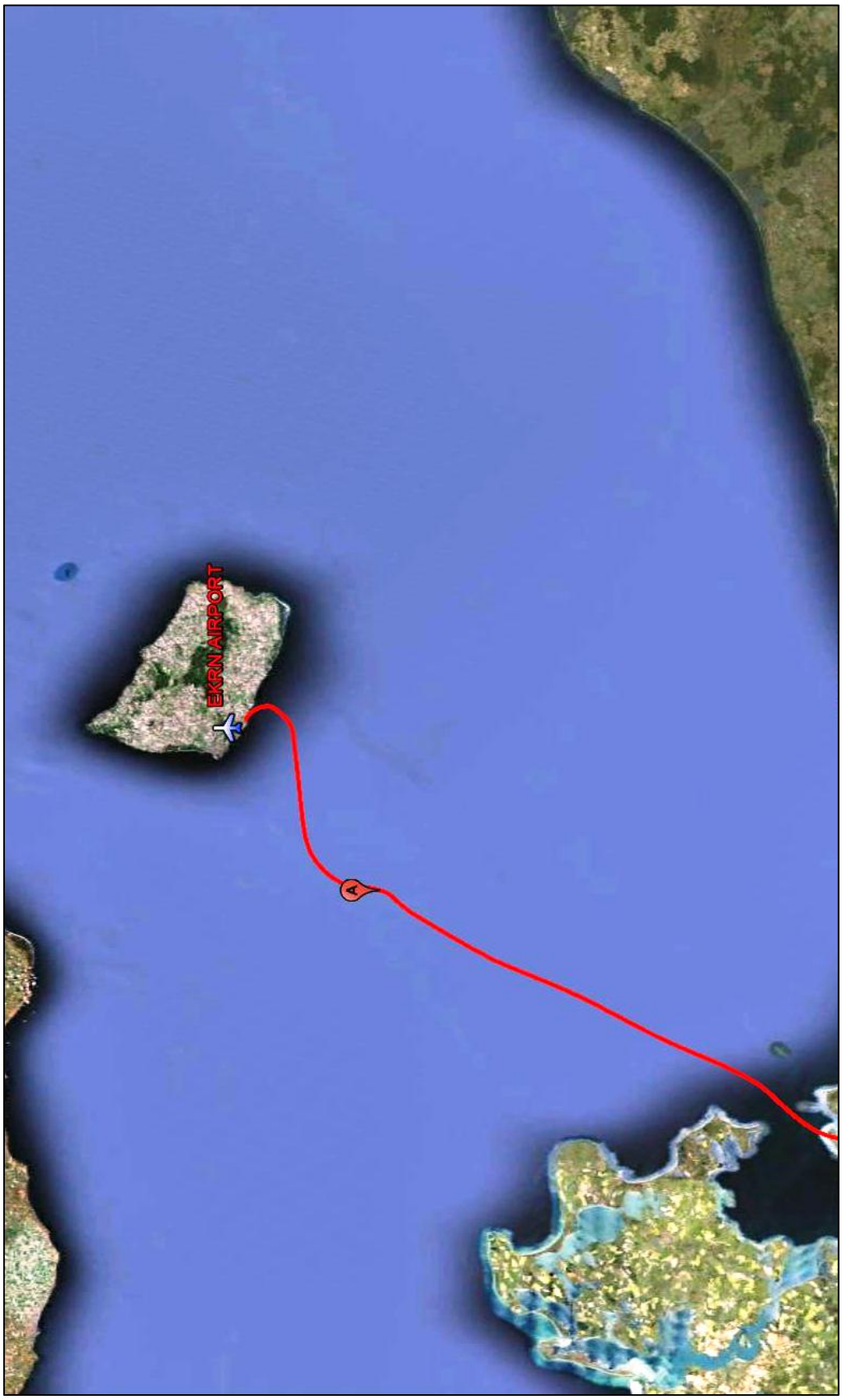
1. ATS flight plan
2. GPS readout (map view)
3. GPS groundspeed (GS) readout
4. Radar plot
5. GPS readout (approach)
6. Fuel system
7. GPS GS and calculated IAS on approach (linearly interpolated)
8. Stall speeds
9. IFR fuel planning

