Report

Accident on **27 November 2008**
off the coast of Canet-Plage (66)
to the **Airbus A320-232**
registered **D-AXLA**
operated by **XL Airways Germany**

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

Ministère de l'écologie, de l'énergie, du développement durable et de la mer, en charge des technologies vertes et des négociations sur le climat

Foreword

This report expresses the conclusions of the BEA on the circumstances and causes of this accident.

In accordance with Annex 13 to the Convention on International Civil Aviation, with EC directive 94/56 and with the French Civil Aviation Code (Book VII), the investigation was not conducted so as to apportion blame, nor to assess individual or collective responsibility. The sole objective is to draw lessons from this occurrence which may help to prevent future accidents.

Consequently, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretations.

SPECIAL FOREWORD TO ENGLISH EDITION

This report has been translated and published by the BEA to make its reading easier for English-speaking people. As accurate as the translation may be, the original text in French is the work of reference.

Table of Contents

Glossary

°C	Degrees Celsius
AAIB	Air Accident Investigation Branch (United Kingdom)
ADIRU	Air Data and Inertial Reference Unit
ADR	Air Data Reference
EASA	European Aviation Safety Agency
AFS	Automatic Flight System
AGL	Above Ground Level
AMM	Aircraft Maintenance Manual
AMSL	Above Mean Sea Level
AP	Auto-Pilot
APU	Auxiliary Power Unit
A/THR	Auto-thrust
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATP	Acceptance Test Procedure
ATPL(A)	Air Transport Pilot’s License (aeroplane)
ATL	Aircraft Technical Log
ATSB	Australian Transport Safety Bureau
BFU	Bundesstelle für Flugunfalluntersuchung (German federal bureau of aircraft accident investigation)
BKN	Broken cloud (5 to 7 octas)
CAM	Cockpit Area Microphone
CAM	Customer Acceptance Manual
CAS	Computed Airspeed
CEPHISMER	French undersea diving intervention unit (Cellule de plongée humaine et d’intervention sous la mer)
CCER	Test trial acceptance centre (Centre de Contrôle Essais Réception)
CER	Trial and acceptance traffic (Circulation d’Essais et de Réception
CEV	French flight test centre (Centre d’Essais en Vol)
cm	Centimetre
CRM	Crew Resource Management
CRC	Continuous Repetitive Chime
CRNA	Regional ATC centre (Centre Régional de la Navigation Aérienne)
CROSSMED	Mediterranean rescue and surveillance centre (Centre Régional Opérationnel de Surveillance et de Sauvetage en Méditerranée)
CTR	Control zone
DGAC	French civil aviation directorate (Direction Générale de l’Aviation Civile)

DMC	Display Management Computer
DME	Distance Measuring Equipment
DSNA	Direction des Services de la Navigation Aérienne
ECAM	Electronic Centralized Aircraft Monitoring
ECS	Environmental Control System
EGPWS	Enhanced Ground Proximity Warning System
ELAC	Elevator Aileron Computer
EPR	Engine Pressure Ratio
ETOPS	Extended Twin Operation
EU-OPS	European Union aviation operations regulations
F/O	First Officer
FAA	Federal Aviation Administration
FAC	Flight Augmentation Computer
FCOM	Flight Crew Operating Manual
FD	Flight Director
FEW	Few clouds (1 to 2 octas)
FL	Flight Level
FMS	Flight Management System
FPV	Flight Path Vector
FSK	Frequency Shift Keying
ft	Feet
FTO	Flight Training Organisation
FWC	Flight Warning Computer
GAT	General Air Traffic
GSAC	Civil aviation safety group (Groupement pour la Sécurité de l'Aviation Civile)
HDG	Heading mode
hPa	Hectopascal
IAE	International Aero Engines
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IRS	Inertial Reference System
ISATM	In Service Aircraft Test Manual
JAR25	Joint Aviation Requirements 25 – Large Aeroplanes
JAR-FCL	Joint Aviation Requirements – Flight Crew Licences
kg	Kilogram
km	Kilometre
kPa	Kilopascal
kt	Knot
l/h	Litres per hour
m	Metre

MCDU	Multi Purpose Control and Display Unit
MEL	Minimum Equipment List
METAR	Aviation meteorological message
MMO	Maximum Operating Mach
MTOW	Maximum Take-Off Weight
NAV	Navigation mode
NTSB	National Transportation Safety Board (USA)
ICAO	International Civil Aviation Organisation
OAT	Operational Air Traffic
OFC	Operational flight check
OM	Operating Manual
OP DES	Vertical descent mode
PATM	Production Aircraft Test Manual
PFD	Primary Flight Display
PF	Pilot Flying
PNF	Pilot not Flying
PPG	Perpignan
QFE	Atmospheric pressure at the aerodrome altitude
QNH	Altimeter setting to obtain aerodrome elevation when on the ground
QRH	Quick Reference Handbook
RTCA	Radio Technical Commission for Aeronautics
RTL	Rudder Travel Limit
SA CAM	Single Aisle Customer Acceptance Manual
SAMAR	Sea rescue
SAMU	Emergency medical service (Service d'Aide Médicale Urgente)
SAT	Static Air Temperature
SFCC	Slat / Flap Control Computer
AIP	Aviation Information Publication
SID	Standard Instrument Departure
SOP	Standard Operating Procedures
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid State Flight Data Recorder
STAR	Standard Arrival
STBY	Standby
TAF	Terminal Area Forecast
TAIC	Transport Accident Investigation Commission (New Zealand)
TAT	Total Air Temperature
TEMSI	Chart of significant meteorological conditions
TO/GA	Take off / go around
TRE	Type Rating Examiner

TRI	Type Rating Instructor
TSO	Technical Standard Order
ULB	Underwater location beacon
UTC	Universal Time Coordinated
V/S	Vertical speed mode
VAC	Volt Alternative Current
VFR	Visual Flight Rules
VHF	Very High Frequency
VLS	Lowest Selectable Speed
Vmin	Minimum Operating Speed
VMO	Maximum Operating Speed
VOR	Visual Omni Range
SV	Synthetic voice
VSW	Stall Warning Speed
Y/D	Yaw Damper

Synopsis

Date of accident
Thursday 27 November 2008
at 15 h 46[1]

Place of accident
Off the coast of Canet-Plage (66)

Type of flight
Flight at end of leasing agreement

Aircraft
Airbus A320 – 232 MSN 2500
registered D-AXLA

Owner
Air New Zealand Aircraft
Holdings Limited

Operator
XL Airways Germany GmbH
(under a leasing agreement)

Persons on board
2 Flight Crew, 5 passengers

[1]All times in this report are UTC, except where otherwise specified. One hour should be added to express official time in metropolitan France on the day of the accident.

Summary

Flight GXL888T from Perpignan – Rivesaltes aerodrome was undertaken in the context of the end of a leasing agreement, before the return of D-AXLA to its owner. The programme of planned checks could not be performed in general air traffic, so the flight was shortened. In level flight at FL320, angle of attack sensors 1 and 2 stopped moving and their positions did not change until the end of the flight. After about an hour of flight, the aeroplane returned to the departure aerodrome airspace and the crew was cleared to carry out an ILS procedure to runway 33, followed by a go around and a departure towards Frankfurt/Main (Germany). Shortly before overflying the initial approach fix, the crew carried out the check on the angle of attack protections in normal law. They lost control of the aeroplane, which crashed into the sea.

Consequences

	Injuries			Equipment
	Fatal	Serious	Slight/None	
Crew members	2	-	-	Destroyed
Passengers	5	-	-	
Other persons	-	-	-	

ORGANISATION OF THE INVESTIGATION

The BEA was informed of the accident on Thursday 27 November 2008 at around 16 h 00. In accordance with Annex 13 to the Convention on International Civil Aviation and the French Civil Aviation Code (Book VII), a technical investigation was launched by the BEA. A technical investigator arrived in Perpignan in the evening and four others arrived the following morning.

In accordance with the provisions of Annex 13, Accredited Representatives from Germany (State of Registry and the Operator of the aircraft) and the United States (State of Design of the aircraft's engines) were associated with the investigation. Since the passengers were of New Zealand nationality, the BEA accepted the participation of New Zealand in the investigation. The New Zealand Accredited Representative asked for assistance from the AAIB.

Operations to locate the flight recorders started on 28 November. The recorders were recovered on 29 and 30 November 2008.

During the course of the investigation, working groups were set up in the following areas:

- Sea searches
- Operations
- Maintenance documentation
- Flight recorders
- Systems
- ATM data
- Witness testimony
- Human factors
- Angle of attack sensors

The Draft Final Report was sent for comments to the Accredited Representatives of Germany, the United States and New Zealand, in accordance with Article 6.3 of Annex 13. It was also sent to EASA and the French DGAC.

1 – FACTUAL INFORMATION

1.1 History of Flight

Note: Throughout this section, except where otherwise indicated, the headings are magnetic headings, the speeds are computed (CAS) and the altitude values are those of the recorded parameter corrected for QNH (AMSL altitude).

The A320-232 registered D-AXLA operated by XL Airways Germany had been ferried to Perpignan aerodrome on 3 November 2008 for maintenance and painting work. EAS Industries had issued the approval for release to service on 27 November 2008.

The aeroplane, leased from Air New Zealand, was at the end of its leasing agreement and was to be returned to its owner. The leasing agreement specified a programme of in-flight checks; to this end, a flight had been planned for the afternoon. The crew consisted of a Captain (PF) and a co-pilot (PNF) from the airline XL Airways Germany.

A pilot and three engineers from Air New Zealand, as well as a representative of the New Zealand Civil Aviation authority were on board. The pilot had taken a seat in the cockpit.

The estimated departure time in the flight plan was 12 h 30 for a total planned flight time of 2 h 35 over the west of France with a return to Perpignan. The flight identification was GXL888T. At the end of the flight, the aeroplane was supposed to return to Frankfurt/Main.

The departure was postponed to 14 h 00 then to 14 h 30. The aeroplane left the ramp at 14 h 33.

At 14 h 38, the Air New Zealand pilot formalized his participation in following the programme of flight checks by asking the crew to raise a hand in case he was interrupting them in the course of the flight.

The takeoff took place at 14 h 44.

A 14 h 47 min 20, as soon as he received the strip relating to flight GXL888T, the CRNA south-west controller contacted the Perpignan approach controller by phone. He wanted to ensure that the crew had the necessary authorizations to undertake what he described as a “disguised test flight”. He thought that this flight had not been the subject of an appropriate request by the operator, as had already been the case five hours previously for XL Airways Germany Boeing 737-800, flight GXL032T. The crew of this flight, whose flight plan was identical to that of GXL888T, had contacted this CRNA south-west sector and had also asked on several occasions to be able to perform manoeuvres that had required coordination on several occasions between the different control sectors.

Thirty-six seconds later, the co-pilot contacted the CNRA south-west controller. At 14 h 49 min 20, the Captain asked to perform a “360”. The controller explained to the crew that this type of flight could not be undertaken in general air traffic and that the flight plan filed was not compatible with the manoeuvres requested. The crew announced that they wanted to continue on the route planned in the flight plan and asked to climb to FL310.

At 14 h 54 min 25, the Captain proposed to the Air New Zealand pilot to delay the check on the flight controls to the approach.

At 15 h 00 min 54, the crew was cleared to climb to FL 320, which they reached two minutes later.

Between 15 h 04 and 15 h 06, angle of attack sensors 1 and 2 stopped moving and remained blocked until the end of the flight at almost identical local angles of attack and consistent with the cruise angle of attack, without the crew noticing it. The local angles of attack 1 and 2 were recorded at 4.2 and 3.8 degrees respectively.

At 15 h 05 min 30, the crew began the descent to FL 310, reached one minute later.

At about 15 h 12, the crew turned back towards Perpignan. The Captain performed the flight control checks in normal law that had been delayed.

While the crew was waiting for clearance to climb to FL 390, the Air New Zealand pilot said that there were not many checks remaining to be performed during the descent. He said that in case of a refusal by the controller, the check on the APU at FL 390 could be done during the flight back to Frankfurt, as the Captain had suggested. The Air New Zealand pilot also described the low speed Configuration Full check without however mentioning the values of VLS and Vmin indicated relative to the weights in the check programme. He added that this check should not be performed on approach but at FL 140. The crew was cleared to climb to FL 390 which was reached at 15 h 22.

The descent towards Perpignan was initiated at 15 h 26.

At 15 h 33 min 04, the crew was cleared to descend to FL130. Eighteen seconds later, while the plane was descending through FL 180 with a speed close to 300 kt, the Air New Zealand pilot asked the crew if they were ready to talk. He told them that the following check was that of the flight controls in alternate law, scheduled in the programme during descent above FL 140. The Captain decided to perform it at FL 130. The Air New Zealand pilot accepted this.

At 15 h 33 min 34, descending to FL 130, the crew contacted Perpignan Approach. They were cleared to descend to FL 120 towards the PPG VOR. The approach controller asked them to reduce speed to 250 kt and to plan a hold at the PPG VOR. They were number two on approach. One minute later, the crew requested radar vectoring. The approach controller asked them to turn left on heading 090 and reduce speed to 200 kt. The check on the ECS supply from the APU was performed before a turn to the 090 heading.

At 15 h 36 min 47, when the aeroplane was level at FL120, the Captain asked *"you want alternate law"* and the New Zealand pilot answered *"okay alternate law"*.

Eleven seconds later, the approach controller asked the crew to reduce speed to 180 kt and to descend to FL 80. The crew performed the check on the flight controls in *alternate law* before beginning the descent.

At 15 h 37 min 52, flight control laws in pitch and roll returned to *normal law*, indicating the end of the check on the flight controls in *alternate law*, and autopilot 1 was reconnected. The New Zealand pilot then said "*Low speed flight is now probably next*" then described the sequence of events for the check at low speed Configuration Full mentioned previously. The Captain asked if his intention was to go down to VLS and alpha prot. The Air New Zealand pilot confirmed that and said that, on reaching VLS, it would be necessary to pull quite hard to go as far as the alpha floor function. The Captain answered that he knew. The New Zealand pilot continued, saying: *"then you need to pitch forward and err… you're happy with disconnect and reengage. And out of alpha floor"*. He mentioned neither the altitude nor the limit speeds indicated in the programme.

At 15 h 38 min 52, the approach controller asked the crew to descend to FL 60. The aeroplane was then slightly below FL 100 and its speed was 214 kt. Five seconds later, the co-pilot asked to engage the wing anti-ice system when the aeroplane's altitude was about 9,900 ft. The Captain agreed to this.

At around 15 h 40, the approach controller asked the crew to turn to the right on heading 190 and to maintain 180 kt. The aeroplane speed was 215 kt. About a minute later, the approach controller cleared the crew to the LANET-ILS approach for runway 33 and to descend to 5,000 ft. At the request of the crew, she repeated the message. While the Co-pilot read back, the Captain told the Air New Zealand pilot that the low speed check in landing configuration would have to be done later or during the flight to Frankfurt. He also mentioned the possibility of not performing it.

The aeroplane reached 5,000 ft altitude at 15 h 42. Its speed was then around 210 kt.

At 15 h 42 min 14, the approach controller asked for the aeroplane's speed. The Co-pilot answered initially that it was falling, then at 15 h 42 min 25 said that it was 180 kt. The aeroplane speed was then slightly above 190 kt and the selected speed went from 180 kt to 157 kt. The approach controller asked them to maintain 180 kt and to descend to 2,000 ft. The slats and flaps configuration control was placed in position 2.

At 15 h 42 min 23, the lateral AP/FD mode changed from HDG to NAV. A few seconds later the aeroplane began to descend.

At 15 h 42 min 46, the Captain said that the approach was not in the database. Thirty-six seconds later, the co-pilot performed the approach briefing.

Between 15 h 43 min 20 and 15 h 43 min 55, the spoilers were deployed.

At 15 h 43 min 37, the Captain disengaged the autopilot. He said *"Down below the clouds so you want what?"* The New Zealand pilot answered in a questioning manner "*to go slower you mean*". The Captain and the co-pilot responded affirmatively. At 15 h 43 min 41, the Captain positioned the thrust control levers on IDLE and autothrust disengaged. The New Zealand pilot added "*We need to go slow with err recovery from… recovery*". The altitude was 4,080 ft and the speed was 166 kt.

The Captain called for landing gear extension then at 15 h 43 min 48 said *"we do the err the…"*. The New Zealand pilot answered *"low speed yeah"*.

At 15 h 43 min 51, the Captain asked for speed values from the Air New Zealand pilot, who answered *"just… to come right back to alpha floor activation*". During this time the approach controller twice asked the crew for their intentions. The Co-pilot answered by saying that it would be a go-around and a departure towards Frankfurt.

At 15 h 44 min 30, the Captain stabilised the aeroplane at an altitude of 3,000 ft. The aeroplane was in landing configuration. Flight directors 1 and 2 were still active and the vertical mode changed from OP DES to V/S +0000. The speed was 136 kt.

At 15 h 44 min 44, the aeroplane was at an altitude of 2,980 ft and a speed of 123.5 kt (VLS).

At 15 h 44 min 57, while the aeroplane was near LANET, a "triple click" was recorded and the AP/FD lateral mode changed from NAV to HDG. The selected heading was the current heading of the aeroplane. One second later the aeroplane was at an altitude of 2,940 ft and a speed of 107 kt (Vmin).

Between 15 h 44 min 30 and 15 h 45 min 05, the stabiliser moved from -4.4° to -11.2° corresponding to the electric pitch-up stop. It stayed in this position until the end of the recording.

At 15 h 45 min 05, the aeroplane was at 2,910 ft altitude and a speed of 99 kt. Pitch angle was 18.6 degrees. The stall warning sounded.

In the second that followed, the thrust control levers were moved to TO/GA. A symmetrical increase in engine RPM was observed up to N1 values of about 88%. The aeroplane began to roll to the left. The Captain countered this movement.

At 15 h 45 min 09, the bank angle reached 8° to the left and the speed 92.5 kt. The Captain gave a lateral input to the right and a longitudinal movement forwards on his side-stick.

At 15 h 45 min 11, the aeroplane wings straightened up and began to roll to the right. The Captain made a lateral input to the left stop. The rudder pedal began to move in the direction of a left turn.

At 15 h 45 min 12, both flight directors disengaged. At 15 h 45 min 14, autothrust disarmed.

At 15 h 45 min 15, the flight control laws, which were in *normal law,* passed to *direct law*. Bank angle reached 50° to the right. The Captain's lateral input was still at the left stop. The rudder pedal reached a 22 degrees left position. At the same moment, the Captain's longitudinal input changed to the forward pitch down stop position. Pitch was 11 degrees, the speed 100 kt and the altitude about 2,580 ft.

A 15 h 45 min 19, the stall warning stopped. The Captain's longitudinal input was still at the forward stop position. The elevators reached their maximum nose-down position of about 11.6°. The bank angle reached 40 degrees to the left and the Captain progressively cancelled his lateral input. One second later, the aeroplane's pitch was at 7 degrees. Its wings were close to horizontal and its speed was 138 kt. The Captain cancelled his longitudinal input. At 15 h 45 min 23, the pitch and the altitude then began to increase. The altitude reached about 2,250 ft. The Captain immediately made a longitudinal input to the forward stop.

This did not stop the aeroplane from climbing, with speed dropping. The stall warning sounded again at 15 h 45 min 36. Three seconds later, the crew retracted the landing gear. At 15 h 45 min 40, the pitch was 52 degrees nose up, the bank angle reached a maximum of 59 degrees to the left and the normal load factor dropped below 0.5 g. The flight control law passed to *abnormal attitudes*[(2)]. The Captain's roll input was practically at neutral; the longitudinal input was still forward but was not constantly at the stop. The yaw damper orders were nil and remained so until the end of the flight.

[(2)]Due to exceeding some thresholds (see. 1.6.7).

At 15 h 45 min 42, the speed dropped below 40 kt.

At 15 h 45 min 44, the maximum values recorded were: pitch 57degrees nose up, altitude 3,788 ft.

At 15 h 45 min 47, the stall warning stopped. It started again about five seconds later.

Between 15 h 45 min 49 and 15 h 45 min 53, the Captain made a longitudinal pitch up input. The elevator reached values of about 30° pitch-up.

At 15 h 45 min 50, the normal load factor exceeded 0.5 g. The thrust control levers were placed in the CLIMB position for one second then repositioned on TO/GA.

From 15 h 45 min 52, the speed passed above 40 kt.

At 15 h 45 min 53, the pitch reached 7 degrees nose down. The bank angle was less than 10 degrees, to the left.

Between 15 h 45 min 55 and 15 h 45 min 58, the Captain made a lateral input to the left stop; the aeroplane began to roll to the right. The bank angle went from 3 degrees to 97 degrees to the right. At the same time, the pitch went from 3 degrees nose down to 42 degrees nose down.

From 15 h 45 min 57, the Captain's longitudinal input was nose up; the elevator was at 14.5 degrees nose down.

At 15 h 45 min 58, the flaps and slats were selected to position 1, then to position 0 two seconds later. The Captain made inputs on the flight controls and thrust levers.

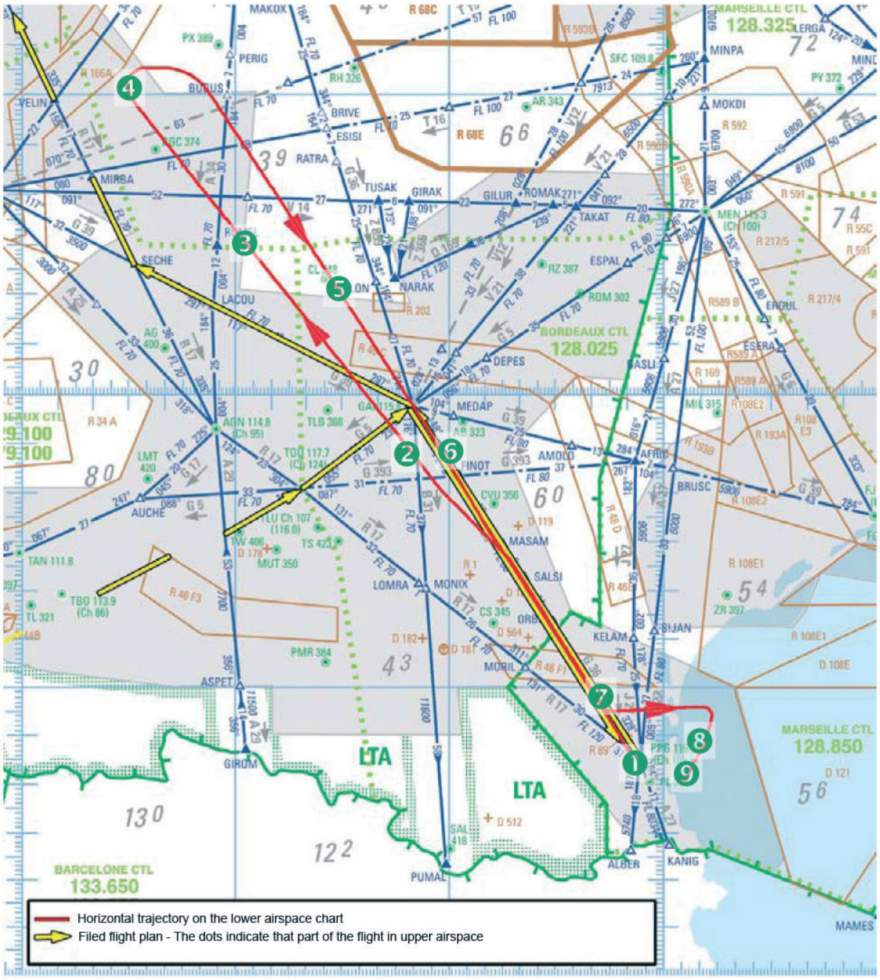
At 15 h 46 min 00, the stall warning stopped and was followed by a CRC warning that corresponded to a *Master Warning,* which stopped two seconds later. At 15 h 46 min 01, the pitch reached a maximum of 51 degrees nose-down. The bank angle was 45 degrees to the right, the speed was 183 kt and altitude about 1,620 ft. From this moment, the Captain's longitudinal pitch input was at the rear stop.

At 15 h 46 min 02, the thrust levers were moved back to a position close to IDLE then advanced to the CLIMB position. The EPR on the two engines dropped towards 1.2 before increasing to 1.25.

At 15 h 46 min 04, an *EGPWS TERRAIN TERRAIN* warning was recorded, followed one second later by another CRC warning (Master Warning).

The recordings stopped at 15 h 46 min 06.8. The last recorded values were a pitch of 14 degrees nose down, a bank angle of 15 degrees to the right, a speed of 263 kt and an altitude of 340 ft.

Between the time the stall warning sounded for the first time and the moment the recordings stopped, sixty-two seconds had passed.



1. **14 h 44**
   Takeoff from Perpignan aerodrome
2. **14 h 52**
   The controller told the crew that they could not perform a "360"
3. **Between 15 h 04 et 15 h 06**
   Blockage of angle of attack sensors 1 and 2
4. **15 h 12**
   Turn back
5. **15 h 22**
   Arrival at FL 390
6. **15 h 26**
   Beginning of descent
7. **15 h 34 min 34 s**
   Co-pilot: "(…) we'll appreciate a radar vector the approach"
8. **15 h 43 min 41 s**
   Thrust levers on IDLE
   Beginning of the check on the low speed angle of attack protections
9. **15 h 45 min 05 s**
   Stall warning

1.2 Injuries to Persons

Injuries	Crew members	Passengers	Others
Fatal	2	5	-
Serious	-	-	-
Slight/None	-	-	-

1.3 Damage to Aeroplane

The aeroplane was completely destroyed on impact with the surface of the sea.

1.4 Other Damage

None.

1.5 Personnel Information

1.5.1 Flight crew

1.5.1.1 Captain

Male, aged 51

- ❒ Air Transport Pilot License ATPL(A) n° 3311003773 issued by the Federal Republic of Germany on 24 August 1987 in accordance with the requirements of JAR-FCL1.
- ❒ Type rating on A318/A319/A320/A321 valid until 5 March 2009.
- ❒ Type rating Examiner authorisation for A318/A319/A320/A321 (TRE) n° D-196 issued on 2 July 2003 and valid until 2 August 2009.
- ❒ Qualification as instructor for type rating training on A318/A319/A320/A321 (TRI) valid until 18 September 2011.
- ❒ Rating for Cat III precision approaches valid until 5 March 2009.
- ❒ Last line check on 29 March 2008.
- ❒ Last base check on 30 September 2008.
- ❒ Last CRM training course on 21 May 2008.
- ❒ Medical aptitude class 1 on 12 December 2007 valid until 12 December 2008.
- ❒ Flying hours:
    - 12,709 flying hours of which 7,038 on type.
    - 128 hours in the previous three months, all on type.
    - 14 hours in the previous thirty days, all on type.
    - No flying hours in the previous 24 hours.

- Duty hours:
  - End of last duty period before the accident flight: 2 November 2008 at 21 h 24.
  - Start of duty on the day of the accident: 4 h 30.
  - Rest time: 13 h 30 min.

The Captain was employed by XL Airways Germany in February 2006 as Captain and head of air and ground operations. He had occupied this position when he was working for Aero Lloyd airline.

He had never performed flights to or from Perpignan. He had undertaken an acceptance flight on 30 March 2004 at Toulouse when he was working for Aero Lloyd.

1.5.1.2 Co-pilot

Male, aged 58

- Air Transport Pilot License ATPL(A) n° 3311003971 issued by the Federal Republic of Germany on 2 March 1988 in accordance with the requirements of JAR-FCL1.
- Type rating on A318/A319/A320/A321 valid until 8 July 2009.
- Rating for Cat III precision approaches valid until 8 July 2009.
- Last line check on 29 October 2008.
- Last base check on 17 June 2008 (extension of type rating on A318 /A319/ A320/A321).
- Medical aptitude class 1 on 18 November 2008 valid until 5 December 2009, with the requirement to wear corrective lenses and to carry a spare pair of glasses.
- Flying hours:
  - 11,660 flying hours of which 5,529 on type.
  - 192 hours in the previous three months, all on type.
  - 18 hours in the previous thirty days, all on type.
  - No flying hours in the previous 24 hours.
- Duty hours:
  - End of last duty period before the accident flight: 4 November 2008 at 20 h 52.
  - Start of duty on the day of the accident: 4 h 30.
  - Rest time: 120 hours.

He was employed by XL Airways Germany as a co-pilot in April 2006. He had never performed flights to or from Perpignan and had not flown with the Captain in 2008.

In 2007, the co-pilot had begun a training program to become Captain, at his own request, a request that was agreed to by the Captain as head of air operations. He decided to end this course himself for personal reasons, after having undertaken:

- ❒ The theoretical and flight simulator training,
- ❒ The base test in the position of Captain,
- ❒ Four stages (of ten minimum) of the line check as Captain under supervision.

1.5.1.3 Crew positioning

The crew was based in Frankfurt. To get to Perpignan, the crew took a taxi at 4 h 30 in order to take a flight at Frankfurt – Hahn (about 130 km west of Frankfurt) at 7 h 00 bound for Montpellier. Arriving at 8 h 30, the crew rented a vehicle. They arrived at the EAS Industries premises on Perpignan – Rivesaltes aerodrome at about 11 h 00.

The co-pilot entered the cockpit to prepare the flight at about 14 h 25, the Captain five minutes later.

1.5.2 Other persons on board

Five other people, from New Zealand, were on board the aeroplane.

1.5.2.1 Air New Zealand Pilot

Male, aged 52

- ❒ Air Transport Pilot License ATPL(A) n° 14440 issued by New Zealand and valid until 4 May 2009.
- ❒ Type rating on A318/A319/A320/A321.
- ❒ Type rating on B737 (-300/-400/-500) / B767 / F27
- ❒ Type rating Examiner authorisation for A318/A319/A320/A321 n° 14440 valid until 4 May 2009.
- ❒ Qualification as instructor for type rating training on A318/A319/A320/A321 valid until 4 May 2009.
- ❒ Medical aptitude class 1 valid until valid until 4 May 2009.
- ❒ Flying hours:
  - 15,211 flying hours of which 2,078 on type.
  - 101 hours in the previous three months.
  - 24 hours in the previous thirty days.
  - No flying hours in the previous 24 hours.

He was hired by Air New Zealand in September 1986. He had been a Captain on A320's since 27 September 2004. He was included on the list of Air New Zealand pilots that could perform Operational Flight Checks. He had been designated as observer on the flight before the transfer of D-AXLA and was scheduled to perform the ferry flight from Frankfurt to Auckland.

He left Auckland on 19 November 2008 and arrived in Perpignan on 22 November 2008.

He did not understand the German language.

1.5.2.2 Three engineers from Air New Zealand

The engineers arrived in Perpignan in November 2008 to supervise the maintenance operations on D-AXLA, to finalize the lease agreement as well as to prepare the return flight of D-AXLA to New Zealand.

1.5.2.3 Engineer from the New Zealand Civil Aviation Authority

As a New Zealand civil aviation airworthiness engineer, he was supposed to issue a new airworthiness certificate for the aeroplane before its return to New Zealand at the end of the lease agreement.

1.6 Aircraft Information

1.6.1 Airframe

Manufacturer	Airbus
Type	A320-232
Serial number	2500
Registration	D-AXLA
Entry into service	July 2005
Certificate of Airworthiness	N° 31 781 of 2 June 2006 issued by the German civil aviation authority
Airworthiness review certificate	Ref. T519/ARC/009/2008 of 8/10/2008, issued by the German civil aviation authority and valid for one year
Utilisation as of 27 November 2008	10,124 flying hours and 3,931 cycles

1.6.2 Engines

Manufacturer: International Aero Engines (IAE)

Type: IAE V2527-A5

	Engine n° 1	Engine n° 2
Serial number	V12001	V12003
Installation Date	July 2005	July 2005
Total running time	10,124 hours and 3,931 cycles	10,124 hours and 3,931 cycles

1.6.3 Background

The aeroplane, initially registered ZK-OJL, was delivered by Airbus in July 2005 to its owner Air New Zealand, which immediately leased it to Freedom Air Limited, an airline that was part of its group.

It was subsequently dry leased to AGAIRCOM GmbH[3] from May 2006, with the approval of the German civil aviation authority. At that time, the registration of the aeroplane was changed to D-AXLA. It was listed in the fleet of XL Airways Germany and was supposed to be returned to Air New Zealand on 28 November 2008.

[3]AGAIRCOM GmbH was first renamed Star XL German Airlines then XL Airways Germany GmbH in December 2006.

1.6.4 Maintenance

The Maintenance Manual[4], approved by the German civil aviation authority and applicable to the airline's whole A320 fleet, described in detail the maintenance programme, in accordance with the manufacturer's manuals.

[4]IHP A320 GXL

The documentation showed that the inspections following scheduled maintenance and mandatory inspections resulting from Airworthiness Directives had been carried out.

1.6.5 Weight and balance

The aeroplane's weight and balance on takeoff were estimated at 56,450 kg and 22.8%. The certified maximum takeoff weight (MTOW) is 77,000 kg.

At the time of the event, the weight and balance were estimated to be 53,700 kg and between 22 and 22.5%.

1.6.6 Angle of attack sensors

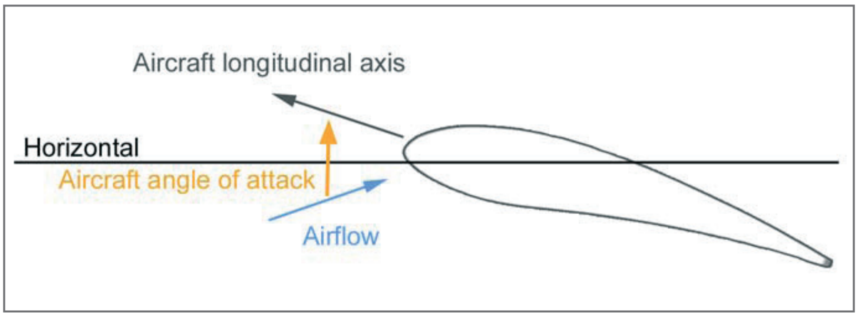
1.6.6.1 Definitions

Local angle of attack is measured by the sensor and corresponds to the value of the locally existing angle between the relative wind and the reference axis of the sensor. As the fuselage disturbs the flow of air, these measurements have to be corrected to obtain the aeroplane angle of attack.

The aeroplane angle of attack (also called true, real or corrected angle of attack) is defined by the angle between the relative wind infinitely upstream and the longitudinal axis of the aeroplane. It is generally noted as α (alpha). Thus we call *aeroplane angle of attack* the angle of attack deduced from the *local* angle of attack from the configuration of the slats and flaps.

Aeroplane angle of attack has in addition been estimated from other parameters recorded by the SSFDR. This angle of attack is designated calculated *angle of attack* in the report.

Angle of attack, though significant for the study of the aerodynamic situation of the aeroplane, is not a piloting parameter.



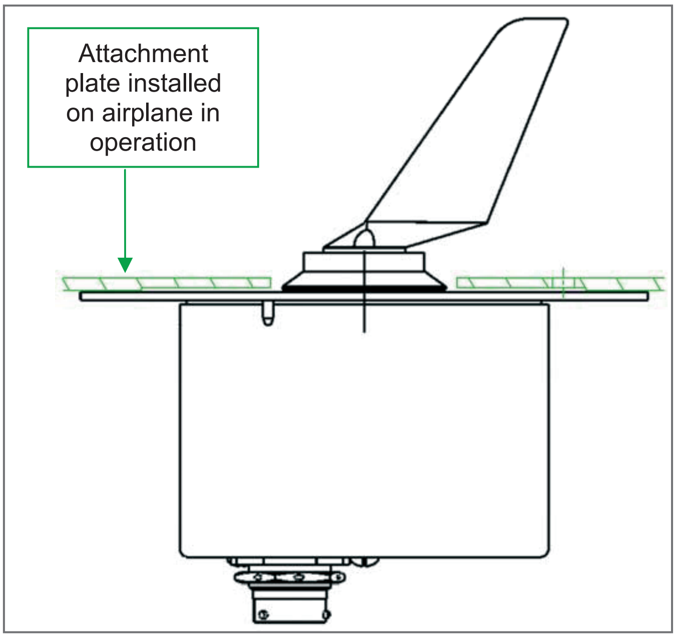
1.6.6.2 Angle of attack sensors installed on the A320 family

Several sensors of different makes (Thales and Goodrich[5]) meet the specifications of Airbus and the technical conditions for certification. These different angle of attack sensors are mechanically and electrically interchangeable but an aeroplane must be equipped with sensors of the same make.

[5] Formerly Rosemount Aerospace.

D-AXLA was equipped with three Goodrich angle of attack sensors with type number 0861ED, approved to be installed on the A319/A320/A321 family:

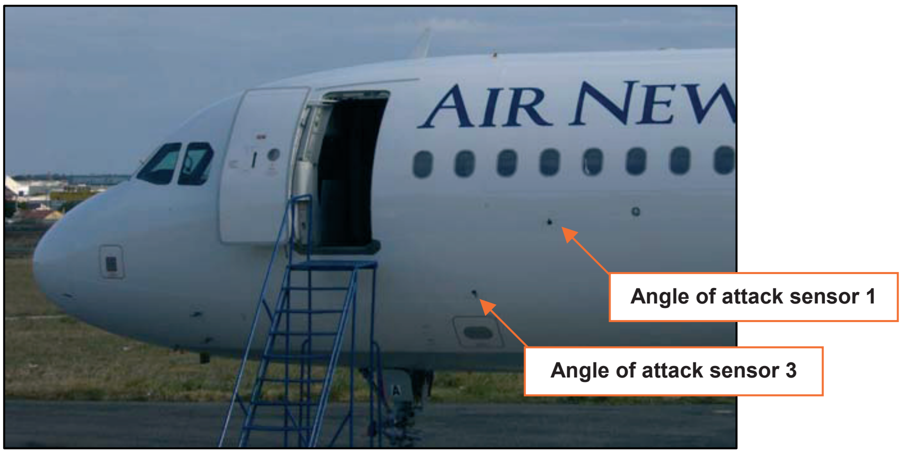
Sensor 1	Serial number	1722
	Installation date	July 2005
	Total operating time	10,125 hours and 3,931 cycles
Sensor 2	Serial number	1723
	Installation date	July 2005
	Total operating time	10,125 hours and 3,931 cycles
Sensor 3	Serial number	1721
	Installation date	July 2005
	Total operating time	10,125 hours and 3,931 cycles



By August 2010, about 1,100 aeroplanes from the A320 family were equipped with this model of angle of attack sensors.

1.6.6.3 Description and position on A320

Two of the three angle of attack sensors are installed symmetrically, one behind the forward left passenger door (sensor 1) and the other to the right of the fuselage, above the forward cargo door (sensor 2). The third (sensor 3) is located on the left side, in front of and below sensor 1.



Only the values of the *local angles of attack* coming from sensors 1 and 2 are recorded by the SSFDR.

The angle of attack sensors are part of the aerodynamic data system that includes three independent measurement channels, with continuous surveillance. Channels 1, 2 and 3 are associated respectively with instruments for the Captain, the co-pilot and standby. Each channel includes a Probe Heat Computer (PHC) that ensures checks on and surveillance of sensor heating through measurement of the intensity of the current consumed. It is capable of identifying and memorizing failures.

The sensors are heated electrically (115 VAC) automatically in flight and on the ground as soon as an engine is running. Only the vane of the angle of attack sensors is heated. In case of failure in the heating of one of the angle of attack sensors, an ANTI ICE CAPT (F/O or STBY) AOA message appears on the ECAM (respectively for sensors 1, 2 and 3). The affected sensor is listed as an inoperative system. The message is accompanied by a SINGLE CHIME warning and a visual MASTER CAUTION warning. When two ECAM messages relating to two angle of attack sensors appear, the crew must apply the exceptional DOUBLE AOA HEAT FAILURE procedure.

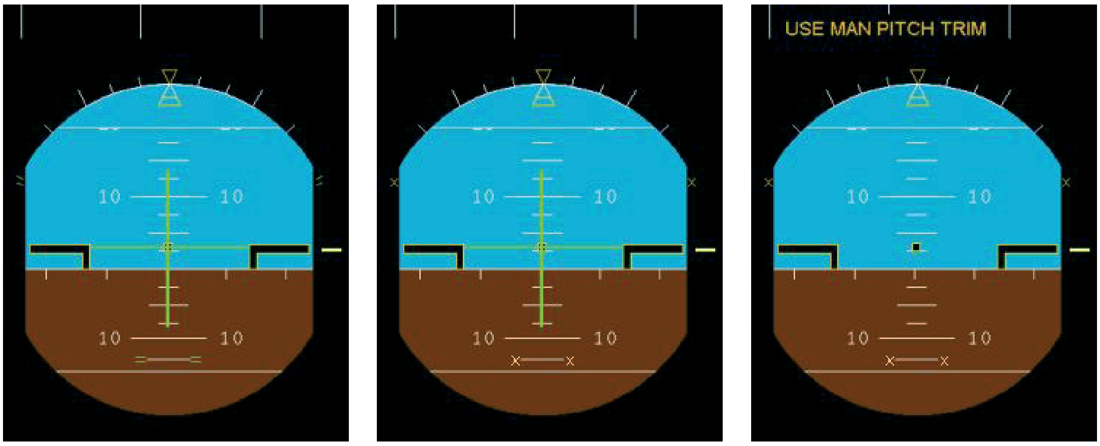
1.6.7 Flight control laws

The Airbus A320 has fly-by-wire flight controls. The aeroplane is flown using two sidesticks whose movements are transmitted in the form of electrical signals to computers that transform them into orders to the actuators of the various surfaces. The laws that govern these transformations are called “flight control laws”. On the A320, in nominal operation, the flight control law is called *normal law*. Under certain conditions, it can be replaced by two degraded control laws: *alternate law* and *direct law*.

Normal law offers protections in attitude (the pitch and bank values are limited), in load factor, in overspeed and at high angle of attack. Pitch trimming is ensured automatically by the auto-trim. Turn is coordinated, with the rudder minimizing the sideslip through the yaw damper function. The sidesticks control the load factor according to the normal aeroplane axis and the roll rate.

In *alternate law*, the sidesticks control the load factor according to the normal aeroplane axis as for *normal law*, but with fewer protections. In roll, they directly control, as they do in *direct law*, the ailerons and the spoilers. The passage from *normal law* to *alternate law* is accompanied by a MASTER CAUTION warning, SINGLE CHIME aural warning and an ECAM message. The green dot indicators for attitude protection (see diagram below) are replaced by amber crosses. In *alternate law*, when the landing gear is extended, the pitch control law passes to *direct law*.

In *direct law*, there is no automatic pitch trimming. Trimming is performed manually using the trim wheel. The orders to the flight control surfaces are a direct function of the control inputs on the side-stick. The passage to *direct law* is accompanied by a MASTER CAUTION warning, SINGLE CHIME aural warning and an ECAM message. The display on the PFD is identical to that in *alternate law*, with in addition the USE MAN PITCH TRIM message in amber.



