FINAL REPORT

Final report of the investigation into the probable causes of the accident with the KLM Cityhopper flight KL433, Saab 340B, PH-KSH at Schiphol, Amsterdam Airport on 4 April 1994, conducted by the Netherlands Aviation Safety Board, composed of:

G.W.M. Bodewes, Chairman

L.W. Snoek, Member

J. Hofstra, Member

C. Barendregt, Member

H.P. Corssmit, Member

J. Smit, Deputy Member

M.M. Boyer, Secretary

Hoofddorp, October 1995

chairman

secretary

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- LIST OF ABBREVIATIONS -

AEO	All Engines Operative
AMS	Amsterdam Schiphol Airport
AOM	Aircraft Operations Manual
AP	Auto Pilot
APR	Automatic Power Reserve
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATPL	Airline Transport Pilot's Licence
B1	ATPL (Netherlands Airline Transport Pilot's Licence)
B2	SCPL (Netherlands Senior Commercial Pilot's Licence)
B3	CPL (Netherlands Commercial Pilot's Licence)
BHX	Birmingham Airport
BRE	Bremen Airport
BRU	Brussel Airport
BVOI	Bureau Vooronderzoek Ongevallen en Incidenten (Accident en Incident Investigation Bureau)
C	Celcius
CA	Cabin Attendant
CHU	Commuter Handling Unit
CMC	Cockpit Management Course
CPL	Commercial Pilot's Licence
CRM	Cockpit Resource Management
CTOT	Constant Torque On Take off
Cu	Cumulus
CVR	Cockpit Voice Recorder
CWL	Cardiff Airport
CWP	Central Warning Panel
ECL	Emergency Checklist
EGFF	Cardiff Airport
EGGD	Bristol Airport
EGHI	Southampton Airport
EGLL	London Heathrow Airport
EHAM	Amsterdam Schiphol Airport
FAR	Federal Aviation Regulations (of the FAA)
FDAU	Flight Data Acquisition Unit
FO	First Officer
FL	Flight Level
FST BV	Flight Simulator Training B.V.
ft	Feet
fpm	Feet per minute
GMT	Greenwich Mean Time

HPa	Hectopascals
IAS	Indicated Airspeed
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IF	Instrument Flying
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IR	Instrument Rating
JAR	Joint Airworthiness Regulations
kg	Kilogram(s)
KLC	KLM Cityhopper
KLM	Koninklijke Luchtvaart Maatschappij (Royal Dutch Airlines)
km	Kilometer(s)
kt	Knot(s)
Lat	Latitude
lb	Pound(s)
LH	Left Hand
Long	Longitude
LUX	Luxembourg Airport
m	Meter(s)
MHz	Megahertz
MLH	Basel Mülhouse Airport
MMX	Malmö Airport
MTOW	Maximum Take Off Weight
N	North
NLRGC	Stichting Nationaal Lucht- en Ruimtevaart Geneeskundig Centrum (Netherlands Aerospace Medical Centre)
NLM	Nederlandse Luchtvaart Maatschappij
nm	Nautical miles
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board (USA)
NVLS	NV Luchthaven Schiphol (Schiphol Airport)
OEI	One Engine Inoperative
OM	Outer Marker
PAN-call	Urgency call
PAS	Public Address System
PF	Pilot Flying
PIC	Pilot in Command
PNF	Pilot Not Flying
psi	Pounds per square inch

PSU	Passenger Service Unit
QNH	Sea Level Atmosphere Pressure
RA	Radio Altitude
RD	Route Day
RLD	Rijksluchtvaartdienst (Civil Aviation Authority of the Netherlands)
RH	Right Hand
RIV	Rapid Intervention Vehicle
RPM	Revolutions per Minute
RT	Radio Telephony
RTB	Reserve Thuis Beschikbaar (Reserve/available)
RTL	Reserve Thuis [oproepbaar] (Reserve/on call)
RV	Reis Verlof (Off Duty)
Sc	Stratocumulus
SCPL	Senior Commercial Pilot's Licence
SOU	Southampton Airport
SXB	Strassbourg Airport
UFDR	Universal Flight Data Recorder
UHF	Ultra High Frequency
UTC	Coordinated Universal Time
V	Airspeed
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VSI	Vertical Speed Indicator
VT 1	Summer Type Recurrent
V_{TH}	Threshold Speed
W	West

GENERAL INFORMATION OF THE ACCIDENT AND THE INVESTIGATION

a.	Place	:	Just outside Schiphol Airport, on agricultural terrain adjacent to runway 06, at position:
	Latitude	:	N 52°17'27.4"
	Longitude	:	W 004°45'16.3"
b.	Date and time	:	4 April 1994, 12:46 UTC
c.	Aircraft	:	PH-KSH, SAAB 340B,
	The aircraft sustained severe damage during the accident.		
d.	Crew	:	2 pilots, 1 cabin attendant
e.	Passengers	:	21
f.	Type of flight	:	Scheduled flight; IFR/VMC daylight
g.	Type of accident	:	Loss of control during go around

All times in this report are Coordinated Universal Time (UTC) unless otherwise indicated. Local time at the place of the accident was Central European Daylight Saving time, which is UTC+2.

THE INVESTIGATION

The investigation of the accident was performed by the Accident and Incident Investigation Bureau of the Netherlands Aviation Safety Board, in accordance with the Netherlands Air Accidents Law.

SYNOPSIS

After take off from runway 24, the aircraft followed a VALKO departure as cleared by Air Traffic Control (ATC). During climb, passing flight level 165 (FL165), the Master Warning was triggered by the right engine oil pressure Central Warning Panel (CWP) light. The Captain slowly retarded the right hand power lever to flight idle and called for the emergency checklist.

After completion of the emergency checklist procedure, the right hand engine oil pressure CWP light was still on and the Captain decided to return to Amsterdam. The right hand engine remained in flight idle during the remainder of the flight.

While returning to Amsterdam, the flight was radar vectored by ATC for an Instrument Landing System (ILS) approach on runway 06. After passing approximately 200 feet height, the aircraft became displaced to the right of the runway and a go around was initiated. During the go around, control of the aircraft was lost and, at 12:46 UTC, the aircraft hit the ground, in a slight noselow attitude with approximately 80° bank to the right, approximately 560 meters right from the runway 06 centerline, just outside the airport. Two passengers and the Captain died in the accident; eight passengers and the First Officer (FO) were seriously injured.

An investigation was initiated by the Netherlands Aviation Safety Board. Following the procedures contained in International Civil Aviation Organization (ICAO) Annex 13, Accredited Representatives and their Advisors from Sweden and the United States of America joined the investigation.

The investigation team was assisted by specialists from the Aeronautical Inspection Directorate of the Department of Civil Aviation of the Netherlands, the aircraft manufacturer Saab Aircraft Company, the engine manufacturer General Electric, the propeller manufacturer Dowty Aerospace Propellers, the operator KLM Cityhopper and KLM Royal Dutch Airlines.

A copy of the Universal Flight Data Recorder (UFDR) tape was handed over to the United States National Transportation Safety Board (NTSB, USA) to make a data extraction independent from the results of the data extraction in The Netherlands.

The Air Branch of the Netherlands State Police assisted with the questioning of witnesses.

Following the procedure of ICAO Annex 13, the draft final report was presented to the Accredited Representative of Sweden and of the United States of America on 3 August 1995 for comments.

The Accredited Representative of the United States of America replied on 8 August 1995 stating that there were no comments; the Accredited Representative of Sweden replied on 19 September 1995 stating that there were no comments.

Hoofddorp, 3 October 1995

1 FACTUAL INFORMATION

1.1 History of the Flight

General

KLM flight KL433 was a scheduled daily flight from Amsterdam "Schiphol" Airport (EHAM) to Cardiff Airport (EGFF), operated by KLM Cityhopper with a SAAB 340B. The crew consisted of two pilots and one cabin attendant (CA). The crew reported for duty on the 4th of April 1994 at 06:35 to operate flight KL439 to Southampton (EGHI) and subsequently, after their return flight to Amsterdam, flight KL433, from Amsterdam to Cardiff, with the same aircraft. The flights to and from Southampton were uneventful and the aircraft returned to Amsterdam at 10:55, after which the crew had 1:15 hour to prepare for flight KL433.
In the previous three months the Captain had made 7 flights to Cardiff, the FO 4 flights.

Flight Preparation

The flight plan, weather and Notice to Airmen (NOTAM) information did not contain any information that would have required special attention. Planned flight time from Amsterdam to EGFF was 1:18 hour and flight plan fuel was 1,830 kg with Bristol Airport (EGGD) as alternate airport. The aircraft was to carry 22 passengers plus 3 crew.

At boarding time three passengers did not show up, but later two of these three passengers were transported to the aircraft by bus. The aircraft left Amsterdam with 21 passengers plus 3 crew and 20 pieces of baggage.
There were no dangerous goods or International Air Transport Association (IATA) restricted articles on board the aircraft. The take off weight was calculated by the flightcrew to be 12,589 kg (27,754 lbs).

KLM Cityhopper applies a fixed seat policy whereby the Captain occupies the left hand (LH) seat and the FO occupies the right hand (RH) seat. On this stretch the Captain was the Pilot Flying (PF) and the FO the Pilot Not Flying (PNF).

Taxi

At time 12:11:12, KL433 contacted Schiphol Clearance Delivery and requested start up, stating that they had received Automatic Terminal Information Service (ATIS) information "November". Delivery approved start up and indicated that runway 24 would be the take off runway, after which the airway clearance was given.

At 12:15:18 taxi was approved by Schiphol Ground to exit 2 of runway 06, which is the 2,300 meters intersection of runway 24. The UFDR automatically started to record flight data at 12:13:53. Information recorded on the Cockpit Voice Recorder (CVR) started automatically at 12:15:21.

KL433 was the second SAAB in a sequence of five aircraft to depart Amsterdam from runway 24. Runway 01L was also used as (secondary) take off runway, while runway

01R was the main landing runway.
The "Taxi-Out" checklist was completed, and approaching the 2,300 meters intersection of runway 24, KL433 was instructed by Schiphol Ground to contact Schiphol Tower. At 12:17:57 Schiphol Tower instructed KL433 to line up in sequence behind the preceding Saab. The "Before Take Off" checklist was completed at 12:18:56 and at time 12:19:38 KL433 was cleared for take off.

Take Off

Passing 1,950 feet height KL433 contacted Schiphol Departure and was cleared to climb to FL090. The Captain commanded for the "After Take Off" checklist at 12:22:17. At 12:24:15 KL433 was instructed by Schiphol Departure to contact Amsterdam Radar.

Climb

Amsterdam Radar cleared KL433 to climb to FL140. An active trough, with cumulonimbus clouds with tops up to FL150, was situated over the southern part of the North Sea. To remain clear of the clouds KL433 contacted Amsterdam Radar and requested FL200 for cruising level instead of FL180 as indicated on the filed flight plan, which was approved.
Amsterdam Radar instructed KL433 at 12:28:41 to turn to the right to fly heading 270, in order to maintain separation with a Boeing 737.

Oil Pressure Warning

During climb at 12:30:46, while passing FL165, the Master Warning was triggered by the right engine oil pressure CWP light. The Master Warning was reset. The Captain retarded the RH power lever slowly to flight idle and commanded "Take action". The RH engine torque decreased from 78% to 10%. The FO confirmed the command "Take action" and announced "Emergency checklist".

> ***The right engine oil pressure CWP light indicates a possible low oil pressure in the right engine and/or in the right propeller gear box. The procedure in the Emergency Checklist (ECL) for an engine oil pressure low warning is therefore a combined procedure. The first item in the procedure is to read the oil pressure indicators. Any follow-up action depends on these readings.***

At 12:31:29 the Master Warning was triggered again and after the warning was reset, the FO indicated that the oil pressure of the RH engine was lower than the oil pressure of the LH engine and also that the oil pressure of the RH engine was decreasing. ***[Note: at that time the Captain was still retarding the RH power lever]***
At 12:31:35 the Master Warning was triggered for a third time and, after it was reset again, the FO stated to the Captain that the oil pressure of the right engine was indeed decreasing. This was confirmed by the Captain and the FO then concluded - following the ECL procedure - that the Propeller Oil Pressure Low procedure was not applicable and he continued with the Engine Oil Pressure Low procedure.

At 12:31:43 the FO proceeded with reading the ECL: "...engine oil pressure control warning panel light on...or, engine oil pressure below thirty psi". The Captain responded with: "That is not the case, but it is still normally in the green, that is what is so strange", which was confirmed by the FO. There were no indications on the CVR that the Engine Oil Pressure Low procedure was completed. The right engine oil pressure CWP light remained on and the captain left the RH power lever at the flight idle position, where it would stay for the remainder of the flight.