Appendix 1 - ATS flight plan

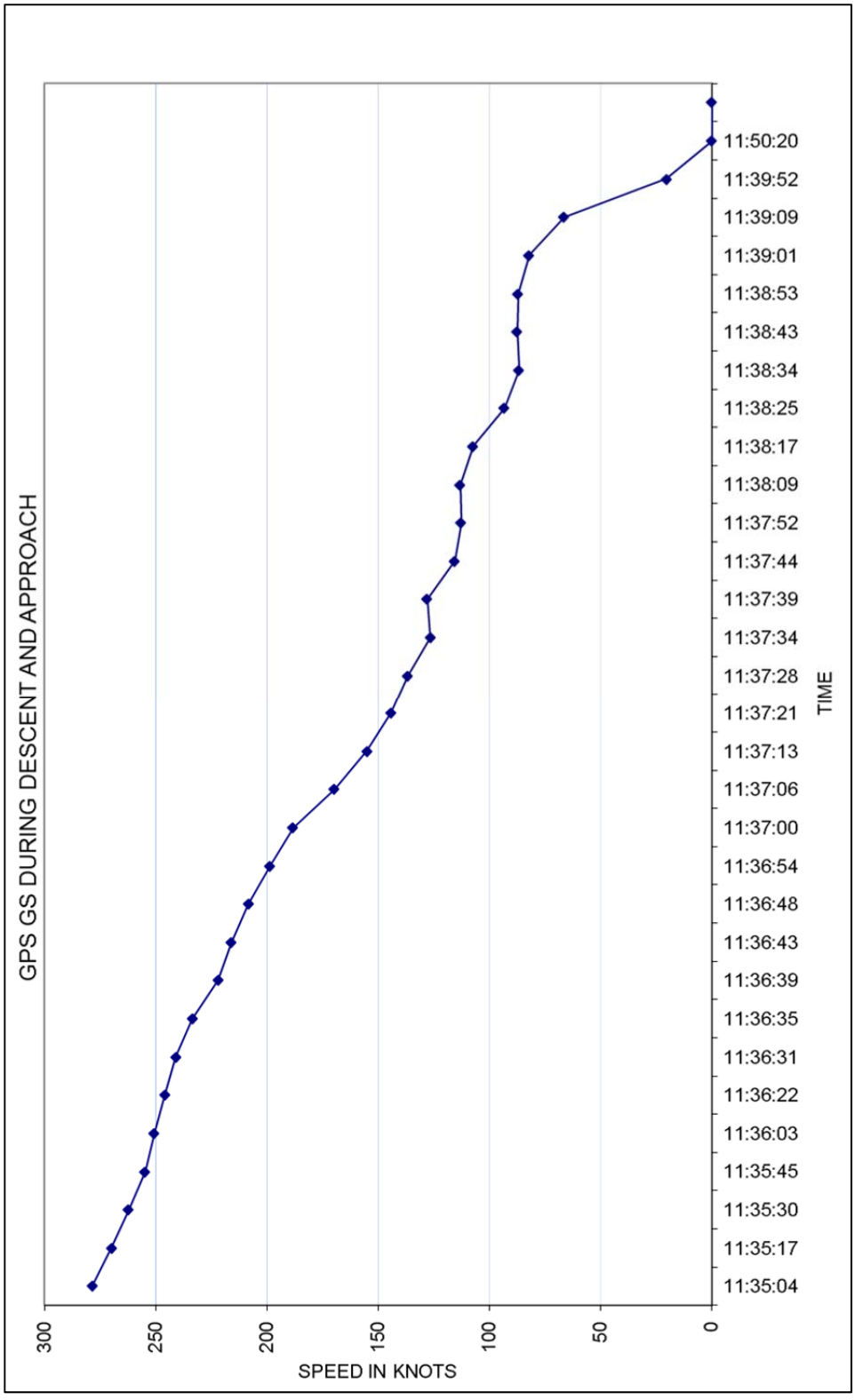
"AD EDAYZTZX EDGGZFZX EDMMZFZX EDDZZPZX EDDXYIYR
(FPL-DCMMM-ZG
-LJ24/L-DFGIKLUHYMOPRSTX/S
-EDAY1045
-N0400F210 GERGA/N0400F190 IFR M725 KOGIM M44 ARGAD P12 ROE
-EKRN0030
-EET/GERGA0001 RMK/FILED BY RMK/CREW CONTACT
DOF/120915
-E/0130 P/002 R/UVE S/PDMJ J/LF D/1 5 YELLOW A/WHITE AND
BLUE N/CREW CONTACT NUMBER

Note.
The AIB DK has removed personal information.