Normal law | *Alternate law* | *Direct law*

Differences in PFD displays of the flight control laws

When the aeroplane exceeds certain attitude thresholds, roll, angle of attack or speed, the system uses a specific law. The display on the PFD is identical to that for *alternate law*. This *abnormal attitudes law* breaks down into two phases:

- For the first phase, the law used in pitch corresponds to the *alternate* law without auto-trim and with only the load factor protection. In roll, a *direct* law with maximum authority is used. The yaw is controlled mechanically. This first phase should make it easier for the crew to return to more usual attitudes.

- The second phase is instigated when the aeroplane is stabilized for a certain time and remains stabilized for a while. The auto-trim becomes available again and the law in yaw becomes *alternate*.

Axis ▶ ▼ Global law	Pitch	Roll	Yaw
Normal	*normal*	*normal*	*normal*
Alternate	*alternate*	*direct*	*alternate* or *mechanical*[1]
-gear extended	*direct*	*direct*	*alternate* or *mechanical*[2]
Direct	*direct*	*direct*	*alternate* or *mechanical*
Abnormal attitudes	*alternate*	*direct*	*mechanical*
- phase 2	*alternate*	*direct*	*alternate*

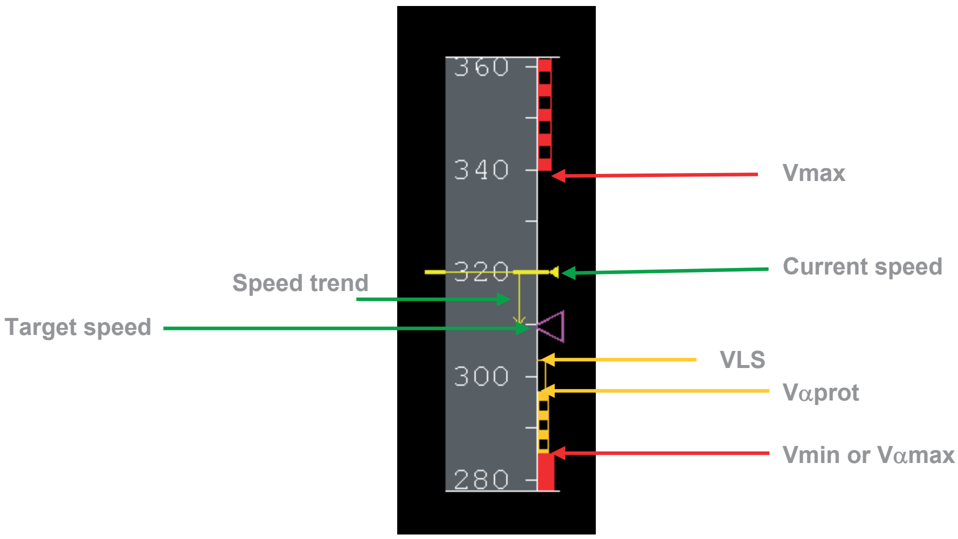
[1] In relation to loss of systems that led to a change of law
[2] The law in yaw remains the same as in gear not extended

1.6.8 Angle of attack protections in normal law

When the aeroplane decelerates below VLS, the angle of attack can reach a value called "alpha prot" (α_{prot}) and automatic pitch-up trimming is then stopped. With no input on the side-stick, the angle of attack remains at this value.

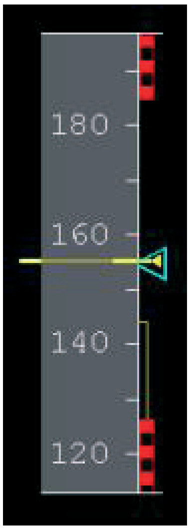
If there is an input on the side-stick, the deceleration continues. When the angle of attack reaches a value called "alpha floor" (α_{floor}), the maximum available thrust is automatically applied in order to regain energy. This alpha floor function can be disengaged by the pilot by disconnecting auto-thrust. Further, if he maintains the side-stick at the rear stop, the aeroplane can only decelerate to a limit angle of attack called "alpha max" (α_{max}). Its speed (Vmin or $V\alpha_{max}$) is maintained with an adapted flight path. The value of this angle of attack is lower than that of the stall angle of attack.

The limit speeds corresponding to the alpha prot and alpha max protections are calculated by the FAC and displayed on the PFD speed strip. They are a function of the computed airspeed, the angle of attack, the Mach, the flap and slat configuration and the position of the airbrakes.



Example of PFD speed strip in *normal law*

In *alternate* or *direct laws*, the angle of attack protections in *normal* law described are no longer available and the stall warning is triggered.

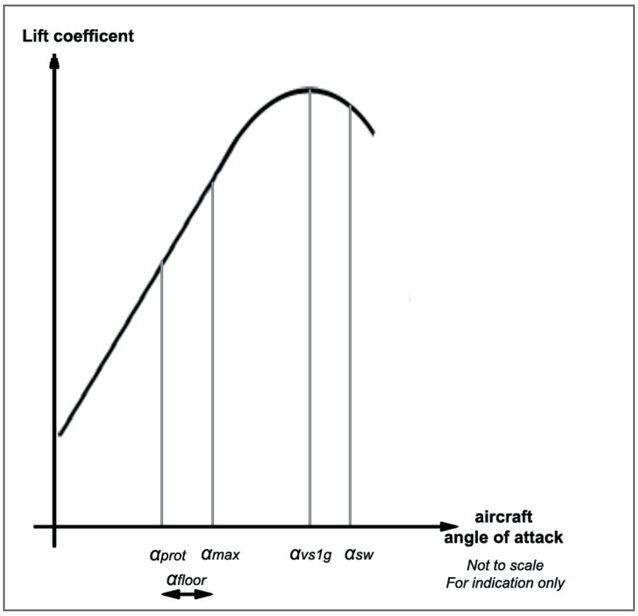


Example of PFD speed strip in *alternate* and *direct law*

1.6.9 Stall warning

In *normal law*, given the protections available, the stall warning was designed to avoid its activation before those angle of attack protections and not to provide an additional protection. So, this warning is triggered in *normal law* as soon as the value of the angle of attack of one of the three sensors reaches 23 degrees in landing configuration, higher than the angle of attack associated with Vs1g.

N.B.: For a given configuration, Vs1g is the lowest speed at which the aeroplane can develop lift equal to the weight of the aeroplane.



Angle of attack protections and stall warning in *normal law*

In *alternate* and *direct law*, this threshold is modified in order to allow the stall warning to be set off at a lower angle of attack than that associated with Vs1g.

1.6.10 Angle of attack information on board the aeroplane

1.6.10.1 Processing of the angle of attack values

Three independent ADIRU are present on board the aeroplane. Each one is associated with a system of measurement. The ADR part of each ADIRU handles processing of the measurements linked to airflow, possible corrections and the processing of flight parameters. The processing associated with angle of attack for each sensor consists of:

- Checking the consistency of the signals coming from each resolver used,
- Calculating a *local angle of attack* value based on information coming from each resolver used,
- Making a comparison between the *local angle of attack* values of the two resolvers used,
- Converting the *local angle of attack* value (value provided by one of the two resolvers) to *aeroplane angle of attack*.

When angle of attack information is sent to the other computers, each ADIRU indicates the validity of the parameter calculated[6].

[6] SSM (Sign Status Matrix)

1.6.10.2 Systems using the angle of attack values

The FWC, the FAC, the ELAC and the SFCC receive the *aeroplane angle of attack* value supplied by each ADIRU. The DMC receives the *local angles of attack* information and transmits it to the parameter recording system[7]. Only those functions linked to angles of attack are described below.

[7] FDIU (Flight Data Interface Unit)

<u>**FWC**</u>

The FWC use the maximum value of the valid angles of attack to generate the stall warning. The triggering threshold for this warning depends on the slat and flap configuration and the flight law in effect.

<u>**FAC**</u>

The calculation of the limit speeds and the activation of the alpha floor function are ensured by two FAC's. The limit speeds calculated by the FAC 1 (respectively FAC 2) are displayed on the Captain's PFD speed strip (respectively co-pilot).

The angle of attack values are used by each FAC to calculate:

- The weight and the position of the centre of gravity,
- The VLS,
- The limit speeds associated with the α_{prot}, α_{max} and α_{SW} angles of attack,
- The air slope.

The alpha floor function as well as the low energy and windshear warnings are also activated by the FAC, based on the angle of attack values.

The limit speeds Vαprot, Vαmax and Vαsw are calculated based on the computed speed, the angle of attack, the Mach, the position of the airbrakes the slats and flaps configuration. This calculation requires at least the validity of one SFCC, one ADR and one IRS. The VLS speed is determined by the calculated weight.

[8]The ″FAC FAIL″ parameter of this FAC is then registered as the ″FAIL″ value by the FDR.

If the calculation of the limit speeds is no longer ensured by one of the FAC[8], the limit speeds displayed on the PFD are those calculated by the remaining FAC. The other FAC functions are not affected.

If the calculation of the limit speeds is no longer ensured by both of the FAC, the flight directors, the autopilots and the autothrust are disconnected. The "SPD LIM" flag is displayed in red at the bottom and to the right of the speed strip on the PFD. This has no influence on the flight control law.

[9]FCOM 4.06.20

A "CHECK GW" message is displayed in amber on the MCDU when the difference between the aeroplane weight calculated by the FAC and the aeroplane weight calculated by the FMS is greater than seven tonnes[9]. When this message appears, the crew:

- Must check the current weight of the aeroplane on the MCDU and correct it if necessary,
- Must not, if this weight is correct, take into account the limit speeds calculated by the FAC and displayed on the speed strips on the PFD (VLS, green dot, F, S, etc.) and must use the QRH speeds,
- Must, if the source of the error seems to come from the load sheet, compare the limit speeds on the FAC and the QRH and take the most appropriate one into account.

ELAC

The two ELAC calculate the flight control laws and ensure the control of the elevator, the horizontal stabiliser and the ailerons. The ELAC uses the angle of attack values to calculate the estimated sideslip angle value and participates in assessing the conditions for activation of the angle of attack protections.

The ELAC uses the average value of the *aeroplane angles of attack* coming from sensors 1 and 2. In case of rejection of one of the three ADR's, it is the average value of the *aeroplane angles of attack* of the two remaining sensors that is used. In case of rejection of more than one ADR, the flight control law becomes *alternate*.

SFCC

The SFCC use the angle of attack values for the *alpha lock* function, which inhibits the retraction of the slats from position 1 to position 0 when the *aeroplane angle of attack* exceeds a certain threshold.

1.6.11 Surveillance of angle of attack values

ADIRU

[10]Class 3 maintenance messages are not presented to the crew during the flight.

In straight and level flight, when the Mach greater than 0.75, a comparison between the attitude and the aeroplane angle of attack is made by each ADIRU. A class 3 maintenance message[10] is generated if the difference between these two parameters exceeds 0.6 of a degree.

FWC

The FWC checks only the validity of the angle of attack parameters received from the ADIRU and does not make any comparison between the *aeroplane angle of attack* values received.

FAC and ELAC

The FAC and the ELAC check the validity of the angle of attack parameters received from the ADIRU. The FAC and the ELAC compare the valid angle of attack values to the median value. The ELAC also check the consistency of these values on the ground between 80 and 100 kt.

A voting mechanism allows rejection of the source of information that presents a difference from the two others. This vote is not apparent for the pilots and the system is always capable of ensuring all of its functions when one of the values is rejected.

Thus, when one of the angle of attack values is blocked and valid, the FAC and the ELAC reject the corresponding ADR as soon as the gap between the blocked value and the median value exceeds a certain threshold.

When two angle of attack values are blocked at the same value more or less simultaneously, this blocked value is used: when there is a possible significant variation in the angle of attack, the ADR that is supplying the non-blocked angle of attack value is rejected. A rejection of an ADR by the ELAC or the FAC generates a maintenance message. In that case, the calculation of the Valpha prot and Valpha max speeds made by the FAC is erroneous. These are then proportional to the CAS(11).

(11)See appendix 9.

1.6.12 Speed information on board the aeroplane

The aeroplane has three Pitot probes and static pressure sensors. These sensors are equipped with electrical heating designed to prevent them icing up. The pneumatic measurements are converted to electric signals by eight ADM (Air Data Module) and supplied to the computers in this form.

The CAS(12) and the Mach number are the main speed information used by the pilot and the systems to fly the aeroplane.

(12)The speed is deduced from the measurement of the difference between the total pressure (Pt) measured by a Pitot tube and the static pressure, measured by static pressure sensor.

Calculation of these parameters is performed by three independent calculation systems that include the sensors used, the heating systems and the ADIRU.

1.7 Meteorological Conditions

A depression centred over the north of Morocco controlled a southwest flow, moderate at FL 180 to strong at FL 300. In the lower layers of the atmosphere, the depression was moving towards the south of Spain and generating light east winds over Catalonia and pulling two small cloudy fronts of Cu and Sc whose base was at 3,300 ft, the ceiling being at around 18,000 ft, giving light rain over Perpignan.

1.7.1 Significant messages

Perpignan METAR

LFMP 271400Z VRB02KT 9999 FEW033 BKN051 07/00 Q1019 NOSIG=
LFMP 271500Z 28003KT 9999 -RA FEW033 BKN053 07/03 Q1018 NOSIG=
LFMP 271600Z 30005KT 9999 FEW033 SCT043 BKN058 07/03 Q1018 NOSIG=

Perpignan TAF

LFMP 271100Z 2712 / 2812 32010KT 9999 FEW040 BKN060 BECMG 2715 / 2717 SCT020 BKN040 TEMPO 2718 / 2803 8000 SHRA BECMG 2807 / 2809 32015G25KT FEW040=

1.7.2 Information supplied to the crew

The flight file supplied to the crew contained the following information:

- A TEMSI EURO SIGWX valid at 18 h 00 (see appendix 1);
- Various altitude wind charts (from FL 50 to FL 530);
- A list of METAR's and TAF's corresponding to the flight, including those for Perpignan at 11 h 00.

1.7.3 Geographical area where the local angle of attack values stopped evolving

Analysis of the meteorological information close to the geographical area where the *local angle of attack* values stopped moving (around 15 h 05), shows that:

- The air mass was relatively dry (around 50% humidity) at FL 300 and even drier in the upper levels. This is confirmed by the absence of high clouds in this area.
- The static temperatures calculated from the SSFDR parameters were around -50 °C.

1.7.4 Meteorological conditions at Perpignan from 24 to 26 November 2008

Between 24 and 26 November 2008 inclusive, dates when D-AXLA was on the parking ramp, outside the EAS Industries hangars, the following average meteorological conditions were observed:

- Average temperatures between 4 and 12 °C;
- Average humidity between 56 and 67%;
- Average QNH between 998 and 1023 hPa;
- No precipitation;
- Visibility over 10 km.

1.8 Aids to Navigation

The LANET - ILS 33 approach procedure at Perpignan - Rivesaltes uses the following radio-navigation equipment:

- A locator (PL on the 351 kHz frequency);
- An ILS on runway 33 (PL on the 111.75 MHz frequency) associated with the DME installed alongside the glide; the localizer beam is on the runway centreline; the glide has a slope of 5.2%;
- A VOR (PPG on the 116.25 MHz frequency) installed alongside the DME.

1.9 Telecommunications

1.9.1 En-route control centres

The crew was in contact with the CRNA south-west then with the CRNA south-east. Just before the first call from the crew on his frequency, the CRNA south-west controller contacted the Perpignan controller by telephone. He asked her if the crew had the authorisations to perform a test flight. In the morning, he had already had the crew of an aeroplane on the frequency with a similar registration that was making a "disguised test flight" and which had asked to perform several manoeuvres (see 1.18.3). She said that flights at the end of maintenance operations should be subject to a specific request, but that this was rarely the case.

1.9.2 Perpignan ATC services

Telephone call to the Perpignan control tower

On his arrival in Perpignan, the Captain contacted the ATC services by telephone. He described his plan to perform a flight, which he described as an acceptance test flight, to perform a missed approach to Perpignan followed by a flight bound for Frankfurt. He asked if there was any dedicated airspace to undertake this flight. By checking his flight plan, the controller informed him that only test flights performed in level flight following routes detailed in the flight plan were usually accepted. The controller supposed that the flight plan had been filled out by EAS Industries and that the aim of the flight was identical to that of the flight performed that morning (see 1.18.3). The transcript is in appendix 2.

ATIS information (127.875 MHz)

- Information available on departure from Perpignan:

  GOLF Information, recorded at 14 h 00: VOR DME ILS approach runway 33, runway 33 in service, transition level 050, birds in vicinity, wind calm, visibility 10 km, FEW 3300, BKN 5100, temperature 7 °C, dew point temperature 1 °C, QNH 1 019 hPa, QFE 1014 hPa.

- Information available on return towards Perpignan:

  HOTEL Information, recorded at 15 h 00: VOR DME ILS approach runway 33, runway 33 in service, transition level 050, birds in vicinity, wind calm, visibility 10 km, light rain, FEW 3300, BKN 5300, temperature 7 °C, dew point temperature 3 °C, QNH 1 019 hPa, QFE 1 013 hPa.

Approach on 120.75 MHz

When the crew of D-AXLA contacted the Approach controller at 15 h 33 min 34, four aeroplanes were already on the frequency:

- A light plane at FL 105 in VFR that was transiting from Montpellier aerodrome to that in Pau. The Approach controller transferred the crew to the Toulouse Information frequency thirty-five seconds after the first contact with the crew of D-AXLA.
- A light plane in VFR flying between 1,000 ft and 3,000 ft between points N and E on the Perpignan CTR.
- A training school plane in IFR at 4,000 ft holding at PPG.

- A B737, registered RYR936F on approach to LANET-ILS for runway 33 to Perpignan.

Tower on 118.30 MHz

The Approach controller asked the crew to contact the tower controller at 15 h 45 min 45. The crew neither answered this request nor contacted the tower controller.

1.10 Aerodrome Information

Perpignan - Rivesaltes is a controlled aerodrome, open to public air traffic, located 4 kilometres northwest of the town of Perpignan. It is attached to the southeast civil aviation management (Direction de l'aviation civile sud-est) for airport services and to southeast ATC service (Service de la navigation aérienne sud-est) for air traffic control services.

The aerodrome has one paved runway 15/33 that is 2,500 m by 45 m and one paved runway 13/31 that is 1,265 m by 20 m. The reference altitude of the aerodrome is 144 ft.

The level of protection of the rescue and fire fighting services is 7 (ICAO classification) during air traffic control duty hours[13].

[13]From Monday to Friday from 4 h 30 to 21 h 30, Saturday from 4 h 30 to 20 h 00 and Sunday from 5 h 30 to 21 h 30. In winter, one hour should be added to these times.

1.11 Flight Recorders

In accordance with the regulations, the aeroplane was equipped with a cockpit voice recorder (SSCVR) and a flight data recorder (SSFDR).

1.11.1 Cockpit Voice Recorder (CVR)

The SSCVR was a protected recorder with a solid state memory capable of reproducing at least the last two hours of recording:

- Make: Allied Signal (Honeywell)
- Type number: 980-6022-001
- Serial number: 1424

The following tracks were recorded:

- VHF and Captain headset microphone (left seat), thirty minutes duration,
- VHF and co-pilot headset microphone (right seat), thirty minutes duration,
- VHF and public address, thirty minutes duration,
- Cockpit Area Microphone (CAM), two hours duration,
- Tracks 1, 2 and 3 mixed, two hours duration.

A FSK signal coding the UTC time was recorded on tracks 3 and 5.

1.11.2 Flight Data Recorder (FDR)

The SSFDR was a protected recorder with a solid state memory capable of reproducing at least the last twenty-five hours of recording:

- Make: Honeywell
- Type number: 980-4700-042
- Serial number : 11270

1.11.3 Data Readout

The SSCVR and the SSFDR, under judicial seals, were handed over to the BEA by a senior police officer on Sunday 30 November.

The Underwater Locator Beacon (ULB)(14) from the SSCVR was no longer attached to the recorder.

(14)The ULB attached to a recorder is an acoustic beacon that is triggered on contact with water and transmits on the 37.5 kHz frequency. It should allow the recorder to be located during searches.

The electronic cards from the protected modules containing the recorded data were extracted. These cards were cleaned and then dried. Attempts to read them out using several types of independent equipment did not make it possible to recover the recorded data.

The electronic cards were placed under judicial seal again following these operations. They were examined at Honeywell, manufacturer of the recorders, in the United States on 5 and 6 January 2009 in the context of an International Commission of Inquiry. Some short-circuits were discovered on the cards. Eliminating the short-circuits allowed a complete read-out of the data. The recordings were of good quality and the whole flight was included.

Graphs of the flight parameters are in appendix 3. The transcript of the SSCVR data is in appendix 4.

The recordings were synchronised in UTC time according to the *Master Caution, Master Warning, BCD GMT time, GMT minute, GMT second* parameters.

1.12 Wreckage and Impact Information

The violence of the impact caused the aeroplane to break up. The wreckage lay about five kilometres off the coast. The wreckage zone measured 700 x 400 m at a depth that varied between 30 and 50 metres.

1.13 Medical and Pathological Information

The examinations carried out on the victims did not provide any information relevant to the understanding of the accident.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The aeroplane wreckage and its dispersal bore witness to the violence of the impact with the surface of the water. In such conditions, the accident was not survivable for the occupants.

1.16 Tests and Research

1.16.1 Angle of attack sensors

1.16.1.1 Regulatory aspects

The type certificate of the A320-232 was issued by the DGAC on 28 September 1993. The A320 meets the requirements of the airworthiness regulations in force at the time of the request for type certification, in this case the

JAR25 change 11, as well as the special conditions issued by the DGAC. The equipment installed on the A320 was developed in accordance with regulatory requirements defined in the JAR 25 part F.

To ensure conformity with these requirements, the minimum level of performance applicable to the equipment, under all the specified operational conditions, is defined where applicable in the technical standards for equipment qualification, in this case in the TSO C54[15] for the angle of attack sensors.

From these regulatory requirements and these standards, the aeroplane manufacturer develops technical specifications[16] for each item of equipment on the aeroplane. For the angle of attack sensors, these specifications include the physical characteristics (shape, weight, resistance to shocks, etc.), electrical characteristics, and the degree of reliability sought as well as the environmental conditions.

The equipment supplier guarantees the conformity of its equipment to the regulatory requirements as well as to the specifications provided by the manufacturer through a document called a design and performance declaration. This document must include among other things the reports on the tests performed as well as a certificate of conformity with the minimum applicable performance.

The Goodrich 0861ED angle of attack sensors installed on D-AXLA obtained approval from the FAA to the standard TSO C54 in September 1997. They meet the specifications required by Airbus and were approved to be installed on the A319/A320/A321 family.

Note: The ETSO ("European Technical Specification") C54, issued by EASA in October 2003, reproduces in an identical manner the content of the TSO C54, issued by the FAA, in October 1961.

1.16.1.2 Impermeability of the angle of attack sensors

Minimum performance level

The criteria to ensure conformity to the minimum level of performance defined by the TSO C54 are detailed in a performance standard applicable to stall warning equipment (document SAE Aerospace AS 403 A of October 1952, revised in July 1958). Concerning the impermeability of the angle of attack sensors, this performance standard requires that the stall warning equipment shall continue to function correctly when it is subjected to rain and to moderate icing.

Environmental Tests

To meet these criteria, each item of equipment must satisfy the environmental tests (temperature, altitude, vibrations, impermeability…). The aim of these tests is to determine, in the laboratory, the characteristics and the performances of the equipment in conditions representative of those encountered in operations. The environmental tests in the international

[15] Technical Standard Order C54, issued by the FAA, relating to stall warning equipment, in October 1961.

[16] These specifications cover or refer to the equipment qualification standards, but can go beyond or include items not taken into account in the standards.

standard RTCA DO 160 C were used in the context of the qualification of the type 0861ED angle of attack sensors to equip the aeroplanes in the A320 family. This standard defines the category for each environmental condition in relation to the characteristics of use of each item of equipment. The impermeability tests are not correlated with the icing tests.

For the impermeability tests, four categories of tests are planned in order to determine if an item of equipment could resist the effects of water sprayed or dropped onto the equipment:

- Category X: for equipment installed in places where it was not exposed to water precipitation.
- Category W: for equipment installed in places where it could be exposed to water precipitation in operations.
- Category R: for equipment installed in places where it could be exposed to water flow or to a spray of water at any angle in accordance with the RTCA DO 160 C standard. The equipment that responded to the test conditions associated with this category also responded to the test associated with category W.
- Category S: for equipment installed in places where it could be exposed to jets of fluids such as those encountered during de-icing, washing or cleaning operations.

Level of performance of the angle of attack sensors

The Airbus specifications state that the angle of attack sensors satisfy the impermeability test corresponding to category W, of the RTCA DO 160 C standard, in accordance with the impermeability criteria defined by TSO C54.

The angle of attack sensors made by Goodrich with type number 0861ED satisfy the impermeability requirements for category R, and thus also category W.

Impermeability test procedure according to RTCA DO 160 C

To satisfy the conditions corresponding to category R, the equipment must be installed in a way that is representative of its position on the aeroplane. The equipment is then supplied with electrical power and subjected to a jet of water. The jet must be directed perpendicularly at the most vulnerable area of the equipment[17]. Each zone tested must be subjected to a jet for at least fifteen minutes. The jet must be applied a maximum of 2.5 m from the zone. The exit pressure from the spray equipment must be about 200 kPa and the rate of flow 450 l/h. At the end of the test, no trace of water may be present inside the equipment.

Impermeability Test performed in the context of the qualification of the angle of attack sensors

According to the report on the impermeability test performed in the context of the qualification of the 0861ED angle of attack sensors, the water jet was directed onto the vanes, in relation to the lateral and longitudinal axes of the aeroplane.

[17]As mentioned in the performance standard applicable to the equipment, in this case the SAE Aerospace AS 403 A standard.

The attachment plate used during qualification tests is positioned differently compared to that installed on the aeroplane (see appendix 5). Goodrich did not have, at the time of the tests undertaken in the context of the sensor qualification, attachment plates similar to those used during operations. There are no installation instructions for the angle of attack sensors in the technical specifications supplied by Airbus to Goodrich in relation to the qualification of these sensors.

During the investigation, in April 2010, the impermeability test (category R on the RTCA DO 160 C document) was performed by Goodrich with an angle of attack sensor and an attachment plate identical to that installed on the A320. After the test, the interior of the sensor showed no traces of water.

1.16.1.3 Failure analyses

(18) Failure Mode Effects and Criticality Analysis, FMEA

Analysis of the failure of the angle of attack sensors(18) carried out by Goodrich described the sensor failure modes, the effects of these failures as well as the probability of their occurrence in the context of sensor specifications. Calculations are made on the failure of each sensor component and damage to the vane in the parking area.

In the context of compliance with JAR25.1309 with a view to type certification, a failure analysis must be carried out by the aeroplane designer for the whole of the system of aerodynamic data acquisition. In particular, analysis of the failure of the angle of attack acquisition system is based on that of the sensor and the associated sensor systems and considers, specifically:

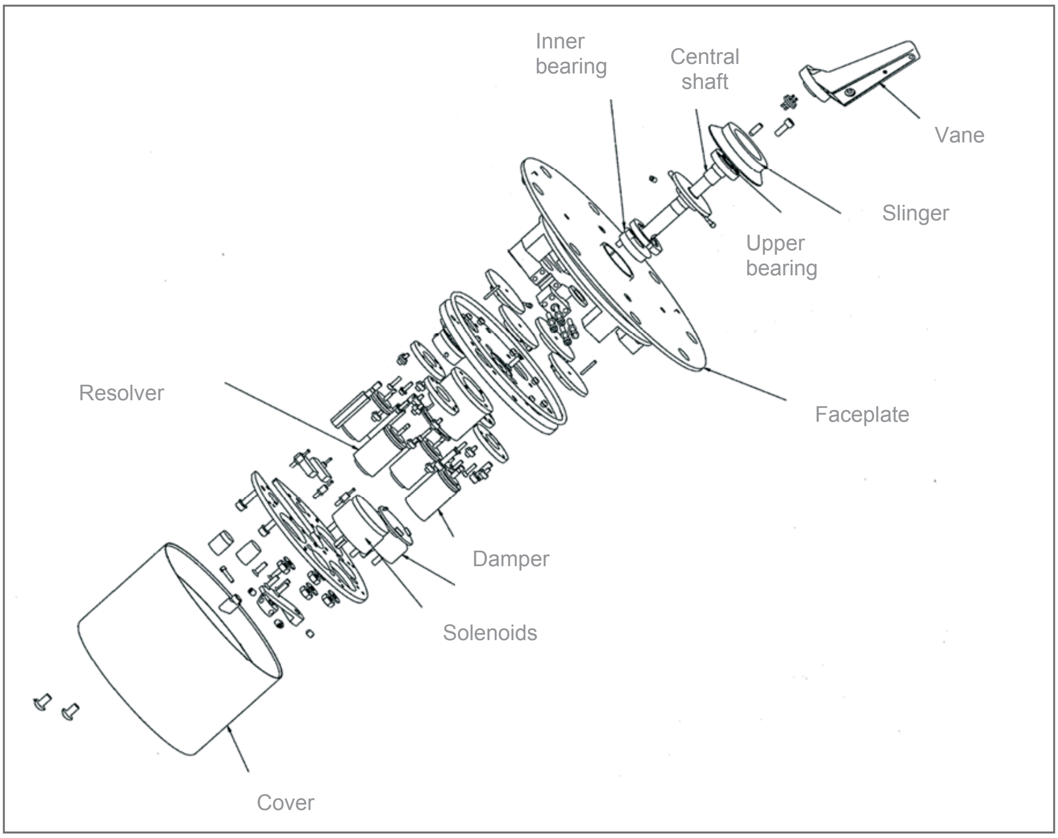
- Mechanical blockages of one, two or three sensors at low speed,
- Damage to an angle of attack sensor leading the associated ADR to supply an erroneous angle of attack value which could lead to a false stall warning.

1.16.1.4 Sensor composition

Each sensor is made up of five sub-assemblies:

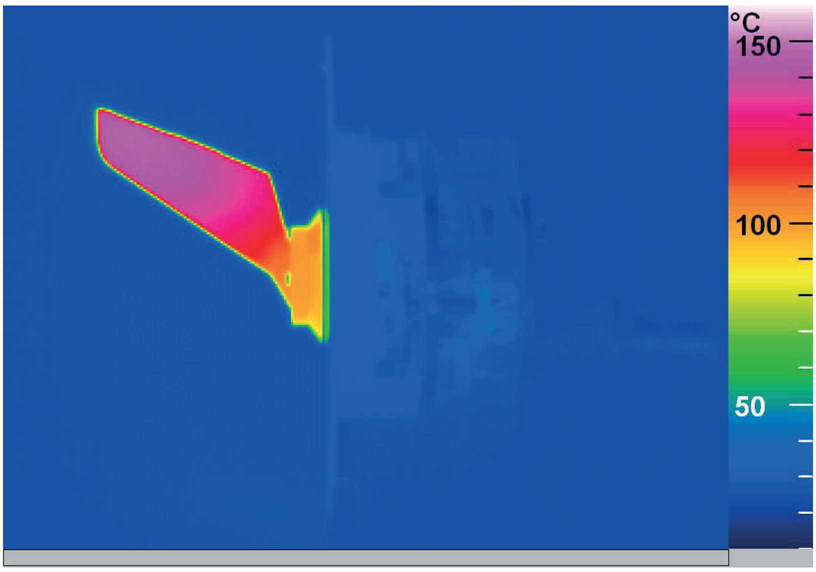
- **Sub-assembly including a heated vane, a slinger and a central shaft.** This rotates freely and positions itself in the relative wind. The vane is fitted with an electric de-icing and anti-icing device. The rotation movement is transmitted to three electric resolvers using a gear train. Two resolvers each modulate two electric signals according to the position of the vane. The third resolver is unused.
- **Faceplate.** This fastens the mobile and fixed unit using two sets of lubricated ball bearings (upper and lower), where the bearing housing is insulated by flexible sealing flanges. The labyrinth mounting must prevent water being absorbed and allow the sensor to “breathe”.
- **Housing.** This contains the damper, allowing the vane to stabilise, and the three resolvers. The latter provide a signal in alternative current proportional to the angle measured by the vane.

- **Rear bearing support.** This allows access to the resolvers as well as to the setting of the damper.
- **Autotest system.** This is made up of two actuating coils that act on the vane to orientate it according to a predetermined position.



1.16.1.5 Temperature measurements

The thermal image below, taken with an infra-red camera, shows the distribution of temperatures of a new angle of attack sensor whose heating system and resolvers have been powered for five minutes in ambient conditions.



This thermal image does not show the temperature inside the sensor housing.

(19)See paragraph 1.6.6.1 for the definitions of the various angles of attack.

1.16.1.6 Angle of attack values

The *aeroplane angle of attack* values(19) from sensors 1 and 2, based on *local angle of attack* values recorded by the SSFDR, were compared with the *calculated angle of attack (*see appendix 6).

From take-off until level-off at FL 320, the angle of attack values varied consistently with the aeroplane movements. From about 15 h 04, the *local angle of attack* values 1 and 2 remained blocked at almost identical values and did not change until the end of the flight.

The *calculated angle of attack* started to deviate in a significant manner from the *corrected angle of attack* values at about 15 h 06 at the time of another level change.

Thus, the *local angle of attack* values from sensors 1 and 2 stopped evolving between 15 h 04 and 15 h 06 and until the end of the flight. From this time onwards, the *corrected angle of attack* values supplied by ADR 1 and 2 to the other systems were almost identical.

It was not possible to determine if angle of attack sensor 3, whose position is not recorded by the FDR, completely stopped moving at any time during the flight. However, at 15 h 45 min 05, angle of attack sensor 3 was operating correctly since it triggered the stall warning.

1.16.1.7 Examination of angle of attack sensors

Angle of attack sensor 3 was not recovered. Angle of attack sensors 1 and 2 were brought to the surface and transported under judicial authority for examination at the Centre d'Essais des Propulseurs (Saclay). A detailed report appears in appendix 7.

Examination of the two sensors shows in particular that:

- The two angle of attack sensors were damaged on impact with the sea. There was no mechanical malfunction previous to the impact with the sea likely to have blocked the angle of attack sensors. The water pressure, at a depth of 30 metres, led to the absorption of sand, sludge and sea debris into the angle of attack sensor casing, including angle of attack sensor 1 whose casing was not fractured on impact.
- The white and red composite fragments found inside angle of attack sensor 2 casing were obviously foreign to the sensor.
- The translucid polyester particles (terephtalate type) found in the angle of attack sensor 2 casing did not come from the paint or masking products used during the maintenance and paint operations carried out by EAS Industries. The introduction of these particles was subsequent to the accident.
- The examinations and electrical tests carried out on the power circuit and resolvers did not reveal any evidence indicating that the angle of attack sensors may have been faulty or blocked in rotation before the accident.
- The white paint deposited on top of the two sensors' casing and on the mounting base of their vanes was a finishing coat of polyurethane paint but it was not shown that this deposit came from the paint operations at EAS Industries. This white paint around the vanes' mounting base was not spread under the

covered surface of these bases toward the central recess of the sensors inlet. Furthermore, the paint was not as thick as the gap between the vane foot and the opposing fixed surface, so that no contact or rubbing could have interfered with the rotation of the vanes.

- The mounting flange of angle of attack sensor 1, which remained attached to the sensor and to the fragment of the panel, showed the presence of the application of a yellow paint underneath the white paint. This yellow paint, which corresponds to one of the aeroplane's previous liveries, was also visible under the white paint of a section of the fuselage framing this mounting flange.

ZK-OJL (the previous registration of D-AXLA) in the Freedom Air Limited livery
(source: Air New Zealand)

- The seal rings between the upper flange and the housing edge of each sensor showed no signs of damage.
- The circular hole, in the lower part of the flange, was not blocked (this 4.8 mm-diameter hole acted as a drain, allowing the evacuation of water).

1.16.1.8 Detection of blocked angle of attack values by flight analysis

Analysis of D-AXLA flights from 15 February 2007 to 25 October 2008 from flight parameter recordings on the QAR showed no anomaly linked to the angle of attack sensors and the associated systems.

The analysis of flights recorded on the SSFDR from 2 November 2008 to 3 November 2008 showed no anomaly either.

An analysis of A320 flights by the Air New Zealand fleet was performed over a period of twelve months. This made it possible to detect angle of attack values, coming from an angle of attack sensor (of the same type as that installed on D-AXLA) from one of the A 320's, which blocked during some flights. This sensor was removed and was subjected to tests to determine the cause of the malfunction (see 1.16.1.9).

1.16.1.9 Angle of attack sensor tests

The aim of these tests was to:

- Check on the bench (Goodrich) if water could enter the inside of a sensor of the same type as the one installed on D-AXLA after being exposed to a jet of pressurised water[20] and if this water could lead to blocking the sensor under certain conditions;

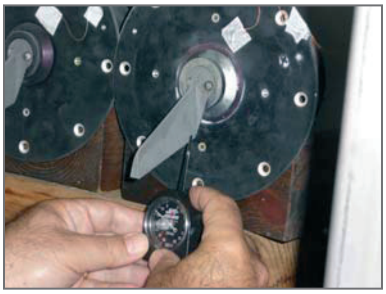
[20]This was not an attempt to reproduce a rinsing operation simulation but rather to check if water could penetrate inside the casing.

- Determine the consequences of water penetration inside an angle of attack sensor in real flight conditions (Airbus);
- Determine the origin of the malfunction of a sensor removed from an Air New Zealand aeroplane in service (see 1.16.1.8).

1.16.1.9.1 Tests performed on a new angle of attack sensor

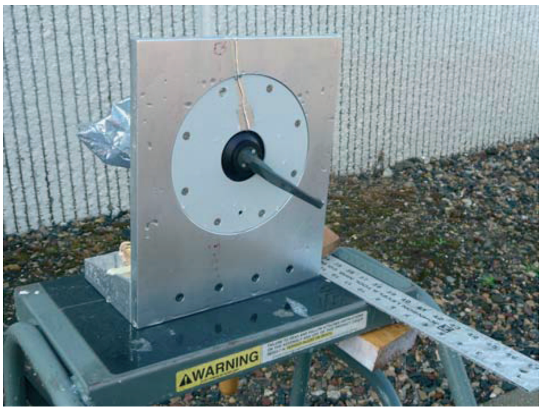
A new angle of attack sensor was the subject of a control and acceptance test of angle of attack sensors (ATP, Acceptance Test Procedure). It did not show any value beyond accepted limits.

Friction tests in an environmental chamber without electrical power supply to the heating system were then carried out (test A corresponding to paragraph 5.2 of the protocol in appendix 8).



The angle of attack sensor was mounted on to a panel reproducing an aeroplane fuselage panel. It was exposed to jet of water at 270 kPa[21] at a distance of 30 cm from all directions within a cone at ±45 degrees centred on the perpendicular axis to the sensor face, for five minutes. Without being dismantled, the device was placed in an environmental chamber simulating the temperature (- 54 °C) and altitude pressure conditions prevailing at FL 350 in standard atmosphere (test B corresponding to paragraph 6.3 of the protocol). The angle of attack sensor heating system was not powered during the temperature and pressure conditions set-up in the environmental chamber.

[21]The objective had been to reach a pressure of 300 kPa, which was not possible due to the characteristics of the nozzle.



Simulation of the aeroplane installation

Exposure to a jet of pressurised water

N.B: This water exposure test is different from the sensors qualification test (see paragraph 1.6.1.1) and more restrictive.

Test A results

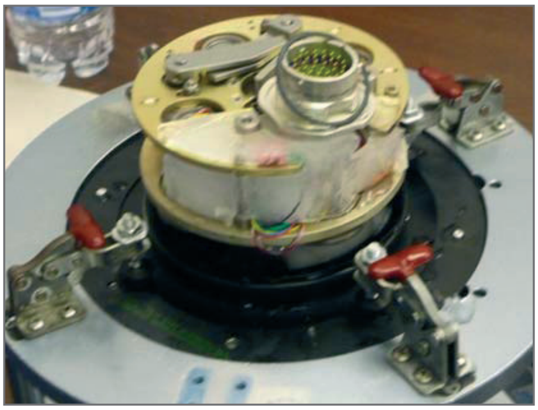
The friction measurements at - 20 °C, - 30 °C and - 54 °C were within the angle of attack sensors' release to service tolerances. This test was consequently not extended by powering the heating system.

Test B results

At - 54 °C, with heating system not powered, the vane was blocked.

Next, the heating system was electrically powered. The friction measurements carried out at - 54 °C, - 20 °C, - 10 °C and - 2 °C showed that the vane remained blocked.

On opening the angle of attack sensor housing, a significant amount of water was revealed (in the form of ice or liquid) likely to block the turning parts (bearings and vane counterweight).



After the water was drained off and the electronic cards were dried in compressed air, the sensor was placed back in the chamber and the temperature was lowered to - 20 °C without the heating system being electrically powered. It was observed that the sensor blocked again.

This aggressive test, which went beyond the requirements of TSO C54, showed that:

- Exposing the sensor to a jet of pressurised water can lead to water being introduced into the sensor body as well as to blocking of the turning parts by icing, at the time of exposure to negative temperatures without heating;
- A small amount of water in the bearings was also enough to block the turning unit in these conditions.

1.16.1.9.2 In-flight tests

Airbus offered to carry out two test flights reproducing the flight profile of the accident.

First flight

It was carried out after having applied the Airbus cleaning procedures on sensor 1[22] and rinsing procedures after metal cleaning on sensor 2 (see 1.17.3.1).

[22] The application of an adhesive strip to the base of the shield equipment was however intentionally omitted.

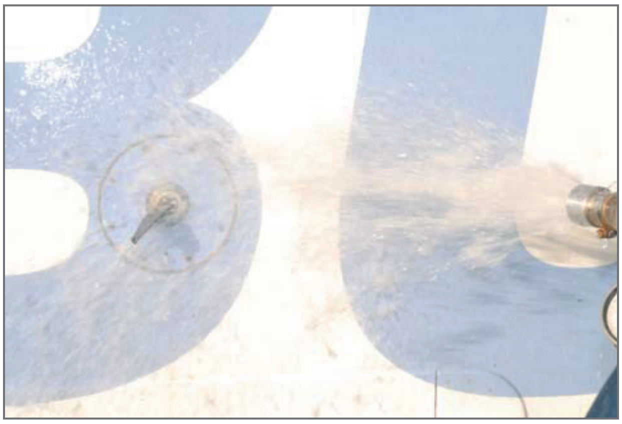
During the flight, the sensors did not block and functioned normally. Disassembly of the sensors at the end of the flight did not reveal the presence of water inside the casing.

Second flight

For the second flight, sensor 1 was fitted with six temperature sensors[(23)] (see appendix 9) in order to record temperatures at different places inside the housing.

[(23)] Five I-buttons and a temperature sensor made of platinum (PT100) installed close to the upper ball bearings.

Sensor 2 was exposed to a water jet, without protection, in conditions similar to the test carried out at Goodrich (see 1.16.1.9.1). The jet was applied, with a hosing tool (not recommended by Airbus for cleaning procedures) which was used during the tests carried out at Goodrich, with a to and fro movement on and around the sensor, staying within a cone of ±45 degrees centred on the perpendicular axis to the sensor face.