By then, the Boeing 737 had passed KL433 and Amsterdam Radar cleared KL433 to proceed direct to position REFSO over the southern part of the North Sea. The FO confirmed this clearance at 12:32:08, but at the same time the Captain indicated to the FO, that he would not continue to his destination with an "engine oil pressure low" warning. The FO indicated to the Captain that according to the ECL procedure, it should be determined whether or not the engine oil pressure was below 30 psi with the oil pressure warning light on.

According to the ECL procedure the engine must be shut down if the oil pressure warning light is on and the oil pressure is below 30 psi. If the warning light is on and the engine oil pressure is above 30 psi, normal operation should be continued.

At 12:32:37 the Captain stated, that the RH engine oil pressure was above 50 psi and after confirmation of this fact by the FO, the Captain announced: "Continue normal operation". At 12:32:54 the Captain again told the FO, that he did not want to continue the flight to its destination and thereafter back to Amsterdam. The FO agreed. Neither the captain nor the FO expressed a reason for their decision.

The Captain then remarked, that the climb performance of the aircraft was considerably reduced. The Captain instructed the FO to obtain clearance to descend to FL160 and to inform ATC that KL433 possibly had to return to Amsterdam due to a technical problem. The FO suggested to the Captain to send out a PAN-call and after some consideration the Captain agreed that a PAN-call would be appropriate.

At 12:33:26, KL433 contacted Amsterdam Radar starting the message with a PAN-call, informing them that they had an engine problem and that they liked to maintain FL160 for a return to Amsterdam.
Amsterdam Radar confirmed the PAN-call of KL433 at 12:33:35 and cleared KL433 to turn right, heading to Schiphol. KL433 responded that they were turning right and that they were descending to FL160.

At 12:34:39 the FO contacted the Commuter Handling Unit (CHU) at Amsterdam on the company frequency and informed CHU that KL433 was returning to Amsterdam with a technical problem with the RH engine. The nature of the problem was not indicated. The message was confirmed by CHU at 12:34:42.

After having informed Schiphol Approach that KL433 was returning to Amsterdam with an engine problem, Amsterdam Radar cleared KL433 to descend to FL070 at 12:34:44 and instructed KL433 to contact Schiphol Approach.

Descent

While the Captain started the descent to FL070, the FO suggested to the Captain to inform the passengers. The Captain decided, that the CA had to be informed first, after which the passengers could be informed. At the suggestion of the FO, the Captain decided that the FO was to inform both the CA and the passengers, while he would handle the aircraft.

At 12:35:12 the FO informed the CA and the passengers that the aircraft was returning to Amsterdam and that the aircraft would land in approximately 20 minutes.

In the meantime Schiphol Approach had informed Schiphol Tower, that KL433 was returning to Amsterdam and consequently Schiphol Tower had informed the Schiphol Airport (NVLS) duty manager. The NVLS duty manager indicated that he would listen out on the Schiphol Approach frequency to follow flight KL433.

At 12:36:32 the Captain, who was handling the radio while the FO was informing the passengers, contacted Schiphol Approach starting with a PAN-call. Schiphol Approach responded by offering KL433 a straight-in approach for either runway 06 or runway 01R and the Captain indicated, that he would use runway 06. Schiphol Approach confirmed the choice of runway 06, cleared KL433 to descend to 2,000 feet on QNH 993 HPa and instructed KL433 to fly heading 090. At 12:36:52 Schiphol Approach informed Schiphol Tower that KL433 was returning for runway 06 as an emergency and requested to stop all traffic.

After the FO had finished his statement on the public address system (PAS), he reported back to the Captain and was informed that the aircraft was cleared to descend to 2,000 feet on QNH 993 HPa for a straight-in runway 06. The Captain called for the "Descent" and "Approach" checklists. While reading the checklist, the fasten seatbelt sign was switched on at 12:37:14.
After reading the item "crew briefing" in the descent checklist, the FO asked whether the crew briefing would follow after the checklist was completed. Seven seconds later he suggested: "...or standard zero six?" to which the Captain responded with: "Standard 06, 111.1 standby, 061". *[Which means: standard approach for runway 06, localizer SL on frequency 111.1 MHz on standby, inbound approach track 061°]*

At 12:37:35 Schiphol Approach informed Schiphol Tower that KL433 would make a straight-in approach for runway 06. Schiphol Approach requested Schiphol Tower to order the fire brigade to take position along the landing runway. Schiphol Tower passed this on to the NVLS duty manager who reported "ready" at 12:38:00.

In the meantime, Schiphol Approach asked KL433 if they could give any details regarding their situation and the Captain responded that they had an engine oil pressure problem in engine no. 2, but that the situation was under control. When asked by Schiphol Approach if the engine was feathered, the Captain stated that the engine was running in flight idle. This information was passed to Schiphol Tower and from there to the NVLS duty manager.

At that time, the aircraft was descending through FL105 at 18 nautical miles (nm) from the airport and Schiphol Approach asked KL433 whether the distance-to-go was sufficient for the landing procedure. The Captain responded that it was sufficient.

The FO started with the approach checklist and, in response to the relevant checklist item, he indicated to the Captain that for a standard approach, the approach speeds would be 113, 119 and 128 knots. The Captain confirmed these speeds after which the approach checklist was completed.

The speeds mentioned by the FO were the reference speeds for:
$V_{THRESHOLD\ flaps\ 20}$, V_{TH20} *(119 knots)*
$V_{THRESHOLD\ flaps\ 35}$, V_{TH35} *(113 knots), and*
$V_{FINAL\ CLIMB}$, V_{FC} *(128 knots).*
These are reference speeds for a standard two engine approach, related to aircraft weight.

In the meantime Schiphol Approach had a separate working station operational: Schiphol Arrival working on a separate frequency, which would exclusively handle KL433. At 12:38:48 KL433 was consequently instructed to contact Schiphol Arrival.

Intermediate Approach

Passing FL075 Schiphol Arrival informed KL433, that the surface wind was 250° with 10 knots and that the aircraft was number one for landing on runway 06.

At that time, KL433 was 11 nm due west of Amsterdam and Schiphol Arrival vectored the aircraft to a position for landing at runway 06 by instructing KL433 to fly heading 220. Schiphol Arrival requested also the preferred direction of turn. KL433 confirmed heading 220 and replied that the aircraft was making a turn to the right. In response to the wind readout from Schiphol Arrival, the FO informed the Captain that there would be a tailwind component of 10 knots for landing on runway 06, which was acknowledged by the Captain.

Schiphol Arrival remained in contact with Schiphol Approach to make arrangements for separation with other traffic and at 12:39:37 Schiphol Arrival instructed KL433 to stop the descent initially at FL050. As KL433 was already cleared to an altitude below the transition level, the pressure altimeters were set to QNH (993 HPa) and had to be re-adjusted for the standard 1013.2 HPa setting just before the aircraft reached FL050. Schiphol Arrival then instructed KL433 to fly heading 240. During level flight at FL050, the Captain stated to the FO, that the right hand oil pressure indicated a steady pressure of more than 50 psi, which was confirmed by the FO, who also informed the Captain that he agreed with his decision to return to Amsterdam. At 12:40:22, Schiphol Arrival instructed KL433 to descend to 2,000 feet, which was confirmed by KL433.

Passing 4,200 feet, while descending to 2,000 feet, Schiphol Arrival sent the following message: "KLM433, you can steer left heading 060 for finals runway 06 uh...what direction you will turn?" The Captain called out: "Left", after which the FO responded to Arrival: "We are turning over left heading 060, KLM433".

At 12:41:22 KL433 was informed by Schiphol Arrival that the aircraft had 12 nm to go before landing and at 12:41:52 KL433 was offered the choice either to intercept the localizer or to continue on heading 060 while Arrival would continue to provide radar vectors. KL433 replied to these options by just stating: "KLM four three three".

In order to avoid any further frequency change for KL433 Schiphol Arrival had agreed with Schiphol Tower that Schiphol Arrival would control KL433 until landing. At 12:42:00 Schiphol Arrival stated to KL433: "You are cleared to land for this approach, ten miles to touch down", after which KL433 confirmed the landing clearance.

Upon reaching 2,000 feet, at 12:42:00, thrust was applied to the LH engine for the first time since KL433 started its descent from FL160 and the airspeed was reduced from 180 knots to approximately 155 knots. At this time the FO mentioned to the Captain: "Because you are flying flight idle, you probably have less problems than you might have had otherwise", to which remark the Captain responded with: "Yes".

At 12:42:26, Schiphol Arrival instructed KL433 to fly heading 050 and to report runway in sight, stating that the distance to go before landing was 8 nm. At 12:42:39, the FO reported: "Runway in sight", which was confirmed by the Captain 4 seconds later. The FO also informed the CA that landing was imminent.

At 12:43:06, KL433 intercepted the runway 06 ILS localizer after which the gear was selected down and approximately 78% torque was applied on the LH engine. Shortly thereafter the runway 06 ILS glide slope was also intercepted, the flaps were set to 15° and the torque was reduced. At 12:43:25, the aircraft was established on the runway 06 ILS with the gear down and flaps set at 15°, and the Captain commanded for the landing checklist.

Final Approach

Landing flaps were set at 20° at time 12:44:03, just prior to passing the Outer Marker (OM), at which time the landing checklist was completed by the FO. Passing the OM, the aircraft was established on the runway 06 ILS in landing configuration and flying with the Auto Pilot (AP) engaged. Torque on the LH engine was set at 28%, while the RH engine remained at flight idle. The Indicated Airspeed (IAS) at that moment was 142 knots and was reducing to the target approach speed of 125 knots.

At 12:44:22, while passing 1,080 feet Radio Altitude (RA) and with 127 knots IAS, torque on the LH engine was increased to 60% in order to stop airspeed reduction and to maintain a target approach speed of 125 knots. Initially the airspeed decreased further to 120 knots and then increased to 130 knots.

At 12:43:42 and at 12:45:12 Schiphol Arrival stated the wind to be respectively 280° at 8 knots and 280° at 9 knots. Both reports were confirmed by the FO, by clicking his microphone button. At 12:44:05, on request of the Captain, the FO stated that the tailwind component was 8 knots.

At 12:44:38, while the aircraft was passing 880 feet RA with the AP still engaged, the FO remarked: "The trim is all the way to the left...". He suggested to the Captain to set the ruddertrim to neutral just before landing, to which suggestion the Captain responded with: "Yes, that will make it easier, doesn't it".
At 12:45:00, while passing 612 feet RA, the Captain disconnected the AP.

At 12:45:02, passing 500 feet RA, landing clearance was confirmed by both pilots and shortly thereafter torque on the LH engine was reduced to 45% and airspeed was maintained at approximately 128 knots until - passing 300 feet RA - torque on the LH engine was further reduced to 30% in order to obtain his final approach speed of 119 knots. At that time, the aircraft was approximately 0.6 dots below the glide path and pitch was increased to correct the vertical flight path of the aircraft.

The airspeed started to reduce and at 12:45:33, while passing approximately 230 feet RA with an airspeed of 120 knots, the FO indicated to the Captain that he would position the rudder trim to neutral to which action the Captain agreed. At that time the aircraft was on the glide slope. Shortly thereafter the pitch of the aircraft was decreased and consequently the aircraft became 0.4 dots below the glide slope. The pitch of the aircraft was increased again for another correction of the vertical flight path, while torque on the LH engine was increased from 30 to 40%. In the meantime the airspeed had decayed to 115 knots and at 12:45:41 the FO stated: "Mind your speed".

Passing approximately 120 feet RA, an aggressive increase in torque (from 40% to 65%) was applied, but hardly any additional rudder input was given to correct for asymmetry. After correcting the initial small rolling movement to the right, the aircraft was kept wings level by significant aileron input. The aircraft veered approximately 6° to the right and while passing 90 feet RA, just before the landing threshold, the aircraft positioned itself to the right of the extended centerline. At 12:45:46, torque was reduced from 65% to 40%, which further reduced the airspeed to 110 knots.

At 12:45:53, while passing 45 feet RA, flying to the right of the runway at an airspeed of 110 knots, the Captain commanded: "Going around...set torque, flaps seven, gear up".

Go Around

These commands, given by the Captain, were acknowledged by the FO. At 12:46:00, torque was set at 98% on the LH engine (the RH engine remained at flight idle) and the flaps started to move from the 20° position towards the 7° position. No acknowledgement was given for the command "gear up", but the landing gear was selected up immediately after "flaps 7°" was selected.

At 12:46:06, the flaps were at 7°. No conclusive data could be found on the UFDR to confirm that the landing gear reached its fully retracted position, but it could be verified from pictures taken by witnesses that the landing gear functioned normally and that it reached its fully retracted position approximately 8 seconds after the landing gear was selected up.

Between 12:45:53 and 12:46:00, while the torque was increased from 40% to 98% no additional rudder deflection was applied, but again the initial roll to the right and the additional asymmetry were counteracted by significant aileron input up to maximum control wheel deflection.
Initially, the pitch of the aircraft was increased from approximately 4° to 7°. At 12:45:57 pitch was further increased to a maximum of 12°. At that time the airspeed had decreased to 105 knots and the sudden increase in pitch and associated increase in angle of attack triggered the stall warning. The stall warning stopped at 12:46:00 when the pitch of the aircraft was lowered to 6°.