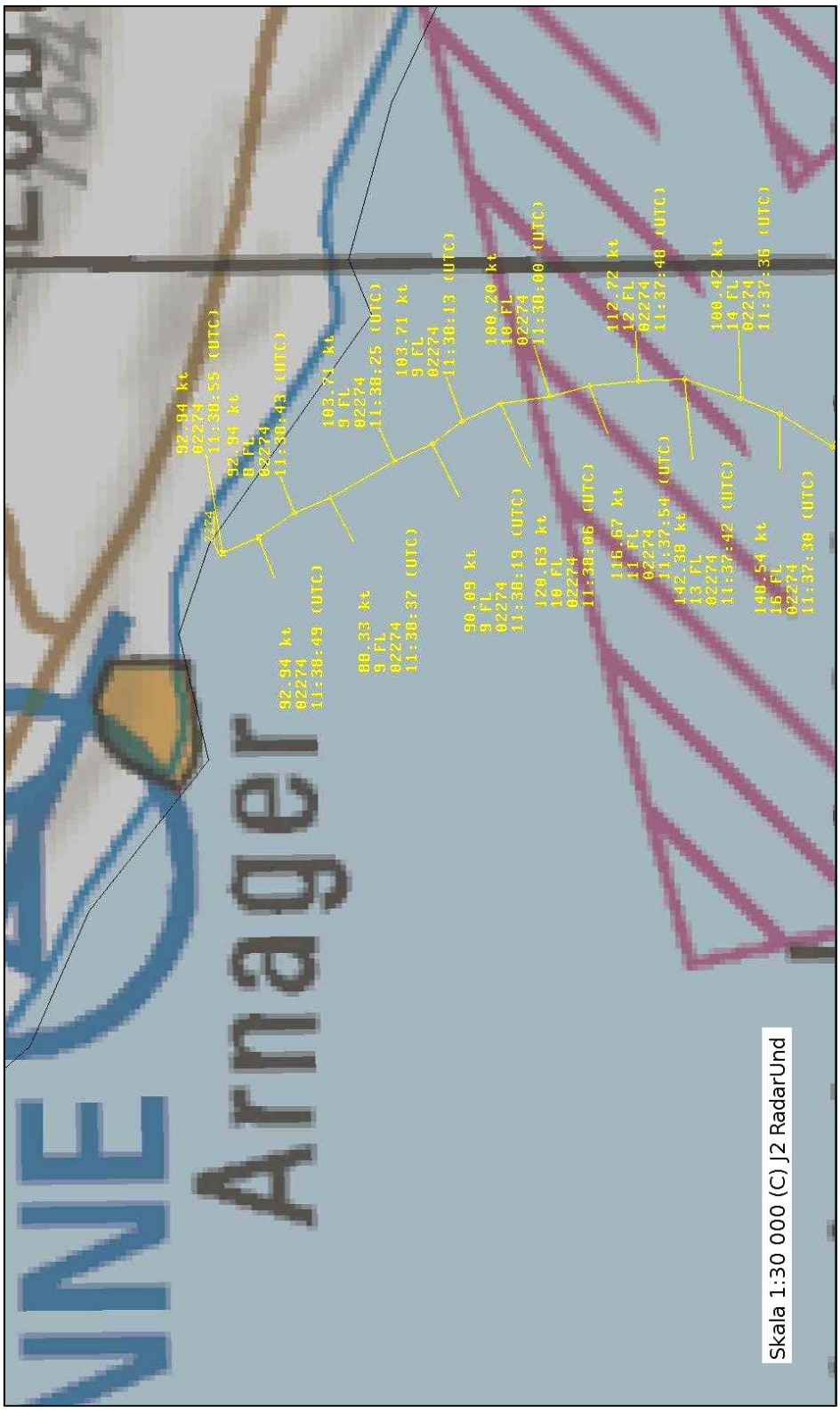
Appendix 2 - GPS readout (map view)



Appendix 3 - GPS groundspeed (GS) readout



Appendix 4 - Radar plot



The radar plot presents radar computed ground speed (GS). The aircraft speed reduction tendency was consistent with the GPS presented GS.