The temperature at take-off was about + 8 °C. Climbing through FL 300, about 23 minutes after take-off, sensor 2 was blocked at + 1 ° value while sensors 1 and 3 indicated values consistent with the flight phase. The SAT was - 51 °C, the TAT was - 26 °C and the temperature recorded by the temperature sensor located close to the sensor 1 upper bearing was – 15 °C. Sensor 2 started to unblock gradually 51 minutes later. The SAT was + 2 °C, the TAT + 4.75 °C and the temperature close to the upper bearing was + 4.5 °C. The angular position delivered by angle of attack sensor 2 became nominal 1 min 32 s later while the SAT was + 1.75 °C, the TAT + 9,5 °C and the temperature close to the upper bearing was + 5.5 °C. Appendix 9 presents the evolution of specific flight parameters, including temperatures inside the casing.

Dismantling of sensor 2 casing confirmed the presence inside of a small amount of water. The difference between the volumes of water found inside the casing during the tests at Goodrich and at the end of this flight could be explained by the different application of the water jet on the angle of attack sensors. During the tests performed at Goodrich, the water jet was aimed more or less permanently at the angle of attack sensor while, in the context of the in-flight tests, it was applied with a to and fro movement and around the sensor.

During both flights, the angle of attack heating system was operating.

1.16.1.9.3 Tests carried out on the angle of attack sensor supplied by Air New Zealand

A tomography of this sensor was carried out and revealed damage to the sealing ring between the upper panel and the housing edge.

Sensor tomography
In green, the sealing ring.
Red represents less dense matter

The angle of attack sensor underwent an ATP test:

- The precision test was out of tolerance for resolver 2,
- The static friction test was at the upper tolerance limit,
- During the casing leak rate test the 10 PSI pressure differential could not be reached due to the detection of too high a leak rate,
- The other tests did not reveal any other out of tolerance values.

Test A results

The friction measurements at - 20 °C, - 30 °C and - 54 °C showed an increase in the friction of the vane while staying within the tolerances for angle of attack sensor release to service. This test was not extended by powering the resolvers and heating system.

The tomography showed that the sensor housing sealing ring was damaged. This was confirmed on disassembling the sensor. Contaminants, including silicon lubricant used for the attachment of the seal, dust and fibres were found near the bearings. It was not possible to establish the presence of water.

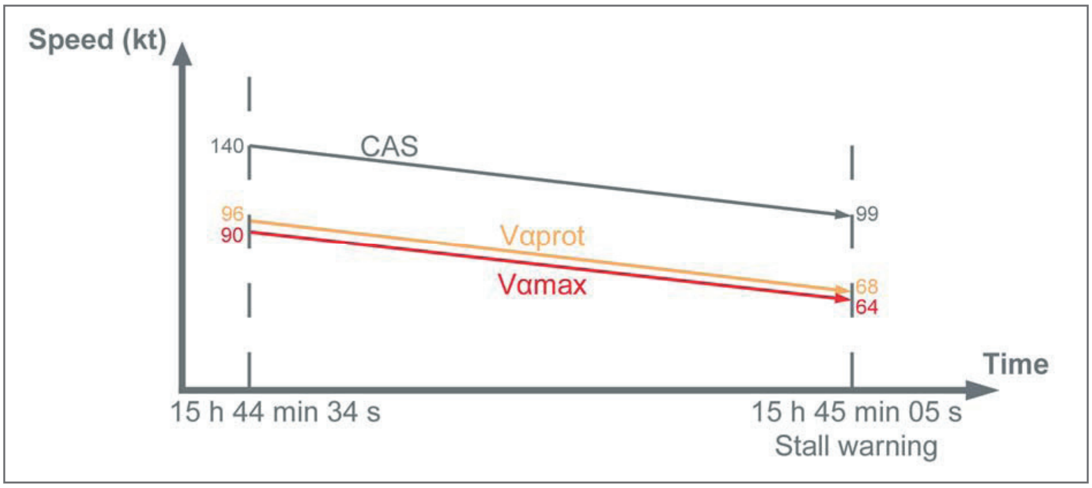
This examination revealed another possible way to block the vane than the ingestion of water through the front part of the sensor: the air in the cabin which is of higher pressure than outside air also has a degree of humidity. Because of the difference in pressure it flows from the cabin to the inside of the sensor housing through the damaged seal to escape outside by going through the bearings at the sensor base. Humidity could then settle on the bearings and immobilize them.

1.16.2 Function of Systems during the flight

Readout of the SSFDR parameters as well as the specifications of the various systems showed that the systems that ensure the handling, use and monitoring of angle of attack values functioned correctly given the angle of attack information they were able to receive during the flight (see appendix 10).

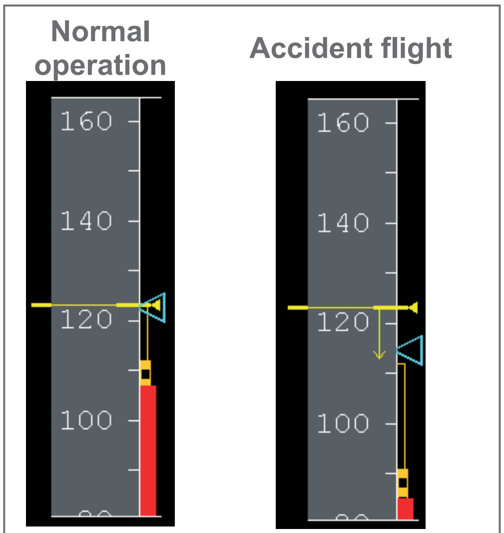
This readout made it possible to:

- Estimate the weight calculated by the FAC: this weight was compared to the weight recorded by the SSFDR (which came from the FMS). The weight calculated by the FAC was underestimated at the end of the flight because of the blocked values of angle of attack sensors 1 and 2. The estimated difference between these two weights reached seven tons, CHECK GW message triggering threshold, at about 15 h 41.
- Check changes in the flight control laws during the flight, notably the passage to direct law at 15 h 45 min 15 s (*alternate law* gear extended) then the passage to Abnormal attitudes law at 15 h 45 min 40 s.
- Indicate that the corrected angle of attack values provided by ADR 3 were valid when the stall warning sounded at 15 h 45 min 05 s in as far as the calculated angle of attack was between 21.7 et 23.2 degrees, very close to the theoretical angle of attack for initiating the warning in landing configuration.
- Calculate the limit speeds presented to the crew during the accident flight. Once the angle of attack values stopped evolving, the limit speeds presented to the crew were proportional to the air speed. Thus, when the air speed dropped, the limit speeds also dropped by the same proportion. By way of comparison, the limit speeds where angle of attack values would not have been blocked were also recalculated (normal operation). These calculations facilitated the reconstitution of the speed band in normal operation and for the event flight.
- Understand the movements of the elevator in the last seconds.

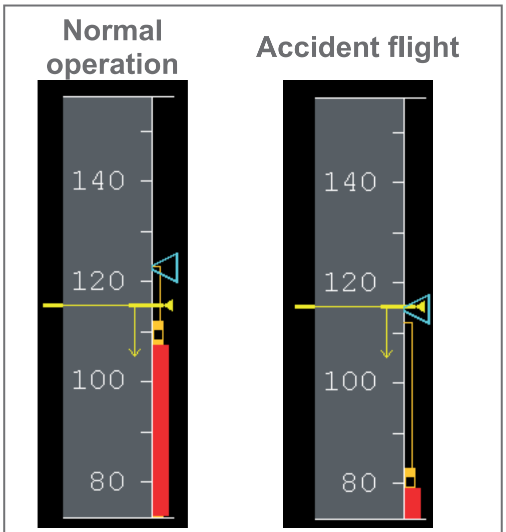


Evolution of limit speeds during the accident flight (for information only)

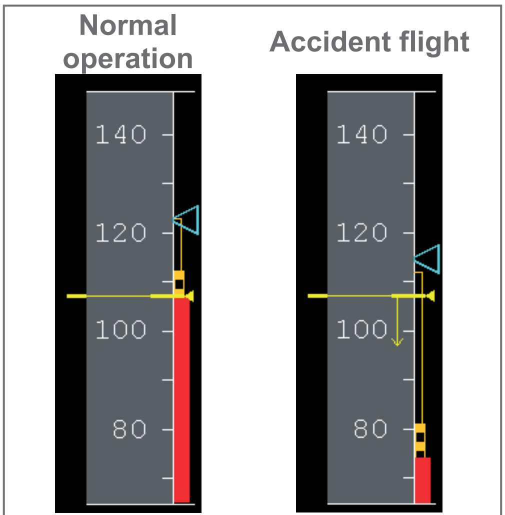
(in normal operation and in the accident flight conditions, Vamax = 107 kt and VLS = 123 kt)



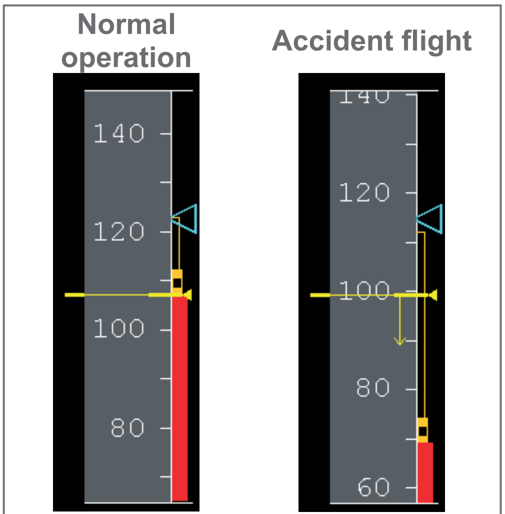
15 h 44 min 44 s
CAS = 123 kt
(corresponding to VLS)



15 h 44 min 51 s
CAS = 115 kt



15 h 44 min 58 s
CAS = 107 kt
(corresponding to V alpha max)



CAS = 107 kt[24]

15 h 45 min 05 s
CAS = 99 kt

Auto-trim

From 15 h 44 min 30 the automatic trim function displaced the stabiliser as far as the electric nose-up thrust stop (- 11 degrees). The stall warning sounded at 15 h 45 min 05. The nose down commands applied by the Captain on the sidestick brought the elevators, due to the load factor, to the neutral position, without however pushing them to the stops[25]. Consequently, the trimmable stabilizer did not move even though the flight control law was *normal*.

From 15 h 45 min 15 until the end of the flight, the automatic trim function remained unavailable. In fact, the *direct* law was active from 15 h 45 min 15 to 15 h 45 min 40 and the *Abnormal attitude* law phase 1 (without auto-trim) remained active till the end of the flight.

[24]In normal operation of the high angle of attack protections, the speed cannot drop below Vαmax.

[25]The elevators must go beyond the neutral position before the auto trim function adjusts the position of the stabilizer.

1.16.3 Underwater search

The BEA took part in operations to localise the recorders and identify parts. Ships arrived in the zone within hours after the accident. Witness statements and floating debris did not enable a sufficiently precise zone to be defined to begin the underwater search for the recorders.

Preliminary data from Montpellier's secondary civil radar allowed a starting point to be defined with N42°40'34,56' E003°06'31,43'' (WGS84) as coordinates.

The description of the underwater searches appears in appendix 11.

1.16.4 Reconstitution of the radar trajectory

In the first days of the investigation, the SSFDR data not being available, the aeroplane's flight path was reconstituted from radar recordings. Read-out of the south-east and south-west CRNA cassettes allowed the extraction of a file of radar data containing secondary radar channels/routes, and voice transmission files. Military radar data was also used (ARISTOTE military surveillance system). A screenshot of the semaphore video of Cap Béar was geo-referenced with the other radar data using the latitude and longitude indications on the video.

The geographic coordinates of the aeroplane's last position were thus validated.

The horizontal and vertical separations between D-AXLA and two aircraft also in the Perpignan control zone (a B737 and a flying school aeroplane) were estimated from the positions detected by Montpellier radar. At no point was there a loss of separation between these aircraft.

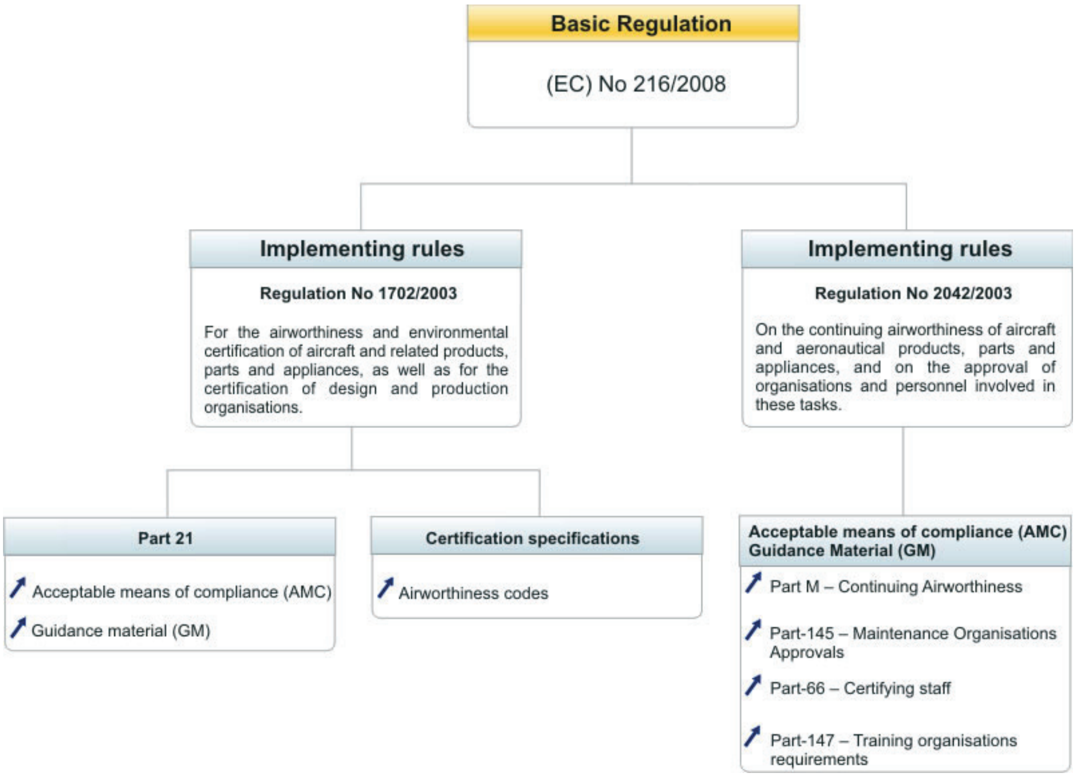
1.17 Information on Organisations and Management

1.17.1 Statutory Aspects

1.17.1.1 Technical rules

The basic ruling[26] established the certification regulation (for airworthiness, environmental issues, design and production bodies) and maintaining aeroplane and product airworthiness, parts and aeronautic equipment, based on the following structure:

[26] EC No 216/2008



Paint operations are not subject to approval and are not mentioned in Part 145.

Equally, Part 66 sets out no arrangements for staff responsible for paint operations.

1.17.1.2 Non-revenue flights

In Europe, the EU-OPS specifies that each flight carried out by an operator must be undertaken in compliance with its Operations Manual[27] specifications. This manual must define procedures and limitations for non-revenue flights[28]. The EU-OPS gives the following list of these non-revenue flights[29]:

[27] EU-OPS 1.175

[28] EU-OPS 1.1045

[29] See appendix 1 to EU-OPS 1.1045

- Training flights,
- Test flights,
- Delivery flights,
- Ferry flights,
- Demonstration flights,
- Positioning flights,

and it specifies that these types of flights must be described in the Operations Manual.

In New Zealand, operational flight checks are needed for the release to service of an aeroplane after maintenance operations which may have appreciably affected the flight characteristics or operation of the aeroplane[30]. Crews that carry out this type of flight must check that these characteristics have not been modified and report any defects encountered in the course of the flight. Only those persons having an essential function in the check flight may be present on board[31].

[30] Civil Aviation Rules Part 43.103

[31] Civil Aviation Rules Part 91.613

1.17.1.3 Leasing

The practice of airlines leasing aeroplanes is becoming more and more common in order to meet the needs of adjusting their fleet capacity, amongst other things. A leased aeroplane is an aeroplane operated *in accordance with a contractual leasing agreement* (ICAO document 9626), commonly called a leasing contract. There are two main types of aeroplane leasing:

- Leasing with crew: the aeroplane is operated on the leaser's Air Carrier Certificate (the party from whom the aeroplane is leased);
- Dry leasing (without crew): the aeroplane is operated on the Air Carrier Certificate of the lessee (the party to whom the aeroplane is leased). For a dry lease of an aeroplane belonging to an organisation that is not part of the European Union, an EU airline must obtain authorisation from the civil aviation authority responsible for issuing its air carrier certificate. This authorisation is intended mainly to guarantee that in the course of the transfer from the lessee to the lessor, the responsibilities relating to the operation and airworthiness maintenance of the aeroplane are clearly defined in the leasing contract. This authorisation bears mainly on the differences notified by the operator in relation to the requirements defined in the sub-sections of the EU-OPS relating to instruments, equipment and communication and navigation equipment. The leasing contract conditions are not taken into account by the authorities to provide leasing authorisation.

A sub-lease refers to the leasing of an aeroplane that is already leased to another organisation.

1.17.2 Information on air traffic organisation

1.17.2.1 Air traffic

In the Europe zone, two types of air traffic co-exist:

- **General air traffic** (GAT). This is made up of all the movement of civil and State aircraft subject to the norms and recommended international practices (ICAO) and/or the regulations specific to this type of traffic.
- **Operational air traffic** (OAT). This includes all the flights that do not come under those carried out in GAT and for which specific procedures are developed by the appropriate authorities.

In France, air traffic includes:

- General air traffic (CAG). This corresponds to GAT.

- Military air traffic (CAM). This corresponds to OAT and includes:
  - military flights that come under Military Operational Traffic (COM),
  - trial and acceptance flights in Trial and Acceptance Traffic (CER), the responsibility of the Test Trial Acceptance Centres (CCER) under the authority of the Ministry of Defence. Test flights necessary after maintenance operations usually require methods of air space use identical to those required for undertaking trial or reception flights. They can thus be partly or fully carried out in CER.

Unlike other countries, civil and military checks are provided essentially in distinct checking organisations. The organisation of work is noticeably different. In CAG, a controller is responsible for all the flights in a section of space. In CAM, a controller is responsible for a given flight, throughout the organisation's space.

1.17.2.2 Air traffic flight plans

Every flight carried out by an air carrier requires the filing of an air traffic flight plan or appropriate information to allow the implementation of emergency services if necessary.

Drafting and communication procedures for air traffic flight plans are defined by ICAO and specified in each country's AIP. An air traffic flight plan should in particular include the flight type (in box 8 of the flight plan), based for commercial air transport according to the type of operations offered by the operator, by means of one of the following letters:

- S for regular air transport,
- N for unscheduled air transport,
- G for general aviation,
- M for military aviation,
- X for other flight types not covered in the previous categories.

When required by control organizations or judged necessary by the operators for the supply of air traffic services, further information can be mentioned (in box 18 of the flight plan) by using the appropriate indicators. In particular:

- STS/: for flights requiring special treatment for specific reasons and if the situation justifies it.
- RMK/: for any other remark.

Flight plans and the associated messages that are correct from a syntactic and semantic point of view are processed automatically. The others are subject to manual processing. The correct processing of flight plans, characterized by the sending of a message of acknowledgement to the sender of the flight plan, does not necessarily mean the consideration of specific criteria peculiar to the nation members that would be unfamiliar to the Central Flow Management Unit (CFMU). When there are comments in box 18 of the flight plan (RMK/), their contents are not checked by automatic processing.

Flight plans concerning specific flights in IFR in France

Flights in IFR of a specific nature (technical type, aerial photography, sports event coverage, etc.) taking place under the responsibility of the CRNA have an impact on the workload and capacity of control organisations. In the context of air traffic management, in the AIP France (ENR 1.9 Management of air traffic flow) it is specified that this type of flight must be subject to a request made to the Operations Directorate of the DSNA, with advance notice of three working days. Without prior agreement, the flight could have real-time modifications imposed on it or be refused if the circumstances require.

To carry out test flights in CER, airlines must file an approval request with the head of the Test Flight Centre (CEV). The AIP France specifies the address to which this request must be sent as well as the telephone numbers for programming the flights.

An aeronautical information notice relating to « *flights carried out after maintenance work to restore the airworthiness certificate to aircraft* » (AIC A 03/03 France) issued in 2003 by the SIA, indicates that, after having obtained approval, flight requests must be accompanied by a flight profile and must be made before 15 h 00 the day before the flight by fax to the Coordination Unit of the CER division in Istres. Depending on the departure and destination airports, the flight is either taken care of totally by the CCER or successively by civil ATC organisations (of the airport, approach or en route) and by the CCER. For each flight a flight plan must be filed and a telephone discussion is mandatory between the Captain (or representative) and the Duty Officer of the first CCER concerned by the flight to confirm:

- The transponder code,
- The working radio frequencies,
- The flight profile,
- Work sector.

All the elements contributing to the smooth running and safety of the flight.

1.17.2.3 En route control centres

The sector TG controller of the southwest CRNA filled in an Event Notification Form[32] (ENF) at around 15 h 00 on 27 November 2008 relating to flight GXL888T. He stated on the form that for the second time that day, the crew of this aeroplane departing from Perpignan airport wished to carry out specific manoeuvres (*"360° right/left climb in upper airspace"*). He had qualified this flight as a test flight. A southwest CRNA controller had already filled in a ENF on the morning of the same day at around 8 h 30 relating to flight GXL032T (see 1.18.3 flights of B737-800 registered as D-AXLH and operated by XL Airways Germany) and had mentioned it to the controllers in the replacement shift.

[32]Transmitted, read out and analyzed by the SMQS service.

Analysis of the two ENF by the southwest CRNA SMQS service specified that no comment in the flight plan showed if it concerned test flights or check flights.

1.17.2.4 Perpignan ATC organization emergency alert service

In the event of simultaneous loss of radio and radar contact when radio contact is mandatory, or in the event of loss of radio contact on approach, the Alerfa phase must be triggered within five minutes maximum and the Détresfa phase within ten minutes maximum.

Before these emergency phases are triggered and as soon as a specific event or accident has been detected, warning procedures (that distinguish between stand-by mode, warning mode and accident mode) described in Perpignan control tower's operating manual must be implemented, either by the coordinator when there is one, or by the approach controller.

At the moment of loss of radar contact at 15 h 46, the approach controller established the monitoring mode and first informed the head of the emergency services by telephone and the runway control centre. She was also informed at the same time by the emergency services (SAMU) that the SAMAR plan had been triggered. This accident message was broadcast in compliance with Perpignan control tower's operations manual (see appendix 12).

1.17.3 Information on Airbus

1.17.3.1 Painting procedures

The reference documents for carrying out painting operations are the AMM[33] and the SRM[34]. These operations are undertaken in three stages:

[33] Aircraft Maintenance Manual

[34] Structure Repair Manual

[35] AMM et SRM 51-75-11

Stripping[35]

Depending on the amount of dirt on the aeroplane, cleaning may be recommended before stripping paint. Stripping the old paint off the metallic surfaces is done either with chemical stripping agents or by sanding. Composite surfaces can only be stripped by sanding, to avoid damage from chemical strippers.

Before starting stripping, some materials, surfaces and components must be protected by:

- When chemical strippers are applied: a polyethylene film and a strip of adhesive aluminium, both resistant to solvents;
- When sanding: brown paper and adhesive paper.

After stripping, a rinse (water pressure limited to 600 kPa for a hose or to 5,000 kPa for a high pressure cleaner) with protections still in place enables the removal of any residual paint and stripper. At the end of the rinse, all the protections must be removed. Surfaces that were masked and those where the paint stripper did not totally remove the old paint must be sanded. These surfaces are then cleaned with a cleaning product and then dried with a cloth.

Cleaning[36] (see appendix 13)

[36] AMM 12-21-11

- Protection

Before starting the cleaning, protective devices must be put in place especially on the sensors and sensors (total temperature, Pitot, AOA) and the static ports.

The three angle of attack sensors must be protected by devices (two possible types) that are part of the flight kit. They are delivered with the aeroplane and are regularly used during stopovers.

Example of protective equipment

The angle of attack sensor protections are not totally impermeable. The cleaning procedure specifies however that adhesive tape must be placed wherever cleaning products could penetrate.

❐ Cleaning

The aeroplane is cleaned by spraying on a cleaning solution (pressure less than 70 kPa and temperature less than 50 °C). The spray must be about one metre from the surface to be cleaned, at an angle of 45 degrees (never at 90 degrees) and the product must not be sprayed for more than five seconds in one place on the surface.

❐ Rinsing

To remove any cleaning solution that may remain on the surface and cause corrosion, the aeroplane's surfaces must be rinsed sufficiently with clean water at a temperature below or at 65 °C ten minutes after the cleaning solution is applied. Rinsing is performed with the same type of hose at the same pressure as for the cleaning.

Painting[37]

The standard method for painting is as follows: application of a wash primer, then application of a primer coat and finally application of a finishing coat.

Before starting the painting, some materials, surfaces and components, including the angle of attack sensors, must be protected with brown paper and paper adhesive. During painting operations near the angle of attack sensors, the latter must be protected with a specific protective tool[38].

For the three stages, it is also indicated that adhesive must not be used on the sensors, tubes and sensors (static, Pitot, total air temperature, angle of attack) so that no residue remains that might affect indications on the instruments in the cockpit.

Service Information Letter on maintenance precautions relating to the angle of attack sensors

[37] AMM and SRM 51-75-12 and SRM 51-23-11

[38] This tool is applied to the Thales type sensors and has not been adapted to be used for Goodrich angle of attack sensors.

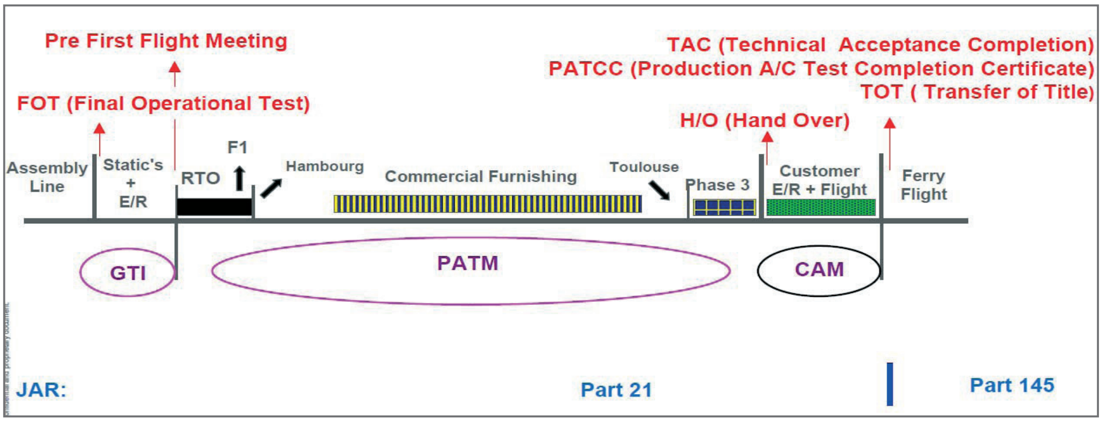
On the basis of in-service experience of Thales angle of attack sensors, Airbus informed operators and maintenance organisations in 1993 and 1998 in a letter[39] of the maintenance precautions to take to protect angle of attack sensors, particularly during cleaning and painting:

[39] SIL 34-074 dated of 23 January 1998

- Cleaning:
  - As well as specific protections, visible adhesive tape must be used to mask the gap between the base of the sensor and the aeroplane plate to which the sensor is attached (the AMM was modified accordingly). This extra protection helps avoid any penetration of water, solvents, cleaning agents and any other liquids in the sensor. The letter specifies that water penetration of the sensor could increase the risk of corrosion, of icing in flight or of faulty electrical connection.
  - High pressure jets must not be pointed at the sensors. These jets could push liquids into the bearings and electrical connectors, damage the joints, cause corrosion and remove necessary lubricants.
- Painting:
  - The sensors must be protected with a specific tool. Any paint marks found on the sensor must not be removed with metallic objects or sandpaper but delicately using a specific product.
  - Checks should be made that no liquid has gone into the bearings via the gap between the sensor and its base.

1.17.3.2 Production test, demonstration and check flights

As a Part 21 approved production organization, Airbus carries out several types of flights during which tests are carried out according to a specific programme. These flights are operated in compliance with Airbus "flight test operations manual".



A320 production and delivery process

The tests and checks described in the manuals associated with these types of flights, and particularly those at low speed, are drawn up for the attention of Airbus' test crews. The conditions in which they should be undertaken are specified in the "flight test operations manual". In practice, these tests and inspections are undertaken in visual flight conditions and icing conditions are avoided before starting these tests.

Furthermore, the test crews disconnect the autopilot and the flight director and use the FPV (*bird*). Before commencing deceleration, the test engineer calls out the expected speeds as well as the minimum speeds corresponding to the aeroplane's mass and configuration. Deceleration of one knot per second is shown on the PFD's speed band by a 10 kt speed trend arrow.

The crew must anticipate the incorrect functioning of the system under test and must define the manner in which the test or the check is to be stopped. The tests start when necessary, by detection of a deviation or errors in comparison with the theoretical values indicated in the manuals. The tests are thus interrupted as soon as the values observed on the ground or in flight by the test crew do not correspond to these theoretical values.

Post-production test flight

In order to obtain an individual airworthiness certificate for a new aeroplane, Airbus must present a certificate of conformity (EASA form 52) which certifies, among other things, that all the ground and in flight checks are satisfactory:

These ground and in flight tests, carried out by Airbus before delivery to the client, are described in the PATM (Production Aircraft Test Manual). They include successively:

- ❒ Ground tests,
- ❒ An abandoned take-off,
- ❒ In-flight tests during flight checks corresponding to the post-production test flight.

Flight testing is done with two Airbus pilots (including one test pilot) and a test engineer from Airbus.

Low speed checks

The aim of low speed checks is to check the activation at planned and signalled speeds on the PFD speed band of the angle of attack protections in *normal* law.

Customer acceptance flights on delivery

When all the tests scheduled in the PATM have been carried out satisfactorily, a technical demonstration of the aeroplane is undertaken for the client. This allows the client to request any further work (mentioned in the material report of the aeroplane) before the client's acceptance of the aeroplane. This technical demonstration includes the checks recommended by Airbus in the context of the client's acceptance of this new aeroplane. The checks are presented in the CAM[40] manual and include:

- ❒ Checks to be performed on the ground with engines stopped;
- ❒ Engine tests on the ground;
- ❒ Checks during a demonstration flight on delivery (acceptance flight). This flight is performed under the authority of Airbus. The crew is made up of a minimum of three people from Airbus (a test pilot, a test flight engineer and a cabin safety specialist) and the client's pilot, rated to fly the aeroplane.

[40]SA CAM pour l'A320 (Single Aisle Customer Acceptance Manual)

The manual contains a list of actions and checks that the manufacturer proposes to undertake in the client's presence. It specifies that any unplanned change in the programme during the flight could endanger the safety of the flight and is thus not permitted. At the client's request, further checks, defined by Airbus in the SA SHOPPING LIST manual, can be added to the acceptance flight programme.

The technical demonstration of the aeroplane to the client is performed shortly after the ground tests and the post-production test flights carried out according to the PATM. The CAM checks do not reproduce in detail the PATM checks. The CAM manual checks are not part of the airworthiness certification process and should not be considered as a demonstration of the aeroplane's conformity. Before the demonstration flight, the client's pilot takes part in a briefing with an Airbus test engineer.

The client receives a photocopy of the CAM manual with the results of the checks that were performed during the demonstration flight.

Low speed checks

The low speed checks described in the SA CAM must be performed between FL 140 and FL 100. Their description in the SA CAM manual is less detailed than that of the low speed tests in the PATM in so far as they only relate to a client demonstration and not an in-flight check.

The crew must first of all stabilise the aeroplane's speed (in clean configuration) to *Green dot* then note the aeroplane's weight and the position of its centre of gravity.

The aim of these checks during the delivery demonstration is to show the client's pilot; in a qualitative way, activation of the angle of attack protections in *normal* law and in landing configuration at the scheduled speeds signalled on the PFD speed band. To do this, the crew must adjust the thrust to maintain speed at VLS. When the speed is stable, the thrust levers must be in the IDLE position and the flight attitude must be monitored to obtain a deceleration rate of one knot per second. While decelerating, the crew must observe the automatic trim stop (activation of alpha prot) then activation of the alpha floor mode. This mode must then be deactivated. The crew must reduce speed and maintain it at Vmin, keeping the thrust levers in the IDLE detent after having deactivated the alpha floor mode and adjusting the flight attitude.

The VLS and Vmin (speed below which the check must be stopped) speeds are shown in a table at the end of the page under the description of the low speed checks, according to the aeroplane weight and engine type, with a tolerance margin respectively of more or less 3 and 4 kts.

In-service test flights

Airbus has developed an In-service Aircraft Test Manual (ISATM) which is used by its test crews in the context of technical assessments or transfers of aeroplanes already in service, at the request of airlines or of Airbus Asset Management, which owns around 60 aeroplanes. This manual was drawn up taking into account the test pilots' and engineers' training, experience and specific skills. It includes:

- ❐ Ground checks, engines stopped;
- ❐ Engine ground checks;
- ❐ Checks during in-service test flights;
- ❐ An in-service test flight certificate is issued at the end of the flight and includes all the defects detected during the flight;
- ❐ Appendices.

The checks described in the ISATM correspond partly to those in the PATM. The in-service test flight is undertaken by a full Airbus test crew (two pilots, including at least one test pilot, and one test engineer) or one of the airline's pilots assisted by an Airbus test pilot and engineer. During flight preparation, the crew adapts the flight programme according to the aeroplane, any repairs or modifications carried out on it and environmental conditions.

The ISATM is supplied to airlines who request it for information and who have signed a disclaimer letter. The letter specifies in particular that the ISATM:

- ❐ Has been designed for Airbus test crews, taking into account their experience and qualifications;
- ❐ Is adapted by Airbus test crews according to the flight context;
- ❐ Is supplied to airlines for information only;
- ❐ Must be modified according to the specific needs of the airlines who wish to use it for tests for aeroplanes *in service*;
- ❐ Cannot be used as a flight manual;
- ❐ Is confidential and may not be passed on without Airbus' authorisation.

Low speed checks

These are to verify, for an in-service aeroplane, the activation, at scheduled and signalled speeds on the PFD speed band, of the angle of attack protections in *normal* law.

The description of low speed checks in the ISATM is similar that of low speed tests in the PATM. Ground checks, then checks in flight in clean, then landing, configuration performed between FL100 and FL140, are defined. Before starting low speed checks, the crew must reduce and stabilise speed in order to record the three angle of attack values and compare them to the attitude and pitch.

[41] A320 AMM 05-59-00

Check flights[41]

The Airbus A320 maintenance manual does not impose any check flights after maintenance operations but recommends performing them in two cases:

- ❐ When two engines have been replaced or reinstalled;
- ❐ When maintenance operations, that could affect the aeroplane's performance and aerodynamics, cannot be fully checked and confirmed on the ground.

For these two cases, the operator can obtain a flight programme to follow by contacting Airbus.

1.17.3.3 Stall warning - FCOM

The FCOM[42] indicates that *the* stall warning sounds continuously at low speeds in *alternate* and *direct law*. However, a false stall warning can also sound in *normal* law if an angle of attack sensor is damaged. It describes the recovery technique to use in case of a stall warning:

- The pilot must place the thrust levers in the TOGA position, reduce pitch attitude, set the wings horizontal and check that the airbrakes are retracted. If there is a risk of contact with the ground, the flight attitude reduction must be adjusted to allow an increase in speed, and no more.
- The pilot must then maintain speed close to VSW until acceleration is possible. After the warning has stopped and when there is no longer any risk of ground contact, the crew can retract the landing gear. The crew carries out configuration changes (slats / flaps) according to speed evolutions.
- At high altitude, when the angle of attack is close to that for the onset of buffeting, the stall warning can also sound. To exit these conditions, the pilot must release nose up pressure on the sidestick and reduce pitch if necessary.
- In clean configuration and below 20,000 ft, configuration 1 must be selected.

[42]Flight Operations - supplementary techniques - Flight controls 3.04.27 page 5a

1.17.4 Information on EAS Industries

1.17.4.1 General

EAS Industries is an approved Part 145 (N° FR.145.301) maintenance organisation that carries out base and on-line maintenance. Its area of activity includes:

- Approval for classes and categories, in accordance with Part 145, with personnel qualified according to part 66;
- Paint and decoration work as well as weighing aeroplanes in maintenance.

Its main base is in Perpignan, on land adjoining Perpignan - Rivesaltes aerodrome served by a taxiway. The covered installations comprise two hangars, a supply depot, a tool store, workshops and offices.

If a check flight is necessary at the end of maintenance, the checks, flight programme, airspace reservation and flight plan are determined by the customer airline. EAS Industries inspectors are present on board the aeroplane during these check flights. EAS Industries has CEV approval to carry out these checks in CER. The request for a check flight is however made by the airline. Depending on the nature of the checks and their number, the check flight may not be subject to a specific request to the CEV and can be done in CAG.

1.17.4.2 Painting procedure

To limit and keep to the aeroplane grounding deadlines, the organisation of painting operations, which include stripping, cleaning and painting, must be flexible and in concordance with other maintenance tasks. As a consequence of this flexibility, painting operations are staggered over different sections of the aeroplane according to the aeroplane's availability. They are thus often performed at night or over weekends, when no other maintenance work is being carried out. During these operations, the hangar is only accessible to people with adequate protective equipment, responsible for this work.

To issue approval to carry out paint operations, the GSAC checks the premises and materials used, the list of skilled personnel and the presence of the manufacturer's documentation. Work is carried out entirely under the supervision of a site manager and the EAS Industries quality control department who check the implementation of procedures.

[43] MPPI 01-001, document, edition 2, revision 0, of 13/03/02

An EAS Industries' internal procedure, describes the « permanent instructions for painting projects »[43]. This procedure is applicable to any type of aircraft. It indicates in particular that the maintenance manual (AMM) must be complied with. A file is set up for each painting project. The Airbus service information letter of 1998 on the precautions to take during painting and cleaning operations is included in EAS Industries' documentation. According to this procedure, a painting project takes place in the following way:

Preparation of the aircraft

- ❐ Washing: it is specified that the protections on the tubing and electrical connectors must not be flooded;
- ❐ Masking using masking kits (made of aluminium for stripping and vinyl for painting).
- ❐ Stripping:
  - stripping is carried out by applying thin coats one after another;
  - all the stripped sections are rinsed thoroughly to totally eliminate any product residue;
  - no antenna must be stripped, sanded or repainted;
  - the protective devices are removed when stripping is finished.
- ❐ Sanding: no antenna must be stripped, sanded or repainted.

Preparation of surfaces before painting

The surfaces to be painted are cleaned with an alkaline wash then rinsed. The surface preparation is done either with an abrasive and water or with cloth and solvent.

Paint

Painting work is carried out in dust-free hangars. If there is dust present before the final coat application, it is removed with anti-dust cloths.

If defects are detected after the paint is dried, they are removed by dry polishing with disk or sandpaper. The resultant sanding dust is removed with clean dry white cloths.

Paint application checks

Following painting operations, a check on the application of the paint is undertaken.

1.17.4.3 Cleaning procedure

EAS Industries uses the Airbus cleaning procedure[44] (see 1.17.3.1).

[44] AMM 12-21-11

1.17.5 Information on the Operators

1.17.5.1 XL Airways Germany

On the day of the accident XL Airways Germany was an air carrier D – 139 certificate holder, issued by the Federal Republic of Germany on 3 May 2006. It was re-validated on 16 July 2008, as a result of a change in the regulation and was valid until 31 May 2009. An A320-232, an A320-214 and five Boeing B737-800, with which it undertook charter flights, appeared on its air carrier certificate. All these aeroplanes had been leased. The latest version of XL Airways Germany's Operations Manual corresponded to revision 4 on 1 September 2008.

The safety management service was set up in February 2007 with the creation of a flight analysis system.

Operations Manager

The operations manager handles in-flight operations and operations on the ground. He or she takes responsibility in particular for the following duties at XL Airways Germany:

- ❒ Development and application of the regulations and procedures as well as parts A, B and C of the Operations Manual;
- ❒ Authorisation for all air operations within the airline according to the regulations in force, the German regulations, the requirements of the aeroplane production bodies and ICAO;
- ❒ Coordination with the head of the safety management service for risk assessment, the results of systematic flight analysis and aspects linked to safety of operations management.

The operations centre is part of operations management. It deals with flight preparation and ensures that for each flight, a full crew is designated that meets all the requirements in terms of skills, experience and flying time limitations.

In order to be appointed to this position, the operations manager must be an airline pilot, Captain and in active service.

Aeroplane leasing

The dry leasing procedure for an aeroplane belonging to an organisation other than a European Union operator is listed in Chapter 13 of the Operations Manual and is identical to the EU-OPS paragraph 1.165.

XL Airways Germany had never requested flights for the reception or return of an aeroplane in the context of a lease. Ferry flights of leased aeroplanes after the signing of leasing contracts served as acceptance flights for the aeroplane and were carried out without a specific programme. Only the leases of D-AXLA and D-AXLH, B737-800 (see 1.18.3) were the subject of flights with programmes established with the lessors of these aeroplanes.

Procedures and limitations applicable to non-revenue flights

XL Airways Germany's Operations Manual repeats EU-OPS non-revenue types of flights and establishes associated procedures and limitations, with the people that can be transported during these flights:

- Training flights: the training flight Captain must have a licence with an instructor's qualification for the aeroplane concerned;
- Test flights: performed after certain maintenance and / or repair operations and at the request of civil aviation authorities. The programmes for these flights are decided by the person in charge of maintenance in agreement with the person in charge of air operations. Only experienced pilots can be designated to perform these flights, in the presence, if necessary, of engineers or mechanics. The crew must be briefed by an official from the maintenance management on the aim of the test flight, the programme of checks and on the influence of the maintenance operations that were carried out on the aeroplane's airworthiness;
- Delivery flights: on the purchase or leasing of an aeroplane, between manufacturer's or seller's or lessor's plant and the airline's facilities (and vice-versa);
- Ferry flights of aeroplanes going to maintenance facilities;
- Demonstration flights: performed with the purpose of a sale or advertising or to display handling characteristics to a potential buyer (flights with journalists or clients for the release to service of a new aeroplane in the XL Airways Germany fleet). These flights, when passengers are on board, cannot be combined with training flights;
- Positioning flights of an aeroplane on an aerodrome for a commercial flight.

The procedures described in XL Airways Germany's management specifications for maintaining airworthiness (CAM-MOE) also specify, with regard to test flights, that they may be performed:

- After specific maintenance operations,
- At the operator's request,
- On integration of a new aeroplane in the fleet list or
- At the civil aviation authorities' or manufacturer's request.

It is also specified that:

- They must be carried out according to the recommendations of aeroplane production organisations and at the request of the maintenance management;

- They must receive authorisation from the engineering manager and the person in charge of operations;
- No passenger, except for officers from maintenance management or the civil aviation authorities directly implicated in the flight's execution, may be taken on board;
- The crew must be designated by the person in charge of operations;
- The maintenance engineer designated to carry out the flight and brief the flight crew must have at least a part 66 aircraft maintenance licence and during the flight must record all the results of the checks;
- The flight programmes are drawn up by the maintenance service, using, if necessary, the production organisations' manuals;
- Before take-off, all the systems checked during the flight, must, as far as is possible, be checked on the ground and during taxiing.