At 12:46:00, the airspeed had decreased to 97 knots. At that time the aircraft started a shallow turn to the right with a progressively increasing bankangle. At 12:45:58 some additional rudder deflection was applied, but full rudder deflection was only reached at 12:46:06.

At 12:46:03, the pitch of the aircraft had been increased again to 9° and the stall warning was triggered for the second time. Airspeed at this moment was 100 knots. The stall warning remained activated until the moment of impact. During the last few seconds of the flight the aircraft banked further to the right and airspeed decreased to less than 93 knots. At 12:46:09 the aircraft crashed into the ground just outside Schiphol Airport with approximately 80° right bank.

At 12:46:04 Schiphol Tower informed Schiphol Arrival that KL433 was making a go around and at 12:46:10 information was received that KL433 had crashed.
At the same time a major alert was given and all flights to and from Amsterdam were stopped at 12:46:22.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others	Total
Fatal	1	2	0	3
Serious	1	8	0	9
Minor/None	1	11	0	12
Total	3	21	0	24

1.3 Damage to Aircraft

The aircraft was damaged beyond repair.

1.4 Other Damage

The soil of the crash site was polluted with kerosene and an area of approximately 9,000 m² agricultural soil had to be removed and replaced.

1.5 Personnel Information

1.5.1 Captain

1.5.1.1 General

Male	:	Age 37
Licence	:	Netherlands B2, no. 92–0036, with Instrument Rating, Radio Telephony and aircraft rating for the Saab 340B
Type qualification	:	23 April 1992
Last medical check	:	December 1993
Total hours	:	2,605
Hours on type	:	1,214
Hours last 90 days	:	182
Hours last 30 days	:	54

Joined KLM Cityhopper on 02-03-1992.

1.5.1.2 Duty and Rest Periods

Duty and rest times in the period of 7 days preceding the accident flight.

Date	Code	Duty	Rest	Start	End
28/03/94	RTL	Reserve		09.00	18:00
29/03/94	KL079	AMS-LUX-SXB	20:35	15:35	19:05
30/03/94	KL070	SXB-LUX-AMS	07:20	03:55	07:24
31/03/94	RV	Off duty		04:00	04:00
01/04/94	RV	Off duty		04:00	04:00
02/04/94	RV	Off duty		04:00	04:00
03/04/94	RTL	Reserve		09:00	18:00
04/04/94	RTB	Reserve		05:00	17:00
04/04/94	KL439 KL433	AMS-SOU-AMS AMS-CWL-AMS	118:39	07:33 12:15	10:55 –

Originally, the captain was scheduled for reserve duty on 4 April 1994, but this schedule was changed to flying duty on the evening of the day preceding the accident. During the previous 3 months, the captain had flown 7 flights from Amsterdam (AMS) to Cardiff (CWL) vice versa.

1.5.1.3 Medical History

While exercising the privileges of his licence, the captain had to wear correcting glasses. No other restrictions applied to the licence of the captain. At the time of the accident the captain was wearing contact lenses.

1.5.2 First Officer

1.5.2.1 General

Male	:	Age 34
Licence	:	Netherlands B3, no. 90–0190, with Instrument Rating, Radio Telephony and aircraft type ratings for Piper PA-31 and Saab 340B
Type qualification	:	10 March 1992
Last medical check	:	May 1993
Total hours	:	1,718
Hours on type	:	1,334
Hours last 90 days	:	173
Hours last 30 days	:	35

Joined KLM Cityhopper on 27-01-1992.

1.5.2.2 Duty and Rest Periods

Duty and rest times in the period of 7 days preceding the accident flight.

Date	Code	Duty	Rest	Start	End
28/03/94	KL401	AMS-BRE-AMS		04:15	11:09
29/03/94	KL407	AMS-BHX-AMS	16:31	05:10	09:54
30/03/94	VT 1	Simulator Type Recurrent	25:06	11:00	15:00
31/03/94	RD	Route day		07:00	15:00
01/04/94	RV	Off duty		04:00	04:00
02/04/94	RV	Off duty		04:00	04:00
03/04/94	KL423 KL023	AMS-BRU-AMS AMS-MMX-AMS	86:15	06:15 11:50	08:50 13:40
04/04/94	RTB	Reserve		05:00	17:00
04/04/94	KL439 KL433	AMS-SOU-AMS AMS-CWL-AMS	17:25	07:35 12:15	10:50 –

Originally, the FO was scheduled for reserve duty on 4 April 1994, but this schedule was already changed to flying duty 3 days preceding the accident flight. During the previous 3 months, the FO had flown 4 flights from Amsterdam (AMS) to Cardiff (CWL) vice versa.

1.5.2.3 Medical History

There were no restrictions imposed on the licence of the FO.

1.6 Aircraft Information

1.6.1 General

Type	: SAAB 340B
Registration	: PH-KSH
Serial no	: 195
Acceptance date	: 26 June 1990
Certificate of Airworthiness	: No. 4115, valid until 2 June 1994
Total airframe hours	: 6,558

1.6.2 Engines

The SAAB 340B is equipped with two General Electric CT 7-9B turbo-prop engines, each developing a maximum of 1,870 shaft horsepower at 22,000 power turbine RPM. The CT7-9B has a gas generator powering a free power turbine directly coupled to the propeller gearbox.

The engine has two independent oil systems: the propeller gearbox oil system and the power unit oil system. Each oil system has two separate oil pressure measurement systems, which provides for both a cockpit oil pressure indication and low oil pressure warning light. The oil pressure indication comes from a pressure transducer to the cockpit gauge, whereas the low oil pressure warning light is activated by a pressure switch.

Engine operation is basically manual, using the power lever and condition lever (for propeller pitch and fuel), with associated automatic fuel metering and automatic protection systems. The system also incorporates a Constant Torque On Take off (CTOT) and an Automatic Power Reserve (APR) function. The CTOT regulates fuel flows beyond the power lever position to a preselected value. The APR provides 7% extra thrust on the good engine, in case of a powerloss on the other engine.

The SAAB 340B is not provided with an Automatic Throttle System. Such a system is not compulsary.

1.6.3 Propellers

The engines are equipped with Dowty Rotol constant speed propellers. These are variable pitch, single acting, full feathering, reversing propellers each with four composite blades. The propeller is hydraulically controlled by the propeller pitch control (condition lever).

1.6.4 Engine and Propeller History

LEFT			
	Engine	Gearbox	Propeller
Serial number	GE-E-785137	UDAG-0739	DRG/10173/89
Total time	6,517	4,606	6,887
Total cycles	6,636	4,634	
Hours since major repair	2,245	1,665	New
Cycles since major repair	2,149	1,616	
RIGHT			
Serial number	GE-E-785421	UDAG-0691	DRG/1385/91
Total time	3,688	6,067	4,730
Total cycles	3,553	6,085	
Hours since major repair	193	193	New
Cycles since major repair	173	173	

1.6.5 Weight and Balance

Comparing the actual boarding list with the computer loadsheet, a discrepancy of minus one passenger was found (21 instead of 22). This information was corrected on the loadsheet by the flightcrew and a take off weight of 12,589 kg (27,754 lbs) was calculated [maximum take off weight is 13,155 kg (29,000 lbs)].
During the investigation, this take off weight was recalculated on a manual loadsheet to check the figures known to the flightcrew. The recalculation revealed a take off weight of 12,603 kg (27,785 lbs). The difference in outcome between both calculations was not traceable, but had no influence on the speeds used by the crew for take off and landing.

The total amount of fuel used during the flight was 199.5 kg (440 lbs) (UFDR data) and the weight of the aircraft at the moment of the accident was 12,404 kg (27,345 lbs). At the moment of the accident the amount of fuel in the tanks was 1,600 kg (3,527 lbs).

At the time of the accident the centre of gravity of the aircraft was at 47.2 loaded index, which was within the limits of the loadsheet envelope, between 36 and 52.2.

1.6.6 Flighthandling and Performance aspects

The SAAB 340B was certificated according to the airworthiness regulations of FAR/JAR Part 25.
Calculations, using data provided by the manufacturer, showed that in the configuration: Flaps 7°, landing gear up, one engine shut down and propeller feathered, the minimum

control speed under the prevailing weather conditions (temperature and altitude) was 99 knots. With one engine at flight idle (propeller not feathered), the calculated minimum control speed was equal to or less than 103 knots. At the moment the go around was initiated the speed was 110 knots.

Under the actual conditions (actual weight, temperature, altitude) the available climb performance deteriorated considerably with the RH engine in flight idle due to the high propeller drag. The calculation showed that in this case the climb performance in the landing configuration (20° flaps, landing gear down) was approximately 0.4% (50 fpm) and in the go around configuration with flaps 7° and landing gear up, the achievable climb gradient was approximately 2.3% (250 fpm).

1.7 Meteorological Information

General weather conditions for Schiphol on 4 April 1994, at approximately 12:50 UTC:

Behind a cold front clear, cooler, and unstable air was to determine the weather in The Netherlands. At 13:00 UTC an active trough was positioned over the southern part of the North Sea, and was moving eastward with a speed of approximately 30 knots.

Weather conditions at Schiphol:

Surface wind	:	270°/11kt Temperature 9° C Visibility > 10 km
Wind at 1,000 ft	:	250°/20kt Temperature 6° C Visibility > 10 km
Weather	:	Dry
Clouds	:	2/8 Cu, basis 1,500 ft, tops 3,000 ft
	:	4/8 Sc, basis 3,500 ft, tops 9,000 ft
	:	5/8 Sc, basis 5,000 ft, tops 9,000 ft
0° C level	:	4,500 ft
Ice formation	:	In showers moderate to severe, in Sc moderate.
Turbulence	:	In and near showers moderate, in trough severe.
Convective activity	:	Nil

During final approach of KL433 the surface wind was reported to be 280° with 8 knots and 280° with 9 knots.

1.8 Aids to Navigation

All navigational aids relevant to the accident flight were operational and functioning within their prescribed limits at the time of the accident. There was no NOTAM information regarding these navigational aids.

The runway 06 ILS glide path was flight tested on 13 December 1993 and on 4 March 1994. The runway 06 ILS localizer was flight tested on 6 April 1994. During all flight tests the runway 06 ILS was found to operate within the limits for Category III operation.

1.9 Communications and Recordings

1.9.1 Air Traffic Control

The Radio Telephony (RT) callsign of the flight was KLM 433. Standard Very High Frequency (VHF) communication was used between the aircraft and ATC and the technical quality of the communication recordings with all ATC units involved was normal.

1.9.2 Ground Operations

Ultra High Frequency (UHF) communications were used between the Tower, the NVLS Duty Manager, the Police, the fire brigade and all other personnel involved in post accident operation and coordination.

Shortly after the alarm was given that the aircraft had crashed, a malfunction of the Airside emergency communication system occurred, which persisted for about 50 minutes. Due to this malfunction no communication was possible between Airside Control Center and the fire brigade units at the scene of the accident, resulting in delays in coordinating actions with external fire fighting and rescue units. Communication between fire brigade units was not affected and functioned normal.

1.10 Airport Information

During the flight of KL433 from and to Schiphol, runways 24 and 01L were used for departures, while runway 01R was the main landing runway, according to the preferential runway system. Runway 06/24 is 3,250 by 45 meters, runway 01L/19R is 3,300 by 45 meters.

The airport field elevation is 11 feet below mean sea level, the threshold elevation of runway 06 is minus 3.6 feet. The threshold crossing height of runway 06 during ILS approach is 55 feet.

1.11 Flight Recorders

The aircraft was equipped with a Fairchild CVR and a Sundstrand UFDR. Shortly after the accident both recorders were removed from the aircraft at the accident site by the Schiphol airport fire brigade on order of the Netherlands Aviation Safety Board.

Data recorded by the CVR were of good quality. The only remark to be made concerns channel 4 (area microphone): the noise of the engines and propellers were recorded much louder than other cockpit sounds, which were hardly audible on track 4. The KLC SAAB 340B aircraft was fitted with "hot" microphones and all cockpit sounds were also recorded and clearly audible on track 2 (FO) and track 3 (Captain).

The data recorded on the UFDR were of excellent quality. Raw data were converted by use of a mainframe program. The only parameter on the UFDR which was not correctly recorded was "GMT". Apparently the timebase, used by the Flight Data Acquisition Unit (FDAU), was 26 minutes and 55 seconds off.

The CVR does not contain any time reference, but accurate timing has been established using recordings of ATC communications. The latter were recorded together with a time-base on the ATC recording system. Data on the UFDR were time-synchronized with events on the CVR. The main synchronization event was the moment during final approach when the auto pilot was disconnected. This event was recorded by two discretes on the UFDR and an identifiable sound was recorded at the same time on the CVR.