Appendix 5 - GPS readout (approach)

Appendix 6 - Fuel system

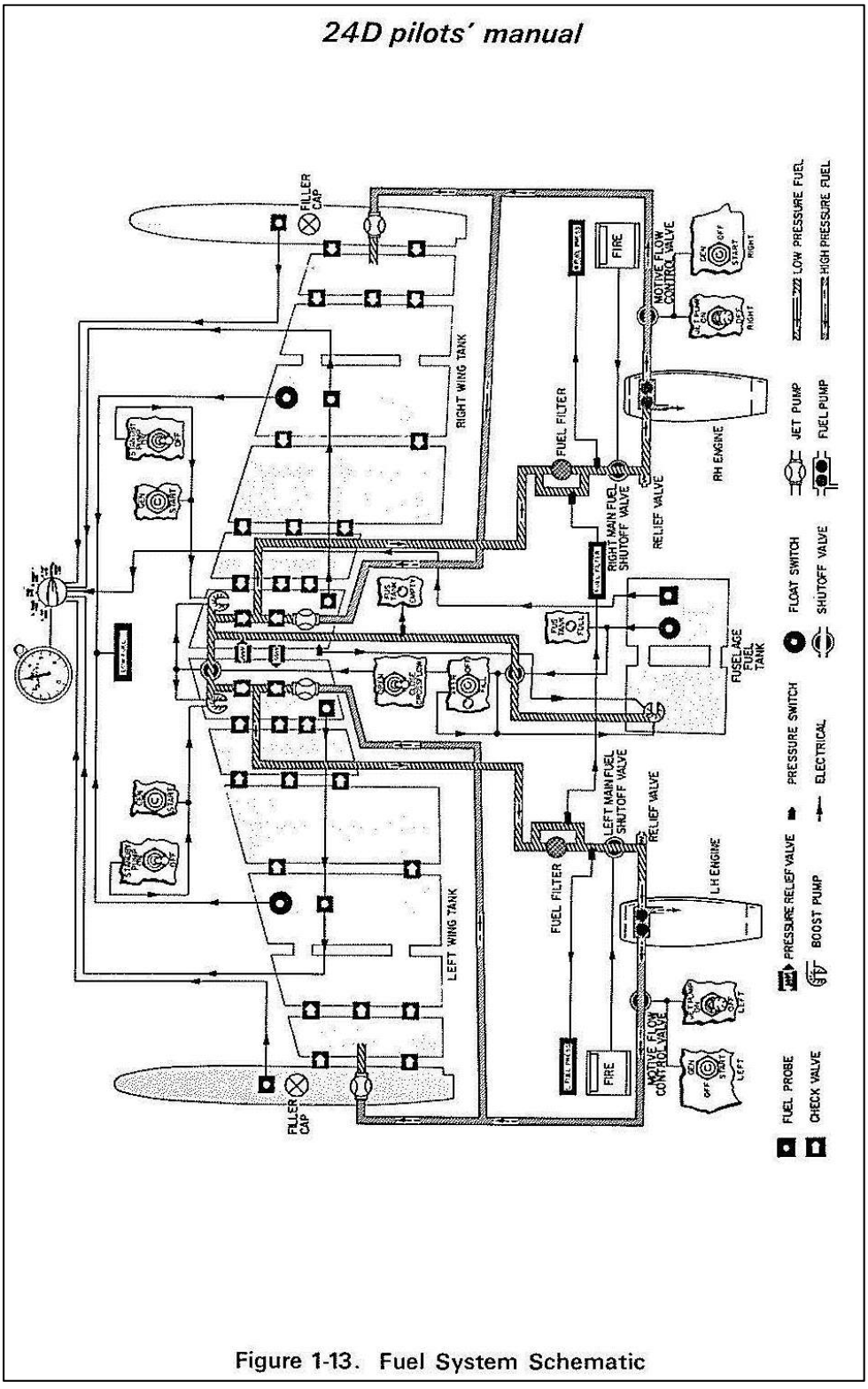
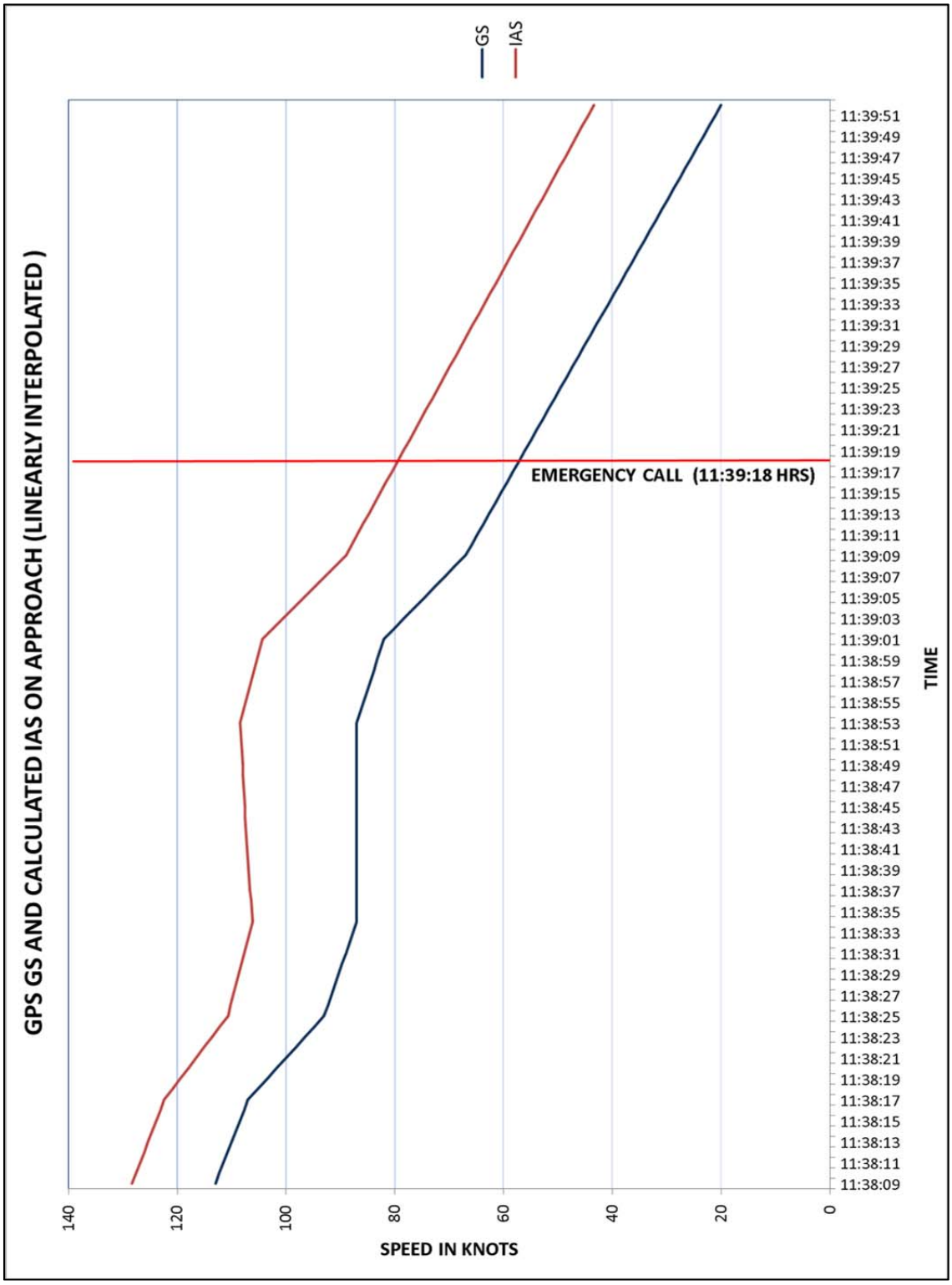