Operational procedures / limitations

The normal operational procedures used by XL Airways Germany crews correspond to the flight manual procedures and to the Airbus FCOM Standard Operating Procedures (SOP).

Stall recovery procedure

Chapter 3.15 of part B of the Operations Manual (stall recovery procedure) describes the procedure for recovery from an approach-to-stall. It indicates that an approach to stall warning can only sound in *direct* or in *alternate law*. As soon as this warning has been activated, the PF should:

- Advance the thrust levers to maximum thrust;
- Smoothly adjust the pitch attitude to between 5 and 0 degrees and minimize height loss;
- Smoothly level the wings;
- Do not change gear or flap configuration, except when clean below FL 200. When below FL 200 select configuration 1 to reduce the VLS;
- As IAS increases, increase the pitch carefully ensuring that the stall warning does not activate again as the aircraft continues to accelerate;
- When ground contact is no longer a problem, a positive rate of climb is established and IAS is increasing beyond the flap schedule speed for the configuration, then retract the flaps and gear using the normal go-around technique.

The PNF should:

- Check maximum thrust is applied;
- Monitor altitude and speed ;
- Call out any trend towards ground contact or lack of acceleration.

Chapter 2.8 of part B of the operations manual also refers to the technique described in the FCOM (paragraph 1.17.3.3).

Documentation used on board

Maps of the Perpignan terminal region (SID, STAR and approach maps) do not appear in the FMS database (supplied by Lufthansa Systems) for XL Airways Germany's fleet of A320's as Perpignan is not a destination in its network.

[45] In accordance with EU-OPS 1.1040 (m)

XL Airways Germany was authorised by German civil aviation authorities to use at least two laptop computers in the cockpit to replace paper printouts[45]. These laptop computers must not be used by the crew at a height of less than 1,000 ft or during critical flight phases. They are used for performance calculations on take-off, landing and for balance and weight calculations. They contain:

- The Flight Crew Operating Manual (FCOM),
- The airline's Operations Manual (OM, parts A, B and D),
- The cabin crew personnel manual,
- The ground operations manual,
- The aeroplane's flight manual,
- The Standard Operating Procedures (SOP),
- The Minimum Equipment List (MEL),
- Route maps (en route) and maps of the terminal region.

European Aeronautical Group is the map supplier for XL Airways Germany. The ILS approach map for runway 33 at Perpignan available in the crew's laptop computers (see appendix 14) showed no differences with the SIA's official map.

Flight crew training

XL Airways Germany crew training for type rating on A320 is provided by FTO organisations according to programmes determined by Airbus. XL Airways Germany's crews do not follow an "upset recovery training" course. However, the programme for each simulator session includes flying in direct law, requiring manual use of the trim.

1.17.5.2 Air New Zealand

Procedures and limitations applicable to non-revenue flights

According to the Air New Zealand fleet procedures manual, *operational flight checks* are performed:

- When ground checks do not make it possible to establish that the flight characteristics and operation of an aeroplane have not been modified following repair, adjustment or replacement of systems or equipment;
- After the change of both engines on a twin-engine aeroplane;
- To allow an aeroplane to undertake ETOPS flights;
- To perform additional operational checks on the aeroplane or systems, at the request of a senior person from Air New Zealand;
- Before acceptance or delivery of an aeroplane, in the context of a lease or purchase to determine that the aeroplane meets specifications agreed between the supplier/recipient and Air New Zealand. All the planes in the Air New Zealand fleet must be checked and accepted before their release to service. This includes inspections on the ground and an Operational Flight Check.

Air New Zealand's operations manual describes three types of check flights:

- Check flights to enable an aeroplane to undertake ETOPS flights;
- Check flights during which standard operating procedures are sufficient to confirm the state of the aeroplane after specific maintenance operations. These flights can be undertaken by all crews;
- Check flights which require the application of procedures other than normal operating procedures.

This third type of check flight, required in particular before reception or delivery of an aeroplane in the context of a lease or purchase, must be undertaken only with an approved crew. When changes or procedures that do not correspond to the usual operation of the aeroplane have to be performed, the flight is made in daytime. The operations manual specifies that the Captain undertaking the flight must observe the flight programme and its procedures and must make sure that the flight is performed in a safe manner. He or she must also check before the flight that adequate air space is available to perform the flight. To make sure the purpose of this type of check flight and the associated conditions are fully understood, the crew is briefed on the flight programme.

Only approved pilots can perform check flights that require the implementation of procedures other than normal operating procedures. To become approved, these pilots must have an instructor qualification for training on the aeroplane type rating.

1.17.6 D-AXLA's leasing contract

The sublease contract for the aeroplane initially registered under ZK-OJL was concluded between Freedom Air Limited (lessor) and AGAIRCOM GmbH (lessee) on 24 May 2006. By this contract, the lessor and the lessee came to a specific agreement on the following points:

- The acceptance date for the aeroplane, specified in the acceptance certificate provided by the lessee to the lessor, was Wednesday 24 May 2006 at 21 h 00[46]. This certificate was provided by the lessee to the lessor to confirm that it accepted the aeroplane as set out by the conditions of the leasing contract. The certificate specified that at this acceptance date, the use of the aeroplane and the total engine run time was 2,946.40 flying hours and 956 cycles[47];
- The contract expiry date: thirty months after the reception date of the aeroplane, that is to say 25 November 2008;
- The aeroplane lease period begins on the date of acceptance of the aeroplane and ends on the expiry date. It can be extended if the lessee cannot return the aeroplane before the expiry date but this extension does not constitute a renewal of the terms of the leasing contract. The lessee must pay the lessor to avoid any prejudice caused and the additional leasing fees that are due are proportional to the number of days that pass after the expiry date.

[46] 25 May 2006 at 09 h 00 (NZ local time)

[47] 2,275 flying hours, 1,271 cycles for the APU

The leasing contract also specified all the conditions for delivery and return of the aeroplane that included, in particular:

- Maintenance and paint operations with a view to returning the aeroplane at the end of the leasing contract(see 1.17.7);
- Flights called "test flights" having to be undertaken before the aeroplane's delivery and return dates (see 1.17.8).

1.17.7 Maintenance operations

1.17.7.1 Work contract between XL Airways Germany and EAS Industries

XL Airways Germany contacted EAS Industries in May 2008 with a view to returning D-AXLA to Air New Zealand. The following actions were requested, in compliance with the maintenance operations set out in the leasing contract:

- A 20-month check;
- A 40-month check;
- External cleaning of the aeroplane, interior cleaning and refurbishing if needed of the flight deck and cabin;
- A complete borescope of the engines and APU;
- Complete stripping and painting of the aeroplane in Air New Zealand's livery.

For this last point, the following operations were to be carried out:

- Stripping the metal parts of the fuselage, fin, trimmable stabilizer and the wings;
- Sanding composite surfaces on the fuselage, the fin with the rudder, trimmable stabiliser and the engine cowls;
- Application of pressure seals;
- Application of a wash primer;
- Provision and paint in Air New Zealand's livery;
- Checking the contours of doors and emergency exits;
- Provision and installation of Air New Zealand logos;
- Provision and installation of registration marking on the fuselage and wings;
- Provision and installation of technical inscriptions;
- Balancing the rudder without disassembly.

The work contract concluded between XL Airways Germany and EAS Industries stated that, given the operations to be carried out, it was estimated that the aeroplane would be grounded from early morning on 3 November 2008 to the end of the afternoon on 21 November 2008.

1.17.7.2 Progress of maintenance operations

On 3 November 2008, the aeroplane was ferried to Perpignan to EAS Industries. Additional work was added to the maintenance operations during the visit. The work was completed on 27 November 2008 at 14 h 30 and the release to service certificate for D-AXLA was issued by EAS Industries before the flight.

Painting operations

The aeroplane was repainted in Air New Zealand's livery, following a job order[48] that defined the zones to be dealt with (fuselage, engine pods, horizontal stabiliser and fin) and the work to be carried out (stripping, sanding and paint). It included the plans and paint file specified in the procedure. It did not refer to the A320's AMM.

Given the number of coats of paint on the aeroplane fuselage on arrival at EAS Industries, chemical stripping was not sufficient and further sanding of the fuselage and wings was necessary, which grounded the aeroplane on 10,12, 13 and 14 November 2008. The requested actions were carried out according to the following calendar:

	DATE	WORK CARRIED OUT
November 2008	**Wednesday 5**	Cleaning and degreasing of traces of oil and grease on the aeroplane belly.
	Thursday 6 Friday 7 Saturday 8	Full masking of aeroplane using aluminium adhesive tape before stripping the fuselage and wings.
	Saturday 8 Sunday 9	Chemical stripping of fuselage and wings.
	Monday 10	Rinse fuselage and wings after stripping[49]. Stripping check.
	Monday 10 Wednesday 12 Thursday 13 Friday 14	Sanding fuselage and composite parts.
	Saturday 15	Rinsing fuselage and checking sanding. Masking fuselage using paper adhesive tape. Application of Wash Primer then of primer on the fuselage.
	Sunday 16	Application of three coats of white paint on the fuselage.
	Monday 17	Preparation, masking and painting of engine cowls.
	Tuesday 18 Wednesday 19	Sanding wings.
	Thursday 20	Preparation, rinse, masking the wings (paper adhesive tape).
	Friday 21	Application of grey paint: wings, fuselage belly and horizontal stabiliser.
	Saturday 22	Application of blue paint on the fin. Placing the logo on the fuselage.
	Sunday 23	Placing the logo on the fin. Full unmasking of the aeroplane.
	Monday 24	"Rinsing"[50] with clean water by two operatives from EAS Industries (one manœuvring the nacelle, the second hosing down the fuselage) for 15 to 20 minutes to eliminate dust settled on the top of the fuselage. Placing the technical lettering.

During these operations, the angle of attack sensors were protected by:

Work task	Designation	Colour	Identification
Stripping / Cleaning	Brown paper	brown	Cellulose
	Aluminium adhesive tape (jutting over the fuselage in relation to the sensor)	Aluminium	Width 50 mm and 25 mm Glue: polyvinyl acetate
Painting	Brown paper	Brown	Cellulose
	Paper adhesive tape	Cream	Width 50 mm: cellulose fibre band. Width 25 mm: PVC band. Glue: polyvinyl acetate
		Orange	Width 9 mm and 25 mm Band: PVC. Glue: polyvinyl acetate.

N.B: For some work EAS Industries a used transparent plastic device made of polythene.

(48) Job order N° 542778

(49) The aluminium tape protections having been used for the stripping remained in place for the cleaning.

(50) The term "rinsing" corresponds to the term employed by EAS Industries to describe the operation to remove the dust on the airplane undertaken by the two employees. This term is used for the rest of this report.

However, the “rinsing” on 24 November 2008 was carried out without any protection on the angle of attack sensors with a fire-hose without a nozzle, connected to the general water supply system. The water pressure of this system is in the region of 300 kPa and the rate of flow is about 5,500 litres an hour. The EAS Industries operatives that undertook this rinsing did not consider the application of the water jet to be a maintenance operation. It was not possible to determine precisely the distance and the angle between the jet and the fuselage during the rinsing in the area around the angle of attack sensors.

D-AXLA was taken out of the hangar at the end of the painting operations on Monday 24 November 2008. It stayed outside for electrical and engine tests until departure on Thursday 27 November 2008.

EAS Industries stated that the painting operations were carried out under the responsibility of the head of the painting team by:

- Six EAS Industries painters, including the head of the painting team. They had training as painters and had followed an aeroplane familiarisation course;
- A temporary painter;
- Four loaders;
- Four painters subcontracted from the AIR P.A. company;

A painting inspector supervised these operations.

1.17.8 “Tests flights” Provided for in the Leasing Contract

The leasing contract of D-AXLA between Air New Zealand and XL Airways Germany stated that some flights called “test flights” had to be performed to check the state of the aeroplane and to guarantee its compliance with the contract conditions:

- At least three days before the aeroplane delivery date with an Air New Zealand flight crew. The aeroplane was operated on Air New Zealand’s air carrier certificate. Five XL Airways Germany representatives or observers could be on board;
- At least three days before the aeroplane return date to Air New Zealand with an XL Airways Germany flight crew. The aeroplane was to be operated on XL Airways Germany’s air carrier certificate. Five Air New Zealand representatives or observers could be on board.

The contract specified that these flights had to be run in compliance with “Airbus check flight procedures”, by mutual agreement of the two operators. The flight could not last more than two hours.

1.17.8.1 “Test flights” programme

At the start of 2006, Air New Zealand decided to lease two A320 from its fleet, registered ZK-OJL and ZK-OJK, to make its A320 fleet capacity correspond to air traffic demand. This was Air New Zealand’s first aeroplane lease from its A320-type fleet. Leasing agreements were found with XL Airways Germany and TAM (in Brazil) operators to dry lease, respectively the ZK-OJL and the ZK-OJK.

Contact was made between Air New Zealand and these two airlines about the conditions in which the return flights of the two aeroplanes should be run. Given the aeroplane's ages and their capacity for integrated tests, Air New Zealand planned to shorten the duration of these flights by limiting the checks. XL Airways Germany stated that it wanted simply to check the aeroplane's handling characteristics in a flight lasting one hour and during an approach. At TAM's request which, owing to a bad experience during a previous aeroplane lease with another airline, insisted on following the flight programme described in the Airbus ISATM manual, Air New Zealand's technical supervisor asked the Airbus correspondent in New Zealand for this manual. The Airbus correspondent gave him a copy of this manual after making him sign a disclaimer letter indicating that the ISATM manual:

- Had been created for Airbus test crews, considering their experience and qualifications;
- Was supplied for information only to Air New Zealand and that it could not be used as a flight manual for Air New Zealand;
- Was a confidential document that could not be transmitted without Airbus' authorisation.

Given this warning, the reference used to draw up the programme of flights provided for in the leasing contracts was not the ISATM manual but the copy, which Air New Zealand had, of the CAM manual used by Airbus for delivery of its new A320. This CAM manual corresponded to the generic Airbus CAM manual completed, at Air New Zealand's request for the reception of all its new A320s, by checks on *alternate law* and MMO from the SA SHOPPING LIST manual. This request for the addition of Alternate Law checks by Air New Zealand was intended to deepen knowledge and operation of this control law for pilots taking part in Airbus demonstration flights before reception of the aeroplanes.

The first version of the *Operational Flight Check* (OFC) document for the A320 was then drawn up by Air New Zealand by comparison of in-flight checks from this CAM manual personalised with the OFC document used for B737s, to guarantee a certain level of standardisation between all the OFC documents for Air New Zealand's fleet.

This first version of the OFC document did not include any ground checks and did not go over all the checks provided for in the SA CAM manual section linked to the flight exhaustively. Checks on the behaviour of the aeroplane at low speed between FL 140 and FL 100 (LO SPEED CHECKS GENERAL and LO SPEED - CONF FULL) were thus removed in so far as no similar check appeared in the OFC document for the B737. Nevertheless, the checks described in the OFC document and the SA CAM manual are similar; they are detailed according to the flight phase:

Engine start-up	Cabin preparation Flight preparation
Taxiing	
Take-off	Take-off After rotation
Climb	Initial climb Climb to FL 310
Cruise	Cruise to FL 310 – 300 kt Climb to FL 390 – Mach 0.78
Descent	Descent to FL 140 Descent and cruise to FL 140 – Suitable speed
Approach and landing	Approach First approach (automatic landing) Automatic go-around Second approach (manual landing) Manual landing
Taxiing and engine shutdown	Taxiing Engine shut-down

On 10 May 2006, this version of the OFC document was sent to XL Airways Germany airline as well as to TAM airline in Brazil, specifying that this programme based on the CAM manual was sufficient to meet the needs of the delivery flights of an aeroplane under one year old.

According to these two airlines' replies, this version of the OFC document was modified; two different OFC documents (one for XL Airways Germany and one for TAM) were thus created to respond to their requests.

XL Airways Germany responded one week later and requested that the flight programme described in the OFC document be revised on the arrival of the airline's two pilots planned for 20 May 2006 in Christchurch (New Zealand). After discussions on content of the flight programme and the OFC document between the people from Air New Zealand and XL Airways Germany present in Christchurch for the flight, the low speed Configuration Full checks (OFC document page entitled *"Descent FL 140 cont'd")* and emergency extension of landing gear were inserted in the OFC document programme for the delivery of the A320 to XL Airways Germany:

Engine start-up	Cabin preparation Flight preparation
Taxiing	
Take-off	Take-off (TOGA) After rotation
Climb	Initial climb Climb to FL 310
Cruise	Cruise to FL310 – 300 kt Climb to FL390 – Mach 0.78
Descent	Descent to FL 140 Descent and cruise to FL140 – Suitable speed **« *Descent FL 140 cont'd* »**
Approach and landing	Approach First Approach (automatic landing) Automatic go-around **Emergency extension of landing gear** Second approach (manual landing) Manual landing
Taxiing and engine shutdown	Taxiing Engine shutdown

N.B.: On 25 May 2006, TAM airline accepted the detailed programme in the version of the OFC document it had received fifteen days earlier. It did however ask for cabin leak rate, air conditioning system efficiency and engine de-icing checks to be added, which Air New Zealand agreed to.

Low speed checks in the OFC document (see appendix 15)

Low speed checks are described on the OFC document page called "*DESCENT FL 140 cont'd*". This page title has the only altitude reference indicated to carry out a low speed check in landing configuration. There is no preliminary verification of the aeroplane mass and of its centre of gravity position.

The description of low speed checks in the OFC document is identical to that in the SA CAM manual in landing configuration. However, the crew must not go as far as alpha max protection. It must note the auto-trim stop (alpha prot activation) and the alpha floor mode activation, which it must de-activate.

VLS and Vmin speeds are also indicated in a table, at the bottom of the page under the description of low speed checks, for IAE engines, with a respective tolerance of more or less 3 and 4 knots. For a weight of 53.7 tons at the time of the check, the OFC document indicates a VLS speed of 123 kt and a minimum speed of 107 kt.

Note: the speeds indicated in the SA CAM document depend on the engine type. The OFC document speed reference corresponds to CFM engines but the speeds indicated comply with the SA CAM manual speeds for IAE engines.

1.17.8.2 "Test flight" before reception by XL Airways Germany

The test flight before reception by XL Airways Germany took place in Christchurch on 21 May 2006 and lasted 1 h 30. The OFC – XL Airways Germany document was followed. The crew was made up of:

- ❒ Two Air New Zealand pilots;
- ❒ One Air New Zealand representative as first observer, to observe and coordinate the checks in flight.

The three crew members had carried out a flight simulator session to get to know the contents of the OFC document programme drawn up with a view to leasing to XL Airways Germany.

The Captain of the accident flight and XL Airways Germany's head of training were on board this flight, as observers. They had agreed with the Air New Zealand crew before the flight that the emergency extension of the landing gear would not be carried out.

1.17.8.3 "Test flight" before return to Air New Zealand

Several electronic messages were exchanged from the beginning of November 2008 between Air New Zealand and XL Airways Germany concerning the "*test flight*" with a view to the return of D-AXLA to Air New Zealand. Someone from XL Airways Germany operations centre first of all stated that XL Airways Germany used the Airbus Industries programme for this type of flight. The Air New Zealand pilot asked the Captain to use the same OFC document as for the delivery flight on 22 May 2006 specifying that it was a reduced version of the Airbus document. The Captain accepted but also indicated to the Air New Zealand pilot that "*in the near past, we did not perform any such flight tests*" but that "*before that, years ago, we purely followed the Airbus flight test program*".

The Captain and the Air New Zealand pilot also agreed that the flight would be performed by an XL Airways Germany flight crew and that the Air New Zealand pilot would observe and fill out the OFC document from the central seat of the flight deck.

Given the length of time initially anticipated for the aeroplane to be grounded for maintenance operations, a ferry flight between Perpignan and Frankfurt was planned for 21 November 2008. The departure time was programmed at 19 h 05 and flight time estimated at 1 h 10. At the request of the Air New Zealand pilot on the possibility of carrying out all the checks during the ferry flight given the air space restrictions, the Captain indicated that as it was a night flight, the operations manual did not allow for the carrying out of "*exercises*". He had made provision to make the checks the morning after the ferry flight in a check / acceptance flight departing from Frankfurt, which would avoid any constraints linked to air traffic management. The Captain also indicated that the Air New Zealand engineers could travel as passengers on the ferry flight but that for the check / acceptance flight, only those people necessary for the performance of the flight could be on board.

During their e-mail message exchanges, the Captain and the Air New Zealand pilot described:

- The flight with the terms "*flight check*" or "a*cceptance and check flight*";
- The flight programme with the terms "*flight test program/schedule*".

As the maintenance operations were delayed due to the greater number of layers of paint on the aeroplane and the greater number of maintenance operations than originally specified in the work contract signed between XL Airways Germany and EAS Industries, the flight to carry out the OFC document checks and the ferry flight were postponed first to 24 November then to 27 November 2008. It was not possible to determine if the XL Airways Germany crew knew of the two-day extension of the D-AXLA contract beyond the expiry date of the contract (25 November 2008).

Flight plans filed by XL Airways Germany operations centre

On 25 November 2008, XL Airways operations centre asked EAS Industries to check with the "*AIS*[51] *local*" on which route a "*training flight*" of two hours could be performed and a flight level above FL 310. EAS Industries replied on 26 November 2008 that this type of request was not dealt with by EAS Industries and that a phone call to Perpignan control tower would perhaps provide the information sought.

(51) Aeronautic Information Service

The Captain requested that the operations centre fill in two air traffic flight plans:

- The first for a ferry and training flight departing from and arriving at Perpignan;
- The second for a positioning flight departing from Perpignan and arriving at Frankfurt.

XL Airways Germany operations centre filed the flight plan on Wednesday 26 November 2008 at 20 h 03 for the check flight the next day departing from and arriving at Perpignan. The flight code mentioned was GXL888T[52]. To specify the type and nature of the flight, it indicated N for an unscheduled flight in box 8 (flight type) and RMK/FERRY TRNG FLIGHT in box 18 (miscellaneous information) on the flight plan. The estimated time of departure from the parking area indicated in the flight plan was 12 h 30 and the total estimated flight time was 2 h 35. The route and flight plan are in appendix 16.

[52] T for Training or Technical

The maximum flight level indicated in the flight plan was FL 390.

Two messages of acknowledgement and flight plan processing on 27 November 2008 at 11 h 19 and 14 h 27 indicated that the estimated time of departure from the parking area was moved back to 14 h 00 then to 14 h 30. The aeroplane left the parking area at 14 h 33.

The flight plan for the ferry flight from Perpignan to Frankfurt was filed by XL Airways Germany operations centre on 27 November 2008 on 09 h 48. The estimated time of departure from the parking area indicated in the flight plan was 15 h 30 and the total estimated flight time was 1 h 44. At 14 h 46 min, at the request of the approach controller to the crew, the flight plan was delayed by thirty minutes. This flight was defined as an unscheduled air transport flight and the comment FERRY POSN FLT appeared in box 18 of the flight plan.

Crew training for check flights

The Air New Zealand pilot had never performed this type of flight. Alone, he carried out two simulator A320 flight sessions by following the OFC document programme before his departure for Perpignan. Between the two simulator sessions, he had discussed Airbus demonstration flights (and in particular the test engineer's role) with an Air New Zealand pilot who had taken part in several of these flights.

The XL Airways Germany crew did not follow any specific training for this flight.

Checks performed during the flight

Flight phases		OFC Programme	Checks carried out during flight of 27 November 2008
On the ground	Cabin preparation Flight preparation	Cabin general points Before start-up Start-up After start-up Taxiing	
	Taxiing		
Take-off	Take-off TOGA After rotation	Before take-off Check thrust rate Thrust acquisition Automatic flight systems Retracting landing gear	 performed
Climb to FL310	Initial climb Climb to FL 310	Auto-thrust system Flight controls (*normal* law)) Automatic flight systems Systems (ECAM pages) Communication systems Navigation systems	performed performed performed performed performed performed
Cruise	Cruise to FL 310	Engine parameters Aeroplane trim	performed
	Cruise to FL 390 – Mach 0.78	APU start-up	performed
Descent	Descent to FL 140 Descent and cruise to FL 140 – Speed at convenience	Wing anti-icing system Overspeed MMO (above FL250) Overspeed VMO (under FL250) Flight controls (*alternate* law) ECS supply from APU sample Low speed – full configuration	performed performed performed performed FL 120 performed FL 120 started at 4 080 ft.
Approach and landing	First Approach (autoland) Go-around-automatic (at 1,000 ft AGL) Second approach (manual) Manual landing	Aeroplane General points ILS Radio altimeter VS announcements Automatic flight systems Emergency landing gear extension Aeroplane General points Flight controls Deployment of spoilers Automatic braking	
Taxiing and engine shutdown	Taxiing Engine shutdown		

1.18 Additional information

1.18.1 Witness Statements

1.18.1.1 XL Airways Germany maintenance technician

An XL Airways Germany maintenance technician in charge of co-ordinating maintenance operations with EAS Industries stated that the XL Airways pilots had arrived at around 11 h 00 from Montpellier. The Captain contacted him by mobile telephone at the EAS Industries office number. The five New Zealand representatives then arrived at the end of the morning.

He carried out a visual inspection outside the aeroplane for about twenty minutes and checked that the surfaces that had been protected had been cleared.

When he went into the cockpit, shortly before departure, the XL Airways Germany pilots were seated at the controls, the New Zealand pilot was in the centre seat and an Air New Zealand mechanic was in the jump seat. He did not know if they changed places before departure. The other people were standing in the cabin. He saw the Captain get out his mobile phone and put it behind the centre console. He did not know if the Captain had picked it up again afterwards or if it was working.

The aeroplane took off shortly after the technician left it. As far as he knew, the flight was supposed to include a local flight then an instrument approach and touch-and-go, before a departure for Frankfurt/Main.

The crew and the pilot from Air New Zealand had had a meeting for about an hour in a room on EAS Industries premises.

Between 15 h 35 and 15 h 45, he received four or five phone calls on the line in the office lent by EAS Industries. During the first call, no one spoke and he was unable to identify the caller. He seemed to think that the second call came from the cockpit, without him being able to identify the person calling. For the following call, he heard one person communicating by radio and a second voice saying "Gear Up"; it was on line, no one spoke. A colleague answered the final call for him (see below).

1.18.1.2 Witness statement from second XL Airways maintenance technician

This technician took the last call on the telephone line and identified it as coming from the cockpit. According to his estimate, he was on the line for between 40 and 45 seconds during which time several alerts sounded that he was unable to recognize. He also heard someone shout but could not identify the person.

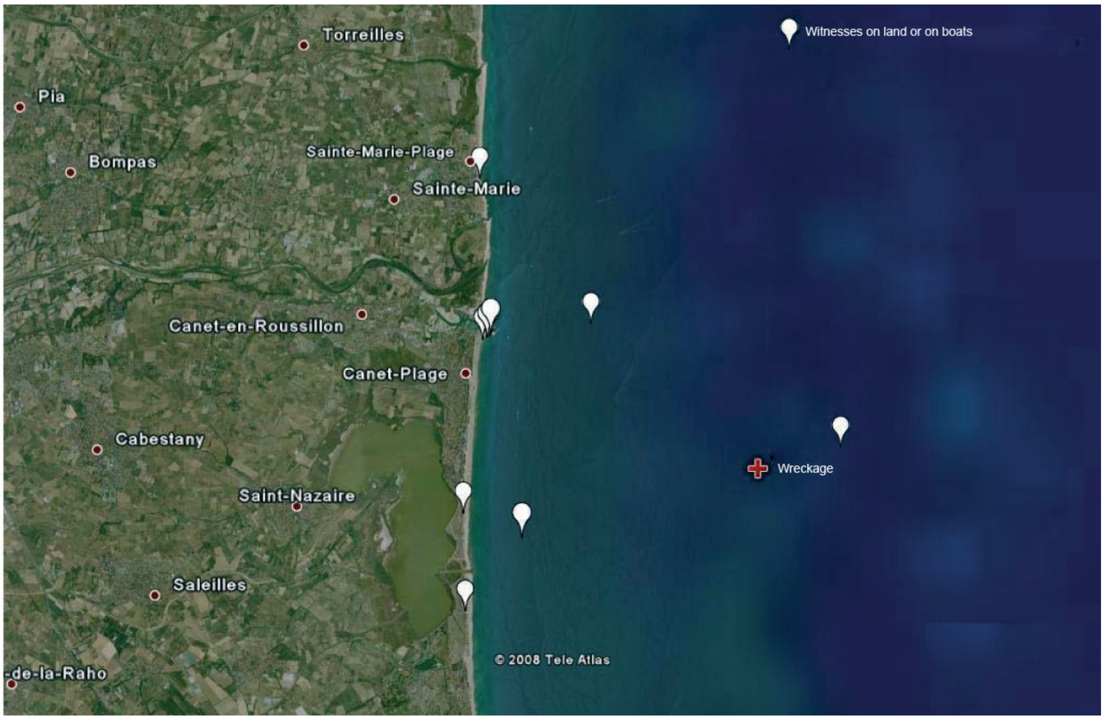
1.18.1.3 Approach controller

The approach controller stated that the air traffic was light and that she had not noticed any anomalies as regards the exchanges with the crew of D-AXLA.

After having cleared the aeroplane for the VOR DME ILS approach to runway 33, she noticed on her screen that the aeroplane's speed was high and that this could cause separation problems with the preceding aeroplane, a B737. She then asked the crew on two occasions to reduce its speed. After having asked them to contact the tower, she noticed on her screen a deviation of the trajectory to the left. The loss of radar contact occurred shortly afterwards. After having alerted the rescue and fire fighting service, she called the duty room and, at the same time, received a call from the emergency medical service.

1.18.1.4 Eyewitnesses

Many people witnessed the end of the aeroplane's flight. They were spread out along the coast between Sainte-Marie and Saint-Cyprien. Yachtsmen and fishermen were on board three boats near the area of the accident.



Despite the divergences that can be explained by the different viewing angles, the testimony made it possible to break down the end of the flight into three major phases:

- The aeroplane was seen in level flight above the sea on approach towards the coast. Those who heard the engines stated that they were surprised and drawn by the sound of loud acceleration that was regular and unbroken. Several people said that it sounded like the noise generated by aeroplane during takeoff.
- A few seconds after the increase in the engine rpm, all the witnesses saw the aeroplane suddenly adopt a pitch up attitude that they estimated as being between 60 and 90 degrees. The majority of the witnesses saw the aeroplane disappear behind a cloud layer. The noise generated by the engines was still constant and regular.
- The aeroplane reappeared after a few seconds with a very steep nose-down angle. During the descent, the aeroplane pitch seemed to increase and the aeroplane struck the surface of the sea. Some witnesses remember a very loud "throbbing" that they heard until the impact.

The crew of a yacht that saw the A320 impact the surface of the sea about 500 metres to the left ahead of the yacht contacted CROSSMED by radio.

1.18.2 Telephone calls

During the approach, five telephone calls were made from the Captain's mobile phone to the telephone in the office lent by EAS Industries to XL Airways Germany. They did not correspond to a deliberate attempt by the Captain to contact the office lent by EAS Industries, but rather some redials of the last numbers called through unintentional pressing of the key.

1.18.3 Flights by the B737-800, Registered D-AXLH, Operated by XL Airways Germany

Flight purpose and context

At the end of its leasing contract, the Boeing 737-800 registered D-AXLH was in Perpignan for maintenance (30-month check) at EAS Industries. The leasing contract provided for a flight at the end of the leasing period. This flight, initially planned for 24 November was postponed twice before being scheduled for 27 November 2008. Departure was planned for 07 h15.

On the evening of 25 November 2008, the crew was informed that before D-AXLH's ferry flight to Frankfurt, a flight should be carried out with a representative on board from the lessor (ILFC). During a telephone communication with the Captain (in his capacity as head of operations), the crew learned that:

- The flight programme would be communicated to them the day before the flight;
- The decision to carry out, or not, the checks in this programme's would be at the discretion of the Captain;
- The flight would be undertaken in a vigilant manner.

The flight programme, of about fifty pages, was provided to the XL Airways Germany crew fifteen minutes before the planned departure time from the ramp. The crew read the programme. Departure from the ramp took place at 7 h 43.

ATC flight plans

As for D-AXLA, two ATC flight plans were filed by the operations centre:

- The first for a "*test flight*" from and to Perpignan;
- The second for a ferry and positioning flight from Perpignan to Frankfurt.

XL Airways Germany operations centre's requests to file the D-AXLA flight plans also concerned the D-AXLH flights. The operations centre filed the flight plan on Wednesday 26 November 2008 at 17 h 36 for the flight to and from Perpignan aerodrome the following day. The flight reference mentioned was GXL032T. To specify the type and nature of the flight, it marked N for an unscheduled air transport flight in box 8 (flight type) and TESTFLIGHT in box 18 (miscellaneous information) of the flight plan. The estimated time of departure from the parking area indicated in the flight plan was 7 h 00 and total estimated flying time was 2 h 43. The route indicated in the flight plan was identical to that of the D-AXLA ATC flight plan to and from Perpignan aerodrome. The maximum flight level indicated was FL 410.

Flight history

The Captain indicated having followed the flight programme without any problems. The maximum flight level was FL410. After about one hour and forty minutes of flight, at 8,000 ft above Perpignan airport, he asked the approach controller to activate the return flight plan to Frankfurt. Landing at Frankfurt took place at 11 h 03.

The controller of a sector of the south-west CRNA filled in an ENF at 08 h 30. He qualified flight GXL032T as a "test flight" which should have been performed in CER. He stated that the flight crew had not followed the filed flight plan and that the south-west CRNA had not been told of the nature of the flight. He also mentioned that the requests for level flight during the climb and the doubts about the crew's intentions had required a lot of coordination with other control sectors.

1.18.4 Other events

1.18.4.1 Angle of attack sensors blocked during a check flight

An event on A320 was reported by an airline after publication of the interim report. The circumstances of this event were established from maintenance documents, from the aeroplane log and from the co-pilot's testimony.

This operator had defined procedures concerning check flights. These were planned:

- To check the smooth running of the aeroplane and its equipment after a major overhaul;
- After specific maintenance operations;
- On reception of a new aeroplane.

It had set up a programme for these check flights. The programme for the A320 was based on the Airbus customer demonstration manual (SA CAM) and was developed from feedback on these flights. Procedures had also been defined for planning and preparing these check flights with ATC centres. Crew composition was established from a list of pilots and service personnel authorized to carry out this type of flight. Each crew member received his/her authorisation after having followed minimum training that included simulator sessions and taking part in check flights as an observer.

In August 2002, a check flight was performed on an A320 that had just come from a type D check and a paint job. During take-off, a series of messages appeared on the ECAM and the aeroplane switched to *alternate* law. The CHECK GW message appeared on the MCDU. The crew decided not to continue the flight, which had lasted thirty-six minutes.

On the ground, all electrical power was shut down. A re-initialisation of the FWC and FAC was then carried out, as was an AFS test.

A second departure was scheduled about one hour later to carry out the programme. The co-pilot was PF. The flight progressed normally until the low speed checks, performed first of all in clean configuration. The crew checked the aeroplane weight which was about 54 tons. The programme available to the crew indicated, for this weight and in clean configuration, a V alpha prot of 171 kt (+/- 4 kt) and a V alpha max of 152 kt (+/- 4 kt). The PF placed the thrust controls in the IDLE position while keeping one hand on the trim wheel. The crew noted the absence of autotrim shut-off and decided to continue verification. The *alpha floor* function was not activated. The PF noticed that the speed was ten knots less than expected V alpha max. The crew felt the aeroplane sinking and the Captain decided to stop the check. The PF carried out a manœuvre similar to a stall recovery. There was no stall warning.

The messages contained in the PFR indicated that during the second flight, the ADR 2 had been rejected by the ELAC 1 and 2 at the estimated time of the low speed check in clean configuration. On the ground, the service personnel carried out the «"CFDS – ADR 1(2)(3) AOA SENSOR TEST" tests for the three sensors. The test on sensor 1 showed a sensor blocked at 5 degrees. A blocking of sensor 3 was reported during the manual check of freedom of movement. The three angle of attack sensors were examined at their manufacturer's.

Note: The angle of attack sensors on this aeroplane were made by Thales. These angle of attack sensors satisfy the impermeability test corresponding to category W of the RTCA DO 160 C standard (see 1.16.1.2). The impermeability test report made in the context of the certification of the Thales angle of attack sensors showed that, as for the Goodrich angle of attack sensors, the attachment plate used during the test is positioned differently from that installed on the aeroplane.

Examination of the sensors for each angle of attack sensor highlighted:

- The presence of traces of white paint on the mounting base and the fixed part of the sensors;
- An out of tolerance torque resistance on the vane;
- The presence of muddy residue from sanding and water in the body of the sensors;
- Oxidation of some internal elements.

The examination report indicated that icing of the muddy residue and water probably led to the blocking of the sensors during the flight.

On another A320 belonging to the same operator, anomalous angle of attack values were also noted during a check flight. The three sensors underwent a workshop examination that showed the presence of fluid in the housing of two of them.

1.18.4.2 Serious incident in January 2009 to a Boeing 737-700

The event occurred on 12 January 2009 in the United Kingdom (aeroplane registration G-EZJK and investigation reference EW/C2009/01/02) during a non revenue flight. It was qualified as a serious incident by the AAIB.

The crew of a Boeing 737-700 had to carry out a post-maintenance check flight combined with a customer demonstration flight with a view to transferring the aeroplane, at the end of a leasing contract, between two airlines. The post-maintenance check flight was to allow an in-flight check of the elevator without hydraulic assistance to identify any asymmetrical flight control forces.

The checks during the flight were not carried out in accordance with the Boeing 737-700 Aeroplane Maintenance Manual (AMM) but following the operator's own Customer Demonstration Flight Schedule.

During the elevator check without hydraulic assistance, performed at FL 150, the hydraulic flight control switches were selected to OFF resulting in the aeroplane commencing a descent which could not be countered by the PF. The recovery attempt then resulted in the aeroplane entering a descent with a high rate that could not be arrested until an altitude of 5,600

During the previous flight, the Captain had tried to detect possible anomalies and had found that the trim setting was close to limits. He had not mentioned it in the ATL but had pointed it out to the servicing personnel on arrival. During the servicing operations, a breakdown in communications led to the elevator trim being adjusted in the wrong direction.

1.18.5 FAA safety message

On 10 December 2008, the FAA, the United States civil aviation authority, issued a Safety Alert for Operators that recommends that operators, according to the means that they have available for analysis, should analyse data from the recorders following non-revenue flights in order to identify any possible deviations from procedures (see appendix 17).

In fact, the National Transportation Safety Board (the US counterpart of the BEA) determined that, in the previous ten years, 25% of accidents to turbine aeroplanes occurred during non-revenue flights, such as ferry and positioning flights. Two factors contributed to these accidents: failure to respect standard operating procedures or a failure to respect the aeroplane's limitations.

2 - ANALYSIS

2.1 Analysis of the Sequence of Events that led to the Accident

2.1.1 Context of the flight

The leasing contract between Air New Zealand and XL Airways Germany specified the performance of a flight at the time of the reception of the aeroplane and of another flight at the time of its re-delivery, defined as "*test flights*". It was established in this contract that the programme for these flights should be in accordance with the "*Airbus Check Flight procedures*". However, it appears that check flights of this type are not described in the manufacturer's documents. Air New Zealand thus submitted a programme to XL Airways Germany of in-flight checks developed on the basis of that used by Airbus for demonstration flights to customers in the framework of the delivery of a new aeroplane. It was on the basis of this programme that the aeroplane transfer flight in May 2006 and the accident flight were performed.

2.1.2 Planning and preparation of the flight

In November 2008, when the Air New Zealand pilot contacted the Captain by e-mail about the re-delivery flight, he sent him the document containing the programme of checks that had been developed in May 2006. According to the exchange of e-mails, the Captain did not seem to remember this document though he had been an observer at the time of the "*test flight*" performed on 21 May 2006 at Christchurch. As he had already participated in an Airbus demonstration flight at the time of the reception of a new A320 in 2004, he indicated to the Air New Zealand pilot that he had already used Airbus procedures for this type of flight. He accepted using the document for the flight while specifying that XL Airways Germany did not undertake this type of flight. Both pilots also agreed that the Air New Zealand pilot would occupy the centre seat in the cockpit as observer and that he would fill out the document during the flight.

Fifteen days passed between the first exchanges of e-mails and the preparation of the flight. The Captain, who initially used the terms "*check/acceptance flight*" or "*flight test*" in his e-mails to the Air New Zealand pilot, then used the term "*ferry/training flight*". This confusion on the part of the Captain doubtless came from the fact that:

- It was not a post-maintenance operations check flight;
- This flight did not correspond to any of the non-revenue flights covered by the EU-OPS and described in the XL Airways Germany Operations Manual;
- The reception and the re-delivery of the other leased aeroplanes in the XL Airways Germany fleet took place without any specific programme and always during ferry flights.

As early as the preparation phase, the performance of this flight did not thus come within a well-defined framework. This meant that those undertaking the flight had to adapt and improvise in order to be able to complete their task.

The XL Airways Germany operations centre asked EAS Industries for instructions to be able to perform a "*training flight*". The answer from EAS Industries, which had an approval for post-maintenance operations check flights, suggested contacting the Perpignan ATC organisation directly. The Captain thus asked the operations centre to file a training and ferry flight plan departing from and destined for Perpignan.

As soon as he arrived on 27 November 2008 at Perpignan around 11 h 00, the Captain as planned contacted a controller in the Perpignan tower. The Captain likely supposed that he would have access to a specific flight sector to fly in to be able to perform the programme of checks planned for the flight that he called a "*test flight*" on the telephone. He mentioned to the controller his intention not to land at Perpignan at the end of this flight in order to depart again directly towards Frankfurt. The fact that D-AXLA was coming out of maintenance led the controller to consider that filing the flight plan had been co-ordinated with EAS Industries and that as a result the authorisations required for this type of flight had been obtained. Following this phone call, the Captain was likely reinforced in his idea that he could follow the planned flight programme.

The Air New Zealand personnel arrived in EAS Industries premises at the end of the morning, which enabled the pre-flight briefing to take place. It was not possible to discover the content of this briefing and the tenor of the discussions between the XL Airways Germany pilots and the Air New Zealand pilot who were meeting for the first time. They agreed to take the Air New Zealand and New Zealand Civil Aviation engineers on board so as not to have to land back at Perpignan at the end of the first flight and thus not waste time between the two planned flights, the flight plans having been delayed by two hours.

2.1.3 Management and conduct of the flight

From the preparation of the cockpit to taxiing, the flight proceeded in accordance with XL Airways Germany procedures, even if the Air New Zealand pilot was present in the cockpit. The Captain was PF and the co-pilot was PNF. The exchanges in the cockpit indicated neither worries about the flight nor tension between the crew. It does however appear from these exchanges that following the programme of checks, which added to the standard procedures, was going to significantly increase the workload. Two types of briefings were thus performed:

- Standard briefings between PF and PNF, relating to the conduct of the flight and made in German;
- Briefings between the Captain and the Air New Zealand pilot, relating to the checks planned in the programme and made in English.