The UFDR readout plots are contained in appendix 2.

1.12 Wreckage and Impact Information

1.12.1 Accident Site Description

The accident site was located just outside Schiphol Airport, in agricultural terrain. The terrain condition of the accident site was wet and muddy. The wreckage came to rest approximately 560 meters right of the runway centreline and 1,125 meters beyond the threshold of runway 06.

1.12.2 Aircraft Wreckage Description

The aircraft hit the ground in a steep right turn with a slightly nose-low attitude and approximately 80° bank to the right. The ground speed at the moment of impact was 93 knots. During the last moments of flight, the landing gear was up and the flaps were extended at 7°, as selected by the FO when the go around was initiated. The estimated damage sequence was reconstructed and is described below:

- The RH wingtip hit the ground and was ripped from the wing,
- the outer panel of the outerwing broke off,
- the inner panel of the outer wing hit the ground and broke off outboard of the engine,
- the RH engine hit the ground, propeller blades separated, engine and inner wing section broke off from the center section,
- the RH inner wing section was projected in such a way, that it hit the RH side of the fuselage,
- the RH horizontal stabilizer tip hit the ground and the stabilizer was bent approximately 20° upwards,
- the RH side of the cockpit and RH side of the forward part of the cabin hit the ground and were damaged,
- the RH wing attachment fittings and aft cross link broke off,
- the aircraft without the RH wing rolled over to the left due to forces of inertia,
- the aircraft yawed to the right and the fuselage rolled over onto the LH wing,

pivoting around the LH wing attachments. The LH stabilizer and elevator hit the ground and were ripped from the fuselage,
- the aircraft came to rest after having turned approximately 100° to the right from the impact direction, with the fuselage lying on its left side on the left wing, blocking the two LH exits,
- the total length of the wreckage trail was 110 meters.

During the disintegration of the RH wing, the contents of the RH fuel tank vaporised and ignited. The cloud of vaporised kerosene burned for only a few seconds.
The LH wing section with its fuel contents remained intact and no further fire developed.

For wreckage and wreckage distribution, see appendix 1.

1.12.3 Technical Examination of the Wreckage

1.12.3.1 General

A full technical investigation was conducted with the assistance of specialists of the aircraft engine and propeller manufacturers.

All aircraft parts and control surfaces were accounted for at the accident site. The aircraft damage was consistent with the exposure to the excessive loads during the impact sequence and the effects of the subsequent fire. No pre-existing defects likely to have contributed to the accident were found.

1.12.3.2 Flight Controls

The flight control systems for rudder, ailerons, elevators, flaps and gust lock system have been inspected regarding their mechanical status. Many broken off and damaged parts were found. There was no indication of any malfunction in these systems.

Full flight control movement is checked in the "Cockpit Preparation" checklist, prior to engine start up, which is not registered on the UFDR. In the "Before Take Off" checklist the flight controls are again checked, to verify gustlock release. The UFDR registration showed that the rudder was used to about half the full travel; ailerons and elevator were checked to about 80% of their respective full travel.

The rudder limiter crank was found in the retracted position, offering unlimited rudder travel. During the flight neither aural nor visual rudder limiter warnings occurred, as evident from the CVR. Therefore it has been concluded that the rudder limiter did not restrict rudder travel during the final approach and go around.

1.12.3.3 Engines and Propellers

The examination of the engines and propellers did not reveal any pre-impact damages or malfunctions.

1.12.3.4 Engine Instruments

The oil pressure and temperature instruments and relevant transducers of both engines were tested. The RH engine oil pressure switch was found to have failed internally. The switch was shorted, resulting in intermittent illumination of the oil low pressure light. All other tested instruments and transducers functioned correctly, with some minor tolerance exceedances, most probably due to impact forces.

1.12.3.5 Flight Instruments

Some of the flight instruments sustained severe impact damage to such a degree that testing was not possible. These instruments were the Captain's altimeter, Vertical Speed Indicator (VSI), airspeed indicator and the Air Data Computer. The FO's altimeter and VSI showed deviations as a result from impact damage. The FO's airspeed indicator, standby altimeter and airspeed indicator were found in serviceable condition.

Given the flight recorder and CVR registrations, together with the flightcrew's actions, the Board is of the opinion that the Captain's instruments were working correctly.

1.13 Medical and Pathological Information

1.13.1 The Crew

The LH side (Captain's side) of the cockpit was almost undamaged. Investigation of the cockpit interior revealed a badly damaged pedestal with broken handles of both throttles and condition levers. The postmortem medical examination of the Captain and the damage observations in the cockpit both revealed that the Captain was not wearing his shoulder harness and that he most probably was smashed against the handles on the pedestal.

The RH side (FO's side) of the cockpit was extensively damaged and consequently the FO suffered severe injuries. As a result of the impact forces the FO suffered from amnesia. Therefore he was not able to give any useful information regarding the accident flight.

The CA was seated on the LH forward side of the aircraft, facing aft. His seat was found in good condition. The CA suffered only minor injuries, most of them caused by debris of the RH galley area, which disintegrated upon impact.

1.13.2 The Passengers

The passengers were seated throughout the aircraft. Most of the minor or uninjured passengers were seated on the RH side of the cabin. The serious injured passengers were seated on the LH side of the cabin. Injuries varied from broken legs and arms to cuts and bruises, pelvis fractures and brain concussions. Of the wounded passengers, 8 were seriously injured and 11 suffered only minor injuries.

The two deceased passengers were seated at 3C and 4C which were located close to the impact point of the crash. See also section 1.15.1. Both passengers died instantly, or very shortly after the accident, due to severe traumatic injuries.

1.14 Fire

The blockfuel of 1,800 kg of Jet A1 fuel was equally divided over both wing tanks. At the time of the accident, approximately 200 kg of fuel had been used.

The right wing was torn off the aircraft upon impact and disintegrated. The fuel from the tank of this wing ignited immediately. The fuselage and the left wing remained connected to each other when they were forced away from the ignited fuel. Although severely damaged, no fuel was leaking from the tank in the LH wing.
The main fire (from the disintegrated right wing) burned out after a few seconds, and only some small flames remained visible at the debris of the right wing, spread around the main parts of the aircraft.

The fire brigade arrived at the scene of the accident about one minute after the crash took place. They were on alert and were positioned alongside the landing runway, approximately 500 meters from the accident site. At the scene of the accident, the fire brigade used the following fire fighting equipment:

- 4 Crash tenders,
- 1 Rapid Intervention Vehicle (RIV),
- 1 water canon vehicle,
- 1 emergency assistance vehicle,
- 1 equipment container vehicle.

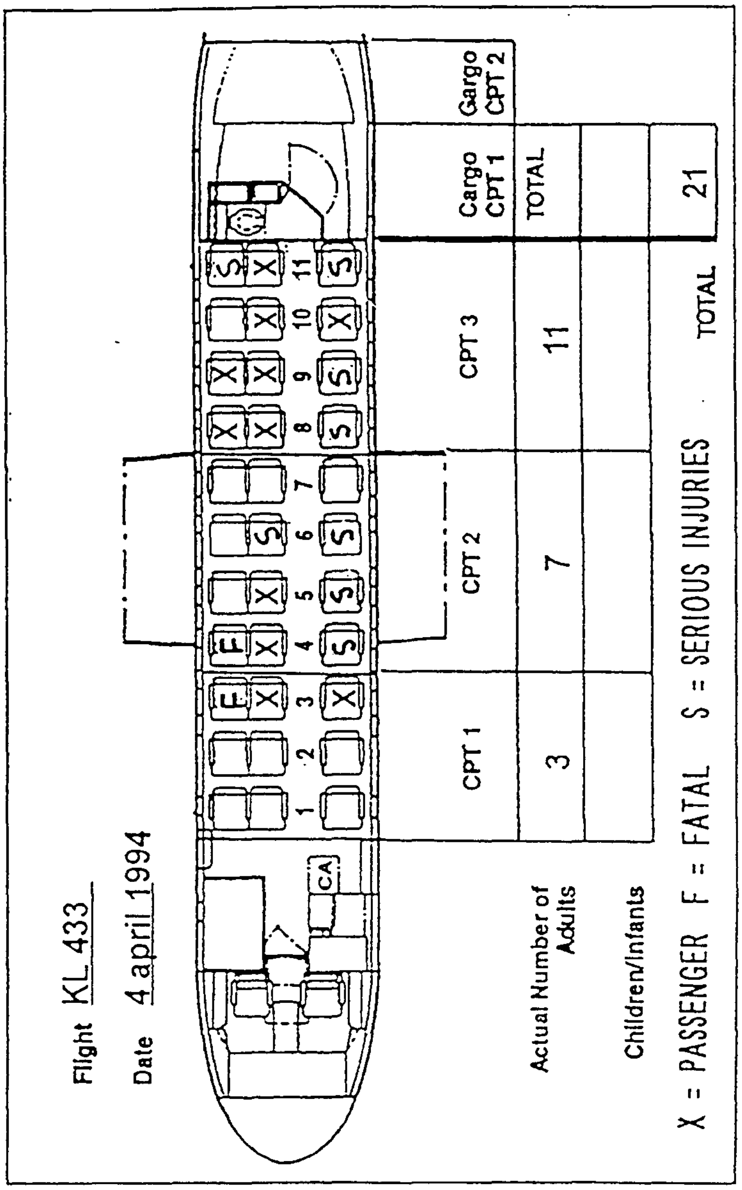
The aircraft crashed in very wet and agricultural terrain consisting of greasy clay. Due to the nature of the terrain, and the fact that the main wreckage was not on fire, no risk was taken with the heavy vehicles to reach the wreckage of the aircraft. Fire fighting personnel, equipped with portable fire extinguishers, hurried to the wreckage, while hoses were rolled out. The small remaining fires were extinguished by the fire brigade and no other new fires ignited. During the rescue operations, the hoses remained permanently manned and aimed at the wreckage, until all occupants of the aircraft were removed and there was no more risk of new fires to ignite. Total fire fighting and protection action lasted several hours.

As a result of the nature of the agricultural terrain rescue vehicles were unable to enter the terrain. A nearby farmer and his family assisted in the transportation of the injured occupants with a tractor-drawn trailer.

1.15 Survival Aspects

1.15.1 Seating Plan

SEATING PLAN



Saab 340B Passenger Cabin Compartments.
Seating of passengers at moment of accident.

1.15.2 Interior Damage and Survivability

1.15.2.1 General

The following paragraphs, describing the survivability aspects are based on the status of the aircraft as examined in the recovery hangar, after salvage. It is known, that during the rescue and salvage operations extensive further damage was inflicted to the wreckage. This reportedly included the cutting of one or more holes in the fuselage, the cutting of seat legs to separate them from the wreckage, the cutting of some of the wing-to-fuselage joints and the removal of items such as baggage.

The impact point on the aircraft was at the RH side of the aircraft, with most of the severe structural damage (besides the disintegrated RH wing) at the RH side of the cockpit and first forward part of the RH side of the fuselage.

1.15.2.2 Cockpit

The cockpit was configured in a standard two-pilot configuration, with an observer seat in the cockpit-to-cabin passage. The Captain was seated in the LH seat, while the FO occupied the RH seat.

The RH side of the cockpit showed severe impact damage. The LH side was virtually undamaged and all four cockpit windows were intact. An examination of the cockpit interior showed the main instrument panel, the glareshield panel, overhead panels and the left side panels all in position. The center panel, although still in position, was moved at its rear end and to some extent to the left. The RH side panels were displaced and here a small hole was found. The two cockpit backwalls were displaced. The LH backwall (consisting of the avionics rack with LH galley and the cabincrew seat attached) was moved slightly forward. The RH backwall was moved to the left and rested against the LH backwall, with the folded observer seat in between. Both pilot seats were still attached to the floor rails and were virtually undamaged.

In order to ascertain the correct seating position of both pilots, an attempt was made to determine the position of both pilot seats using impact marks on the seat rails.
This was not possible due to the large number of impact marks present.
Using photographs of the cockpit interior, taken immediately after the accident it could be concluded that the pilot seats were in a correct position, enabling both pilots to use the flight controls to full extent.

The seatbelts of both pilot's seats as well as the inertial reels functioned correctly when tested after the accident. The screwdrive adjustment of the FO's backrest had been driven past its limit, with the consequence that the retaining function of the shoulderstraps was lost. The cause was traced to be an inadvertent actuation of the backrest release handle, on the right hand side of the seat as a result of the deformation of the RH cockpit sidewall.

1.15.2.3 Galley

The RH galley was displaced inboard with most doors open. The red turn buckles were generally found in the closed position. The LH galley was basically still in position. All drawers were found in the closed position. The red turn buckles were found in the open position.

1.15.2.4 Cabin

The cabin was configured with 11 rows of 3-abreast passenger seats, with double seats on the RH side and single seats on the LH side of the aisle. The cabincrewmember seat was virtually undamaged. The seatbelt and shoulderharness were serviceable. The foldable chairs were in their stowed position.