Figure 1-13. Fuel System Schematic

Appendix 7 - GPS GS and calculated IAS on approach (linearly interpolated)



Appendix 8 - Stall speeds

SUPPLEMENT

gates learjet 24D

STALL SPEEDS

GEAR - UP OR DOWN
THRUST - IDLE

This chart effective for aircraft incorporating AAK 79-10 or AMK 83-5.

NOTE

Stall speeds are increased at altitudes above approximately 22,500 feet.

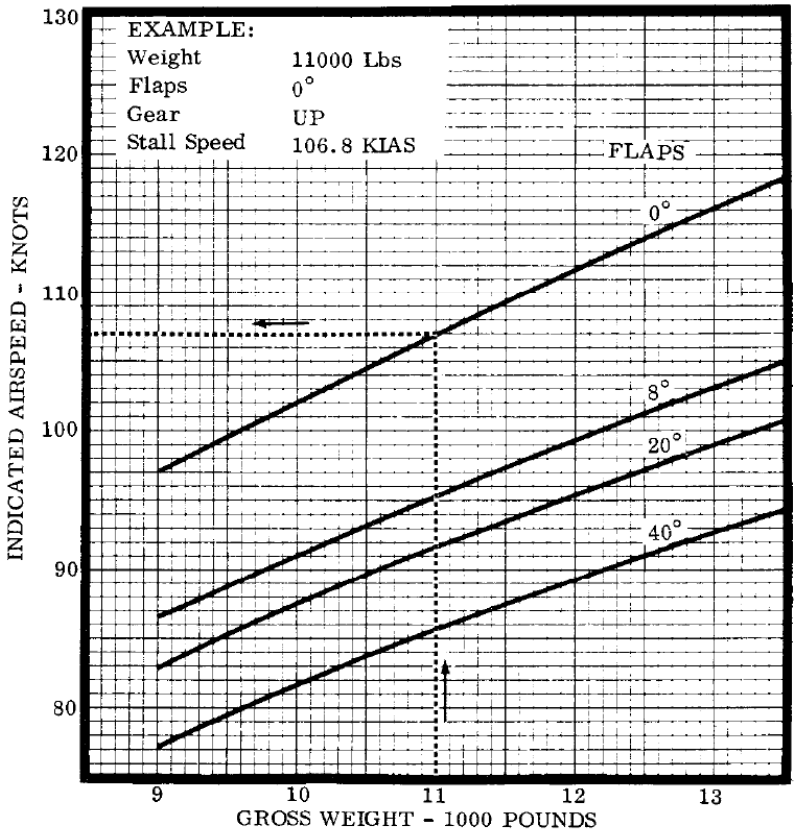


Figure 4-6A

AIB DK note. An estimated mass of 8370 lbs
Aircraft in landing configuration

FAA APPROVED 8-2-76 Change 4 4-13A

Appendix 9 - IFR fuel planning

§ 29
Betriebsstoffmengen

Motorgetriebene Luftfahrzeuge müssen eine ausreichende Betriebsstoffmenge mitführen, die unter Berücksichtigung der Wetterbedingungen und der zu erwartenden Verzögerungen die sichere Durchführung des Fluges gewährleistet. Darüber hinaus muß eine Betriebsstoffreserve mitgeführt werden, die für unvorhergesehene Fälle und für den Flug zum Ausweichflugplatz zur Verfügung steht, sofern ein Ausweichflugplatz im Flugplan angegeben ist.

§ 33
Betriebsstoffvorräte - Flugzeuge

(1) Für einen Flug nach Instrumentenflugregeln ohne Planung eines Ausweichflugplatzes müssen die an Bord mitgeführten Betriebsstoffmengen den Flug zum geplanten Landeplatz und eine weitere Flugzeit von 45 Minuten ermöglichen.

(2) Für einen Flug nach Instrumentenflugregeln mit Planung eines Ausweichflugplatzes müssen die an Bord mitgeführten Betriebsstoffmengen den Flug zum geplanten Landeplatz und anschließend den Flug zum Ausweichflugplatz sowie eine weitere Flugzeit von 45 Minuten ermöglichen.

(3) Bei der Berechnung der mitzuführenden Betriebsstoffmengen sind folgende Umstände zu berücksichtigen:

1. Vorhersage der meteorologischen Bedingungen,
2. zu erwartende Streckenvorgaben und Verzögerungen durch die Flugverkehrskontrollstelle,
3. für Flüge nach Instrumentenflugregeln mindestens ein Instrumentenanflug einschließlich eines Fehlanflugverfahrens am Landeplatz,
4. Druckverlust in der Kabine, wenn eine Druckkabine vorhanden ist, oder Ausfall eines Triebwerkes auf der Flugstrecke,
5. weitere Umstände, die eine Verzögerung der Landung oder einen erhöhten Kraftstoffverbrauch zur Folge haben.