Two channels of communication were thus established naturally, one between the two XL Airways Germany pilots and the other between the Captain and the Air New Zealand pilot. The co-pilot was thus less involved in the performance of the checks. This tended to isolate him during those phases of flight and disturb the usual task-sharing.

During the climb, several checks from the programme were performed in a relaxed and professional manner.

The controller of the CRNA sector that took over the aeroplane knew of the difficulties in coordination between sectors, encountered five hours earlier to respond to the request for manoeuvres from the crew of flight GXL032T, the XL Airways Germany Boeing 737-800. The two flights (GXL888T and GXL032T), departing from Perpignan aerodrome where EAS Industries maintenance organisation is based, as well as the specific requests from the crew of flight GXL032T, led the controller to classify these flights as "test flights" that had not been subject to appropriate requests from the operator(53). The controller thus considered that the filed flight plan did not allow the requested manoeuvres to be performed, and refused the crew of flight GXL888T permission, as the regulations allow him to do.

(53)See. 1.17.2.2

The Captain who had taken care to contact both EAS Industries and Perpignan ATC, found himself, without really understanding why, facing a controller who refused to agree to his requests. He accepted the controller's decision without contest. The controller's refusal of the request to perform manoeuvres nevertheless disturbed the course of the rest of the flight. The Captain, in agreement with the Air New Zealand pilot, then decided to no longer follow the programme of checks as strictly and systematically. The controller's announcement that "test flights" and the requested manoeuvres could not be performed in general airspace certainly prompted the crew to stop making requests to the controllers, for the rest of the flight, relating to some checks in their programme.

The checks performed subsequently were in fact influenced and conditioned by the circumstances of the flight and were undertaken with a logic based on managing opportunities. The Captain mainly communicated with the Air New Zealand pilot concerning the checks in the programme and several times took over control of radio-communications with the CRNA south-west controllers. There was no formal transfer of the communication function between the two XL Airways Germany crew members. The Captain nevertheless became more and more active in the conduct and the management of the flight, which had the direct result of isolating the co-pilot a little more.

At 15 h 00 min 54, the crew was cleared to climb to FL 320, which it reached about two minutes later. According to the SSFDR recording, between 15 h 04 and 15 h 06, the angle of attack sensors 1 and 2 blocked until the end of the flight at local angles of attack that were practically identical and consistent with angle of attack values for cruise, without the crew noticing this.

As the constraints linked to air traffic control made it impossible to follow the planned programme, the crew decided to turn back at 15 h 10, twenty-four minutes after take-off(54). The flight having been shortened, the Captain and the Air New Zealand pilot performed numerous checks during the descent and the approach, which confirmed their wish to complete the programme in its entirety.

(54)The flight plan had been filed for a total time of 2 h 35.

2.1.4 Low speed check in landing configuration

At 15 h 37 min 54, at the end of the check of the flight controls in *alternate* law and while the aeroplane was descending to FL 80, the Air New Zealand pilot read out the "*low speed check in landing configuration*" from the programme. Again, as when this check was first mentioned, he mentioned neither the altitude nor the speeds indicated in the programme document. At the end of this reading, the crew did not immediately perform the corresponding check as they had done previously for the others. This decision was probably linked to the IMC conditions and to the fact that the crew was cleared for approach. The Captain even considered not carrying out this check.

(55) Announcement that the airplane had passed under the clouds, disconnection of the autopilot and asking the Air New Zealand pilot what he wanted to do.

Around two minutes later, the sudden interruption(55) of the approach briefing by the Captain suggests that he was ready to undertake a new check. The Air New Zealand pilot interpreted this initiative as a signal to begin the low speed check. Even though the Captain considered that the IMC flight conditions were a factor that made it impossible to perform this check, he did not take into account the altitude of the aeroplane and, for him, the return to VMC may have represented the last opportunity to be able to carry it out before nightfall.

The check began at 15 h 43 min 41. The speed of the aeroplane was 167 kt and its altitude 4,084 ft. Between this time and 15 h 45 min 05, that's to say one minute and twenty-four seconds later, the work load increased rapidly. The absence of pre-arranged coordination and of precise task-sharing, already noted during the flight, became even more obvious. The Captain controlled the aeroplane configuration with interventions from the indications read out by the Air New Zealand pilot to perform the low speed check. To this should be added the radio-communications, a direct consequence of performing the check during the approach without informing the approach controller. The situation was more complicated since the crew had asked for a missed approach followed by an immediate departure towards Frankfurt, which required additional exchanges with the approach controller. It was in this extremely busy context that the low speed manoeuvre was started.

(56) See 1.16.2. As the characteristic speeds had not been recalled during the briefing, the pilots did not detect that their values were erroneous.

The deceleration of the aeroplane corresponded to that required by the check (1 kt/s). The limit speeds(56) displayed on the speed strips, below the indicated speed, did not act as a signal to the crew to modify their plan of action. The passive wait for the protections to trigger, influenced by the confidence in the operation of the aeroplane systems, as well as lack of awareness of the risk, tend to show that the Captain and the Air New Zealand pilot started the manoeuvre as a demonstration of the functioning of the angle of attack protections rather than as a check.

2.1.5 Loss of control

When the stall warning sounded, the Captain reacted by placing the thrust levers in the TO/GA detent and by pitching the aeroplane down, in accordance with procedures.

The nose-down input was not however sufficient for the automatic compensation system to vary the position of the horizontal stabilizer, which had been progressively deflected to the pitch-up stop by this system during the deceleration. The Captain controlled a left roll movement, caused by the stall. The aeroplane's high angle of attack and the roll movements generated asymmetry, and a speed variation between ADR 1 and 2 appeared. This increasing divergence caused a rejection of the three ADRs by the FAC then the ELAC. The flight control system then passed into *direct* law. It is likely that the crew did not notice this due to the emergency situation and the aural stall warning that covered the warning of a change of flight control laws. The Air New Zealand pilot, by saying *"alpha floor, we're in manual"* likely considered that the alpha floor function had triggered and that in fact the autopilot had disconnected.

The aeroplane rapidly regained speed under the dual effect of the increase in thrust and the pitch-down attitude. Under the combined effect of the thrust increase , the increasing speed and the horizontal stabilizer still at the pitch-up stop, the aeroplane was subject to pitch-up moment that the Captain could not manage to counter, even with the sidestick at the nose-down stop. The exchanges between the pilots at this time show that they did not understand the behaviour of the aeroplane. In particular, the aeroplane's lack of reaction to the nose-down control input did not draw their attention to the position of the horizontal stabilizer and the loss of the auto-trim function.

The aeroplane attitude increased sharply and its speed dropped to the point that rendered it practically uncontrollable, the flight control surfaces becoming ineffective due to the low speed and the high angle of attack. The aeroplane stalled again, this time irrecoverably, bearing in mind the aeroplane's altitude and without any crew inputs on the trim wheel and the thrust levers.

The loss of control was thus caused by a thrust increase performed with a full pitch-up horizontal stabilizer position. This position and the engine thrust made pitch down control impossible. It should be noted that the PF made no inputs on the horizontal stabilizer nor reduced the thrust and that the PNF did not intervene. This seems to indicate that none of them were aware that the automatic trim system, which relieves the pilot of any actions to trim the aeroplane, was no longer available. In the absence of preparation and anticipation of the phenomenon, the habit of having the automatic trim system available made it difficult to return to flying with manual trimming of the aeroplane.

It should be noted that even though, from a regulatory perspective, the limitations on duty time and flying time were respected, the length of time that the two XL Airways Germany pilots had been up, since waking before 4h30 for positioning, until the accident at 15 h 46, may have altered their performance during the flight, especially during the approach phase.

2.2 Angle of attack sensors

2.2.1 Origin of the blockage

The values of the n° 1 and 2 *local angles of attack* recorded by the SSFDR remained fixed from FL 320 until the impact with the surface of the sea. It was not possible to determine the evolution of the value of the n° 3 *local angle of attack* in the course of the flight, which is not recorded. The initiation of the stall warning, however, shows that angle of attack sensor n° 3 was working at the end of the flight.

The constant and practically identical values of the n° 1 and 2 *local angles of attack* suggest a common cause for this malfunction. Since the systems' responses in the course of the flight were consistent with constant *local angle of attack* values, it is possible to limit the origin of the malfunction to the following hypotheses:

- A simultaneous failure in the acquisition chain for each of the *local angle of attack* values;
- A physical and quasi-simultaneous blockage of the two angle of attack sensor vanes.

However, the independence of each acquisition chain (angle of attack sensor and associated ADR), as well as the absence of any warning linked to the initiation of the surveillance made by each ADR, renders the first hypothesis highly unlikely. Further, the functioning of all of the aeroplane systems can be explained by the erroneous angle of attack values coming from the associated sensors. It is thus not plausible that external electro-magnetic disturbances, such as the waves transmitted by the Captain's mobile phone, for example, could have affected system function in this way.

Analysis of the recordings of the last twelve months' angle of attack parameters from D-AXLA brought to light no anomalies in the sensor behaviour. The examinations and electrical tests performed on the power circuits and on the resolvers showed no evidence that would lead to believe that the angle of attack sensors were defective before the accident. The introduction of the fragments found inside the bodies of the sensors resulted from the impact.

The physical and quasi-simultaneous blockage of the two angle of attack sensor vanes at identical angle of attack values rules out a mechanical failure. This can only be explained by the environmental conditions that acted in the same way and simultaneously on the two angle of attack sensors. The low relative humidity of the air mass during the flight as well as the absence of a warning linked to the loss of the angle of attack sensor heating function during the flight make it possible to rule out any external icing of the vanes. Thus, only an internal blockage can be considered as possible.

2.2.2 Painting Operations

The presence of yellow paint under the white paint of the angle of attack sensor 1 attachment plate, identical to that which was present when D-AXLA was still in Freedom Air colours (see 1.16.1.7), indicated that this part of the aeroplane was not stripped by the EAS Industries operatives before the application of the white paint corresponding to its new livery. This part of the aeroplane was masked during the stripping and it is highly likely that the parts around angle of attack sensors 2 and 3 were too. This thus made it impossible for chemical stripper to penetrate inside the sensors. According to the examinations performed on angle of attack sensors 1 and 2, the paints applied by EAS Industries did not penetrate inside the sensors either, which could have led them to block.

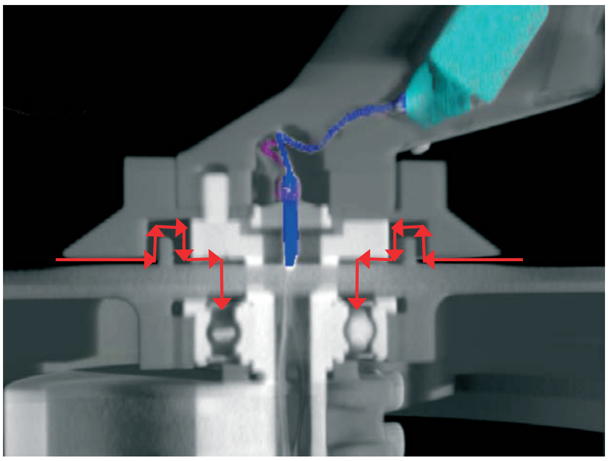
Taking into account the thickness of paint present on the fuselage, the chemical stripping of the aeroplane was not adequate and complete sanding of the aeroplane, which had not been planned, was then necessary. Following this sanding and application of the paint, the products (paper, adhesive tape) used for the masking of the aeroplane were removed.

Before the application of the technical lettering, five days after the sanding of the wings, D-AXLA was rinsed in fresh water to remove the dust accumulated on the top of the fuselage[57]. Considering the surface to remove dust from, the application of the water jet, performed for fifteen to twenty minutes, certainly saved an amount of time in comparison with the use of clean dry cloths as the painting procedure recommends. The fact that the application of the water jet to remove dust from the aeroplane was not considered to be a maintenance operation shows that the operatives who performed the painting operations were not necessarily familiar with all the precautions to take during these operations. Even if the technical regulations (Parts 145, M and 66) do not mention painting and cleaning operations precisely, the latter do not, in principle, require actions involving removal or replacement of groups of components or specific systems. Following basic standard practises and applying the appropriate maintenance manual procedures should be the point of reference. In addition, apart from the cleaning procedure, the EAS Industries procedures refer to "rinsing" after stripping of an aeroplane whose masking protections are still in place and during the preparation of surfaces before painting operations. Equally, the Airbus cleaning procedure includes a sub-task of "rinsing" the aeroplane with the masking protections.

[57]The origin of this dust was certainly the sanding of the wings that took place after the application of paint to the fuselage.

The angle of attack sensors were not protected when the aeroplane was rinsed with fresh water and some water certainly penetrated inside at least two of the three angle of attack sensors (AOA sensors 1 and 2). This water remained inside the sensors for the three days that the aeroplane remained outside of EAS Industries premises before the accident flight. The temperatures encountered during the climb caused this water to freeze and the AOA sensors to block. The seals of the angle of attack sensors bore no traces of damage previous to the impact with the surface of the sea. They thus did not contribute to allowing water to penetrate inside the angle of attack sensors.

Taking into account the results of the bench and in-flight tests (see 1.16.1.9), it is likely that a small quantity of water having penetrated inside of upper bearing (according to the route indicated in the diagram below), following specific washing conditions, was enough to cause, when frozen, the blockage of this bearing and thus of the AOA sensor.



2.2.3 Angle of attack sensors exposure to water projection

The bench and in-flight tests, as well as the events presented in the report (see 1.18.4), demonstrate the possibility of blocking the angle of attack sensors through freezing of liquid that has penetrated inside the body of the sensors from the outside, when the procedures preventing exposure of the sensors to fluids have not been followed. The Airbus information letter addressed to operators and maintenance organisations (see 1.17.3.1) as well as the maintenance procedures put in place (cleaning, painting, etc) recall the precautions to take to avoid any risk of liquid penetration inside the angle of attack sensors, which are not designed to be impermeable.

The angle of attack sensors blockage has consequences in terms of direct measurement of angle of attack by the sensors but also in terms of the aeroplane systems using this measurement. The angle of attack sensors are not designed to be impermeable but must satisfy certain certification criteria. These criteria are based on performance standards that have not evolved for decades. The performance standard that relates to stall warning equipment requires, in relation to the impermeability of the angle of attack sensors, that they continue to operate correctly when they are subject to rain and moderate icing. The angle of attack sensors are in conformity with the minimum performance defined by the TSO C54 and, according to Airbus and Goodrich, no operator had ever informed them in normal operations of any problem linked to the impermeability of the angle of attack sensors. This tends to confirm the adequacy of the performance level, as defined by TSO C54, of the AOA sensors in all operational conditions.

The impermeability tests that were performed in the context of the qualification of the angle of attack sensors were, however, not representative of the conditions encountered in operations, the sensor installation conditions during the impermeability tests being different from the installation of these sensors on aeroplanes in the A320 family. During the investigation, exposure to running water, based on the criteria of the impermeability corresponding to category R of the RTCA DO 160 C standard, on an angle of attack probe installed with an attachment plate identical to that used on the aeroplane revealed no traces of water inside the body of the angle of attack sensor (see 1.16.1.2). To cause water penetration inside the angle of attack sensors on D-AXLA, the conditions of exposure to water of these angle of attack sensors during rinsing of the aeroplane with fresh water three days before the accident flight with no application of the rinsing task in the cleaning procedure, and in particular without any sans protection on the angle of attack sensors, were thus more severe than those of the impermeability tests or those encountered during an aeroplane's life.

2.3 Non-revenue Flights in Leasing Contracts

2.3.1 Status

No reference to flights that are performed in the context of the transfer of an aeroplane between the lessor and the lessee, at the beginning and end of leasing contract, is made in any of the provisions relating to the leasing of aeroplanes (ICAO, EU and non-EU texts). For dry leases, this absence can be explained by the fact that continued airworthiness of the leased aeroplane, operated under the air carrier certificate of the lessee, is sufficient to guarantee the safety of its operations and thus does not require the performance of specific flights during the transfer of the aeroplane.

For lessees, whose numbers are ever on the increase (airlines, aeroplane manufacturers, leasing companies, banks and financial institutions), the criteria that allow continued airworthiness to be ensured are not adequate, especially as aeroplanes can be leased numerous times in the course of their lives. For a lessee receiving an aeroplane or a lessor recovering its aeroplane, the performance of a flight provided for in the leasing contract can thus make it possible for them to evaluate the condition of the aeroplane in real conditions and request any additional work so as to avoid any unexpected costs after reception. If it is planned to perform this type of flight in a leasing contract, the operator adapts by defining the flight in relation to what is described in its operations manual (ferry and training flight for the accident flight). The numerous definitions used for the accident flight bear witness to the difficulty that operators can have in defining, preparing and performing these flights:

- *Test flight* according to the EU-OPS and to the leasing contract;
- *Operational Flight Check* by Air New Zealand;
- *Acceptance flight* by the Captain.

Lessors and lessees do not necessarily have specific requirements for the non-revenue flights mentioned in leasing contracts, as is shown by the XL Airways Germany lack of requirements in the context of the leasing of its aeroplanes. They can nevertheless have specific requirements and thus demand that a flight programme be followed containing a certain number of checks (see 1.17.3.2 and 1.17.8.1). If the aim of the flight is to detect any anomalies that are not linked to continuing airworthiness, checks on the functioning of certain systems during the flight appear to be inappropiate and useless. The fact that these requirements are not systematic can lead operators to prepare and perform these flights according to a check programme in an improvised manner and outside of the context of their operations manual.

2.3.2 Performance

The flight was performed in general air traffic, according to the flight plan filed, with the constraints imposed by the programme of checks. The crew's workload was thus increased by the need to manage both the flight and the check programme. The absence of a context for the performance of this type of flight led to deviations by the crew while undertaking these two missions. The second mission became a priority and was in conflict with the first, especially during the approach with the decision to perform the low speed check. This conflict was all the more difficult to resolve given that the presence of a third person in the cockpit had an influence on the crew's decisions and the conduct of the flight. The two XL Airways Germany pilots and the Air New Zealand pilot thus made up an atypical work group during the flight.

The particular nature of this type of flight in fact leads to the performance of a programme of tests and checks, developed by manufacturers in cooperation with test engineers, by regular airline pilots who are not trained for this activity and who have no experience in this domain. Test pilots take into account unexpected elements such as technical failures, which allow them to quickly detect anomalies, and thus to react more rapidly. In addition, these flights are most often performed in specific sectors in which test crews receive the assistance of a dedicated test controller, essential for the good conduct and safety of these flights.

By contrast, the operators that undertake this type of flight do not generally have among the staff at their disposal test pilots and engineers trained to undertake them in satisfactory safety conditions. They thus call on their own crews by selecting those with the greatest experience, often instructors. Airline pilots or instructor-pilots do not however have the same skills and training as test pilots. Even if they have had the opportunity of being present on a reception flight with a test crew undertaking such a programme (as was the case for the Captain), mere observation of the test crew's work is not sufficient for them to understand the activity, familiarize themselves with it and apply it later.

During the flight, the crew's intention was to check the functioning of the aeroplane and its systems. The approval for release to service for the aeroplane having been issued, correct functioning of the aeroplane and all of its systems was not only expected but was also obvious from the beginning for all three pilots present in the cockpit. The absence of any reference to the VLS and Vmin speeds before starting the check, along with the lack of surveillance of computed airspeed confirms the confidence of all three pilots and tends to show that they had not sufficiently considered the risk associated with the specific low speed manoeuvre when deciding to perform it at low altitude.

2.4 Functioning of the Automated Systems

When the real angle of attack increased, the blockage of AOA sensors 1 and 2 at similar values caused the rejection of the ADR 3 anemometric values, even though these were valid. This rejection was performed by vote without any check that the parameters were consistent with each other. The crew was not aware of this rejection, except indirectly through the loss of CAT 3 DUAL approach capacity.

The low values of the limit speeds did not attract the crew's attention. Due to the blockage of the AOA sensors, calculation of the limit speeds was erroneous and the triggering of the AOA protections in *normal law* was rendered impossible. The values of the speeds corresponding to angle of attack protections (Vaprot and Vamax) were proportional to the computed airspeed of the aeroplane (see 1.16.2). The display of the amber CHECK GW message on the MCDU[58], a consequence of the gap between weights calculated on the one hand by the

[58] It was not possible to determine if this message was really presented to the crew given that it is not recorded on the SSFDR and the crew did not refer to it according to the SSCVR recording.

FAC, based on the angle of attack, and on the other hand by the FMS, based on the takeoff weight and the fuel consumption, would have allowed this anomaly to be detected. This message is however associated with no aural warning, which contributes to reducing its importance.

On approach to stall and taking into account the dynamic of the flight and of the complexity of the displays, the automatic changes in the control laws can fail to be perceived and their consequences can sometimes be misunderstood by pilots. In this case, the passage to *direct law* rendered the auto-trim function inoperative. Even if the amber USE MAN PITCH TRIM flag was displayed on the two PFD artificial horizons, the crew did not notice the position of the stabilizer and did not command the trim wheel manually during the twenty-five seconds in *direct law* between 15 h 45 min 15 s and 15 h 45 min 40 s. From this time on and for the rest off the flight, as a result of passing into *abnormal attitudes law*, the amber USE MAN PITCH TRIM flag was no longer displayed. The systems thus functioned in a degraded manner, without the real overall situation of the aeroplane being known by the crew.

The necessity to trim the aeroplane manually can occur in a situation that is already degraded, as was the case during the accident. This then leaves the crew no time to analyze the situation, especially since, on this type of aeroplane, the crew was used to not performing this task in normal operations. One of the only circumstances in which a pilot can be confronted with the manual utilisation of the trim wheel is during simulator training. However, in this case, the exercises generally start in stabilized situations. It should also be noted that the technique for approach to stall does not remind crews of the possible need to have recourse to the trim wheel in *direct law*. This absence de reference to the use of the trim is also mentioned in AAIB report into a serious incident to a Boeing 737 on 23 September 2007[59]. In addition, the angle of attack constitutes essential information to characterize the situation of an aeroplane on approach to stall, while the speed information is that which is always used.

(59) http://www.aaib.gov.uk/publications/bulletins/june_2009/summary___aar_3_2009___boeing_737_3q8__g_thof.cfm

3 - CONCLUSIONS

3.1 Findings

- The accident occurred in the context of the transfer of the aeroplane, from XL Airways Germany to Air New Zealand, at the end of a leasing contract.
- The leasing contract provided for a flight at the time of the handover of D-AXLA to XL Airways Germany and a flight at the time of its re-delivery to Air New Zealand, according to the Airbus flight check procedures.
- No flight check procedure is defined in the Airbus A320 Maintenance Manual or in the other documents available to operators.
- The regulatory texts relating to non-revenue flights do not mention the flights that can be performed at the time of the transfer of an aeroplane at the beginning or end of the lease.
- The XL Airways Germany operations manual does not mention the specific flights taking place in the context of the transfer of an aeroplane at the beginning or end of the lease.
- The programme of checks specified by the contractual leasing agreement was developed by Air New Zealand based on the manual used by Airbus for customer acceptance flights, which are performed by test crews.
- The crew had licences and qualifications to undertake the flight but did not have the technical skills, the experience, and the methods of a test crew to use this flight programme, even if it was not a test flight.
- The Airbus Customer Acceptance Manual specifies performing the low speed check in landing configuration at FL 140.
- The programme of checks developed for the leasing of D-AXLA did not reproduce in an identical manner the altitude range at which the low speed check should take place.
- The maintenance work was performed or checked in accordance with the approved maintenance programme and by part 66 qualified personnel.
- Painting and external finish operations are not included in the classes and categories of part 145 approvals.
- The stripping and cleaning procedures for the aeroplane, which include rinsing, specify protection of the angle of attack sensors.
- In order to eliminate the dust on the fuselage, a rinse with fresh water was performed on Monday 24 November 2008, without following the rinsing task procedure in the aeroplane cleaning procedure, and notably without any protection for the angle of attack sensors.
- During the rinsing, the angle of attack sensors were not protected. Water penetrated inside angle of attack sensors 1 and 2 and remained there until the accident flight, three days later.

- The AIP France specifies that flights of a specific nature must be subject to a specific request. Without an advance agreement, the flight can be subject to modifications in real time or possibly be refused if the circumstances require it.
- The Captain asked the Perpignan ATC service, on the morning of the accident, if the planned flight required specific airspace. The Perpignan controller indicated that it was not necessary as the crew of XL Airways Germany flight GXL032T had been able to follow a flight plan identical to that of the D-AXLA flight without any problems that morning.
- The crew consisted of two XL Airways Germany pilots. An Air New Zealand pilot, present in the cockpit, participated in an active manner in following the programme of checks.
- The CRNA southwest controller refused the request for manoeuvres by the Captain given that the flight plan that was filed did not include them.
- The crew adapted the programme of checks in an improvised manner, according to the constraints of the flight plan and the air traffic control service.
- Angle of attack sensors 1 and 2 blocked during cruise due to frozen water present inside the casing of these sensors. The system surveillance did not warn the crew of this blockage, which was more or less simultaneous and at identical local angle of attack values.
- The application of a jet of water onto an aeroplane without following the recommended procedure can allow penetration of a small quantity of water into the inside of an AOA sensor which is enough, when solidified, to block the sensor.
- The AOA sensors are not designed to be subjected to jets of fluids such as those encountered during de-icing, washing and cleaning operations.
- The CHECK GW message displayed on the MCDU, the consequence of the gap between the weights calculated by the FAC, on the one hand, based on the angle of attack, and on the other hand by the FMS, based on the takeoff weight and the consumption of fuel, was not detected by the crew.
- The crew decided, without preparation, and in particular without a call-out of the theoretical minimum speeds indicated in the OFC, to undertake the check of the low speed protections at an altitude of about 4,000 ft.
- The almost simultaneous blockage of the angle of attack sensors 1 and 2 at identical local angle of attack values rendered the angle of attack protections inoperative in normal law.
- The limit speeds corresponding to angle of attack protections displayed on the strip (Vαprot and Vαmax) were underestimated and were directly proportional to the computed airspeed, due to the blockage of the angle of attack sensors.
- The crew waited for the triggering of these protections while allowing the speed to fall to that of a stall.

- The auto-trim system gradually moved the horizontal stabilizer to a full nose-up position during the deceleration. The horizontal stabilizer remained in this position until the end of the flight.
- The triggering of the first stall warning in normal law, at an angle of attack close to the theoretical angle of attack triggering the warning in landing configuration, indicates that angle of attack sensor 3 was working at that moment.
- When the stall warning triggered, the Captain reacted in accordance with the approach to stall technique.
- The flight control law passed to direct due to the loss of the normal law operating conditions. The auto-trim system was thus no longer available. The changes of law that followed did not allow the auto-trim system to move from the nose-up position.
- No crew member reacted to the USE MAN PITCH TRIM message.
- The Captain did not react with any input on the trim wheel at any time or to reduce engine thrust in any prolonged manner.
- Due to the position of the stabilizer at full pitch-up and the pitch-up moment generated by the engines at maximum thrust, the crew lost control of the aeroplane during the increase in thrust.
- The aeroplane was completely destroyed on impact with the surface of the sea.

3.2 Causes of the accident

The accident was caused by the loss of control of the aeroplane by the crew following the improvised demonstration of the functioning of the angle of attack protections, while the blockage of the angle of attack sensors made it impossible for these protections to trigger.

The crew was not aware of the blockage of the angle of attack sensors. They did not take into account the speeds mentioned in the programme of checks available to them and consequently did not stop the demonstration before the stall.

❒ The following factors contributed to the accident:

- The decision to carry out the demonstration at a low height;
- The crew's management, during the thrust increase, of the strong increase in the longitudinal pitch, the crew not having identified the pitch-up stop position of the horizontal stabiliser nor acted on the trim wheel to correct it, nor reduced engine thrust;
- The crew having to manage the conduct of the flight, follow the programme of in-flight checks, adapted during the flight, and the preparation of the following stage, which greatly increased the work load and led the crew to improvise according to the constraints encountered;
- The decision to use a flight programme developed for crews trained for test flights, which led the crew to undertake checks without knowing their aim;
- The absence of a regulatory framework in relation to non-revenue flights in the areas of air traffic management, of operations and of operational aspects;
- The absence of consistency in the rinsing task in the aeroplane cleaning procedure, and in particular the absence of protection of the AOA sensors, during rinsing with water of the aeroplane three days before the flight. This led to the blockage of the AOA sensors through freezing of the water that was able to penetrate inside the sensor bodies.

❒ The following factors also probably contributed to the accident:

- Inadequate coordination between an atypical team composed of three airline pilots in the cockpit;
- The fatigue that may have reduced the crew's awareness of the various items of information relating to the state of the systems.

4 - SAFETY RECOMMENDATIONS

Note: in accordance with article 10 of Directive 94/56/CE on accident investigations, a safety recommendation shall in no case create a presumption of blame or liability for an accident or incident. Article R.731-2 of the Civil Aviation Code specifies that those to whom safety recommendations are addressed should make known to the BEA, within a period of ninety days of reception, the actions that they intend to take and, if appropriate, the time period required for their implementation.

4.1 Non-revenue Flights

Based on the first factual information gathered in the course of the investigation, the BEA issued the following safety recommendation relating to non-revenue flights on a 23 February 2009.

"*The flight performed was intended to check the condition of the aeroplane in service, at the end of a leasing agreement. This type of flight, though not exceptional in worldwide air transport, is not included in the list of non-revenue flights detailed in the EU-OPS (1.1045), given that this list has no precisions or definitions for the aforementioned flights. No text applicable to EU states or to non-EU states sets a framework for non-revenue flights, or indeed for flights for the transfer of aircraft covered by leasing agreements. No documents detail the constraints to be imposed on these flights or the skills required of the pilots. As a result, operators are obliged to define for themselves the programme and the operational conditions for these flights in their operations manual, without necessarily having evaluated the specific risks that these flights may present. In the context of their agreement, Air New Zealand and XL Airways Germany had agreed on a programme of in-flight checks based on an Airbus programme used for flights intended for the delivery (acceptance) of a new aeroplane to a client. These flights are performed by Airbus acceptance pilots and engineers*".

There is a great diversity in the description made by operators of non-revenue flights, in the context that they establish for the preparation and execution of these flights, and in the selection and training of pilots. This diversity, along with the almost total absence of any indications or standards on non-revenue flights, can also lead to more or less improvising the performance of tests or to performing tests or checks in inappropriate parts of airspace and/or during flight phases with a high workload.

Consequently, the BEA recommends:

- **That EASA detail in the EU-OPS the various types of non-revenue flights that an operator from a EU state is authorised to perform,**

- **That EASA require that non-revenue flights be described precisely in the approved parts of the operations manual, this description specifically determining their preparation, programme and operational framework as well as the qualifications and training of crews,**

- **That as a temporary measure, EASA require that such flights be subject to an authorisation, or a declaration by the operator, on a case-by-case basis. »**

[60] Notice of Proposed Amendment 2009-02C, propositions, issued by EASA, on evolutions in regulations on aviation operations in the European Union.

EASA confirmed reception of this recommendation on 6 July 2009 and indicated that it was being studied. The DGAC supported recommendation and drew EASA attention to it by making comments on the NPA 2009-2C[60].

Examples of incidents mentioned in this report confirm the level of risk associated with non-revenue flights that air transport companies undertake to check the function of aeroplane systems. Consequently, the BEA supports the recommendations made by the AAIB in its Report on the serious incident that occurred during the transfer of an aeroplane between operators following maintenance operations (see 1.18.4.2).

4.2 Equipment Qualification

To ensure compliance with the regulatory requirements, the minimum levels of performance applicable to each item of equipment, in all of the specified operating conditions, are defined in the technical standard order for the equipment, if it exists (in the case of AOA sensors, TSO C54 issued by the FAA or ETSO C54 issued by EASA). The AOA sensors installed on aeroplanes in the A320 family comply with these technical standard orders, meet the specifications set by Airbus and are approved to be installed on these aeroplanes. However, during the investigation, it was noted that for the impermeability tests, undertaken by the equipment suppliers to demonstrate compliance with the minimum levels of performance defined by the technical standard orders, the installation conditions for the AOA sensors were different from those on the aeroplane.

Even if this difference between the installation of the AOA sensors during the impermeability tests and in operation did not contribute to the accident, it nevertheless constitutes a safety loophole and this is why the BEA recommends:

- **That EASA, in liaison with the other regulatory authorities, ensures that, in order to certify the adequacy of an item of equipment in relation to the regulatory requirements as well as to the specifications defined by a manufacturer, the equipment installation conditions during tests performed by equipment manufacturers are representative of those on the aeroplane.**

4.3 Consequences of Reconfigurations of Flight Control Laws

The change in the flight control law after triggering of the stall warning inhibited autotrim operations. Despite the amber USE MAN PITCH TRIM message initially displayed on the PFD, the crew did not at any time modify the position of the stabilizer, which remained in full pitch-up position until the end of the flight. After the passage into *abnormal attitudes law* this message disappeared. During this phase, the time for the crew to analyze the situation and react was very short. Finally, the stabilizer position and the pitch-up moment generated by the engines at maximum thrust made it impossible for the crew to recover control of the aeroplane.

Consequently, the BEA recommends:

- **That EASA undertake a safety study with a view to improving the certification standards of warning systems for crews during reconfigurations of flight control systems or the training of crews in identifying these reconfigurations and determining the immediate operational consequences.**

4.4 Approach-to-Stall Recovery Technique and Procedure

When the stall warning sounded, the crew reacted in accordance with the procedure for recovering from an approach to stall by applying full thrust to the engines and by trying to decrease the pitch angle. The moment generated by the application of full thrust to the engines and the pitch-up position of the stabilizer made it impossible for the crew to be aware of the situation and to recover control of the aeroplane. In addition, the manual use of pitch trim, which is not included as a reminder in the approach-to-stall procedures, only occurs very rarely in operation and occasionally in training. Several investigations undertaken following accidents and incidents (including that mentioned in 2.4) tend to call into question the procedures relating to approach-to-stall techniques for all types of modern aeroplane. Studies are currently under way with a view to improving these procedures.

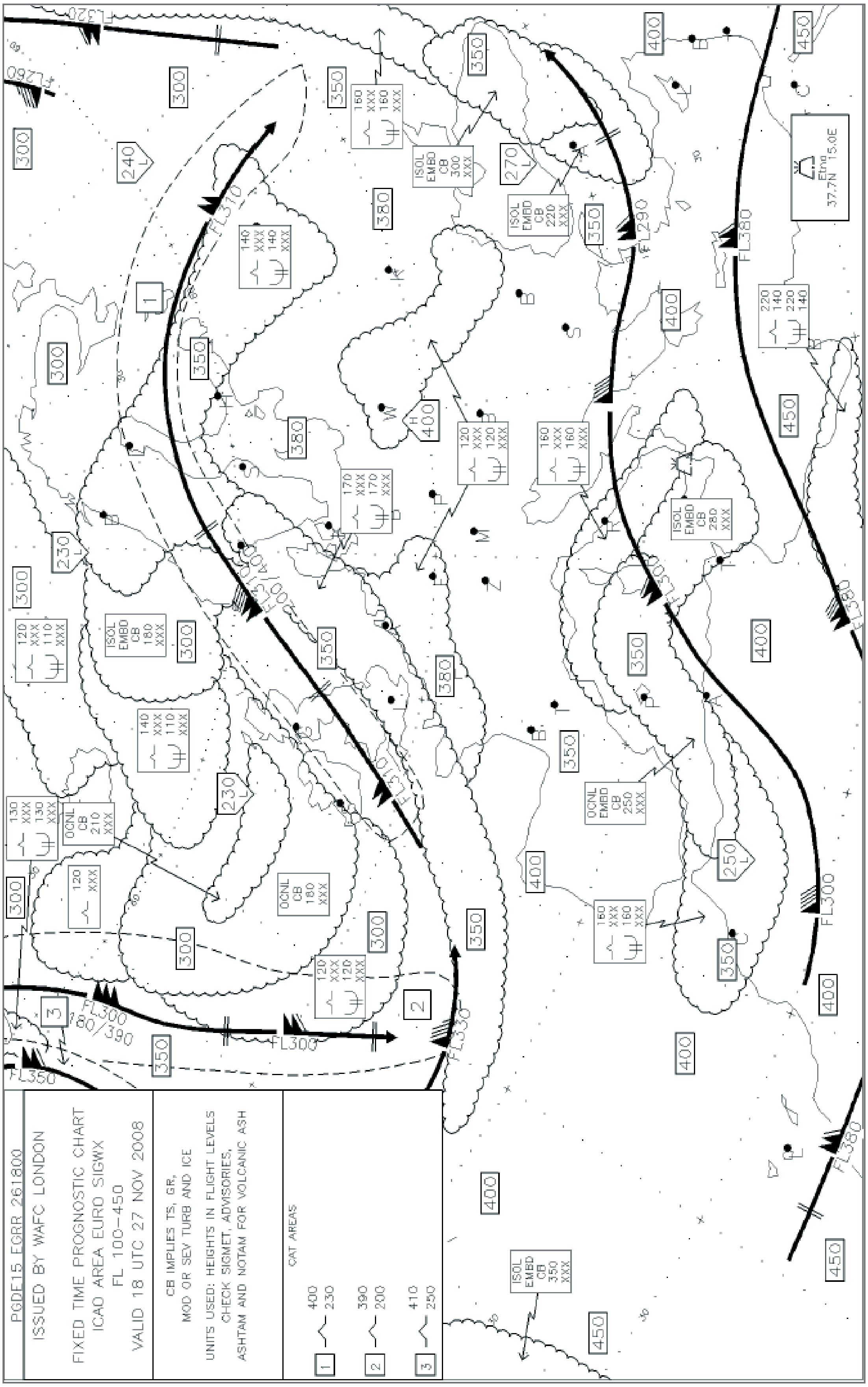
Consequently, the BEA takes into account these elements and also recommends:

- **That EASA, in cooperation with manufacturers, improve training exercises and techniques relating to approach-to-stall to ensure control of the aeroplane in the pitch axis.**

List of Appendices

Appendix 1

TEMSI EURO SIGWX valid at 18 H 00



Appendix 2

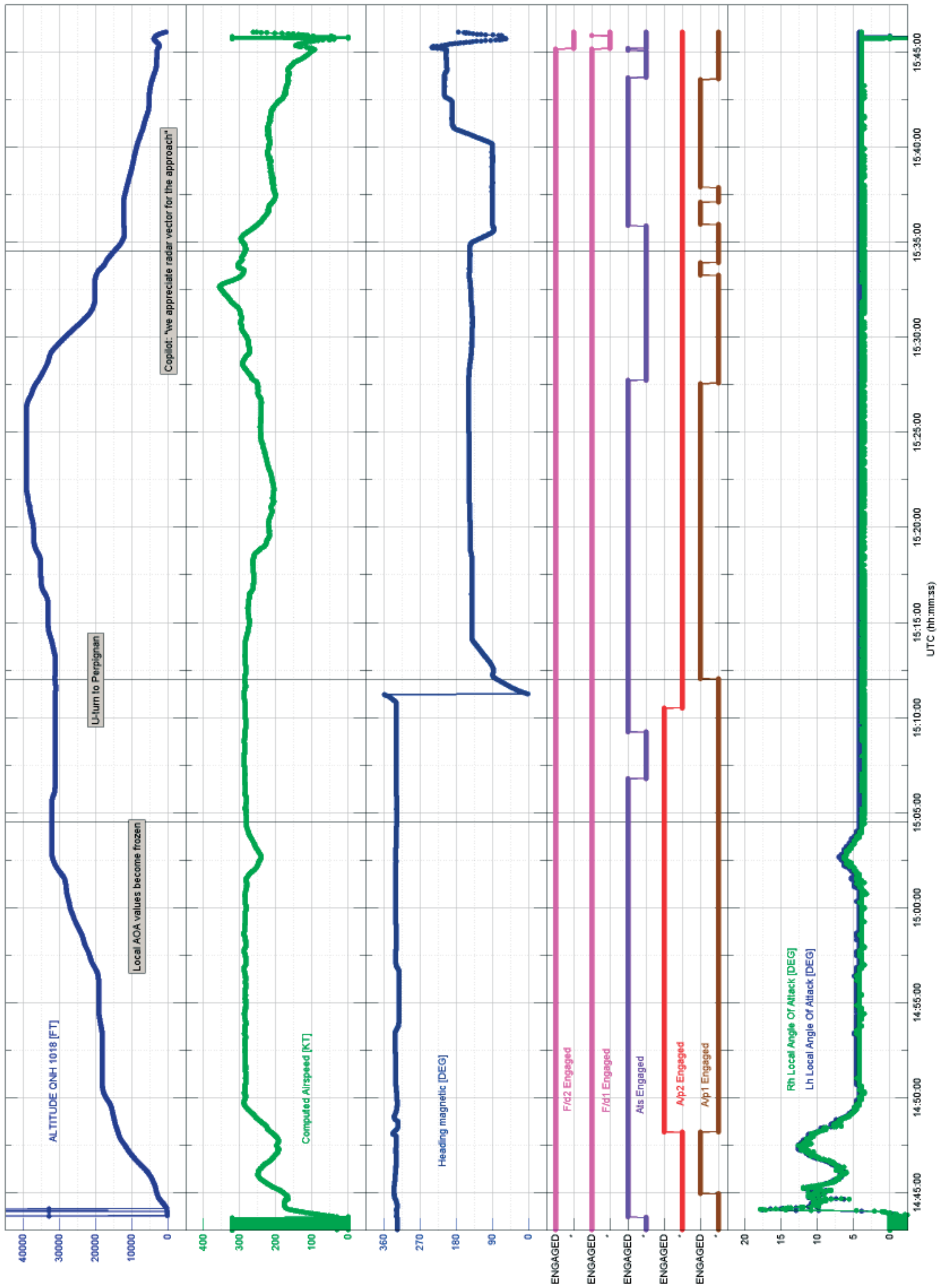
Telephone call to Perpignan control tower