The underfloor structure of the cabin, forward of the wings, was attached, but the floors and seat rails were missing. Seats were missing up to and including seat row 6 except for seats 4B and 5A, which were still in place, with one leg attached to the rails. All seats from row 7 and aft were still in place, with all legs attached and without any significant damage, except for seat 7A. The side walls were still attached from seat row 9 and further backwards.

The luggage bins and Passenger Service Unit (PSU) panel row on the RH side were attached, except that close to the fuselage break the bins drooped down approximately one feet. There were four bins in the fuselage section.

1.15.2.5 Exits

The cockpit has two means of escape: An overhead hatch and via the cabin.
The cabin has four means of escape: The forward passenger door, which qualifies as a type I passenger emergency exit, a type II emergency exit on the opposite side and two type III emergency exits overwing adjacent seat row 6.

As a result of the deformation of the RH side of the cockpit, the passage between the cockpit and the cabin was obstructed. Evacuation/rescue of the pilots had to be conducted through the overhead escape hatch.

The position of the aircraft after impact, lying on its LH side, precluded the use of the main passenger door as well as the LH emergency overwing exit for evacuation. The RH overwing exit was difficult to use, being "overhead" at that time. Rescuers cut through the already deformed RH side of the fuselage, between the forward exit and the overwing exit, in order to be able to extricate the occupants.

1.16 Tests and Research

1.16.1 Procedures

The investigation revealed that differences exist between the KLM Cityhopper SAAB 340B Aircraft Operations Manual (AOM) and the Manual issued by the manufacturer. These will be discussed in paragraph 2.7.

1.16.2 Pilot Selection and Training

1.16.2.1 Main requirements pursuant to Netherlands Aviation Law

Requirement for the issue of a personnel licence for airline operation:

A. For aircraft with MTOW up to 5,700 kg

Commercial Pilot Licence (CPL-B3) with Instrument Rating (IR)
- At least a total of 200 hours, of which:
  - at least 150 hours Pilot in Command (PIC), of which 50 hours cross-country flights;
  - at least 40 hours Instrument Flying (IF);
  - at least 5 hours instruction during night.

B. For aircraft with MTOW up to 20,000 kg

Senior Commercial Pilot Licence (SCPL-B2) with IR
- At least a total of 900 hours, of which:
  - at least 200 hours PIC;
  - at least 25 hours PIC (or 50 hours as FO) at night;
  - at least 10 hours PIC (or 20 hours as FO) during cross country flight at night;
  - at least 20 hours IF.

For airline operations with SAAB 340B (MTOW 13.155 kg) the law requires:

- For the Captain a Senior CPL (SCPL-B2) with IR and type rating;
- For the First Officer a Commercial Pilot Licence (CPL-B3) with IR and type rating.

1.16.2.2 KLC Initial Requirements

All pilots will enter KLC as FO and depending on their progress will eventually be promoted to Captain.

Apart from age limits and education requirements KLC requires:

- Practical CPL-B3 with IR:
- RT Licence;
- Theoretical Netherlands SCPL-B2/B1 Licence;

- Multi-engine rating, with:
  * If in possession of a Netherlands CPL, 50 hours on medium, Netherlands registered, twin engine aircraft.
  * If not in possession of a Netherlands CPL, 250 hours on medium twin engined aircraft. In addition a Netherlands twin rating must be obtained.

1.16.2.3 KLC Selection

Selection of Pilots for KLC consists of:
- Psychological test at the Netherlands Aerospace Medical Centre (NLRGC),
- Psychological test "Psychotechniek",
- Psychodiagnostic test at Mr. H. Havinga (psychiatrist),
- Medical test at KLM Medical Services,
- Security Check,
- Interview.

1.16.2.4 KLC Type Qualification

After passing the KLC selection criteria the pilots will start with the type qualification training which for the SAAB 340B consists of:
- Flight Simulator Training at FST BV,
- Computer Based Technical training,
- Simulator Training SAAB 340B, consisting of 2x6 sessions of approximately 4 hours, 24 hours as PF and 24 hours as PNF,
- Examination Group I/II/III[1] on Simulator,
- Aircraft training on SAAB 340B aircraft,
- Examination Group IV[2] on aircraft,
- Route Training,
- Route Check.

When the route check is completed and assessed as Standard or better (See also paragraph 1.16.2.7) the pilot is ready for line flight duties with a normal crew.

1.16.2.5 KLC Captain's Training/Qualification

All pilots will initially be employed for a minimum of approximately one year as FO. When a FO is selected for Captain's training a few flights with a flight instructor are to be made.
Command Promotion Assessment Forms are used and when the FO is assessed as

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1 Group I : Preflight preparation
Group II : General flying
Group III : Procedures

2 Group IV : Circuits and landings

"suitable" the Captain's training starts.
This training consists of:
- 6 hours Simulator Training (3 sessions of 2 hours), during one of these sessions a Crew Proficiency Check is performed,
- 2½ hours aircraft training,
- Route Training,
- Examination of handbooks.

When the training is completed and assessed as Standard or better (See also paragraph 1.16.2.7) the FO will be promoted to Captain.

1.16.2.6 RLD Inspection of KLC

RLD supervises all operators and conducts spot checks on all aspects of operation on a regular basis. The last inspection of KLC was conducted on 15 July 1993. This inspection was specifically directed to simulator training with regard to SAAB 340B Category II operations.

1.16.2.7 KLC's Assessment Procedure of Proficiency Checks

Assessment
Assessment on the various subjects of proficiency checks is graded with the following abbreviations:

AS : Above Standard
S+ : Standard Plus (i.e. the upper portion of the standard band)
S : Standard
S- : Standard Minus (i.e. the lower portion of the standard band)
BS : Below Standard

Standard Performance
Standard performance is difficult to define. It reflects the required quality level as deducted from explicit requirements arrived at by the company, after careful consideration.
The minimum performance accepted by the company corresponds with "Standard Minus".

The "Standard Minus" performance level:
- Does not equal the minimum level required by law; in practice the "Standard Minus" performance level is much higher.
- Is a safe and acceptabel performance level; "Standard Plus" and "Standard Minus" should be seen as variations in the "Standard Band", nothing more. It is meant to indicate the pilot his/her (relative) strong and less strong points.

The average level of performance is in no way related to the standard required.

A proficiency check performance reflects a momentary observation; previous experience may not be of influence on the assessment.

1.16.2.8 Training/Qualification Captain of Flight KL433

Date	Examination	Result
31-03-1992	Type rating SAAB 340B Group I, II, III (Simulator)	Failed
09-04-1992	Type rating SAAB 340B Group IV (Aircraft)	Failed
16-04-1992	Type rating SAAB 340B	Passed
25-11-1992	Proficiency check simulator (FO)	Passed
24-03-1993	Proficiency check en route (FO)	Passed
01-09-1993	Selected for Captain's training	
September 1993	Crew Management Course 1	-
30-09-1993	Proficiency check simulator	Passed
27-09/17-11 1993	Captains training en route	-
17-11-1993	Promoted to Captain	-
	Proficiency checks as Captain not yet due	-

1.17 Organizational and Management Information

KLM Cityhopper is 100% affiliated with KLM. KLC has its own operational responsibility. The operation department is headed by a KLC manager of flight operations, who reports directly to the KLC Managing Director. KLC's operational structure is based on the specific demands of the regional airline environment. KLC mirrors, where applicable, the professional standards of KLM.

On April 1, 1991, NLM Cityhopper Ltd and Netherlines Ltd merged into one company under the name of KLM Cityhopper Ltd. After this merger, operational differences which existed in the two regional airline companies, had to be taken care of. In addition, standardization of the different aircraft types within KLC had been part of the management task already.

Recruiting and selection of pilots is conducted independently, with KLM standards used as a guideline. KLC has its own training program and simulator contracts.

1.18 Additional Information

The Air Branch of the Netherlands State Police assisted with questioning witnesses and obtaining information for the investigation.

1.19 Useful or Effective Investigation Techniques

Not applicable.

2 ANALYSIS

2.1 Oil Pressure Warning

Post crash examination of both engines did not reveal any pre-existing defects which could have affected normal engine operation. No evidence was found of any degradation of power, other than initiated by the pilot. Examination of the pressure indication related components of the RH engine oil system revealed that the pressure switch closed as a result of an internal intermittent short circuit. No evidence was found of any malfunction of the oil pressure transducer.

2.1.1 Technical Aspects

From the information available, it can be concluded, that the RH engine oil pressure CWP light illuminated as a result of a short circuit in the oil pressure switch. This short circuit closed the switch and as a consequence the oil pressure warning light on the CWP was activated. The RH engine oil pressure transducer was found operating normal and it must be concluded that the actual engine oil pressure was correctly presented on the RH engine oil pressure indicator in the cockpit.

2.1.2 Flightcrew Handling of Oil Pressure Warning

At 12:30:46 the Master Warning sounded for the first time. The FO immediately announced: "Right engine oil pressure", confirmed by the Captain with: "Check". The Captain then slowly retarded the RH power lever to the flight idle position. Retarding the power lever does not form part of the ECL procedure. Possibly this was done with the intention to prevent damage to the RH engine. As a result of this action the oil pressure of the RH engine decreased, which is normal when a large power reduction is applied. The flightcrew commenced with the ECL procedure as follows:

[Translated version of relevant part of the CVR transcript]

Time (UTC)	*Source*	*Transcript*
12:30:58	*Captain*	*Take action*
12:31:00	*FO*	*Take action. Emergency checklist... Engine and propeller engine oil pressure low... 15B*
12:31:16	*FO*	*15B... engine oil pressure low, engine oil and prop oil pressure...checked. Well, engine oil pressure uh...that is this one, this one is slightly lower than the other one, but...*
12:31:32	*FO*	*It is decreasing*
12:31:33	*Captain*	*Yes*
12:31:34	*FO*	*Yes, it is decreasing*
12:31:37	*FO*	*If only prop oil pressure, apply uh...uh...if only prop oil pressure low, apply propeller oil pressure low procedure, well... that is not the case...*

12:31:43	*FO*	*Then next...engine oil pressure control warning panel light on... or, engine oil pressure below thirty psi*
12:31:54	*Captain*	*That is not the case.*
12:31:57	*Captain*	*But it is still normally in the green, that is what's so strange*
12:31:59	*FO*	*That's funny, isn't it?*
12:32:00	*Captain*	*Yes*
12:32:01	*FO*	*It is decreasing uh... [captain's first name] engine oil pressure light on, or...*
12:32:12	*Captain*	*Yes, but we are not going to continue with this...*

Both pilots concluded that the RH engine oil pressure was lower than the LH engine oil pressure and furthermore that the RH engine oil pressure was decreasing. Neither pilot realised that the lower and still decreasing RH engine oil pressure was most probably a result of the retardation of the RH power lever, still continuing at this stage. The FO continued with the engine oil pressure low procedure in the ECL.

[Translated version of relevant part of the CVR transcript]

Time (UTC)	*Source*	*Transcript*
12:32:13	*FO*	*No, no, no, no, no, engine oil pressure..., well light ór below thirty psi, that is not the case. So one of two things... If so, than you may continue, but if they are both on, so if the light is on and the pressure is below thirty psi, then it must be shut down.*
12:32:33	*Captain*	*Ok*
12:32:37	*Captain*	*Well, what do we have? Is it an, ...above fifty?*
12:32:41	*FO*	*Yes*
12:32:42	*Captain*	*And we... [set] the warning pressure is...*
12:32:43	*FO*	*Yes, the light is on. So the light is on, or below thirty, well...*
12:32:50	*Captain*	*Continue normal operation*
12:32:51	*FO*	*Yes*

The redundancy in the engine oil low pressure indication system is to prevent a situation where an incorrect indication by the warning light or an incorrect indication of the pressure indicator could lead to the wrong conclusion. Flightcrew action indicates that both pilots did not understand the system logic.

After completion of the ECL procedure both pilots acknowledged that the RH engine oil pressure was above 30 psi and that normal operations could be continued.

2.2 Decision Making Process

2.2.1 General

The ECL procedure was concluded with both pilots agreeing with the instruction "continue normal operation". The ECL phraseology "continue normal operation" although not specified in the ECL or the KLC AOM should be interpreted as an indication that the flight can be continued using normal engine operation and normal flight techniques. It does not necessarily mean that the flight should proceed to its destination.

2.2.2 Decision to Return to Amsterdam Airport

Considerations not to continue to the destination may be various and could have been for instance a possible maintenance delay or dispatch restrictions once landed. However, from the CVR, there are no indications that these considerations played a role in the flightcrew's decision to return to Amsterdam airport.
The KLC AOM was not consulted for possible dispatch restrictions.
From the CVR conversation it can be concluded that the Captain remained in doubt whether his decision to return was correct.

2.2.3 Decision to Maintain Flight Idle on the RH Engine

Although the flightcrew diagnosed the problem and concluded "continue normal operation" the Captain kept the RH engine running in flight idle. If the flightcrew would have had any serious doubts about the condition of the RH engine they should have carried out the engine shut down procedure followed by the OEI checklist procedure. The decision by the Captain not to use the RH engine at this stage of the flight may have been influenced by his prior experience as FO with an emergency resulting in a return to and landing at Amsterdam under similar conditions. As it is, the reasons for this decision were not discussed between the pilots and the RH engine was left operating in flight idle.

The crew briefing during the descent would have been the last opportunity for the pilots to realise the consequences of an approach with an engine in flight idle. However as the RH engine was not actually shut down, they did not consider the situation as an OEI approach. Rather than discussing the situation the Captain simply stated, on the suggestion from the FO, "standard 06, 111.1 standby, 061" and consequently the standard All Engine Operative (AEO) procedure with associated threshold speeds was followed.
From the CVR at 12:42:21 and 12:42:26 one can derive that both pilots were of the opinion that they would have less problems handling the aircraft keeping one engine in flight idle.

[Translated version of relevant part of the CVR transcript]

Time (UTC)	*Source*	*Transcript*
12:42:21	*FO*	*I also think, that because you are flying in flight idle, that because of that you have less problems than you might have had otherwise*
12:42:26	*Captain*	*Yes*

The above conversation was to all probability related to a comparison with a situation whereby one engine is shut down and the propeller feathered. It illustrates the lack of knowledge of operations with one engine in flight idle and it can be concluded that both pilots were not aware of the consequences related to making an approach with one engine in flight idle.

2.2.4 Choice of Runway 06

After contacting Schiphol Approach, flight KL433 was asked to advise on their preference for runway 06 or runway 01R. The Captain decided on runway 06. Even if at that time the Captain did not fully realise that by his choice of runway 06 he accepted a tailwind approach/landing situation, 3 minutes later this fact was pointed out to him by the FO. He acknowledged this information.
By his choice of runway 06 the Captain accepted a tailwind component which, though within limits and acceptable under normal conditions, is not recommendable in a single engine situation as it aggravates the speed stabilization problem.

2.3 Aircraft Handling

2.3.1 Descent

Due to the tailwind component on return the aircraft was too high for a straight-in landing and Schiphol Arrival had to vector KL433 into an S-turn in order to correctly position the aircraft for the ILS approach on runway 06. The too high position of KL433 in relation to the distance resulted in a descent with both engines running in flight idle. As a consequence the pilots were not confronted with an asymmetrical power setting until just prior to the final approach.

From the moment power was applied on the LH engine the pilots had little time to become accustomed to the unusual flight condition with high asymmetric drag. This resulted in a non-stabilized power/airspeed situation when entering the approach phase of the flight.

2.3.2 Final Approach

The final approach was started when the flaps were extended to 20°, just prior to passing the Outer Marker at 1,300 feet RA.
The aircraft was established on the ILS for runway 06 and was flying with the autopilot

engaged. Airspeed/power/pitch stabilization had still not been achieved.
The IAS was reducing from 142 knots to the target approach speed of 125 knots and LH engine torque was kept at 28%.

While descending through 1,080 feet RA at 12:44:22 LH engine torque was slowly increased to stop the speed reduction, reaching 60% at 12:44:42. The RH engine was kept at flight idle. The IAS however further reduced to 120 knots and then started to increase. At about 600 feet the autopilot was disconnected. The IAS increased to 130 knots and the aircraft became high on glidepath. The Captain gradually reduced torque to approximately 30%, allowing the IAS to reduce and the aircraft to get back on glidepath. At approximately 230 feet the ruddertrim was neutralized.

When the aircraft became low on glidepath the Captain increased pitch and advanced the LH engine torque to 40%. This power increase was insufficient and combined with the increased pitch resulted in a speed decay below the planned threshold speed of 119 knots. At 12:45:41 the FO warned: "Watch your speed", on which the Captain reacted with a brisk increase of the LH engine torque to 65%.
The aircraft yawed to the right and was displaced to the right of the runway. The Captain, probably in a reaction, pulled the power lever back to 40% and realising, that a landing from this position could not be accomplished, aggressively increased LH engine torque to 98% and initiated a go around.

From the UFDR it was evident that as long as the autopilot was engaged automatic ruddertrim was used to compensate for asymmetric power. However the ruddertrim is inherently slow and does not compensate immediately for fast power changes. The UFDR shows that the Captain applied little or no rudder to compensate for the lagging trim. Instead he corrected the resulting roll exclusively with ailerons. From the moment the autopilot was disengaged rudder deflection was kept roughly in the same position, even during substantial powerchanges and neutralizing the trim.

It must be concluded that throughout the entire approach the aircraft never stabilized in power, airspeed and pitch which in all probability was caused by a lack of awareness of the Captain with the existing situation, i.e. one engine in flight idle instead of feathered with consequently a higher drag and higher asymmetrical forces. Insufficient use of rudder resulted in the displacement of the aircraft to the right of the runway.

2.3.3 Go Around

During the go around manoeuvre again no additional rudder was used to compensate for the high asymmetrical power. The resulting roll was counteracted only with ailerons and the aircraft continued to roll to the right. As the pitch was substantially increased during the go around IAS further dropped and the bank angle to the right increased.
At 12:45:58 the bank angle reached 12° with a pitch of +12° and an IAS of 103 knots and the stall warning was activated. Some additional rudder was applied. Pitch was reduced to +6° but immediately increased again to +9° at 12:46:03. Combined with a reduced IAS of 96 knots and a bank angle of 30° the stall warning was activated for the second time. Only at this moment full left rudder was applied. As a result of the low IAS

and the large bank angle control of the aircraft could not be regained.

The only viable option for the flightcrew at this stage would have been a power increase on the RH engine. Apparently the use of the RH engine was mentally blocked.

2.4 Crew Resource Management

Crew Resource Management (CRM) is the effective use of all resources available to the flightcrew, including equipment, technical/procedural skills, and the contributions of crewmembers and others.
Situational awareness is the continuous extraction of information from a system or environment, the integration of this information with previous knowledge to form a coherent mental picture and the use of that picture in directing further perception, anticipating and responding to future events.
Effective communication between crewmembers is essential to share this information, to direct actions and to share what one is thinking.
The transcript of the CVR is the main source for the assessment of CRM, communication and situational awareness in this analysis.

The following examples of flightcrew behaviour are indicative for the lack of explicit and efficient communication, situational awareness and CRM skills.

After the engine oil pressure low warning the flightcrew used the ECL to diagnose the situation. The Captain, at the end of the checklistprocedure, came to the right conclusion: "Continue normal operation". The engine power, however was not restored. Although there was time available, the flightcrew did not thoroughly discuss the consequences of the aircraft configuration for the remainder of the flight, nor did they consult the AOM/Dispatch Deficiency Guide. The Captain merely declared not to proceed to Cardiff and to return to Amsterdam. According to a statement of the chief-instructor of the SAAB 340 division, he and the Captain (at that time FO) had experienced a similar situation (engine oil pressure low warning) during which the situation was thoroughly discussed, and then the decision was made to use both engines in case of a go around.

The Captain chose, without any discussion with the FO, runway 06 for landing. He did not ask for the wind. At first contact with ATC/Arrival a wind of 250° with 10 knots was reported. The FO informed the Captain of a 10 knots tailwind (the maximum allowable tailwindcomponent is 10 knots), again without any discussion.

Although the aircraft was in an abnormal configuration (one engine at flight idle power), during the execution of the descent checklist the Captain accepted without any discussion the suggestion of the FO to use the abbreviated procedure: "Standard zero six".

By not taking into account the configuration of the aircraft and the environmental factors the Captain did not show good situational awareness. The lack of explicit and effective communication between the Captain and the FO contributed to this lack of situational awareness.

The FO communicated most of the time in a non-assertive way. His statements and remarks showed at times good insight but were mainly presented as suggestions, not challenging the Captain to behave in a more proactive way.

The lack of Crew Resource Management skills, poor communication and lack of situational awareness played an essential role in the chain of events leading to the accident.

CRM is legally not yet required.

KLC was in the process of developing Crew Management Courses (CMC-1 and CMC-2). CMC-1 had been introduced; the Captain had followed this course and the FO was scheduled for it. CMC-2 was not yet available.

According to statements of KLC flight instructors and the head of KLC flight operations however, the Captain had sufficient knowledge and experience to be able to handle an emergency as occurred.

2.5 KLC Pilot Selection and Training

KLC's selection criteria and training program are well above minimum legal requirements.

The analysis of the Captain's training history revealed that he experienced n-1 problems during type rating. These problems were at that time corrected by additional training and re-examination. He passed his type rating examination at 16 April 1992 and started flying as FO with KLC.

From that moment until the time that he was found eligible to start the Captain's training the only occasion to assess his n-1 performance was the Simulator Proficiency Check on 25 November 1992. Although this check was assessed as proficient, remarks indicated that he again experienced n-1 problems and had been assessed "Standard Minus" on this subject.

At 27 September 1993 he started the Captain's training. No further n-1 problems occurred and on 17 November 1993 he was promoted to Captain.

The Board realises that in general, proficiency check performance reflects a momentary observation and that a candidate should be given the opportunity to rectify a "Below Standard" and multiple "Standard Minus" performance during a re-examination or by additional training. The Board is however of the opinion that recurrent problems in a specific area of operation should not be addressed merely by additional training and re-examination.

A selection and training program should be organized in such a way that problems of this nature are recognized as potentially structural and in that case should be solved in other and more reliable ways.

2.6 Single Engine Performance SAAB 340B

When the go around was initiated the actual speed (110 knots) was higher than the minimum control speed (103 knots) and with the proper flight technique the aircraft could have been kept under control.

Performance calculations showed that in the configuration with flaps 7° and landing gear up, the available climb gradient of 2.3% should have made a go around possible.

2.7 Procedures

The flightcrew had to operate the aircraft with procedures and instructions as laid down in the KLM Cityhopper SAAB 340B AOM. Relevant paragraphs were checked and compared to the AOM issued by the manufacturer. The Board considers the found differences not directly contributing to the accident. However several procedures stated in the KLM Cityhopper AOM were either unclear or not complete.

2.7.1 Engine & Prop Oil Pressure Low Procedures

One oil low pressure warning light is used both for engine and propeller low oil pressure. The ECL procedure asks for a crosscheck of the engine oil and propeller oil indicators to validate the warning. The subsequent engine oil pressure low ECL procedure is clear and complete.

If however the propeller oil pressure low ECL procedure is applicable and the propeller oil pressure is between 5 and 25 psi then the power lever has to be placed in flight idle and the condition lever in minimum, resulting in a flight condition similar to flight KL433. Neither SAAB nor KLC ECL does give further guidance whether a flight in this case should use OEI or AEO procedures.

2.7.2 Ruddertrim Procedure

On short final at approximately 230 feet the ruddertrim was neutralized, which action contributed to the developing lateral instability.

In the SAAB 340B manufacturer's AOM it is advised to center the yaw trim ("trim zero") prior to the landing flare. No information regarding trimming during (manual) OEI operations is provided in the KLC SAAB 340B AOM.

It is understood from interviews with KLC SAAB 340B instructors that pilots are trained to use autoflight as long as possible, taking the benefit of rudder trimming by the autopilot. There is no common procedure for neutralizing the trim after autopilot disengagement.

2.7.3 Approach Speeds

In the AOM a procedure should be given how to determine approach speeds in normal and abnormal conditions. This determination should be clear and unambiguous.
In general the final approach speed should be maintained until approaching the threshold before reducing to V_{TH}. This V_{TH} should be increased with a wind correction, if applicable a malfunction correction should be applied, and a maximum stated. The minimum final approach speed is V_{TH} + a defined increment (e.g. 10 knots).

In the KLM Cityhopper AOM:
- The approach speed determination for all conditions is not always clear;
- the correction for moderate windspeeds is insufficient;
- the prescribed approach speed below 300 feet is potentially unsafe as the increment to V_{TH} is deleted in Visual Meteorological Conditions (VMC) leaving no margin for low level wind change, turbulence or performance decreasing windshear.

2.8 Flight Safety

2.8.1 Cabin/Passengers Preparation

The *"No Smoking and Fasten Seatbelt"* signs were switched on well before the accident and all the passengers were properly strapped in. However, due to the early arrival, cabin service was not finished. Since a normal landing was expected to take place, no special warnings or briefings were necessary.

2.8.2 Survivability

Survivability was conditioned by the absence of fire in the main wreckage. Generally the impact forces were not extreme. The fatal injuries to the two passengers resulted from direct contact with damaged parts of the fuselage during the main impact. However, due to the lateral direction of the impact forces, a number of passengers were seriously injured.

As a result of the deformation of the center fuselage and the consequent release of a small number of seats in that area, evacuation and rescue were hampered. Also the position of the fuselage, lying on its LH side, hampered evacuation and rescue, as the LH exits were not accessible and the RH exits were difficult to reach. In case of cabin fire this would have been fatal.