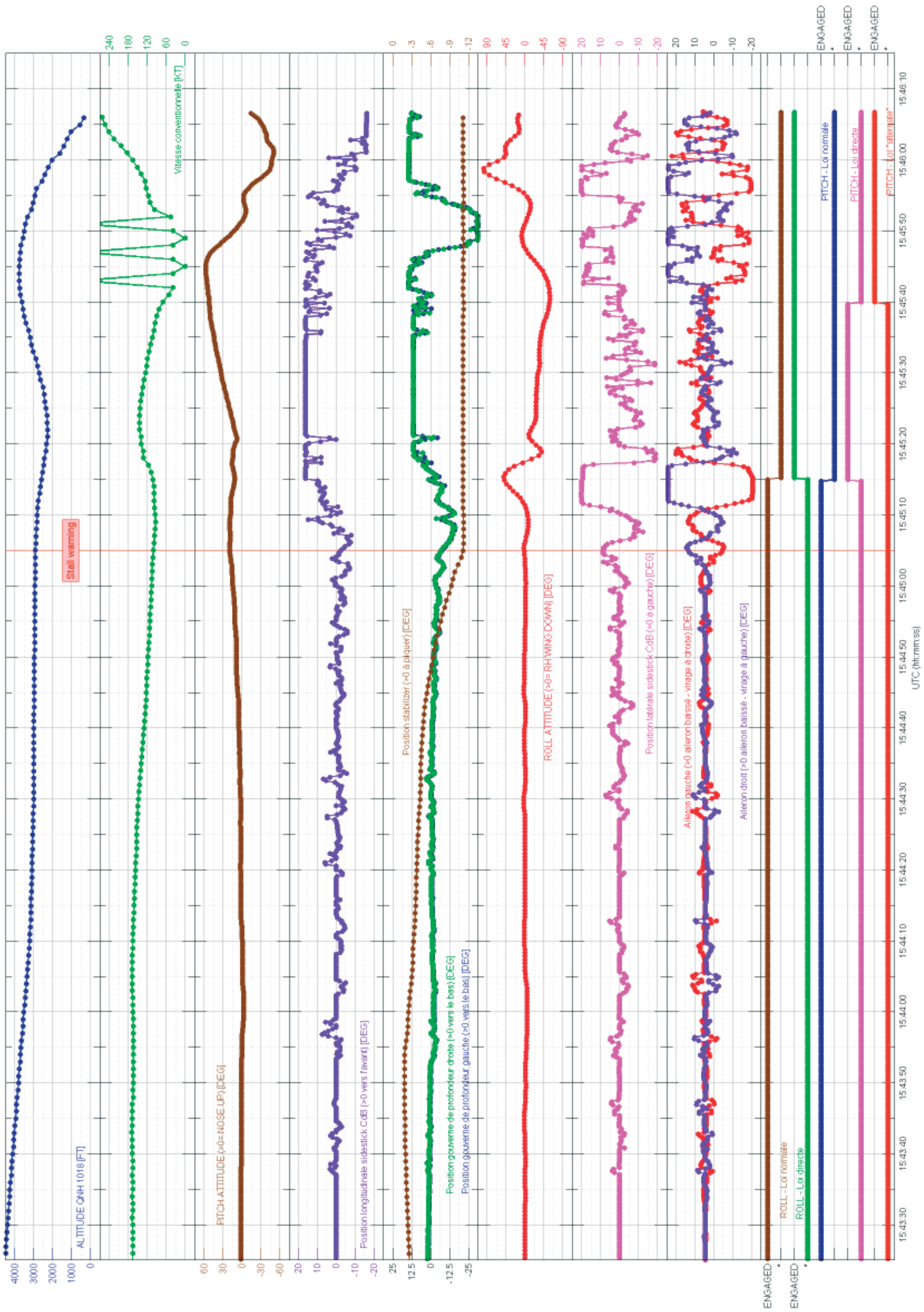
Time	Person identified	Messages
11 h 09 min 25	BEGINNING	BEGINNING OF COMMUNICATION
11 h 09 min 26	Controller	*Perpignan Tower hello*
11 h 09 min 28	Captain	*Yes hello* (...) speaking X L Airways Germany hello
11 h 09 min 31	Controller	Hello
11 h 09 min 32	Captain	Hemm we are new with o ur aircraft that is in the new Air New Zealand (do you read) Delta Alpha Delta Alpha X-Ray Lima Alpha
11 h 09 min 41	Controller	Delta Alpha X-Ray Lima Alpha…
11 h 09 min 45	Captain	Yeah… and we do have a… an acce ptance test flight schedule this afternoon… under the flig ht number Golf X-Ra y Lima… Eigh t Eight Eight Tango
11 h 10 min 00	Controller	Heu I have Golf X-Ray Li ma eight eight eight Papa th is is the return ing flight to Echo Delta Delta Fox Trot…
11 h 10 min 09	Captain	Yeah (…)
11 h 10 min 09	Controller	And before that I suppose you have your test flight
11 h 10 min 13	Captain	Yes we have the test flight before that (then) we… we have actually two flight scheduled….
11 h 10 min 19	Controller	Mmh….yes…
11h 10 min 19	Captain	Hein
11 h 10 min 19	Controller	Ah Okay I’ve got your test flight Golf X-Ray Lima err triple eight Tango
11 h 10 min 25	Captain	That’s That’ it right
11 h 10 min 26	Controller	Err okay Airbus three two zero
11h 10 min 28	Captain	Yeah it’s right (only) I’d like to discuss with you if where do we perform the test flight (you ha ve a standard ro uting) for us a nd the test flight should err... should give u s a climb to flight le vel three one zero and then a step descent with one missed ap proach in err… in Papa Golf Foxtrot here in Perpignan
11 h 10 min 48	Controller	Err Flight le vel three one zero and a missed approa ch a… when you are returning
11 h 10 min 55	Captain	When we are returning and then… and then if ever ything goes well we do not want to land for a full stop
11 h 11 min 02	Controller	Yes like a…like this morning
11 h 11 min 05	Captain	Then we would like a mmmh we would li ke to make a missed approach like (that morning) and activate our flight plan…
11 h 11 min 11	Controller	Yeah… okay
11 h 11 min 12	Captain	(*) and go directly without without even touching
11 h 11 min 14	Controller	Okay but the problem for this morning is that you you w ere under a slot time and err… the time was err…err missing to mak e all the procedure and I hope it would be better this afternoon
11 h 11 min 29	Captain	Okay
11 h 11 min 30	Controller	Okay so err… if I resume this …err… you err tak e off for tes t flight at level three o ne zero with Marseille then when you are returnin g a missed approach and err next your departure to err… Germany
11 h 11 min 49	Captain	Yes right

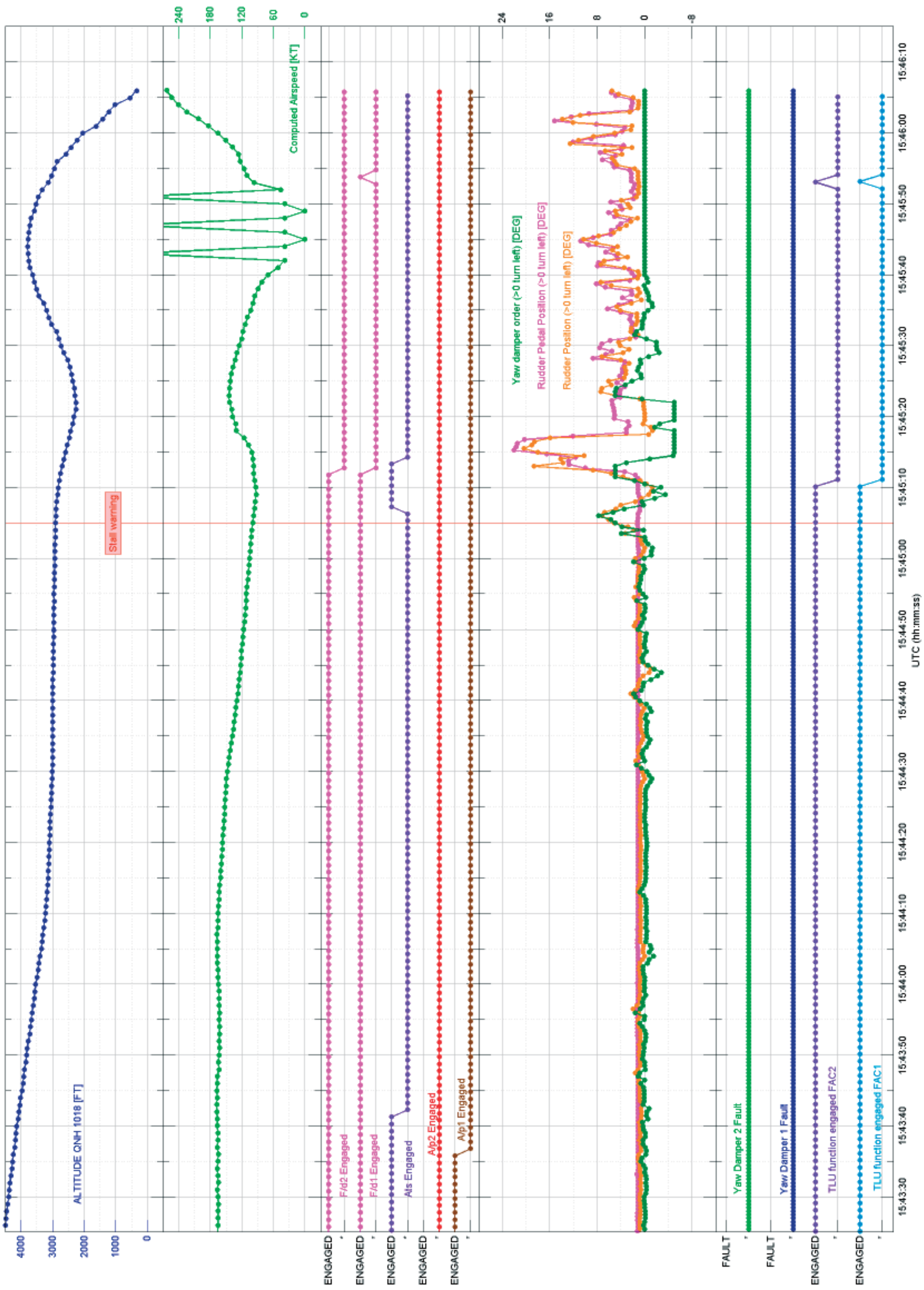
Time	Person identified	Messages
11 h 11 min 50	Controller	Okay
11 h 11 min 51	Captain	This is… this is… this is the plan
11 h 11 min 53	Controller	Okay that's good
11 h 11 min 54	Captain	Okay but err yes now now question where where do we make the test flight do you have an area do you have an airspace that that allowed us to do the test flight and (*)
11 h 12 min 05	Controller	Okay normally the only test flight appro… which are allowed err are test flight with level steady level steady route like if it was err… a normal flight you know?
11 h 12 min 19	Captain	Yeah
11 h 12 min 20	Controller	Err… and it will be done with the A C C err probably the err Bordeaux A C C
11 h 12 min 27	Captain	Okay
11 h 12 min 28	Controller	Okay err just wait a minute I have a look on your flight plan for test flight for this afternoon I suppose that E A S did it err… consulting just… just one minute…
11 h 12 min 45	Captain	I have a rou … I I have a routing here that is vi… via… via Golf Three Six to GAILLAC
11 h 12 min 54	Controller	Yes Golf Three Six to GAILLAC then Golf Three Nine to SECHE err flight level three eight zero at err four hundred and fourty knots err… okay this type of flight should be accepted by the A C C
11 h 13 min 13	Captain	Okay
11 h 13 min 14	Controller	I… I suppose there is no problem
11 h 13 min 16	Captain	Okay but I think the flight that we have scheduled here two hours and thirty minutes is too long but… but we can we can err arrange that with A T C…
11 h 13 min 26	Controller	(*)
11 h 13 min 26	Captain	… when airborne right?
11 h 13 min 27	Controller	I suppose yes
11 h 13 min 28	Captain	Okay I'm happy so we just leave it that way and we just have to re-schedule the flight I would say to schedule it at… to re-schedule it at fourteen thirty local?
11 h 13 min 39	Controller	Fourteen thirty local?
11 h 13 min 40	Captain	Yeah
11 h 13 min 40	Controller	Okay
11 h 13 min 41	Captain	I think fourteen thirty local hem… or… or do you think that's too early… too early for (*)?
11h 13 min 46	Controller	It's okay for us it's okay
11 h 13 min 46	Captain	(*) three o'clock local?
11 h 13 min 49	Controller	Mmh Mmh
11 h 13 min 50	Captain	Three o'clock local and if we have the chance to get out thirty minutes early
11 h 13 min 55	Controller	Okay

Time	Person identified	Messages
11 h 13 min 56	Captain	Yeah?
11 h 13 min 56	Controller	Okay
11 h 13 min 57	Captain	Thank you very much
11 h 13 min 58	Controller	You're welcome
11h 13 min 58	Captain	Any… anything else you should know?
11 h 14 min 00	Controller	Euuuh… no (not really)
11 h 14 min 02	Captain	(*) Perpignan the first time I'm here
11 h 14 min 06	Controller	Oh it's err…there is nothing special err today at Perpignan… that's okay
11h 14 min 11	Captain	Okay (*) yeah okay then y ou are not able to to to whatever control departure control and then you have also our route a nd we we do the the test profile err with the radar controller
11 h 14 min 26	Controller	It's okay
11 h 14 min 27	Captain	Yeah thank you very much
11 h 14 min 28	Controller	Err do you want us to to make any delay on your your test flight or we… err… would you do it yourself?
11 h 14 min 36	Captain	Err no the company does it
11 h 14 min 38	Controller	The company okay I have nothing to do okay
11 h 14 min 38	Captain	(*)
11 h 14 min 40	Controller	Thank you
11 h 14 min 41	Captain	Bye bye
11 h 14 min 43	END	END OF COMMUNICATION

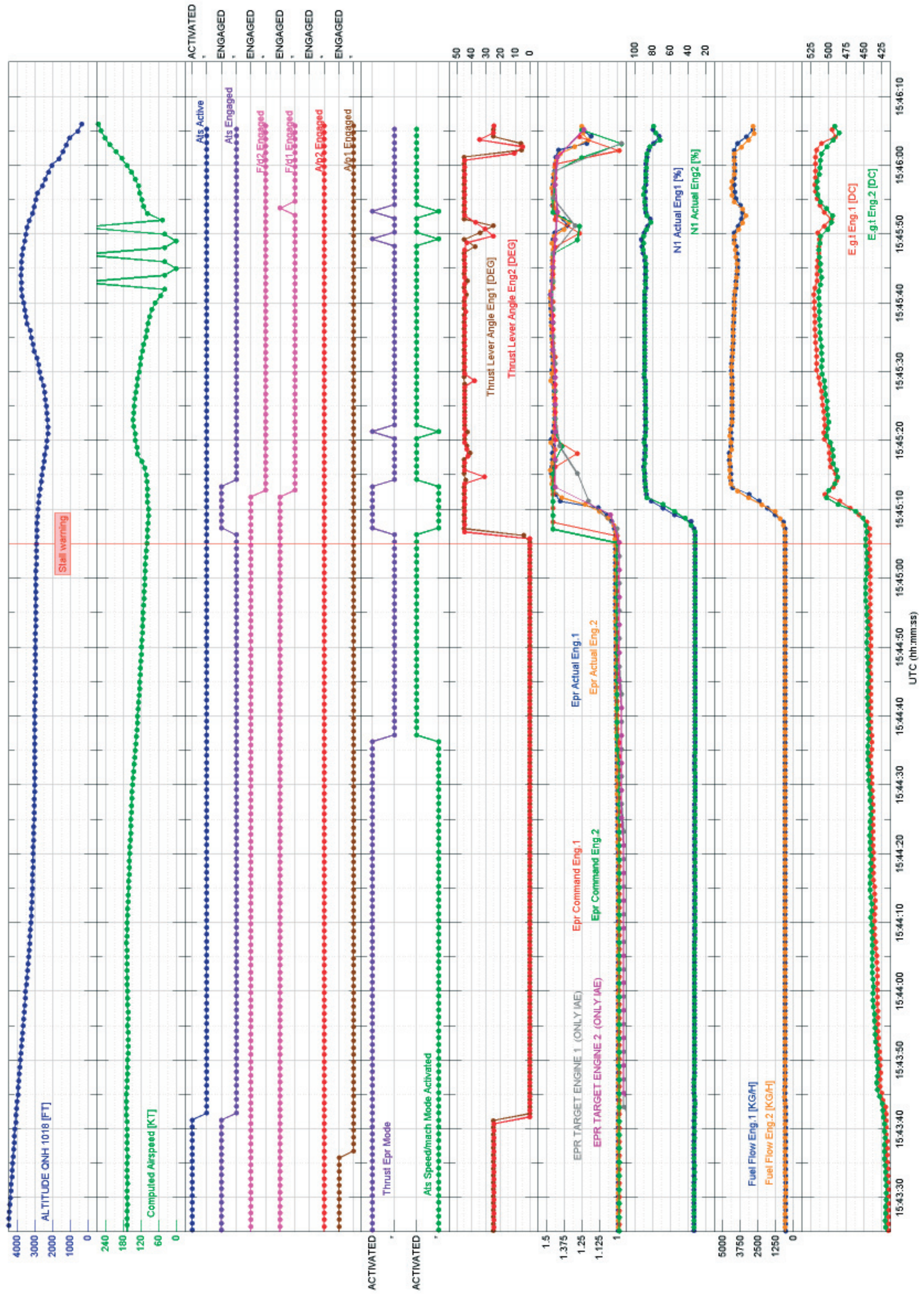
Appendix 3
FDR parameter graphs

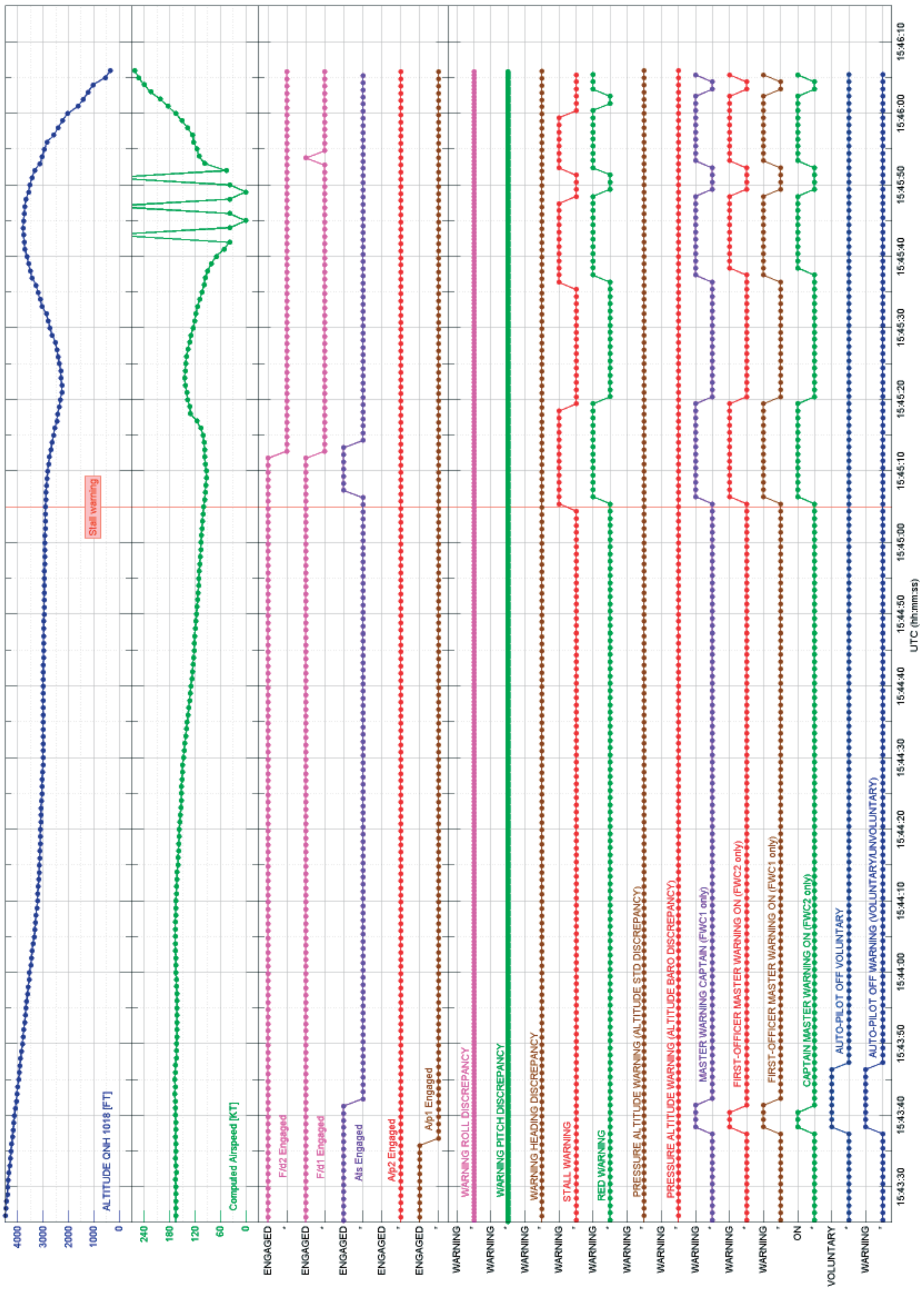



ALTITUDE QNH 1018 [FT]
Vitesse conventionnelle [KT]
Stall warning
PITCH ATTITUDE (>0= NOSE UP) [DEG]
Position longitudinale sidestick CdB (>0 vers l'avant) [DEG]
Position stabilizer (>0 à piquer) [DEG]
Position gouverne de profondeur droite (>0 vers le bas) [DEG]
Position gouverne de profondeur gauche (>0 vers le bas) [DEG]
ROLL ATTITUDE (>0= RH WING DOWN) [DEG]
Position latérale sidestick CdB (>0 à gauche) [DEG]
Aileron gauche (>0 aileron baissé - virage à droite) [DEG]
Aileron droit (>0 aileron baissé - virage à gauche) [DEG]
ROLL - Loi normale
ROLL - Loi directe
PITCH - Loi normale
PITCH - Loi directe
PITCH - Loi "alternate"
ENGAGED
UTC (hh:mm:ss)
15:43:30
15:43:40
15:43:50
15:44:00
15:44:10
15:44:20
15:44:30
15:44:40
15:44:50
15:45:00
15:45:10
15:45:20
15:45:30
15:45:40
15:45:50
15:46:00
15:46:10

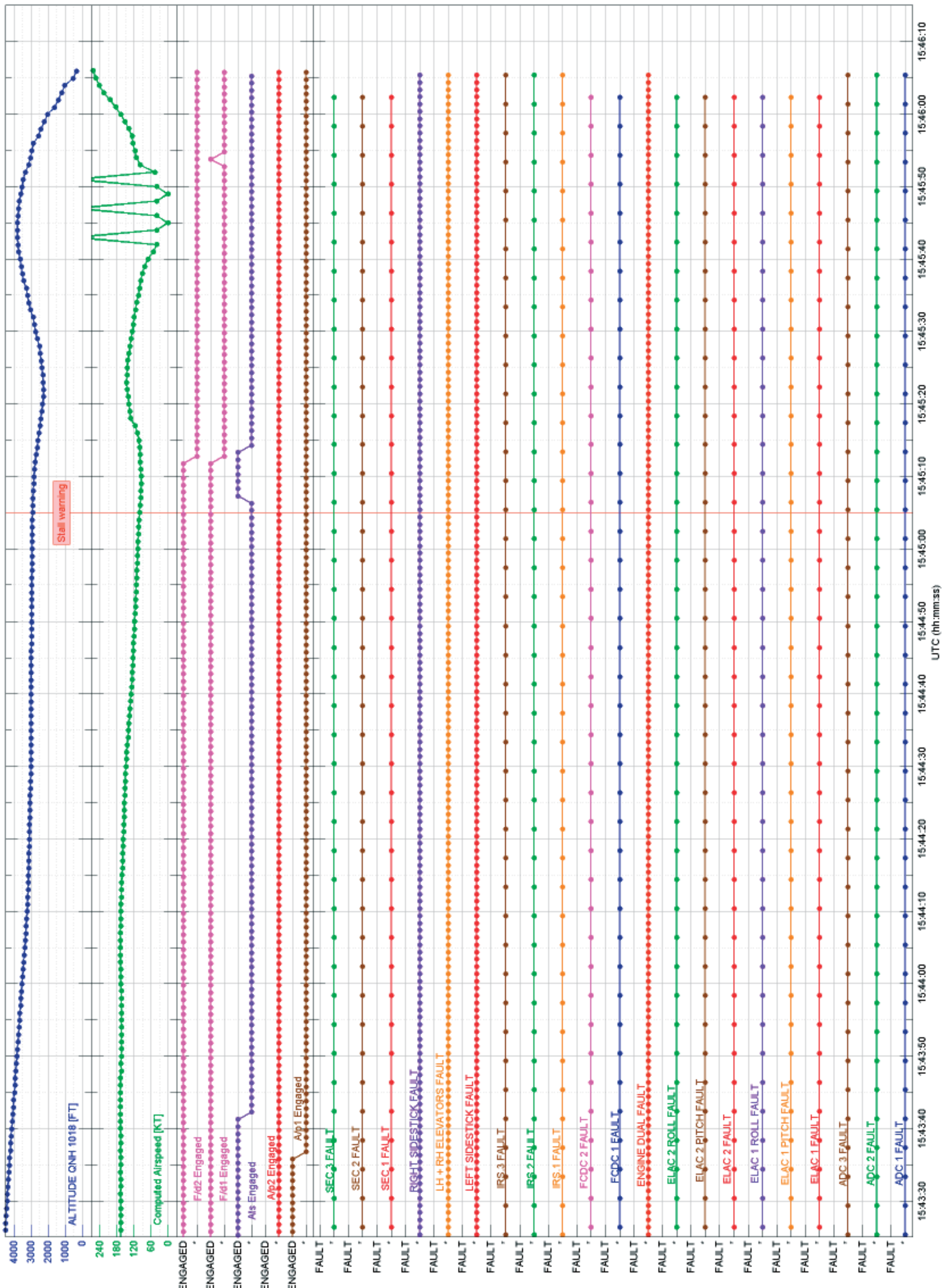


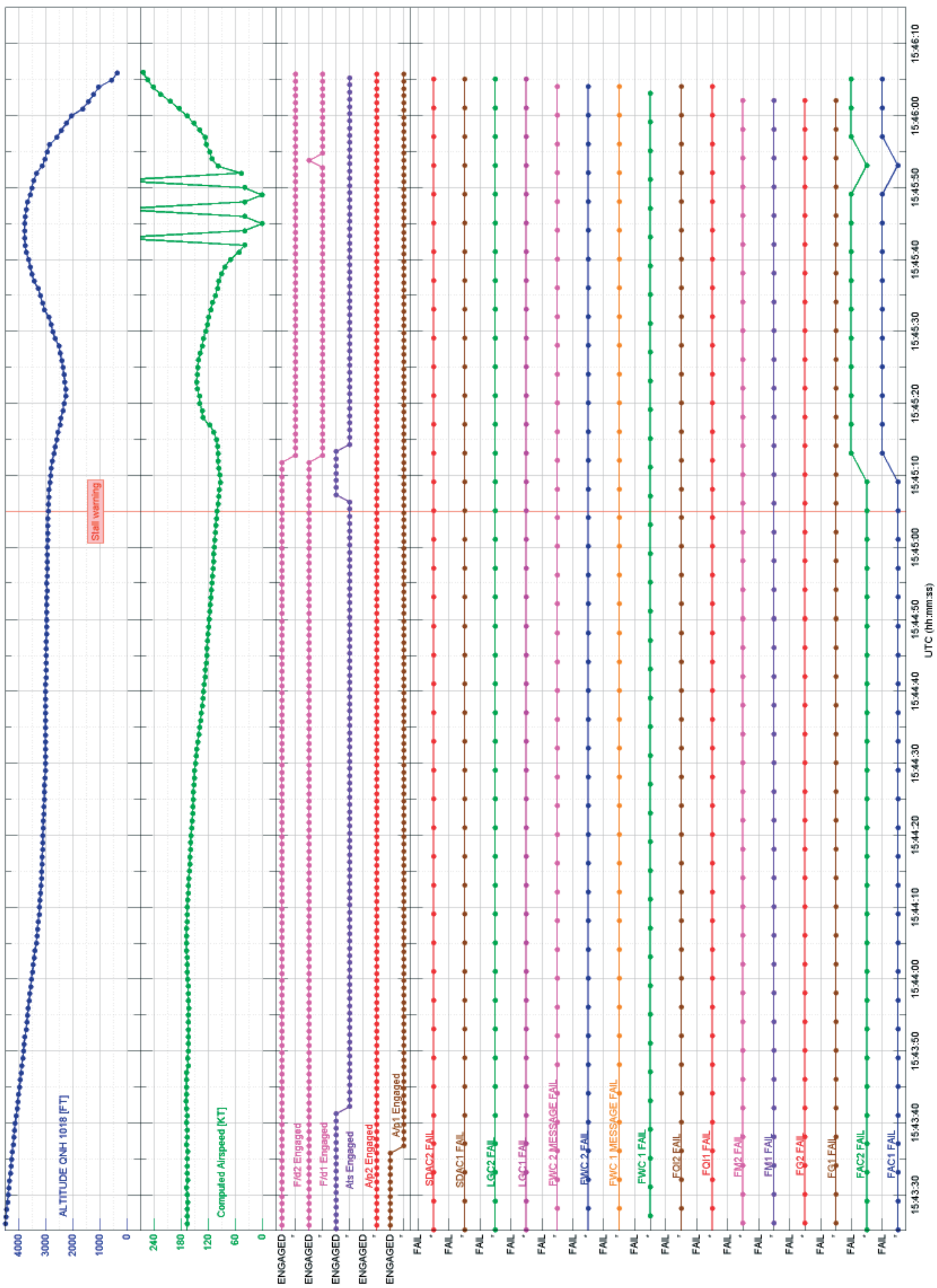
ALTITUDE QNH 1018 [FT]
4000
3000
2000
1000
0
Stall warning
Computed Airspeed [KT]
240
180
120
60
0
F/d2 Engaged
F/d1 Engaged
Ats Engaged
A/p2 Engaged
A/p1 Engaged
ENGAGED
Yaw damper order (>0 turn left) [DEG]
Rudder Pedal Position (>0 turn left) [DEG]
Rudder Position (>0 turn left) [DEG]
24
16
8
0
-8
Yaw Damper 2 Fault
Yaw Damper 1 Fault
TLU function engaged FAC2
TLU function engaged FAC1
FAULT
15:43:30
15:43:40
15:43:50
15:44:00
15:44:10
15:44:20
15:44:30
15:44:40
15:44:50
15:45:00
15:45:10
15:45:20
15:45:30
15:45:40
15:45:50
15:46:00
15:46:10
UTC (hh:mm:ss)

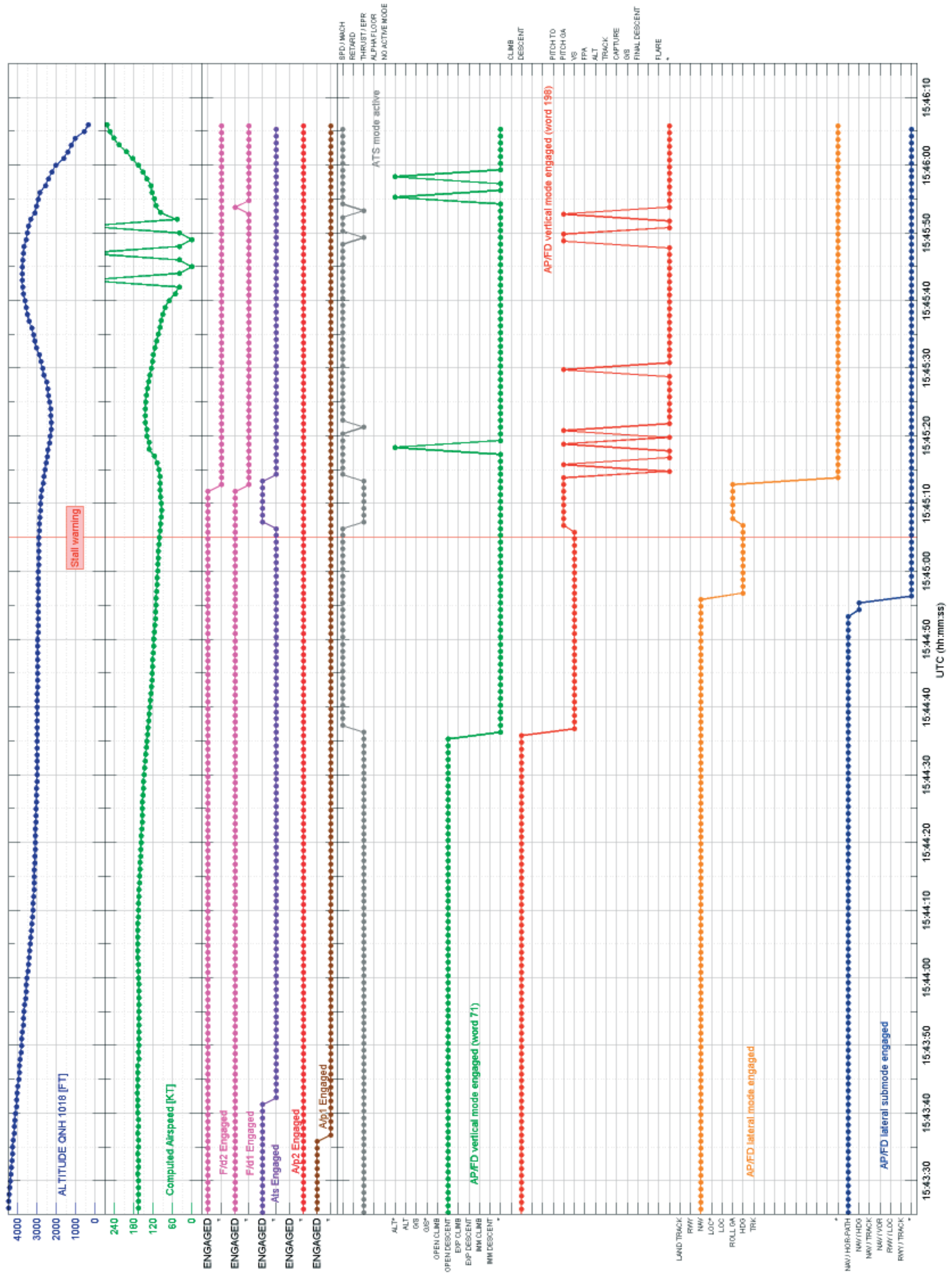

ALTITUDE QNH 1018 [FT]
Computed Airspeed [KT]
Stall warning
Ats Active
Ats Engaged
F/d2 Engaged
F/d1 Engaged
A/p2 Engaged
A/p1 Engaged
Thrust Epr Mode
Ats Speed/mach Mode Activated
Thrust Lever Angle Eng1 [DEG]
Thrust Lever Angle Eng2 [DEG]
EPR TARGET ENGINE 1 (ONLY IAE)
EPR TARGET ENGINE 2 (ONLY IAE)
Epr Command Eng.1
Epr Command Eng.2
Epr Actual Eng.1
Epr Actual Eng.2
N1 Actual Eng1 [%]
N1 Actual Eng2 [%]
Fuel Flow Eng.1 [KG/H]
Fuel Flow Eng.2 [KG/H]
E.g.t Eng.1 [DC]
E.g.t Eng.2 [DC]
ACTIVATED
ENGAGED
UTC (hh:mm:ss)



ALTITUDE QNH 1018 [FT]
Computed Airspeed [KT]
F/d2 Engaged
F/d1 Engaged
Ats Engaged
A/p2 Engaged
A/p1 Engaged
WARNING ROLL DISCREPANCY
WARNING PITCH DISCREPANCY
WARNING HEADING DISCREPANCY
STALL WARNING
RED WARNING
PRESSURE ALTITUDE WARNING (ALTITUDE STD DISCREPANCY)
PRESSURE ALTITUDE WARNING (ALTITUDE BARO DISCREPANCY)
MASTER WARNING CAPTAIN (FWC1 only)
FIRST-OFFICER MASTER WARNING ON (FWC2 only)
FIRST-OFFICER MASTER WARNING ON (FWC1 only)
CAPTAIN MASTER WARNING ON (FWC2 only)
AUTO-PILOT OFF VOLUNTARY
AUTO-PILOT OFF WARNING (VOLUNTARY/UNVOLUNTARY)
Stall warning
UTC (hh:mm:ss)


ALTITUDE QNH 1018 [FT]
Computed Airspeed [KT]
F/d2 Engaged
F/d1 Engaged
Ats Engaged
A/p2 Engaged
A/p1 Engaged
SEC 3 FAULT
SEC 2 FAULT
SEC 1 FAULT
RIGHT SIDESTICK FAULT
LH + RH ELEVATORS FAULT
LEFT SIDESTICK FAULT
IRS 3 FAULT
IRS 2 FAULT
IRS 1 FAULT
FCDC 2 FAULT
FCDC 1 FAULT
ENGINE DUAL FAULT
ELAC 2 ROLL FAULT
ELAC 2 PITCH FAULT
ELAC 2 FAULT
ELAC 1 ROLL FAULT
ELAC 1 PITCH FAULT
ELAC 1 FAULT
ADC 3 FAULT
ADC 2 FAULT
ADC 1 FAULT
Stall warning
UTC (hh:mm:ss)


ALTITUDE QNH 1018 [FT]
Computed Airspeed [KT]
F/d2 Engaged
F/d1 Engaged
Ats Engaged
A/p2 Engaged
A/p1 Engaged
SDAC2 FAIL
SDAC1 FAIL
LGC2 FAIL
LGC1 FAIL
FWC 2 MESSAGE FAIL
FWC 2 FAIL
FWC 1 MESSAGE FAIL
FWC 1 FAIL
FQI2 FAIL
FQI1 FAIL
FM2 FAIL
FM1 FAIL
FG2 FAIL
FG1 FAIL
FAC2 FAIL
FAC1 FAIL
Stall warning
UTC (hh:mm:ss)


ALTITUDE QNH 1018 [FT]
Computed Airspeed [KT]
F/d2 Engaged
F/d1 Engaged
Ats Engaged
A/p2 Engaged
A/p1 Engaged
ATS mode active
AP/FD vertical mode engaged (word 71)
AP/FD vertical mode engaged (word 198)
AP/FD lateral mode engaged
AP/FD lateral submode engaged
Stall warning
UTC (hh:mm:ss)

Appendix 4
CVR transcript

FOREWORD

The following is the transcript of the elements which were understood from the work on the CVR recording. This transcript contains conversations between crew members, radiotelephonic messages and various noises corresponding, for example, to the movement of selectors or to alarms.

The reader's attention is drawn to the fact that the recording and transcript of a CVR are only a partial reflection of events and of the atmosphere in a cockpit. Consequently, the utmost care is required in the interpretation of this document.

The voices of crew members are placed in separate columns for reasons of clarity. Other columns are reserved for the voices of others, the noises and alarms also heard via the Cockpit Area Microphone (CAM) and VHF communications with ATC..