2.9 Air Traffic Control

ATC handled the emergency efficiently, offering a choice of two runways for landing. Consideration was given to possible controllability problems and the aircraft was vectored without delay for an ILS approach runway 06. Frequency changes were minimal.

2.10 Fire Fighting & Rescue Services

Fire fighting and rescue operations were conducted efficiently. The decision not to enter the soft terrain with the heavy fire fighting vehicles was a prudent one, and, in view of the absence of fire in the main wreckage, it is considered correct.

The malfunction of the Airside emergency communication system did not affect the communication between the units at the scene of the accident. The evaluation of the fire fighting and rescue actions by Airside Operations revealed a number of shortcomings. The Board is of the opinion that these shortcomings did not influence the outcome of the fire fighting and rescue actions.

3 CONCLUSIONS

3.1 The flightcrew was licensed, qualified and certified to operate the aircraft.

3.2 Meteorological conditions were on itself not a factor in this accident.

3.3 Prior to the flight the aircraft was fully serviceable.
Weight and balance were within limits.

3.4 During climb the RH engine oil pressure switch failed, resulting in aural and visual warnings in the cockpit.

3.5 In a reaction to the oil pressure warning the Captain slowly retarded the right hand power lever to flight idle.

3.6 The flightcrew did not realise that the decrease of the RH engine oil pressure was the result of the power reduction.
Although the oil pressure remained within normal operating limits they - contrary to ECL procedures - kept the RH engine running in flight idle.

3.7 The Captain did not realise the consequences of flying with one engine in flight idle and was not able to anticipate correctly on the airspeed variations which resulted in an approach not stabilized in power, airspeed and pitch during the final approach. A situation which was possibly aggravated by the tailwind component.

3.8 Neither the manufacturer's AOM nor the KLC's AOM of the SAAB 340B contains guidance material concerning the consequences of an engine in flight idle.

3.9 While actually using only one engine the return flight and approach were executed using All Engine Operative procedures.

3.10 Incorrect use of rudder resulted in a displacement of the aircraft to a position right of the runway, from which a landing was not feasible and a go around was initiated.

3.11 During the go around inadequate use of the flight controls by the Captain resulted in loss of control.

3.12 Crew Resource Management during the flight was virtually non-existent.

3.13 Performance calculations showed that under the prevailing circumstances, with one engine in flight idle, using proper flight techniques, a go around could have been made.

3.14 Except for the failed engine oil pressure switch there was no evidence of any other failure or defect on the aircraft, including engines and systems.

3.15 The accident can be classified as generally survivable. Failure to utilize available restraint provisions (shoulder straps) in the cockpit resulted in a fatal injury.

3.16 The concept of KLC's Pilot Selection and Training is above legal requirements. The current assessment techniques did not allow the recognition of the nature of the n-1 problems of the Captain as possibly structural.

3.17 Several procedures in the KLC AOM/ECL for the Saab 340B were either unclear or not complete:
- Engine and Prop oil pressure low procedure;
- determination of approach speeds;
- neutralizing of rudder trim during One Engine Inoperative approach/landing phase.

3.18 ATC, fire fighting and rescue services handled the emergency and the accident in a proficient way. The fact that NVLS fire fighting and rescue vehicles did not traverse non-stabilized agricultural terrain did not influence the survivability aspects.

4 PROBABLE CAUSES

Inadequate use of the flight controls during an asymmetric go around resulting in loss of control.

Contributing Factors

- Insufficient understanding of the flightcrew of the SAAB 340B engine oil system.
- Lack of awareness of the consequences of an aircraft configuration with one engine in flight idle.
- Poor Crew Resource Management.

5 RECOMMENDATIONS

5.1 Evaluate and improve where necessary the current assessment techniques.

5.2 Establish a Crew Resource Management training and integrate CRM into Command Promotion Assessment.

5.3 Evaluate/improve KLC SAAB 340B AOM/ECL information to contain guidance on:
- Use/prohibition of engine flight idle operation;
- neutralizing ruddertrim during One Engine Inoperative approach/landing phase.

5.4 Review the procedure in the KLC AOM how to determine correct approach speeds.

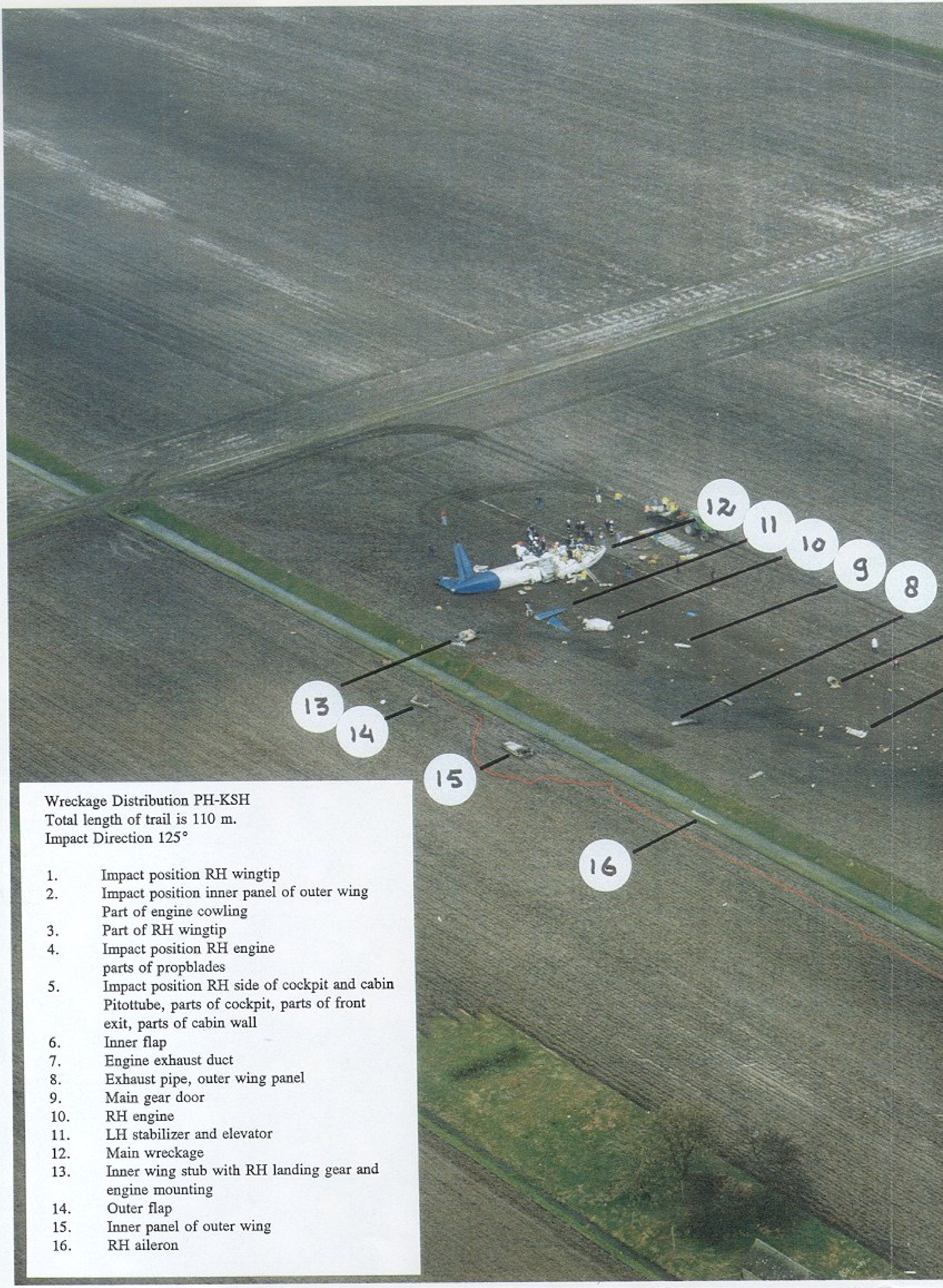
5.5 Evaluate/improve capability of fire fighting and rescue vehicles to traverse non-stabilized terrain.

APPENDIX 1

PHOTOGRAPHS

1. The aircraft during the go around
2. Wreckage distribution

Photo courtesy mr H.J.ten Cate



Wreckage Distribution PH-KSH
Total length of trail is 110 m.
Impact Direction 125°

1. Impact position RH wingtip
2. Impact position inner panel of outer wing
   Part of engine cowling
3. Part of RH wingtip
4. Impact position RH engine
   parts of propblades
5. Impact position RH side of cockpit and cabin
   Pitottube, parts of cockpit, parts of front exit, parts of cabin wall
6. Inner flap
7. Engine exhaust duct
8. Exhaust pipe, outer wing panel
9. Main gear door
10. RH engine
11. LH stabilizer and elevator
12. Main wreckage
13. Inner wing stub with RH landing gear and engine mounting
14. Outer flap
15. Inner panel of outer wing
16. RH aileron

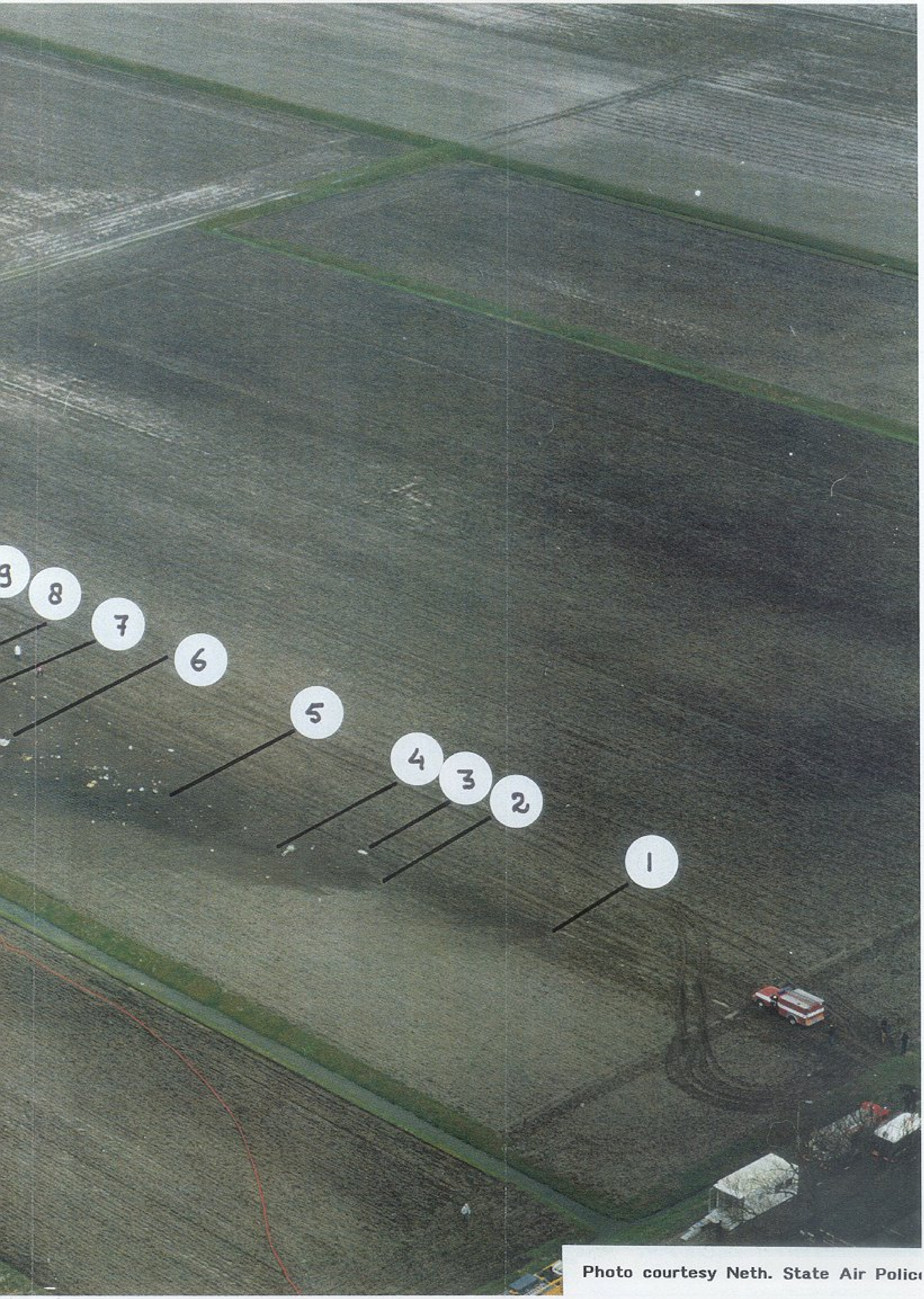
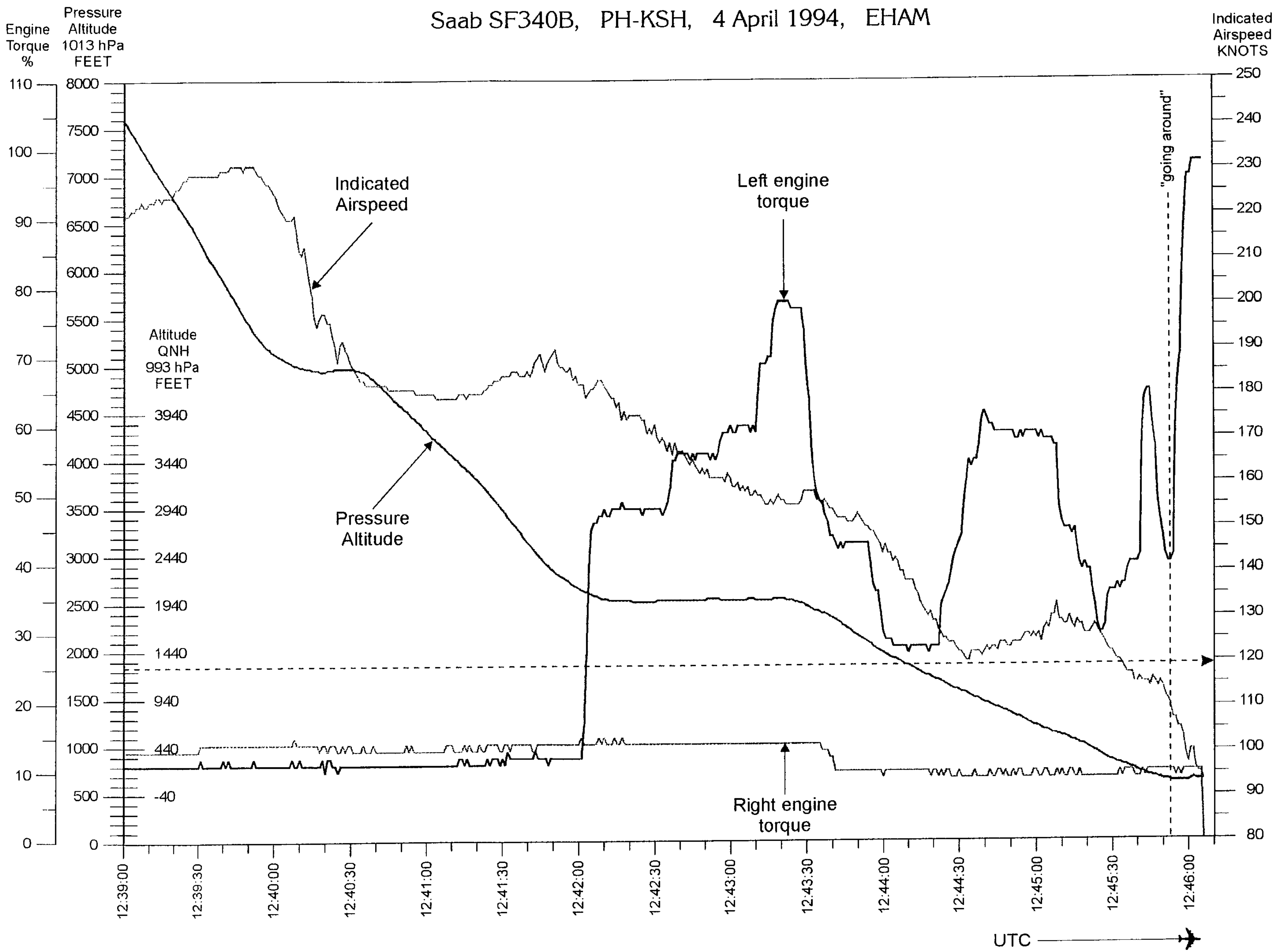


Photo courtesy Neth. State Air Polic

APPENDIX 2

UNIVERSAL FLIGHT DATA RECORDER

READOUTS



Saab SF340B, PH-KSH, 4 April 1994, EHAM
Engine Torque %
Pressure Altitude 1013 hPa FEET
Indicated Airspeed KNOTS
Altitude QNH 993 hPa FEET
Indicated Airspeed
Left engine torque
Pressure Altitude
Right engine torque
"going around"
110
100
90
80
70
60
50
40
30
20
10
0
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
3940
3440
2940
2440
1940
1440
940
440
-40
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
12:39:00
12:39:30
12:40:00
12:40:30
12:41:00
12:41:30
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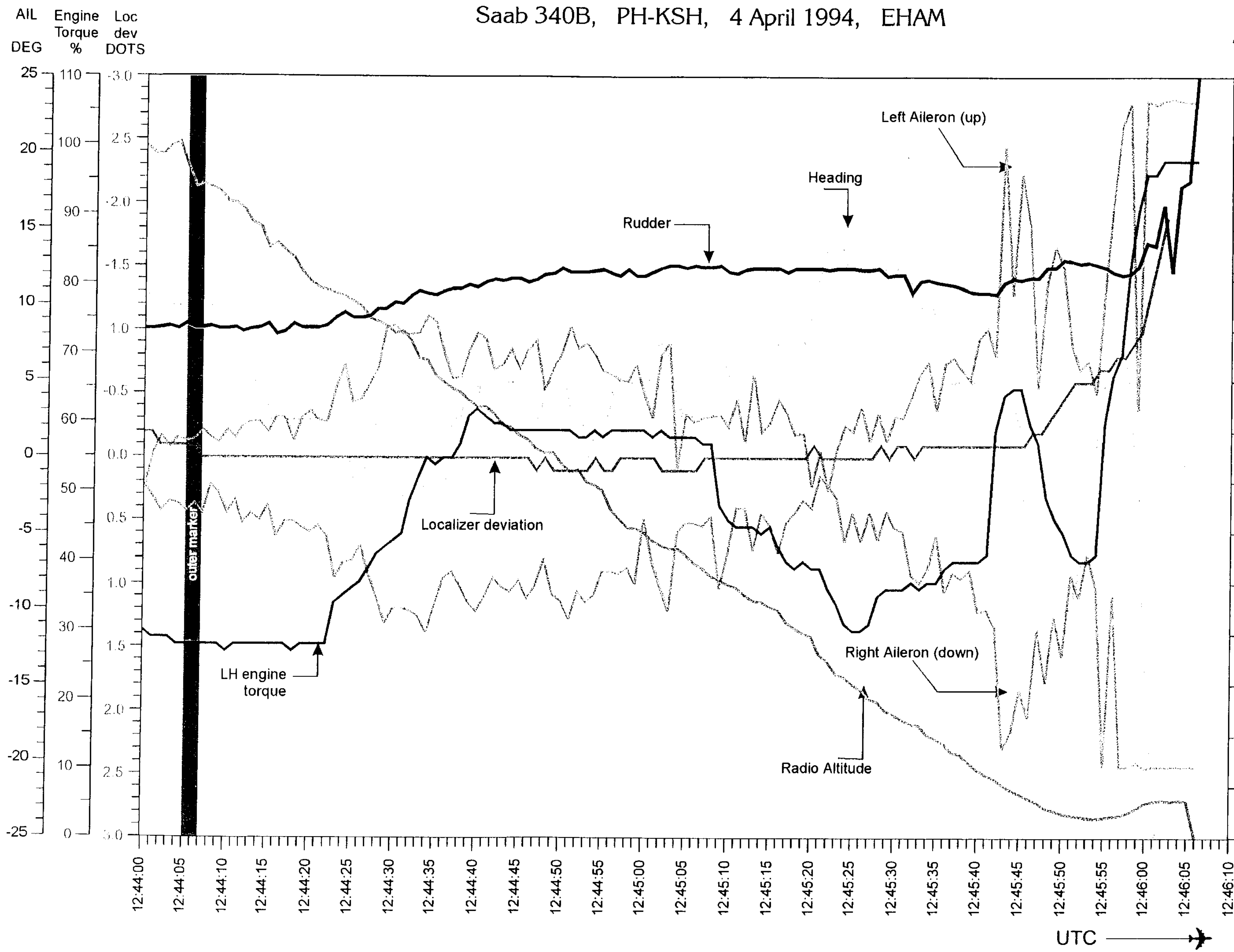
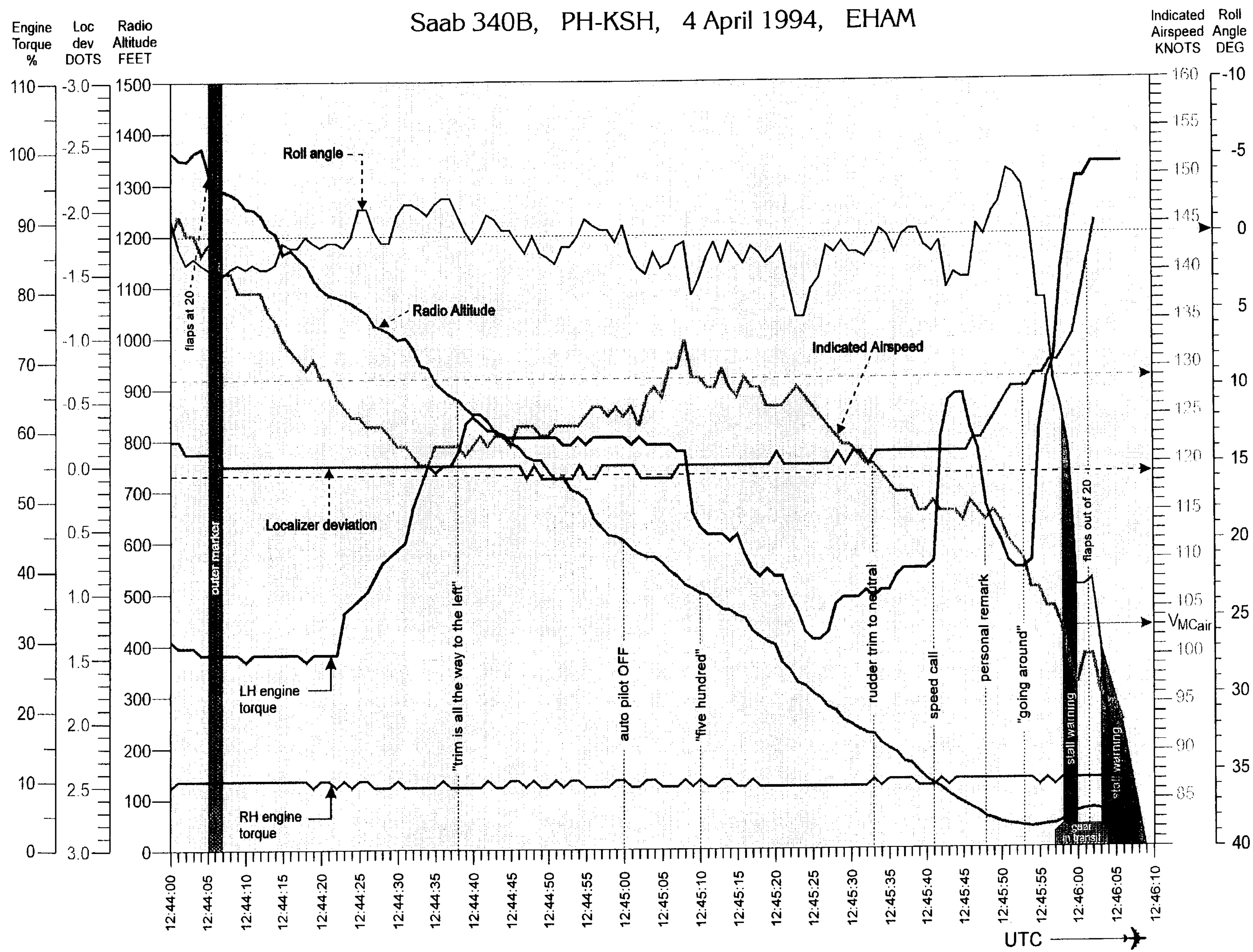
12:46:00
UTC


Saab 340B, PH-KSH, 4 April 1994, EHAM
AIL DEG
Engine Torque %
Loc dev DOTS
Radio Altitude FEET
Rudder DEG
HDG
outer marker
Left Aileron (up)
Heading
Rudder
Localizer deviation
LH engine torque
Right Aileron (down)
Radio Altitude
UTC


Saab 340B, PH-KSH, 4 April 1994, EHAM
Engine Torque %
Loc dev DOTS
Radio Altitude FEET
Indicated Airspeed KNOTS
Roll Angle DEG
flaps at 20
outer marker
Roll angle
Radio Altitude
Indicated Airspeed
Localizer deviation
LH engine torque
RH engine torque
"trim is all the way to the left"
auto pilot OFF
"five hundred"
rudder trim to neutral
speed call
personal remark
"going around"
stall warning
flaps out of 20
gear in transit
stall warning
VMCair
UTC

Saab SF340B, PH-KSH, 4 April 1994, EHAM