The exchanges between the Captain and Co-pilot that are spoken in German have been translated into English and inserted in the right-hand column

GLOSSARY

UTC	Timing synchronized with FDR / ATC communications
SV	Synthetic voice
→	Communications with ATC, the ground and the CC by interphone
( )	Word or group of words in parentheses are doubtful
(…)	Word or group of words with no bearing on the flight
(*)	Word or group of words not understood

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 30 min 04	Crew takes over, beginning of the transcript				
14 h 30 min 23	So ham wir den überhaupt einen Flug und so weiter?				*So do we have a flight and so on?*
14 h 30 min 32	Okay Die Eins?				*Okay number one?*
14 h 30 min 34			Ground mechanic: Die Eins ist frei		*Ground mechanic: number one is clear*
14 h 30 min 35	(*) engine number one start				
14 h 30 min 40		(*) an der Technik (*)			*(*) At the maintenance (*)*
14 h 30 min 43	Suchst`n du?				*What are you looking for?*
14 h 31 min 08	Haben wir eine airborne Frequenz hier?				*Do we have an airborne frequency?*
14 h 31 min 10		Nee			*No*
14 h 31 min 12		Wir haben zwar eine … eine			*Well we do have a … a*
14 h 31 min 20	Ignition fuel flow light up N one				
14 h 31 min 23			(*)		
14 h 31 min 41	Okay ahm bleibst du mal auf der linken kannst schon mal alles abhängen bleib mal auf der linken Seite in Sichtweite wir machen jetzt die After Start Checklist für flight control check und so weiter ja				*Okay stay on the left you may disconnect all stay on the left side visible we do the after start checklist for flight control check and so on yeah*
14 h 31 min 49			Ground mechanic: Alles klar ich bin da		*Ground mechanic: Okay I am here*
14 h 31 min 50	Alles klar Holger				*All right Holger*
14 h 31 min 52			Schönen Flug		*Nice flight*
14 h 31 min 53	Ciao				
14 h 31 min 54	After start items flaps one				
14 h 32 min 00	Mal gucken was wir hier alles haben				*Look what we have here*
14 h 32 min 09	(*) Flight control check here				
14 h 32 min 18	Okay Rudder full right				
14 h 32 min 23	Neutral				
14 h 32 min 25	Full left				
14 h 32 min 28	Neutral				
14 h 32 min 29	After start check list				
14 h 32 min 30		Anti ice?			
14 h 32 min 31	Engine anti ice on				
14 h 32 min 33		Trim?			
14 h 32 min 39	Zero… one point three up				
14 h 32 min 42		Flight controls?			
14 h 32 min 43	checked				
14 h 32 min 44		Checked… after start checklist completed			
14 h 32 min 45		So taxi?			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 32 min 46	Taxi				
14 h 32 min 48		➔ Golf X-ray Lima triple eight Tango we request taxi			
14 h 32 min 53				Golf X-ray Lima triple eight Tango bonjour taxi holding point Uniform	
14 h 32 min 59		➔ Taxi holding point Uniform Golf X-ray Lima triple eight Tango			
14 h 33 min 03	Left is clear				
14 h 33 min 05		Right side is clear			
14 h 33 min 52		Die approach Frequenz müssen wir noch reinsetzen			*We have to set the approach frequency*
14 h 33 min 55	Machs jetzt bei mir dann müssen wir nicht beide				*Do it on my side we don't need it twice*
14 h 34 min 00		Du fängst an?			*You will begin?*
14 h 34 min 01	Ja				*Yes*
14 h 34 min 06	(*)				
14 h 34 min 18			Field elevation is one sixty hundred or same thing		
14 h 34 min 20		Pardon?			
14 h 34 min 22			The elevation of the field is one sixty feet		
14 h 34 min 24		The elevation of the field just a moment			
14 h 34 min 30				Golf X-ray Lima triple eight Tango are you ready to back track the runway?	
14 h 34 min 37		➔ Golf X-ray Lima triple eight Tango please say again			
14 h 34 min 40				Are you ready for back tracking the runway?	
14 h 34 min 43	Yes	➔ Yes we are ready for entering the runway three one			
14 h 34 min 46				Golf X-ray Lima triple eight Tango backtrack runway one three three one vacate via ROMEO report vacated	
14 h 34 min 56		➔ Ok we entering the runway three one and I'll call you runway vacated the Golf X-ray Lima Triple eight Tango			
14 h 35 min 01	Via romeo …				
14 h 35 min 03	Left side clear				
14 h 35 min 05		Right side is clear			
14 h 35 min 07	Ich glaub hundertsechzig oder was musst mal gucken unten				*I think a hundred and sixty or something have a look*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 35 min 09		Ja ich habs direkt			*Yes I have it*
14 h 35 min 10	Die Airport Elevation mein ich				*I mean the airport elevation*
14 h 35 min 11		`Mhh			
14 h 35 min 18		So airport elevation is ah one hundred fourty four			
14 h 35 min 21			Thank you		
14 h 35 min 37		So als nächstes müssen wir dann nach Romeo weg gehen			*So next we have to turn into Romeo*
14 h 35 min 40	Ja				*Yes*
14 h 35 min 41		rechts			*To the right*
14 h 35 min 51		Dann da vorne rechts			*Next to the right*
14 h 36 min 06	So und dann müssen wir noch die Clearance kriegen ne?				*So we still have to get the clearance okay?*
14 h 36 min 09		Ja			*Yes*
14 h 36 min 11		Ich sag mal wir würden jetzt nach rechts abdrehen nicht das wir hier einen Fehler machen			*I just tell her that we turn to the right here to avoid a mistake*
14 h 36 min 14	Yeah turning right yes into Romeo				
14 h 36 min 17		➔ Golf X-ray Lima triple eight Tango we are turning now right and are in taxiway Romeo			
14 h 36 min 23				That's correct sir and taxi to the holding point Hotel for the runway three three	
14 h 36 min 28		➔ We taxi to the holding point Hotel for the runway three three Golf X-ray Lima triple eight Tango			
14 h 36 min 33			seat to run to get elapsed time for the …		
14 h 36 min 36	Yeah we could that … we do that during take off roll		To run		
14 h 36 min 39			Ah okay		
14 h 36 min 40	Is that fine for you?		That's fine		
14 h 36 min 41			So off blocks …		
14 h 36 min 42	We have noticed the block time the blocks ahh the on blocks time on ACARS		Okay very good		
14 h 36 min 46			We can get that later		
14 h 36 min 48		So ich denk die cabin is clear ha was meinste?			*So I think the cabin is clear ha what do you mean?*
14 h 36 min 50	Yeah cabin is clear take off items				
14 h 36 min 52		Take off items			
14 h 37 min 02	Einskommafünf Meilen Papa Golf				*One point five miles Papa Golf*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
	Foxtrott right turn				*Fortrott right turn*
14 h 37 min 04				Golf X-ray Lima triple eight Tango how many minuts do you need to be ready?	
14 h 37 min 07	two minutes				
14 h 37 min 09	(*)	➔ Two minuts we will be ready (*) triple eight sorry Golf X-ray Lima triple eight Tango			
14 h 37 min 14				Roger report ready	
14 h 37 min 17	Standing by for clearance	➔ Ok I'll call for ready Golf X-ray Lima triple eight Tango			
14 h 37 min 20		Was hast du gesagt?			*What did you say?*
14 h 37 min 21	Standing by for clearance Sie soll uns mal ne clearance geben				*Standing by for clearance She should give us a clearance*
14 h 37 min 23		➔ And Golf X-ray Lima triple eight Tango we are standing by for the clearance			
14 h 37 min 28			(*)	Golf X-ray Lima triple eight Tango expect Orbil three November departure Flight level one one zero squawk four seven zero two	
14 h 37 min 30			(...) if if		
14 h 37 min 37		➔ OK that's copied Golf X-ray Lima triple eight Tango the Orbil two November departure climbing flight level one one zero and the squawk four seven zero two			
14 h 37 min 46				Triple eight Tango that's correct unless departure is three November	
14 h 37 min 52		➔ Orbil three November the Golf X-ray Lima triple eight Tango			
14 h 38 min 04	three November… ist die bei dir drauf?				*three November… do you have that?*
14 h 38 min 06		Also ich hab nur ne two November			*Well I just have a two November*
14 h 38 min 08	Ich auch				*Me too*
14 h 38 min 10	Ist das der Hundertneununddreißiger?				*Is that the one hundred thirty ninth?*
14 h 38 min 14		Moment ich muss mal gucken (Orbil?)… nach …			*Moment I have to check (Orbil?)… to…*
14 h 38 min 25		Das ist uralt … elfter…			*Well this is pretty old … eleventh…*
14 h 38 min 26	Lass dir mal die … three				*Ask for the three November She*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 38 min 36	November geben Da soll sie mal sagen wie die geht She is giving us a departure which is not on the plate so we just have to find out				*should tell us*
14 h 38 min 42			What I was going to say it's exactly what happened (*) any time I 'm interrupted just put your hand I will not be affected		
14 h 38 min 44		➔ So Golf X-ray Lima triple eight Tango			
14 h 38 min 47				Go ahead	
14 h 38 min 49		➔ We have only an old map us … the Orbil two November is it also straight ahead direct to Orbil point?			
14 h 38 min 58				Yes it's the departure going to Orbil	
14 h 39 min 03	Yes okay	➔ Ok copied (*) Golf X-ray Lima triple eight Tango			
14 h 39 min 06	Mann Mann Mann!				*Oh dear!*
14 h 39 min 08				Golf X-ray Lima triple eight Tango do you want me to confirm err the departure?	
14 h 39 min 15	Yeah	➔ Yes can explain me the departure?			
14 h 39 min 17				It's Orbil three November I can read it for you if you want	
14 h 39 min 21	Yes please	➔ Ok we are standing by for your reading			
14 h 39 min 24				I call you back	
14 h 39 min 27				Golf X-ray Lima triple eight Tango are you ready to copy?	
14 h 39 min 30		➔ Yes we are ready to copy the Golf X-ray Lima triple eight Tango			
14 h 39 min 33				Triple eight Tango to the departure Orbil three Novembre follow Q D R three two niner Papa Papa Golf magnetic track three to niner to Orbil	
14 h 39 min 43		➔ Ok three two niner to Orbil is copied the Golf X-ray Lima			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
		triple eight Tango			
14 h 39 min 49				altitude one four niner three feet Initial climb gradient noise abatment jet engines maintain take off power until one thousand five hundred feet above aerodrome level then power climbing speed Victor two plus ten knots until three thousand feet Is it the same?	
14 h 40 min 09	It`s the same and we are cleared level flight level one one zero				
14 h 40 min 12		➔ It's the same and we're cleared flight level one one zero we've copied Golf X-ray Lima triple eight Tango			
14 h 40 min 17				Ok report ready	
14 h 40 min 19	Are you ready?				
14 h 40 min 21			Yes ready … we will delay the retraction of the gear and record as we roll … normal take off		
	(*)				
14 h 40 min 26	And you check the take off power				
14 h 40 min 27			take off power		
14 h 40 min 35		Also noch mal zu der Power wir gehen jetzt bis fünfzehnhundert Fuß …			*Well coming back to the power first we go to fifteen hundred feet …*
14 h 40 min 37	Nein wir wir machen das ganz normal haben wir immer bis fünfzehnhundert Fuß Das ist dann wenn unser Climb flasht… Alles … straight ahead to Orbil as briefed any serious malfunction prior V one either of us call stop no action below four hundred feet thereafter we follow departure route and in case of engine failure straight ahead one point five miles right turn heading east Und die Sektoren sind viertausend wir sind noch VMC und radar guidance what ever is necessary Ja?				*No we do it normally as usual up to fifteen hundred feet That is when the climb is flashing… All … straight ahead to Orbil as briefed any serious malfunction prior V-one either of us calls stop no action below four hundred feet thereafter we follow departure route and in case of engine failure straight ahead one point five miles right turn heading east And the sectors are four thousand; we are still in VMC and radar guidance what ever is necessary Yeah?*
14 h 41 min 04		Okay			
14 h 41 min 05	Okay				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 41 min 06	Ready for departure?	Ready			
14 h 41 min 11	Take off items haben wir gemacht Packs off take off checks				*Take off items are done Packs off take off checks*
14 h 41 min 17		Take off all green bis auf cabin ist klar ja			*Take off all green until cabin is clear, ok*
14 h 41 min 20	Cabin is clear				
14 h 41 min 23		Flaps one packs off			
14 h 41 min 24	Take off all green flaps one packs off				
14 h 41 min 30		➔ Golf X-ray Lima triple eight Tango we are ready to departure			
14 h 41 min 33				Triple eight Tango backtrack line up runway three three report fully ready	
14 h 41 min 37		➔ Backtrack line up runway three three and I call you fully ready Golf X-ray Lima triple eight Tango			
14 h 41 min 42		Machen wir das doch ja			*Let's do it yeah*
14 h 41 min 44	Die paar Meter holen wir uns				*Lets take the last meters*
14 h 41 min 59	Approach sector is clear	yeah			
14 h 42 min 03	Timing vergessen wir nicht ja? Weil er notiert das mit	yeah Yes			*Don`t forget the timing yes? Because he will copy it*
14 h 42 min 08	Also auf run stellen die Uhr Und nachher machen wir … bevor wir das Gear hoch machen machen wir ein Timing hier am Chrono				*Well set the clock to run And thereafter before the gear retraction we do a timing with the chrono*
14 h 42 min 17		Aber jetzt sind wir erst mal einmal time hier und ein mal time hier			*But right now we time here and time here*
14 h 42 min 23	I time the gear okay?				
14 h 42 min 24			Okay from til		
14 h 42 min 26			command to all gear gear doors are closed so we need the wheel page opened once we are airborne		
14 h 42 min 35	Okay we do that we just leave the gear out until… they tell us		Yes and then we talk to okay		
14 h 42 min 40		Ready			
14 h 42 min 41	Ready				
14 h 42 min 42		➔ Golf X-ray Lima triple eight Tango we are ready for			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
		departure			
14 h 42 min 45				Triple eight Tango maintain for one minute I call you back	
14 h 42 min 49		➔ Ok we are staying by for take off Golf X-ray Lima triple eight Tango			
14 h 42 min 55		Mensch was ein Stress			*Man what stress*
14 h 43 min 10			(*)	Golf X-ray Lima triple eight Tango cleared for take off runway three three wind calm	
14 h 43 min 15		➔ Cleared for take off runway three three (*) triple eight Golf X-ray Lima triple eight Tango (*)			
14 h 43 min 23	Ready?				
14 h 43 min 24		Ready			
14 h 43 min 25	Okay gents here we go				
14 h 43 min 26			Okay (2) ready		
14 h 43 min 29	Take off				
14 h 43 min 30		Checked			
14 h 43 min 32	It is going to be sporty				
14 h 43 min 33			(2) certainly is		
14 h 43 min 44					Sharp noise
14 h 43 min 45		Power set			
14 h 43 min 46	That's the door				
14 h 43 min 48		Power set			
14 h 43 min 49	Checked				
14 h 43 min 51		Eighty			
14 h 43 min 52	Checked				
14 h 43 min 59		V one			
14 h 44 min 00		Rotate			
14 h 44 min 06		Positive climb			
14 h 44 min 07	Ja				*Yes*
14 h 44 min 10		Du nimmst dann die Zeit ja?			*You check the time?*
14 h 44 min 11	Yes				
14 h 44 min 12	Open the wheel page?		Wheel page… wheel page then we will lift the gear with the turning		
14 h 44 min 18	Okay go ahead				
14 h 44 min 19		Gear up?			
14 h 44 min 20	Yeah				
14 h 44 min 21		Gear up			
14 h 44 min 27			Time		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 44 min 29			Time		
14 h 44 min 38			And the top time was fourteen		
14 h 44 min 40	Yeah				
14 h 44 min 42		Lever climb pack one	Fourteen seconds is good		
14 h 44 min 50		Okay			
14 h 44 min 55	Autopilot one on				
14 h 45 min 03			(*) to maintain three thirty (*)		
14 h 45 min 04		Speed check			
14 h 45 min 07	Flaps up				
14 h 45 min 12	We can go back to the normal…climb page right?				
14 h 45 min 16			Okay		
14 h 45 min 18	Sag ihr mal hallo			Golf X-ray Lima triple eight Tango radar identified I call you back	*Say hello to her*
14 h 45 min 23		➔ I've copied Golf X-ray Lima triple eight Tango			
14 h 45 min 26	Okay				
14 h 45 min 28			(*) (*)		Discussion between two people
14 h 45 min 33					Single chime
14 h 45 min 35	Pack two	Pack two			
14 h 45 min 36			(*) (*)		Discussion between two people
14 h 45 min 44				Golf X-ray Lima triple eight Tango climb flight level one eight zero	
14 h 45 min 48		➔ Climb flight level one eight zero Golf X-ray Lima triple eight Tango			
14 h 45 min 51	Okay do you need anything during the climb?				
14 h 45 min 54			Err just says climbs flight level three one zero and we check things as we go		
14 h 46 min 00	Okay so we can do an expeditious climb right?				
			Yes we can		
14 h 46 min 03	To get up… a little bit of climb				
14 h 46 min 05			So up to err bank angle to thirty three… up to thirty three holds doesn't move		
	Okay				
14 h 46 min 13	Once once we are up right?				
14 h 46 min 15			When ever you … we can do it on the climb during climb three one so it is a		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
			check that it holds the bank angle then beyond thirty three that is rolls back		
	Okay				
14 h 46 min 26			Pitching attitude input is helt constant upon stick released		
14 h 46 min 27				Triple eight Tango Perpignan?	
14 h 46 min 29	Triple eight tango				
14 h 46 min 30		➔ Golf X-ray Lima triple eight Tango go ahead			
14 h 46 min 32				I have a flight plan for you departing from Perpignan to go to Germany at one five three zero do you want us to delay it?	
14 h 46 min 41	Yeah half an hour				
14 h 46 min 44		➔ Yes please delay it three zero minuts so half an hour			
16 h 46 min 45				Roger	
16 h 46 min 46	Thank you	➔ Thank you			
14 h 46 min 51			In the mean time we could… we can try auto pilots pitch and roll modes again if you wish		
14 h 46 min 58	okay				
14 h 47 min 00			Expedite work is done so climb is done		
14 h 47 min 03	Out of flight level one hundred lights off and engine anti ice off in a second				
14 h 47 min 11		Die andere Uhr brauchen wir nicht mehr?			*The other clock we don't need anymore?*
14 h 47 min 13	Die doch die lass laufen das ist ja die Gesamtzeit die lassen wir mal laufen				*Keep it running thats the total time keep it running*
14 h 47 min 17	Okay engine anti ice comes off				
14 h 47 min 19		Yeah			
14 h 47 min 21	Okay what else do you want? Do you want any vertical speed mode so …		Vert speed yeah Yeah		
			Vert speed fine yeah		
	see what he does Look it works				
14 h 47 min 29			Yeah flight path angle maybe?		
14 h 47 min 31	Track F P A				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 47 min 35				Golf X-ray Lima triple eight Tango contact Bordeaux control one two eight decimal zero two five	
14 h 47 min 36			Works fine		
14 h 47 min 41		➔ One two eight decimal zero two five thank you bye bye Golf X-ray Lima triple eight Tango	(*)		
14 h 47 min 46			And managed climb is used		
14 h 47 min 50			Works fine		
14 h 47 min 51			And the roll (*) we have heading … From heading is		
14 h 47 min 56		➔ Bordeaux bonjour it's Golf X-ray Lima triple eight Tango we're climbing flight level one eight zero	Nav works		
14 h 48 min 01					Triple click
14 h 48 min 02			Looks good to me		
14 h 48 min 04			Auto pilot two same thing		
14 h 48 min 07	Okay			Golf X-ray Lima eight eight eight Tango bonjour climb level one eight zero	
14 h 48 min 12		➔ Climbing flight level one eight zero Golf X-ray Lima triple eight Tango			
14 h 48 min 18	So pitch mode works…				
14 h 48 min 26	It works as well				
14 h 48 min 27			Works fine as well		
14 h 48 min 30	Open climb		Flight path angle maybe (*)		
14 h 48 min 33			Time		
14 h 48 min 35	Here it is I do with some roll mode okay?		Works, Okay		
14 h 48 min 40			Yes		
14 h 48 min 46			Fine		
14 h 48 min 47	Yeah				
14 h 48 min 51	We will do the managed				
14 h 48 min 54			We would need a clearance to do the bank angle checks I guess		
14 h 48 min 58	That would be nice actually err once we are at one eight zero… I just talk to them				
14 h 49 min 09	Ja war das war das Mende?				*Yes was it Mende?*
14 h 49 min 11		… ahm Bordeaux das war Bordeaux			*… ahm Bordeaux that was Bordeaux*
14 h 49 min 15				Golf X-ray Lima triple eight	

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
				Tango squawk four three four zero	
14 h 49 min 20	➔ Four three four zero triple eight Tango and just be advised could we maintain flight level one eight zero onheading three three zero and do one or two three sixties?				
14 h 49 min 35				I call you back sir	
14 h 49 min 36	➔ Because we are in acceptance flight so it could be nice if you could give us err some airspace to do few procedures				
14 h 50 min 00	One thousand				
14 h 50 min 01		Checked			
14 h 50 min 19			While we are waiting we could try V O R one and two and DMEs and		
14 h 50 min 26	Okay drehst du mal ein VOR rein? Mende zum Beispiel irgendein VOR?				*Okay could you tune in a VOR? Mende for example any VOR?*
14 h 50 min 35		… Gaillac ist auch okay?			*… Gaillac is okay too?*
14 h 50 min 38	Gaillac hat aber kein DME				*But Gaillac has no DME*
14 h 50 min 41			G A I is fine and in prog page we could enter it check distance		
14 h 50 min 45	Mike Echo November	Bitte?			*Pardon?*
14 h 50 min 46	Mike Echo November				
14 h 50 min 56	Fünfzehn dreißig				*Fifteen thirty*
14 h 51 min 01			And can we enter Mike Echo November in the prog page? Just to check?		
14 h 51 min 07	Yes prog page yeah				
14 h 51 min 18			It is good zero two zero eighty eight miles and Ah on here we have V O R … (*)		
14 h 51 min 26	(*) put it on one you can force it on one Mike Echo November so we have four receivers yeah				
14 h 51 min 35	Yeah				
14 h 51 min 36			Yeah		
14 h 51 min 37			We have Okay … very good, to clear eighty seven, good		
14 h 51 min 39	Err				
14 h 51 min 41			and on number two and we		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
			have there yes		
14 h 51 min 49	*(*)*				
14 h 51 min 51			All good same DMEs, yes check those		
14 h 51 min 54		Okay?			
14 h 51 min 55			Yeap that's fine		
14 h 51 min 56		(*)			
14 h 51 min 57			And ADF one		
14 h 52 min 02	Haben wir ne ADF Frequenz? Sonst können wir die von Ahm die von Perpignan oder Toulouse nehmen		ADF one		*Do we have an ADF frequency? Otherwise we can take the one from ahm Perpignan or Toulouse*
14 h 52 min 15	➔ Bordeaux Golf X-ray Lima triple eight Tango?				
14 h 52 min 19				Stardust Triple eight Tango go	
14 h 52 min 21	➔ Yeah whenever whenever available I'd like to do a three sixty to the left and a three sixty to the right				
14 h 52 min 28				Stardust triple eight Tango I'm afraid we can't do we cannot do test flights in general air traffic you have to be O A T sir for that	
14 h 52 min 39	➔ And where?				
14 h 52 min 42				You have to be an Operational air Traffic we are not doing this kind of flight sir	
14 h 52 min 48	➔ Ok so we are requesting flight well the flight plan was actually… Err… the flight plan was actually requested like that but we are requesting flight level three one zero then				
14 h 53 min 00				Heu…along this routing you'll have to be three zero zero or three two zero sir	
14 h 53 min 07	➔ Three two zero is fine				
14 h 53 min 10		Bis zum beacon Papa Lima …		Triple eight Tango climb we connect with higher sectors climb flight level one niner zero turn left ten degrees	*To the Papa Lima beacon …*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
14 h 53 min 17	➔ Climbing flight level one niner zero left by ten err Stardust Triple eight Tango and just err bring us to an airspace where we …				
14 h 53 min 27				Stardust triple eight Tango climb flight level one niner zero turn left ten degrees	
14 h 53 min 31	➔ Yes climbing flight level one nine zero left by ten degrees please bring us an airspace where we can do err few exercise just for about ten minutes				
14 h 53 min 39				Triple eight Tango you cannot do exercises in general air traffic	
14 h 53 min 45	➔ Well do you actually give we are actually ordering that during our flight…err… flight plan… when we published the flight plan this morningwe were talking to your… local A T C				
14 h 53 min 59				I am asking sir but our rules are that you cannot do test flight… test in your flight we can only deal with regular flight plan sir	
14 h 54 min 11	➔ No problem sir err…we'll let you know what we have to do we'll come back later to Perpignan anyhow so presently we're climbing flight level one niner zero and we are requesting flight level three two zero				
14 h 54 min 25	We do that later on during the approach into Perpignan…		Okay that's fine yep		
14 h 54 min 28				That is correct sir I call you back	
14 h 54 min 30	➔ Thank you				
14 h 54 min 33			Okay we can continue with the ADF		
14 h 54 min 36	Okay hast du eine ADF Frequenz?				*Okay do you have ADF frequency?*
14 h 54 min 37		Ja			*Yes*
14 h 54 min 45		So das ist jetzt Papa Lima von Perpignan			*So this is Papa Lima of Perpignan*
14 h 54 min 47	Okay haben wir den drauf?				*Okay do we have that?*
14 h 54 min 51	Der ist hinter dem Berg den				*It is behind the mountain we do not*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
	kriegen wir nicht				*receive it*
14 h 54 min 54			That one?		
14 h 54 min 55	Now its behind the mountain too far				
14 h 54 min 57			Okay		
14 h 54 min 58	Guck mal ob wir hier vorne was haben?				*So look if there is something around here?*
14 h 54 min 59		(*)			
14 h 55 min 02	Otherwise we do that during the approach into Perpignan or we have to take Toulouse (*)		Yeah		
14 h 55 min 09	Guck mal hier Alfa Bravo		Alpha Bravo yeah		*Look here Alfa Bravo*
14 h 55 min 17	Gib mal Alfa Bravo ein				*Type in Alpha Bravo*
14 h 55 min 19		Alfa Bravo?			
14 h 55 min 20	Alpha Bravo				
14 h 55 min 21			If it point to Alpha Bravo is good enough	Stardust Triple eight Tango?	
14 h 55 min 25	→ Go ahead				
14 h 55 min 26				Stardust Triple eight Tango do you have any name of a person that agreed for you to do this test?	
14 h 55 min 34	→ No they were they were actually checking on a route which which led us to Gaillac and it was discussed with EAS and our operations and Perpignan ATC So no worries just we do… err… we just continue on present routing and request flight level Three one zero and then we go back to Perpignan		So … Ok !		
14 h 55 min 55				Stardust Triple eight Tango you are cleared flight level two eight zero and do you know when you will make an half turn to get back to Perpignan?	
14 h 56 min 04	→ In about twenty minutes from now				
14 h 56 min 05				That is copied sir Thank you	
14 h 56 min 10	→ And just for confirmation Triple eight Tango we're climbing flight level Two eight zero now present heading is three two three				
14 h 56 min 17				Stardust Triple eight	

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
				Tango you may set course to MANAK Mike Alpha Novembre Alpha Kilo and climb flight level two eight zero that is correct	
14 h 56 min 26	➔ Direct to MANAK and climbing flight level two eight zero thank you err Stardust triple eight Tango				
14 h 56 min 34			Can we ask him for transponder check one two identing an altitude and we can then switch the other when you are ready		
14 h 56 min 53			Also we need to call VHF two and VHF three		
14 h 56 min 58			VHF four		
14 h 57 min 01	Machst du das mal mit dem ahm Transponder check?				*Could you do the transponder check?*
14 h 57 min 04		Ja			*Yes*
14 h 57 min 12	Mach mal den Transponder check mit der gleichen Frequenz auf VHF two				*Do the transponder check with the same frequency on VHF two*
14 h 57 min 17	Ja damit wir VHF two checken das machen wir jetzt ja grad				*Yes that's to check VHF two what we are doing right now*
14 h 57 min 21				Stardust Triple eight Tango contact Bordeaux on one one niner decimal three eight zero have a nice flight sir	
14 h 57 min 26	➔ One one nine three eight zero Stardust Triple eight Tango bye bye				
14 h 57 min 29	So jetzt machst du das mal auf ADF two				*So now do this on ADF two*
14 h 57 min 34	One one nine three eight zero right?				
14 h 57 min 35		Yeah			
14 h 57 min 37	Okay bitte auf zwei das müsste auf den Zweier gehen				*Okay on number two please now we have to use number two*
14 h 57 min 40	Ruf ihn mal one one nine three eight zero				*Call him one one nine three eight zero*
		Yeah			
14 h 57 min 47	(*) Bordeaux				
14 h 57 min 53		(*) Bordeaux			
14 h 57 min 59		➔ Bordeaux bonjour Golf X-ray Lima triple eight Tango			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
		we're climbing flight level two eight zero			
14 h 58 min 05				Stardust three Tango bonjour proceed as cleared	
14 h 58 min 09		➔ Proceeding as cleared Golf X-ray Lima triple eight Tango			
14 h 58 min 12		So jetzt schalten wir hier um auf den linken zweiten Transponder und …			*So now we switch to the left second transponder and …*
14 h 58 min 18		Ich schalte einfach um?			*I just switch over?*
14 h 58 min 22	Ja Transponder check				*Yes transponder check*
14 h 58 min 32		➔ Bordeaux this is Golf X-ray Lima triple eight Tango we're now on transpondeur system number two do you have still radar contact?			
14 h 58 min 49				Which traffic calling?	
14 h 58 min 52		➔ Golf X-ray Lima triple eight Tango we're now on transpondeur system number two confirm you have still radar contact?			
14 h 58 min 59				Yes I still have radar contact for me you squawk four thee four zero and that's fine for me	
14 h 59 min 05	I give you an ident				
14 h 59 min 06		➔ And I give you now an ident code on A D C number two just a moment			
14 h 59 min 23		➔ Golf X-ray Lima triple eight Tango you have received our ident?			
14 h 59 min 27				Affirm (*) I can read ident no problem	
14 h 59 min 30		➔ Ok merci beaucoup Golf X-ray Lima triple eight Tango			
14 h 59 min 35	Fine on both		Yes very good		
14 h 59 min 37	We go back to system one				
14 h 59 min 41			okay Weather radar all operating modes		
14 h 59 min 42	okay				
14 h 59 min 46			(*)		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 00 min 18	Yes have a play So we have to go up to flight level three one zero for the leak check in the cabin right? So we do that and then we ask for the return and do the return flight manually		Have a play Yes, I think so yes		
15 h 00 min 29			Two places … Good idea		Laughter
15 h 00 min 43		Okay flight level two eight zero			
15 h 00 min 45	*Yeah*				
15 h 00 min 51			You need weather T is it? And err Cal or something (*) finish it		
15 h 00 min 53	*Yeah*				
15 h 00 min 54				Golf X-ray Lima triple eight Tango continue climb level three two zero	
15 h 00 min 59		➔ Climbing level three two zero Golf X-ray Lima triple eight Tango			
15 h 01 min 01	Okay schön				*Okay nice*
15 h 01 min 13			Can you select prog page for GPS primary		
15 h 01 min 15	The prog page?				
15 h 01 min 23			GPS primary yes (*)		
15 h 01 min 27			TCAS		
15 h 01 min 29			Should be TCAS traffic, yes it is working		
15 h 01 min 35	Yes it is				
15 h 01 min 36			Okay and when we have a chance we need HF call one and two request selcall		
15 h 01 min 44	Okay was haben wir denn für eine Selcall Frequenz hinten drauf?				*Okay what is the Selcall frequency on the back?*
15 h 01 min 50			We have not done the VHF three yet have we? We need to do a call on it		
15 h 01 min 53	Err the VHF? No we haven't done the VHF three yet				
15 h 01 min 58	Okay we can do the VHF three		the VHF three We do that then we (need to)		
15 h 02 min 13		Drei Minuten ahead MANAK			*MANAK three minutes ahead*
15 h 02 min 28	VHF three is on we are listening to it already				
15 h 02 min 30			Okay		
15 h 02 min 43	➔ Flight level three two zero				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
	maintaining Golf X-ray Lima triple eight Tango				
15 h 02 min 48			Very good that's works	Roger copied thank you	
15 h 02 min 51		Still need err weather radar? You still …			
15 h 02 min 55			Say again? (2) (Ahm no I don't need now)		
15 h 02 min 57	Okay we go back to VHF number one on one one nine three eight zero okay?				
15 h 03 min 12			While you are busy may I borrow your system page?		
15 h 03 min 16	Sure go ahead				
15 h 03 min 18			That's it		
15 h 03 min 37	Du könntest im secondary Perpignan Frankfurt eingeben so lang				*You could type in Perpignan Frankfurt in the secondary now*
15 h 03 min 42		Secondary?			
15 h 03 min 43	Ja Perpinan Frankfurt den Plan und dann können wir den nachher aktivieren				*Yes Perpignan Frankfurt the plan We can activate it then*
15 h 03 min 56				Stardust Triple eight Tango say your mach number?	
15 h 04 min 01	➔ Mach number will be point seven eight Stardust Triple eight Tango				
15 h 04 min 03				Roger thank you	
15 h 04 min 08	➔ And Stardust Triple eight Tango in a few minutes from now we'll be turning back to Perpignan we call you back in about five minutes				
15 h 04 min 17				Roger hem … how many miles exactly?	
15 h 04 min 22	➔ And well we've got all traffic around on TCAS about about five zero miles				
15 h 04 min 27				Roger ok err…	
15 h 04 min 32	➔ I keep you advised for the (moment)				
15 h 04 min 35				… for the clearance from control sir	
15 h 04 min 36	➔ Yeah I keep you advised thank you				
15 h 04 min 39				Yes but … I call you back with the new clearance	

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 04 min 43	➔ Thank you				
15 h 04 min 46			When you are on this speakers here we are all tune the same so need to change to something if you get to the feedback		
15 h 04 min 49		Wir sind jetzt wieder auf dem Einser ja?			*We are now back on number one right?*
15 h 04 min 50	Yeah we are back in VHF one				
15 h 04 min 53	(*)		You get in feedback where you some times you change the frequency on to a different one that's stop the feeding back		
15 h 04 min 56	Okay we should we should do the one two one any how				
15 h 05 min 00				Stardust Triple eight Tango so descend level three one zero due to traffic	
15 h 05 min 07			Okay HF one and two		
		➔ Descending flight level three one zero Golf X-ray Lima triple eight Tango			
	Due to traffic				
			Okay		
15 h 05 min 13	Okay			OK and then within now forty five miles you'll turn by the right	
15 h 05 min 21	➔ That is fine no problem triple eight Tango		(*) cruise parameters down		
15 h 05 min 26	Okay shall we do the pressurization stuff already?				
15 h 05 min 30			You can level at three one		
15 h 05 min 32	Yeah we level off at three one zero				
			Then we record everything very quickly		
15 h 05 min 46			Ready packs		
15 h 06 min 00			(*) trim roll		
15 h 06 min 01	Okay we are maintaining three one zero?				
15 h 06 min 04			Okay		
15 h 06 min 06		Bin einen Moment mal Head down ja?			*I am head down for a moment okay? Yes Yes*
	Jaja				
15 h 06 min 10			(*)		
15 h 06 min 20			Mach number is point seven six nine		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 06 min 20	Yeah				
15 h 06 min 26	(*)				
15 h 06 min 27			AP one or two command with heading and alt yes		
15 h 06 min 31	So what do you want?				
15 h 06 min 33			Heading?		
15 h 06 min 37	Heading		And autothrust off this one is off Autothrust off After manual adjustement of the thrust and stabilize record all		
15 h 06 min 47					Single chime
15 h 06 min 49					Single chime
15 h 06 min 56			(*)		Thinking aloud
15 h 07 min 06			One three two three one		
15 h 07 min 11			(*)		Thinking aloud
15 h 07 min 20		Okay secondary is in			
15 h 07 min 25	Ja dann lassen wir ihn drin den Secondary …				*Yes so let's leave it with the secondary*
15 h 07 min 33	Da machen wir dann new destination nach Perpignan rein hier				*There we type in new destination Perpignan*
15 h 07 min 37		Warte mal kurz			*Wait*
15 h 07 min 42	Is that fine?				
15 h 07 min 43			Really good		
15 h 07 min 47				Stardust Triple eight Tango so I confirm you are cleared to go to turn by the right to go back via Gaillac Golf Alpha India	
15 h 07 min 49	Yeah okay				
15 h 07 min 59	One minute One minute	➔ Ok we're turning… in one minute we're turning right inbound to Gaillac Golf X-ray Lima triple eight Tango			
15 h 08 min 05				Affirm that's correct by the right direct to Golf Alpha India you maintain three one zero	
15 h 08 min 10		➔ Maintaining three one zero and after one minute we're turning right direct to Golf Alpha India Golf X-ray Lima triple eight Tango			
15 h 08 min 38	Okay				
15 h 08 min 40			(*) okay (*) that's good		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
			that's done		
15 h 08 min 45	Thats it?				
15 h 08 min 46			That is all we need the trim the stabilized target speed ensure the fuel on board is symetrical and record the roll angle on each P F D		
15 h 08 min 56	Zero (*)		Zero		
15 h 08 min 57			Zero looks good		
15 h 09 min 00	So in one minute we have to turn right				
15 h 09 min 02			Okay (*)		
15 h 09 min 07	I give you fourty five degrees okay?				
15 h 09 min 10			Yes we are ok now autothrust back in		
	Okay				
15 h 09 min 17			Three nine zero if we can		
15 h 09 min 20			Can we go to three nine zero and start APU		
15 h 09 min 26	Let's let's let's try maybe climb flight level three nine zero on the way back to Perpignan				
15 h 09 min 32		Ja	Yeah		*Yes*
15 h 09 min 34		➔ Golf X-ray Lima triple eight Tango is it possible to climb flight level three nine zero for have a route back to Perpignan?			
15 h 09 min 46	First of all we turn back… to get the turn exercise				
15 h 09 min 50			Yeah okay during the turn if we can disengage try set twenty five …		
	Yeah				
15 h 09 min 53			It stays roll to thirty three then fourty five		
	Yeah				
15 h 10 min 00		Können wir jetzt auch turnen?			*Could we turn now?*
15 h 10 min 03	Sagen wir ihm turning Gaillac				*Tell him turning Gaillac*
15 h 10 min 07		And climb three niner zero			
15 h 10 min 09	Nee das müssen wir nachher fragen wenn wir den erste Turn hinter uns haben				*No we need to ask after our first turn completed*
15 h 10 min 13	Otherwise we do that on the flight to Frankfurt Yeah? we can do that on the flight to Frankfurt				
			Yeah		
15 h 10 min 20	Turning sag ihm turning Gaillac				*Turning tell him turning Gaillac*
15 h 10 min 27		Gaillac (*)			
15 h 10 min 31					Cavalry charge (Autopilot

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
					disconnection)
15 h 10 min 39		➔ Golf X-ray Lima triple eight Tango we're turning now on the right turn direct to Gaillac			
15 h 10 min 44				That's copied	
15 h 10 min 45	Okay gib mir mal heading gib mir mal heading east … Heading east … and pull				*Okay give me heading give me heading east* *… heading east … and pull*
15 h 10 min 45			Hands off now and it all stays pitch and roll is good yes		
15 h 10 min 54			continue to fifty … fourty degrees may be		
15 h 11 min 01	Pull				
15 h 11 min 08			Stick release now is good		
15 h 11 min 10			And now just a little further to make sure rolls back that's all we need I think		
15 h 11 min 19			And release (*)		
15 h 11 min 25	(*)				
15 h 11 min 27			Yeap, yes, voilà !		
15 h 11 min 28		(Rolls back)			
15 h 11 min 29			It's good bank angle over three three upon stick release verify current bank angle over thirty three return yeap		
15 h 11 min 37	(*)				
15 h 11 min 39			That's all good		
15 h 11 min 43	Okay direct Gaillac und Nav bitte				*Okay direct Gaillac and Nav please*
15 h 11 min 57			Can you have the the auto pilot in (...)		
15 h 12 min 10			At least we are not going to be (*) the ground (*) operation (*) Frankfurt		
15 h 12 min 13	We could do the three nine zero on the way to Frankfurt or we just ask him lets see what the traffic says		Yes Yeah okay		
15 h 12 min 19	*okay*		Okay		
15 h 12 min 20			Yes let's see what's happen		
15 h 12 min 21	Ich frag ihn mal ja?				*I ask him okay?*
15 h 12 min 22		ja			*Yeah*
15 h 12 min 24	➔ Bordeaux Golf X-ray Lima triple eight Tango				
15 h 12 min 27				Triple eight Tango	

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 12 min 29	➔ All right we're on a way to a turn to Gaillac is there a chance to climb flight level three nine zero for a few minutes and then descending to Perpignan?				
15 h 12 min 40				I can make three three zero and for further climb I have to check but I'm not sure it will be possible	
15 h 12 min 48	➔ Yes please check err please check and give us a call back thank you				
15 h 12 min 52				Triple eight Tango so for the time I confirm you may climb level three three zero confirm you are on course to Gaillac?	
15 h 12 min 58	➔ On course Gaillac climbing flight level three three zero Golf X-ray Lima triple eight Tango Thank you				
15 h 13 min 06	We climb to three three zero already				
15 h 13 min 09			Okay		
15 h 13 min 10	*(*)*				
15 h 13 min 11			Okay		
15 h 13 min 15			It sounds promising		
15 h 13 min 19	okay				
15 h 13 min 21	gibst du mal new destination ein Perpignan? Und gib mir mal auf welcher Freq He he will do that in a minute				*type in new destination Perpignan? And give me which freq…*
15 h 13 min 28			Okay there is no rush whenever you are happy		
15 h 13 min 32			Not much to do while we're sitting		
15 h 13 min 38			In the descent there is an overspeed check		
15 h 13 min 41	During the (*) we will do that yeah				
15 h 13 min 43			Yes and there is one in at one four zeroto remain level and overspeed at this level		
15 h 13 min 48	Yeah				
15 h 13 min 52			And that one is to ease up hold at that speed and record		
15 h 13 min 54	Right yeah				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 13 min 57		Runway three three			
15 h 13 min 58	Yeah runway three three				
15 h 14 min 04		Gibt es keine Arrival?			*Is there no arrival?*
15 h 14 min 06	➔ Approaching flight level three three zero Golf X-ray Lima triple eight Tango				
15 h 14 min 10				Roger	
15 h 14 min 13	➔ I can give you a very fast climb up and be quite fast down again				
15 h 14 min 17				I understand sir but you know you are on general aviation and many sectors above so it's a bit more difficult for us than different controls	
15 h 14 min 29	➔ Fully understand thanks for your cooperation				
15 h 14 min 41	Machen wir… guck mal guck mal in die Karte was er hat				*We do that look look at the map*
15 h 14 min 54		Steht nur Runway three three			*There is only runway three three*
15 h 14 min 59	Okay dann machen wir es hand…				*Okay then we do it manually*
15 h 15 min 31	Nehmen wir das ILS rein?				*Let's tune in the ILS?*
15 h 15 min 33		ILS Frequenz hat er drin			*ILS frequency is in already*
15 h 15 min 35	Papa Lima				
15 h 15 min 37		Und final track three two nine hat er auch			*And final track three two nine is in too*
15 h 15 min 38	Yeah go ahead				
15 h 15 min 50				Golf X-ray Lima triple eight Tango climb level three five zero	
15 h 15 min 54	➔ Climbing flight level three five zero Golf X-ray Lima triple eight Tango thank you				
15 h 16 min 03				Golf X-ray Lima triple eight Tango contact Bordeaux on one two two decimal four one five	
15 h 16 min 10	➔ One two two four one five triple eight Tango thanks a lot bye				
15 h 16 min 13		Soll ich den rufen? Ich ruf den ja Bordeaux?			*Shall I call him? I call him yeah Bordeaux?*
15 h 16 min 20		➔ Bordeaux bonjour Golf X-ray Lima triple eight Tango we're climbing flight level three five zero			
15 h 16 min 25				Stardust Triple eight	

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
				Tango bonjour maintain three five zero when reaching and I call you back	
15 h 16 min 30		→ On reaching maintaining three five zero Golf X-ray Lima triple eight Tango			
15 h 16 min 38	Okay so jetzt auf dreifünfzig dann kriegen wir auch dreineunzig				*Okay so now to three fifty then we will get three ninety as well*
15 h 16 min 51	Müssen wir nur fragen nachher wie es nach Gaillac weiter geht weil wir sind cleared bis Gaillac				*We have to ask later how to continue after Gaillac cause we are cleared to Gaillac*
15 h 16 min 57		*Yeah* Also ILS ist identified für die Runway three three			*Well ILS is identified for runway three three*
15 h 16 min 59	Okay				
15 h 17 min 05			Checking the start of the APU in the next three to five minutes		
15 h 17 min 09	During				
15 h 17 min 11			It must be what they want		
15 h 17 min 12	Pardon				
15 h 17 min 13			Must be just to go up there and to start the APU I guess is the maximum certified altitude for the start		
15 h 17 min 17	Yeah				
15 h 17 min 18	I think I think we will have a chance to get out				
15 h 17 min 26	They gave us this routing for exercise so				
15 h 17 min 29			Yeah yeah		
15 h 17 min 31			Never mind		
15 h 17 min 48	On the way down we just have do do we have to switch the packs off at three nine zero				
15 h 17 min 52			No no problem		
15 h 17 min 53	no		this is a reduce check		
15 h 17 min 55	okay				
15 h 17 min 56			Anti ice		
15 h 17 min 58			On the way down we turn the anti ice on to make sure it goes		
15 h 18 min 00				Stardust Triple eight Tango radar continue climb level three seven	

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
				zero	
15 h 18 min 04			And doesn't leak		
15 h 18 min 05		➔ Climbing level three seven zero Golf X-ray Lima triple eight Tango			
15 h 18 min 08			Going up slowly		
15 h 18 min 09	Ah ah				
15 h 18 min 11			We have to do a maximum over speed on the way down record it		
15 h 18 min 15	Yeah		speed brakes extension…		
15 h 18 min 17			V M O		
15 h 18 min 21			Level at one four zero		
15 h 18 min 23	Yeah we do that				
15 h 18 min 24			In alternate law at one four zero		
15 h 18 min 28			A P U		
15 h 18 min 31			On the packs		
15 h 18 min 35			Then slow down right down we have to go into alpha err floor on approach well not not on approach but at one four zero slow right down		
15 h 18 min 46			Get into alpha floor end then recover		
15 h 18 min 47	Okay				
15 h 18 min 49			It is a little different		
15 h 18 min 51			So that would be a …		
15 h 18 min 52				Stardust Triple eight Tango contact Bordeaux one one nine decimal three eight zero au revoir	
15 h 18 min 57		➔ One one nine decimal three eight zero thank you bye bye Golf X-ray Lima triple eight Tango			
15 h 19 min 02			(*) (*)		Discussion between two people
15 h 19 min 07			Err we get the best we can if we can get the best we can		
15 h 19 min 10		➔ Bordeaux bonjour this is Stardust… triple eight Tango flight level three seven zero we request flight level three nine zero	We go three nine later		
15 h 19 min 11			(*) (*)		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 19 min 16				X-ray Tango you are on a wrong freq please call Bordeaux one three six zero five five	
15 h 19 min 23		➔One three six zero five five thank you bye bye Golf X-ray Lima triple eight Tango			
15 h 19 min 31		➔ Bordeaux bonjour it is Stardust Triple eight Tango flight level three seven zero and we request to climb flight level three nine zero			
15 h 19 min 38				Stardust Triple eight Tango bonjour are you able to be level three nine zero within two minutes maximum?	
15 h 19 min 42	Yes maximum	➔ Yes we are able Golf X-ray Lima triple eight Tango			
15 h 19 min 46					
15 h 19 min 47				Roger Stardust Triple eight Tango climb level three nine zero to be levelled within two minutes maximum due to converging traffic	
15 h 19 min 54	Yeah	➔ Ok maximum in two minutes flight level three nine zero Golf X-ray Lima triple eight Tango			
15 h 20 min 00	So three niner zero within two minutes no problem				
15 h 20 min 02			Ok within two minutes he said		
15 h 20 min 05	Yeah				
15 h 20 min 12			(*)		
15 h 20 min 46	Yeah		When we are levelled at three nine zero we need to bring up the APU page and time the start for the APU and record EGTs		
15 h 21 min 00	Yeah fine				
15 h 21 min 25	It's about it				
15 h 21 min 26			Yeah		Laughter
15 h 21 min 33			(*) seconds win		
15 h 21 min 36	We did promised a lot but not to				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
	much		Yes		Laughter
15 h 21 min 47			Okay we can start the APU if you wish any time		
15 h 21 min 51	Okay you want to do the timing				
			We need to time it … time it from		
15 h 21 min 54	And start the APU				
15 h 21 min 56			Yes timing		
15 h 21 min 57	(*)				
15 h 21 min 59		Machst du time?			*Copy the time?*
15 h 22 min 00	Timing				
15 h 22 min 01			Okay it's good		
15 h 22 min 02	Ok here we are		It's good		
15 h 22 min 11		Ich hol mal die ATIS ja?			*I check ATIS yeah?*
15 h 22 min 16	Ja das brauchen wir nicht drei drei das Wetter wird nicht anders sein				*Well we don't need it three three the weather will be the same*
15 h 22 min 19				Stardust Triple eight Tango say your intentions are you going to land at Perpignan now?	
15 h 22 min 25	➔Err two more minutes at this flight level and then we are ready for descending to Perpignan Stardust triple eight Tango thanks a lot for your cooperation				
15 h 22 min 33				Roger no problem but due to traffic it will be at least within three minutes report for descent	
15 h 22 min 38	➔ It's no problem we call you for descent you call us please thank you				
15 h 22 min 46			There it is EGT coming		
15 h 22 min 50	Eight fourty				
15 h 22 min 51			(2) eight fourty five Eight fourty five okay okay eight fourty five is the peak		
15 h 23 min 10			Still coming		
15 h 23 min 16			(2) (*) That's not a bad start That are now stop timing one minute seventeen		
15 h 23 min 19	Yeah				
15 h 23 min 20			One minute sixteen		
15 h 23 min 22	And off yeah?				
15 h 23 min 27			Stabilized now and we		
15 h 23 min 28	(*)				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 23 min 29			And let stabilize and record N one one hundred percent EGT leave the five five		
15 h 23 min 43			It's good APU running and descent one four zero		
15 h 23 min 53			Wing anti ice on when we can		
15 h 23 min 56	At at one four zero?				
15 h 23 min 57			It can come on now we will do the descentand we will have it on for five minutes to ensure no bleed leak		
	Okay				
15 h 24 min 03	Okay engine and wing?				
15 h 24 min 04			Err just…		
15 h 24 min 06	Just wing				
15 h 24 min 07			I'm sorry engine anti ice and … it says		
15 h 24 min 09	And wing and (*) both normally				
15 h 24 min 09			Just engines		
15 h 24 min 12	Yeah				
15 h 24 min 13			Anti ice wing on maintain wing anti ice on anti ice engine normal		
	Yeah				
15 h 24 min 19	Okay				
15 h 24 min 19			Yeah		
15 h 24 min 21	That off				
15 h 24 min 19			That's it just wing just wing		
15 h 24 min 26	There is some converging traffic				
15 h 24 min 28	And we are ready for descent				
15 h 24 min 31		➔ Stardust Triple eight Tango we are ready for descent			
15 h 24 min 34				Stardust Triple eight Tango I call you back within one minute	
15 h 24 min 38		➔ Ok we are standbying Stardust Triple eight Tango			
15 h 24 min 41	Wing… on the bleed page you can finish		(*)		
15 h 24 min 42	(*)		Yeah, it'll … so we leave on for five minutes		
	Okay				
15 h 24 min 49	You want a timing?				
15 h 24 min 51			Err no timing no just just making sure no ECAM for bleed leak		
15 h 24 min 54	Okay fine				
	Yeah				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 24 min 56			So in the descent we need prior to climb to flight level two five zero APU goes back off		
15 h 25 min 04	Okay				
15 h 25 min 05			I'm sorry correction auto pilot off auto pilot off err… we need to over speed so it says five degrees that's too low I think about two three degrees with moderate power then you can pull off if you need it		
15 h 25 min 07	Okay				
	(*)				
15 h 25 min 17	Yeah				
15 h 25 min 18			So err…		
15 h 25 min 20	You just want the over speed warning to hear		You keep (*) … Over speed and record		
15 h 25 min 23			So ease up to it not too fast so we can record		
15 h 25 min 27	Let let see what she clears us down to				
15 h 25 min 29			Okay		
15 h 25 min 30			It can be done any altitude		
15 h 25 min 32	Yeah				
15 h 25 min 36			Then we recover with… speed brakes to full or normal and then retract		
15 h 25 min 41	Okay				
15 h 25 min 48			Five degrees is too much it goes too fast		
15 h 25 min 51	Yeah yeah yeah				
15 h 25 min 55			(*) with a little power And then you have some control		
15 h 25 min 56	And and you want to have that extra at round about flight level two five zero right?				
15 h 26 min 00			Any any time prior		
15 h 26 min 01	Any time above flight level two five zero			Break break Stardust Triple eight Tango descend flight level three five zero	
15 h 26 min 03			Yeah		
15 h 26 min 07	Descending three five zero	➔ Descending three five zero Stardust Triple eight Tango			
15 h 26 min 14	Fragst du mal nach einem Routing				*Ask for a routing please*
15 h 26 min 17	Weil wir sind ja momentan right in				*Because at the moment we are right*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
	the middle of nowhere				*in the middle of nowhere*
15 h 26 min 29		➔ And Stardust Triple eight Tango we request routing to Perpignan			
15 h 26 min 39				Stardust Triple eight Tango contact Bordeaux on one three two decimal nine one zero bye bye	
15 h 26 min 45		➔ One three two decimal niner one zero thank you bye bye Stardust Triple eight Tango			
15 h 27 min 03		➔ Bordeaux Stardust triple eight Tango we're descending flight level three five zero			
15 h 27 min 07				Bonjour again Stardust triple eight Tango continue down level two Hundred	
15 h 27 min 11	Very good				
15 h 27 min 12	(*) ask for it	➔ Descending down two hundred and confirm routing inbound to Perpignan?			
15 h 27 min 18				Affirm	
15 h 27 min 19		➔ Ok we are descending flight level two hundred and we're going straight inbound to Perpignan			
15 h 27 min 24	Dann gib mal Perpignan …				*So then give Perpignan …*
15 h 27 min 29	Das VOR am Besten				*Prefer the VOR*
15 h 27 min 31			Yeah		
15 h 27 min 32	I take your autopilot off already				
15 h 27 min 36			Okay		Cavalry charge
15 h 27 min 37	Speed brake in				
15 h 27 min 38		Yes			
15 h 27 min 41	And take auto-thrust out actually				
15 h 27 min 44			Yes of course		
15 h 27 min 45			Moder… Moderate power is good for… so half power		Single chime
15 h 27 min 51	Oh we don't need that much				
15 h 27 min 55			So we can ease up into it		
15 h 28 min 00			So we need the… N one N two and mach number (*)		
15 h 28 min 09		Ok direct Perpignan	… both sides Here it comes		
15 h 28 min 12	Direct Perpignan … Hast du drauf				*Direct Perpignan … is this set?*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
	ja?				
		Ja			*yes*
15 h 28 min 18	That's find autopilot heading?				
15 h 28 min 20	That would you …		should be good whatever it is sounds good		
15 h 28 min 23	Look at this		Err… we need to record when it goes on with the Mach number		
15 h 28 min 28	(*) the (*) one		Two two eight two two they are both the same		
15 h 28 min 33					Sharp sound
15 h 28 min 34					Continuous Repetitive Chime
			There it is (two four three five)… (two four three five)		
			Okay		
15 h 28 min 42					End du Continuous Repetitive Chime
15 h 28 min 43			And record the PFD1 if AIDS is not available, We have AIDS available don't we?		
15 h 28 min 49	Pardon				
15 h 28 min 50			We have AIDS in the… recording for engineering in the box so we don't need to do this next one		
	Yes yes yes				
15 h 28 min 56	So we can do it later				
15 h 28 min 57			Okay		
15 h 28 min 58			Speed brake full to recover		
15 h 29 min 01	Full speed brake auto pilot off		Full speed brake		
15 h 29 min 03			Yes		
15 h 29 min 05			Aircraft behaviour normal? yes		
15 h 29 min 08			Speed brake retract		
15 h 29 min 10	Okay we go down a bit faster now				
			Okay stowed yes		
15 h 29 min 18			AIDS don't need that so not applicable		
15 h 29 min 29			And… So we the next is below two five zero…		
15 h 29 min 32			When appropriate		
15 h 29 min 33	Yeah				
15 h 29 min 34			Any flight level maybe two zero zero		
15 h 29 min 36	Yeah				
15 h 29 min 37			And we overspeed a little		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 29 min 38	Okay and we do that at two hundred okay?				
15 h 29 min 41			Okay And same thing recover at full speed brake and retract		
15 h 29 min 48			And it should be… must be… recorded figures between three fifty and three sixty		
15 h 29 min 52	Okay				
15 h 29 min 54			So we have to overspeed and hold the overspeed while we record		
15 h 29 min 58	All right so what we do now we come down with a little bit more speed here				
15 h 30 min 10	(*)				
15 h 30 min 11		Ja			
15 h 30 min 17	Perpignan (*)				
15 h 30 min 35				Stardust Triple eight Tango	
15 h 30 min 37		➔ Gohead Stardust Triple eight Tango			
15 h 30 min 39				Yes for the next time sir it'll be better not to do your… your flight in general aviation it's a bit complicated for us	
15 h 30 min 49	➔ Yes we know but we actually we had planned our flight plan like this with your local ATC so sorry for that and there was misunderstanding we'll do differently next time				
15 h 30 min 59				It will be better ok Anyway have a good flight sir contact heu… Marseille One two eight decimal eight five goodbye	
15 h 31 min 07	➔ One two eight eight five bye bye thank you				
15 h 31 min 11		One eight eight five			
	Ya	(*)			
	Ya				
15 h 31 min 22	Maintaining flight level two hundred für drei vier Minuten sag				*maintaining flight level two hundred for three or four minutes tell him*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
	ihm				
15 h 31 min 25		One thousand			
15 h 31 min 25	Yeah checked				
15 h 31 min 27		➔ Marseille bonjour stardust triple eight Tango we are coming down flight level two zero zero			Altitude alert
15 h 31 min 33				Stardust triple eight Tango bonjour nav two for Perpignan approach descent level one five zero	
15 h 31 min 40	We need two hundred for three minutes	➔ We need two hundred for two or three minutes Golf X-ray Lima triple eight Tango			
15 h 31 min 47				Okay confirm you need to be steady level two zero zero for three minutes maximum	
15 h 31 min 53	Yes	➔ Yes well copy Stardust Triple Eight Tango			
15 h 31 min 56				Roger	
15 h 32 min 03	Ne				*No*
15 h 32 min 09			Master warning ECAM over speed adjust throttle to hold at speed then record		
15 h 32 min 15	Okay				
15 h 32 min 23			Airspeed is coming so (*)	Stardust triple eight Tango new code four seven one zero	
15 h 32 min 29		➔ The squawk four seven one zero Stardust triple eight Tango			
15 h 32 min 34	Okay here we go				
15 h 32 min 36					Continuous Repetitive Chime
15 h 32 min 37			Three fifty five three fifty five		
15 h 32 min 42			Okay full speed brake		
15 h 32 min 48			And you can cancel the warning if you wish		End du Continuous Repetitive Chime
15 h 32 min 53	Okay		That's Good fine and back to normal		
15 h 32 min 57		Go down?			
15 h 32 min 58	Yeah				
15 h 32 min 59		➔ Stardust triple eight Tango we request now to descend			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 33 min 04				Stardust triple eight Tango descent level one three zero one three zero the rest of the descent with Perpignan approach one two zero decimal seven five au revoir	
15 h 33 min 14		➔ One two zero decimal seven five we are descending now flight level one three zero Golf X-ray Lima triple eight Tango			
15 h 33 min 21				Bye	
15 h 33 min 22	(*)		Now next		
15 h 33 min 25			okay to talk?		
15 h 33 min 26	Yeah	Yeah			
15 h 33 min 28			Next is alternate law when below three twenty so now is okay FAC one FAC two goes off		
	Yeah				
15 h 33 min 34		➔ Perpignan approach bonjour the Golf X-ray Lima triple eight Tango we are descending flight level one three zero			
	I do that when we go down to one eighty that we can do that in one three zero				
			Do it at any time		
15 h 33 min 41				Golf X-ray Lima triple eight Tango Perpignan approach good morning again descent flight level one two zero initialy routing Papa Papa Golf you're number two for the approach	
15 h 33 min 52		➔ Descending one two zero we are number two for the approach and we're inbound Papa Papa Golf Golf X-ray Lima triple eight Tango			
15 h 33 min 57					Cavalry charge
15 h 33 min 58		Descending one two zero yeah?			
15 h 33 min 59	Yeah descent one two zero				
15 h 34 min 01		Engine of ice?			
15 h 34 min 03	On				
15 h 34 min 04		(Bleed) on of ice			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 34 min 05	Off	Off			
15 h 34 min 07	Five minutes on				
15 h 34 min 08		Five minutes on	Five minutes on		
15 h 34 min 09			Take bleed page off now if you wish		
15 h 34 min 11	Machst du die Bleed Page weg normal Pages				*Switch off the bleed page normal pages*
15 h 34 min 21			Okay	Golf X-ray Lima triple eight Tango expect to hold overhead Papa Papa Golf reduce speed two five zero knots	
15 h 34 min 27	Frag mal nach Radar Vectors				*Ask for radar vectors*
15 h 34 min 30		➔ Golf X-ray Lima triple eight Tango we			
	We'll appreciate a radar vectors !	➔ we'll appreciate a radar vector for the approach			
15 h 34 min 38				Golf X-ray Lima triple eight Tango heu in this case turn left radar vectoring turn left heading zero niner zero and reduce speed two zero zero knots	
15 h 34 min 50	Sehr schön	➔ Reducing speed two zero zero knots and turning left heading zero niner zero Golf X-ray Lima triple eight Tango			*Very nice*
15 h 34 min 55	Heading zero niner zero speed two two zero				
		Yeah			
15 h 34 min 59	So that's very good		Yeah		
15 h 35 min 00					Altitude alert
15 h 35 min 01	Radar vectors				
15 h 35 min 02		Speed pull			
15 h 35 min 04	(*)		Then we have … when ready the APU bleed on		
15 h 35 min 08	Artung				*Take care*
15 h 35 min 10	(*)	Speed full			
15 h 35 min 12	Speed two two zero… heading zero nine zero				
15 h 35 min 19		Speed two two zero?			
	Yeah				
		On heading zero nine zero			
	Affirm				

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 35 min 27	So now just maintain one two zero				
15 h 35 min 32			And suppose so we can do two things may be		
15 h 35 min 35	Yes go ahead				
15 h 35 min 37			Bleeds err … packs on the so APU bleed on		
15 h 35 min 39	Ok go ahead				
15 h 35 min 40			It’s okay we can change that		
15 h 35 min 42		Have you bleed on?			
			Yes and we need the APU page record the TATS SATS and mach number and flight level		
15 h 35 min 48		APU (bleetch) Ok !	TATS isn’t on a screen		
15 h 35 min 56		And the engine bleed… still on			
			Err… Yes still on		
15 h 35 min 58	Still off				
15 h 36 min 03	Ok we maintain flight level one two zero speed we coming down two two zero selected auto thrust auto pilot on				
15 h 36 min 09			Yes		
15 h 36 min 10			We will (open the other one) shortly and		
15 h 36 min 11	yeah		one two zero		
15 h 36 min 14			Okay and now we are going to record the N one		
15 h 36 min 17			It’s hundred percent		
15 h 36 min 19			EGT (*)		
15 h 36 min 20	Engine anti ice is still on here				
15 h 36 min 23			Err… that’s okay that’s okay		
15 h 36 min 27			Pressure not below ten PSI and the pressure is eighteen		
15 h 36 min 34			APU bleed now can go off		
15 h 36 min 36		APU bleed off			
15 h 36 min 37			Yes		
15 h 36 min 38			APU shut down		
15 h 36 min 39		Off			
15 h 36 min 40			Yes APU can go off		
15 h 36 min 41		And APU also can go off			
15 h 36 min 42			Yes		
15 h 36 min 43	Yeah				
		Off			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 36 min 44	Yeah yeah				
15 h 36 min 45	Hem okay…				
15 h 36 min 47	You want alternate law?		Okay	Golf X-ray Lima triple eight Tango reduce speed one eight zero knots	
15 h 36 min 48			Okay alternate law		
15 h 36 min 52		➔ Reducing speed one eight zero knots Golf X-ray Lima triple eight Tango			
15 h 36 min 55	Ja das ist das machen wir noch in clean hier				*Ah this is we do this while in clean configuration*
15 h 36 min 57		Yeah			
15 h 36 min 58	Okay			X-ray Lima triple eight Tango descend flight level eight zero	
			Okay		
15 h 37 min 01	So you just do the switching okay				
			Okay		
15 h 37 min 02		➔ Descending flight level zero eight zero Golf X-ray Lima triple eight Tango			
			Okay are you ready		
	I'm ready				
15 h 37 min 05			Auto pilot comes off		
15 h 37 min 06		Descending zero eight zero			
15 h 37 min 08	Descend flight level zero eight zero go ahead				Cavalry charge
15 h 37 min 11	yeah go ahead				
15 h 37 min 12			So the alternate law is coming		
15 h 37 min 13		zero eight zero set			
15 h 37 min 14			Now		
15 h 37 min 15	Yeah go ahead				
15 h 37 min 16			FAC one		
15 h 37 min 17			And FAC two is coming now		
15 h 37 min 20			You should get ECAM		
15 h 37 min 22	Here we are alternate law				Single Chime
			Cancel master caution		
15 h 37 min 25	Yeah				Single Chime
15 h 37 min 26			FAC one and two associated on the ECAM both is good… yes is good		
15 h 37 min 32			Verify flight controls alternate law we have the crosses		
15 h 37 min 36	That's it		Yeah?		
15 h 37 min 37			And err… all three axis so just a tiny check may be		

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
			they all work here up down rudders work		
15 h 37 min 45			It's good Pitch auto pitch still works here		
15 h 37 min 48	It does				
15 h 37 min 49			And back to normal		
15 h 37 min 50	FACs on		So FACs come back on		
15 h 37 min 52	Yeah				
15 h 37 min 54	Auto pilot comes on and speed brakes out				
15 h 38 min 03			And all good Low speed flight is probably next		
15 h 38 min 09			Err… Low speed is… I'll read through first It will be landing gear down flaps go to full adjust engine power stabilized		
15 h 38 min 15			When the aircraft speed is stable and set power at idle it'll be manual and adjust the pitch to maintain deceleration around one degree per second		
15 h 38 min 26			During deceleration…		
15 h 38 min 27	You you want to go down all the way to VLS and alpha prot right?				
15 h 38 min 30			Yes So when you get to the bottom of VLS you have to pull quite hard to make it goes		
15 h 38 min 34	Yeah I know yeah				
15 h 38 min 36			And then it will go into the alpha floor		
15 h 38 min 38			Then you need to pitch forward and err… you're happy with disconnect and reengage		
15 h 38 min 42			And out of alpha floor		
15 h 38 min 50			That's it we're into landing		
15 h 38 min 52			HF check we can do on the ground ah	Golf X-ray Lima triple eight Tango continue descent flight level six zero	

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 38 min 57			Or on the way to Frankfurt		
15 h 38 min 58	Six zero	➔ Descending flight level zero six zero Golf X-ray Lima triple eight Tango			
15 h 39 min 03	Lets descend flight level six zero	Ice wing anti ice on?			
15 h 39 min 06	Yeah				
15 h 39 min 07	Ja haben wir Ja ein bischen vielleicht				*Ya we got it maybe for a while*
15 h 39 min 08					Interference on the CAM
15 h 39 min 19		APU page (*)			
15 h 39 min 20	Yeah				
15 h 40 min 04				Golf X-ray Lima triple eight Tango turn right heading one niner zero and descent flight level six zero maintain the speed one eight zero knots	
15 h 40 min 16		➔ Ok turning right heading one niner zero maintaining flight level six zero and speed coming down one nine zero knots			
15 h 40 min 21	One eighty				
15 h 40 min 23	One eighty				
15 h 40 min 24	Right heading one nine zero speed one… one… one eighty				
15 h 40 min 27		Now speed one niner zero			
15 h 40 min 30	Heading one niner zero				End of interference
15 h 40 min 37	So all right				
15 h 40 min 49	Let's get down to				
15 h 40 min 51		Eben hat sie gesagt one eight zero			*Now she told one eight zero*
15 h 40 min 53	Genau				*That's right*
15 h 40 min 54		So one thousand			
15 h 40 min 55	Check it				
15 h 40 min 57	Let's get down to flight level six zero first				
15 h 41 min 00				Golf X-ray Lima triple eight Tango resume own navigation direct LANET end of radar vectoring continue descent five thousand feet QNH one zero one eight cleared LANET ILS approach three	
15 h 41 min 01		(*) Fragen?			*(*) Questions?*

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
				three	
15 h 41 min 12		(*) Air France?			
15 h 41 min 17		➔ Did you call the Golf X-ray Lima triple eight Tango			
15 h 41 min 20				Yes Sir err Resume your own navigation direct LANET now descent five thousand feet QNH one zero one eight you are cleared for the LANET ILS approach three three	
15 h 41 min 33		➔ We are cleared direct to LANET point and we descending five thousand feet the QNH is one zero one eight and we are cleared for the ILS runway three three Golf X-ray Lima triple eight Tango			
15 h 41 min 40	I think we will have to do the slow flight probably later				
	Yeah		Okay		
			Yeah		
15 h 41 min 43	Or we do it on the way to Frankfurt or I even skip it		Ya	That's correct Sir end of radar vectoring	
15 h 41 min 48	Sorry				
15 h 41 min 51	Guck mal wo der LANET point ist				*Have a look where the LANET point is*
15 h 41 min 54	Flaps one				
15 h 41 min 56		Speed			
15 h 41 min 57		Checked			
		Flaps one			
15 h 41 min 58	Activate approach phase	The speed brakes are still…			
15 h 42 min 00		Yeah			
15 h 42 min 03		Is activated			
15 h 42 min 06	(*)	Ich geb dir LANET ein ja			*I type in LANET point for you Yeah?*
15 h 42 min 08	Direct bitte				*Direct please*
15 h 42 min 11			QNH was (*) one eight (*)		
15 h 42 min 12	Yeah thanks				
15 h 42 min 14				Golf X-ray Lima triple eight Tango say speed	
15 h 42 min 17	Reducing				
15 h 42 min 19	Flaps two				
15 h 42 min 20		➔ (Still) reducing now the speed Golf X-ray Lima triple eight Tango			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 42 min 22		Speed check flaps two		Say speed triple eight Tango	
15 h 42 min 25		➔ Speed one eight zero knots coming back			
15 h 42 min 29				Roger maintain one eight zero knots and descend now to two thousand feet QNH one zero one eight	
15 h 42 min 34		➔ QNH one zero one eight descending two thousand feet the Golf X-ray Lima triple eight Tango			
15 h 42 min 39		So LANET is direct ja			
	Ja genau				*Yeah that's right*
15 h 42 min 41	(*)	After LANET (*) for the approach es ist also hier dieser Arc ja			*After LANET to be (*) for the approach (*) is (*) it is an arc yeah*
15 h 42 min 45	Okay				
15 h 42 min 46	The approach is not in the err is not in the database	(*)			
15 h 42 min 49		No no no			
15 h 42 min 50	Okay we (*) ourselves in a loop to Charlie Foxtrot				
15 h 42 min 52		Charlie			
15 h 42 min 53	Okay				
15 h 42 min 54		So the altimeters			
15 h 42 min 56	One zero two zero five thousand now				
15 h 42 min 59		Nee QNH is one zero one eight			*No QNH is one zero one eight*
15 h 43 min 01	Sorry one zero one eight				
15 h 43 min 03		QNH one zero one eight and (*) I have now four thousand eight hundred and now			
15 h 43 min 09	Checked one zero one eight				
15 h 43 min 22		Okay kurz zum Briefing ja ich the das vor			okay *Let's go to the* briefing *yeah I read it*
15 h 43 min 25		Du hast drin das ILS runway three three final track is three one nine three two nine			*you got ILS runway three three final track is three one nine three two nine*
15 h 43 min 30	Yeah				
15 h 43 min 31		Und zwar aus Zweitausend foot (*) fuss so (*) gecleart ja			*Well and out off two thousand feet as cleared*
15 h 43 min 35	Okay				

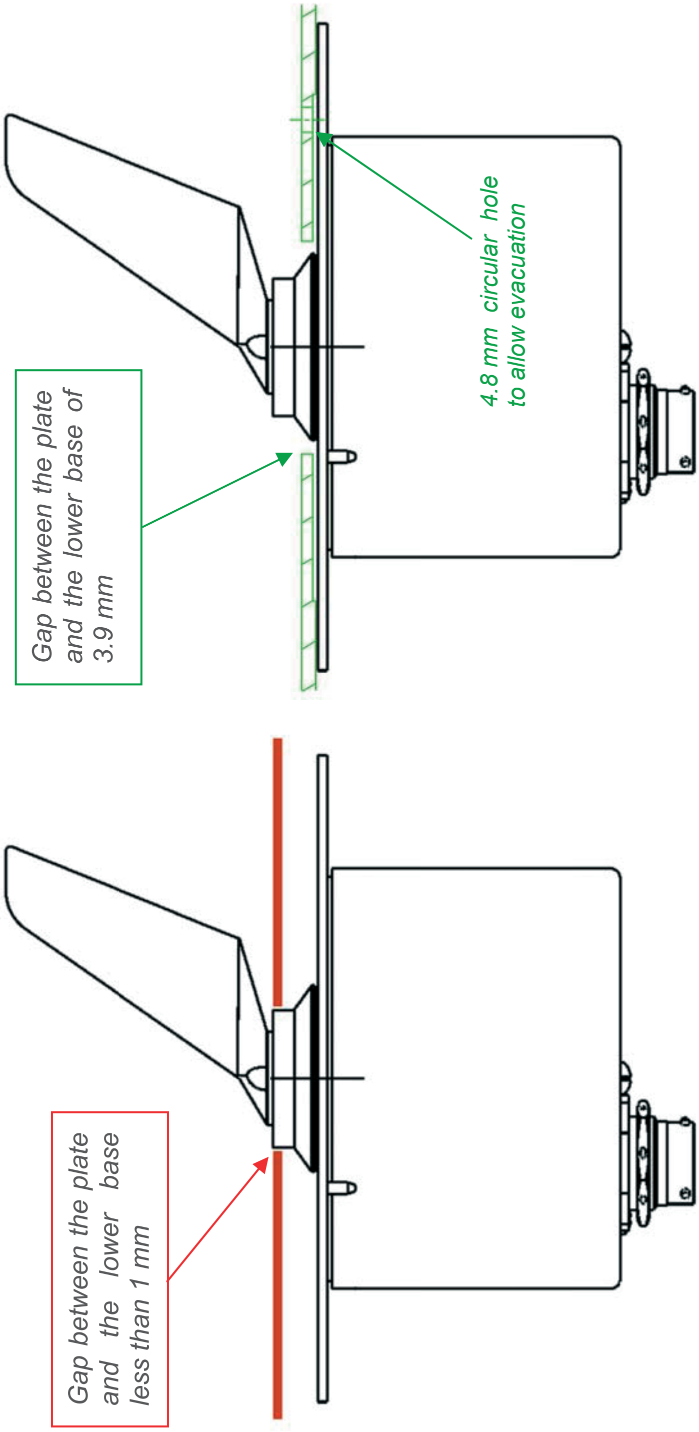
UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
15 h 43 min 37	Down below the clouds so you want what?				Cavalry charge
15 h 43 min 39			To go slower you mean?		
15 h 43 min 41	Yeah	Yeah			
15 h 43 min 43			We need to go slow with err recovery from… recovery		Single chime
15 h 43 min 44	Gear down				
15 h 43 min 45			Yes gear down		
15 h 43 min 45	Gear down				
15 h 43 min 46		Normal			
15 h 43 min 47	Gear down				
15 h 43 min 48	Gear down we do the err the…				
			Low speed yeah		
15 h 43 min 51	Yeah what's the speed			Golf X-ray Lima triple eight Tango confirm it will be a full stop landing?	
15 h 43 min 52			just… to come right back to alpha floor activation		
15 h 43 min 56	Okay we go down				
15 h 43 min 57			get your power at idle adjust the pitch to maintain and Flaps full when ready		
15 h 44 min 03	Okay flaps three				
15 h 44 min 04		Speed checked			
15 h 44 min 05				Golf X-ray Lima triple eight Tango Perpignan	
15 h 44 min 06		Flaps three			
15 h 44 min 08		➔ Go ahead Golf X-ray Lima triple eight Tango			
15 h 44 min 11				Triple eight Tango Confirm it will be a full stop landing	
15 h 44 min 14	Negative it will be a missed it will be a… It will be a go around and then on the way to Frankfurt	Go-around			
15 h 44 min 19		➔ Golf X-ray Lima triple eight Tango we only intend to make an approach with a go around for the go back to Frankfurt			
15 h 44 min 23	Flaps full				
15 h 44 min 24			(maintain three thousand) feet for the spool up may be for the…		
15 h 44 min 26	(*)				
15 h 44 min 29	So maintain three thousand now				
15 h 44 min 31	Okay?				
15 h 44 min 32		Maintaining?			
15 h 44 min 33	Yeah maintain three thousand (*)				
15 h 44 min 34				Golf X-ray Lima triple eight Tango roger I'll call you back	
15 h 44 min 38	Okay	➔ Golf X-ray Lima triple eight Tango and our flight number to			

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
		Frankfurt is Golf X-ray Lima triple eight Papa			
15 h 44 min 46	Okay here we go				
15 h 44 min 49		Und ich sag ihr jetzt dass wir im Moment in Dreitausend bleiben	The weight is fifty four		*And I say now to her that we are maintaining three thousand at the moment*
15 h 44 min 51				Golf X-ray Lima triple eight Tango can you speed reduce speed again	
15 h 44 min 56	We are reducing				
15 h 44 min 57					Triple click
15 h 44 min 58		➔ We are still reducing the speed Golf X-ray Lima triple eight Tango	(*)		
15 h 45 min 03			(*) I will say when the trim stops		The word "stops" is stronger than the rest of the phrase
15 h 45 min 05					SV: Stall (x13) Cricket (stall warning)
15 h 45 min 06			Stop !		Noise similar to thrust levers being moved forward to the stop
15 h 45 min 13	(oh oh oh)				
15 h 45 min 18	(…)				
15 h 45 min 19					End of stall warning
15 h 45 min 20					Single chime
15 h 45 min 24		Ich nehm die Speed noch mal hoch ja?			*(I increase speed*) Yeah?
15 h 45 min 26	Ja it's pitching up all the time				
15 h 45 min 27	(…)		Stick forward (*)		
15 h 45 min 29	Pitching up				
15 h 45 min 30			(*) alpha floor we're in manual		
15 h 45 min 31	It's				Single chime
15 h 45 min 33	It's pitching up this (…)				
15 h 45 min 34		Kriegst du das geregelt?			*Are you able to handle this?*
15 h 45 min 35	Nee				*No*
15 h 45 min 36		Gear up			SV: Stall (12 times)
15 h 45 min 37		Gear up			Cricket (stall warning)
15 h 45 min 39	Gear up	Gear up			
15 h 45 min 40	(*)				
15 h 45 min 42	(…)				
15 h 45 min 44	(…)				
15 h 45 min 45				Golf X-ray Lima triple eight Tango contact tower one one eight decimal three bye	
15 h 45 min 47					End of stall warning
15 h 45 min 48					Single chime
15 h 45 min 51	(…)				
15 h 45 min 52					SV: Stall (9 fois)

UTC time	Captain	Co-pilot	Others	ATC	Noises, Observations
					Cricket (stall warning)
15 h 45 min 54			What's wrong here		
15 h 45 min 55	Flaps up				
15 h 45 min 57			(*)		
15 h 45 min 58	Flaps up				
15 h 46 min 00					End of stall warning
15 h 46 min 00,5					Continuous repetitive chime
			(*)		
15 h 46 min 02			Speedbrakes		
15 h 46 min 02,5					End of CRC
15 h 46 min 03					C chord (Altitude alert)
					SV: (*) terrain terrain
15 h 46 min 04					
15 h 46 min 05	(…)	(…)			
15 h 46 min 06					
15 h 46 min 07	End of recording				

Appendix 5

Differences between the attachment plates used during the impermeability tests and in operation

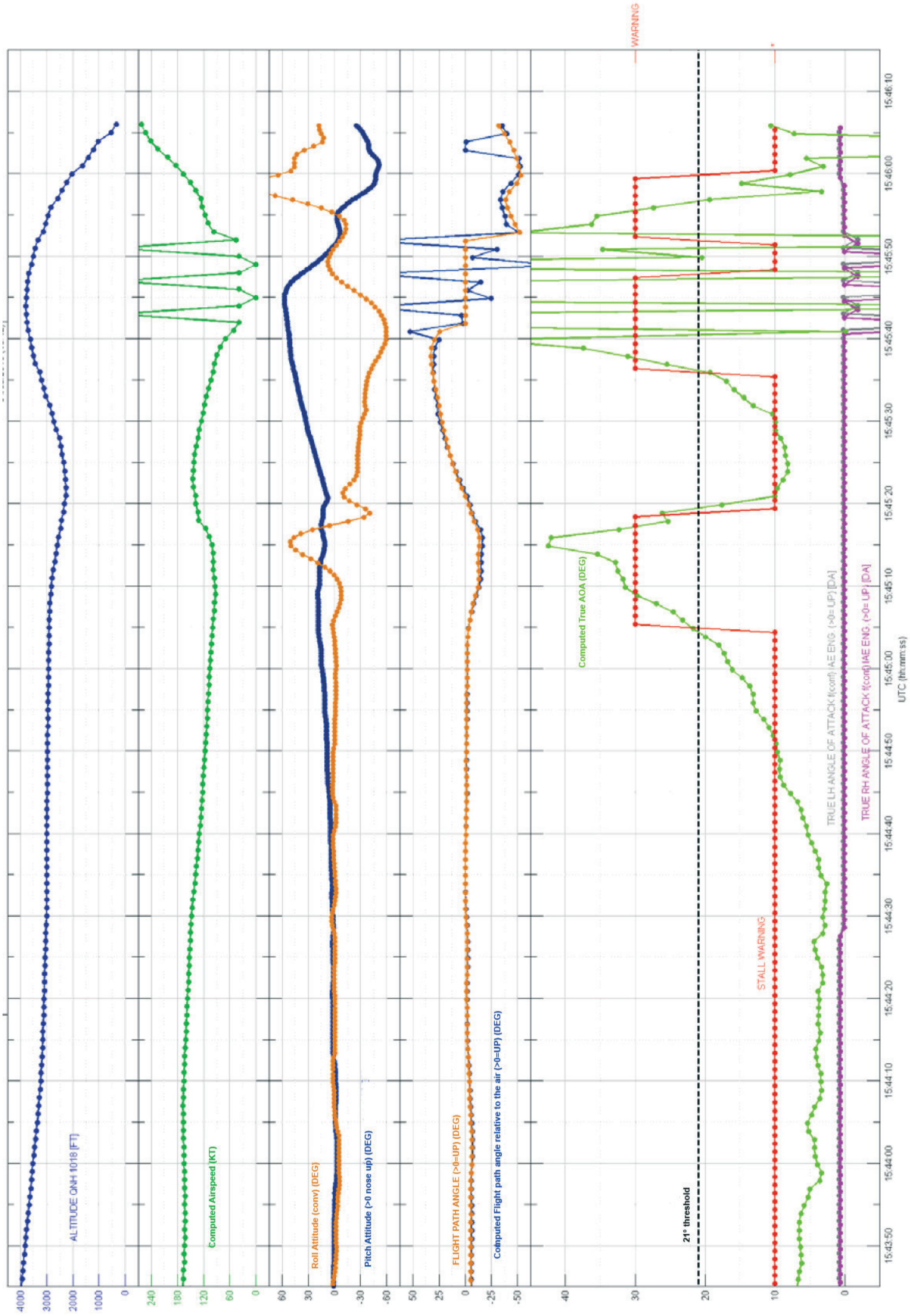


Attachment plate installed on airplane during operations

Attachment plate used during impermeability tests

Appendix 6

Angle of attack values



Appendix 7

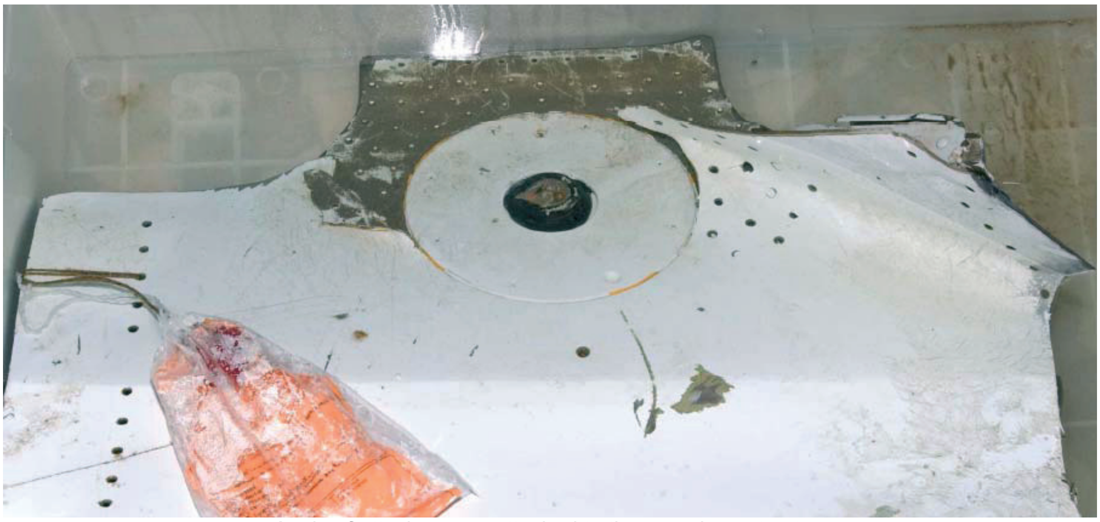
Report on examinations of angle of attack sensors 1 and 2

N.B.: in the following examination, the term "upper" describes the vane side and the term "lower" refers to the 32-pin connector side.

1- Examination of angle of attack sensor 1

General Examination

Angle of attack sensor 1 remained attached to the structure of the aeroplane by its attachment plate, painted white, which covered the face of the sensor. The vane was cut off at its base on impact with the water. It was blocked in rotation, stuck at an angle of about 30 degrees (pitch up) in the longitudinal axis of the aeroplane. The two electrical cables from the de-icing and anti-icing heating element were cut off in line with the break in the vane.



Angle of attack sensor attached to the aeroplane structure

Removal of the attachment plate revealed an accumulation of mud in the free space between this plate and the face of the sensor. Traces of yellow finishing paint under the outer layer of white paint are visible locally on the attachment plate and on the circular surround that this plate was attached to.

Top of the sensor after removal of the attachment plate (presence of yellow paint)

Position of the sensor on the joint in the aeroplane structure (presence of yellow paint)

The forward side of the sensor casing was buckled, following the shape of the components inside. The base of the 32-pin connector was slighty crushed with not opening towards the inside.

General view of the sensor (presence of white paint)

Local damage to the casing

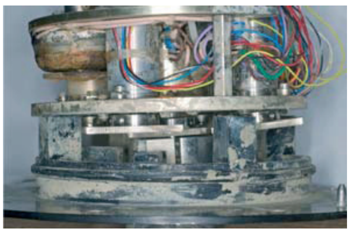
A deposit of white paint covered the upper side of the housing, forming a ring about 5 mm wide, centred around the base of the vane that broke off and spreading locally over onto the lower base. The inner diameter of this circular deposit corresponded to that of the base of the vane. Its thickness varied between 0.10 and 0.15 mm and remained lower than the gap between the mobile and fixed parts of the angle of attack sensor (about 0.65 mm).

Observations at disassembly

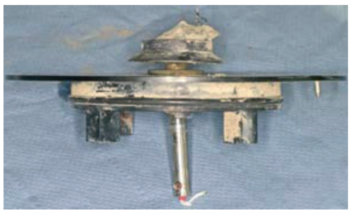
The distorted housing had to be cut in order to expose its internal components. The seal between the upper plate and the edge of the housing was intact. A large amount of light mud had accumulated in the area near the resolvers. With the exception of small particles mixed in with the mud and identified under the microscope as being marine debris, no particles or significant foreign bodies were found in the body of the angle of attack sensor.

The deformation of the casing had misaligned the separators and this had been transmitted to many parts. The four synchro and damper pinions were no longer in line with the central pinion. Examination of the pinions did not reveal any damage on their teeth. On impact, the vane shaft was bent in the region of the vane base by the forces that had caused it to break.

Inside of the sensor covered in mud



Solenoid and two resolvers with pinions out of line



Bent vane shaft, still in place in the upper bearing on the top of the sensor

The upper compartment of the sensor was full of mud that practically filled the labyrinth space. Two particles were extracted from this accumulated deposit:

- A chip of polyurethane paint with several layers (yellow, grey and white) located about 2 mm située the base of the vane;
- A grey shell fragment (calcium carbonate).

Near the lower bearing, a chip of paint was stuck on the wall, away from the ball bearing.

The two ball race bearings on the lower and upper bearings were clean. The rotation of the bearings remained imperfect after ultra-sound cleaning. The examination of bearing components, after cutting the outer ring showed that their tracks were marked by brinelling. These ball marks were left at impact and resulted from buckling of the plate axle.

N.B. : the two bearings consist of self-lubricated ball bearings whose rolling parts are insulated by flexible flanges.

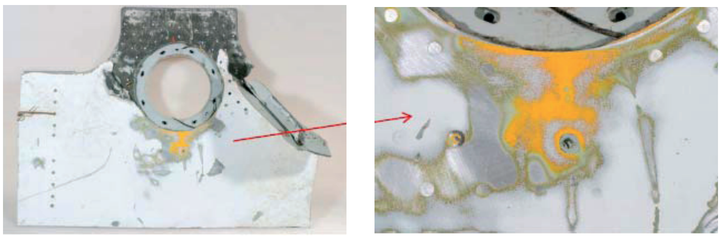
Outer rings of the upper bearing (left) and lower bearing (right) with slight brinelling at impact on the two tracks

Yellow paint under the external white paint

Yellow paint was visible under the white paint on one section of fuselage around the attachment plate and in the paint covering the joint seal between this plate and the fuselage. The flakes of paint observed coming from cruciform screw heads or from shards released during the accident, revealed the juxtaposition of several layers, the whites covering the yellows.

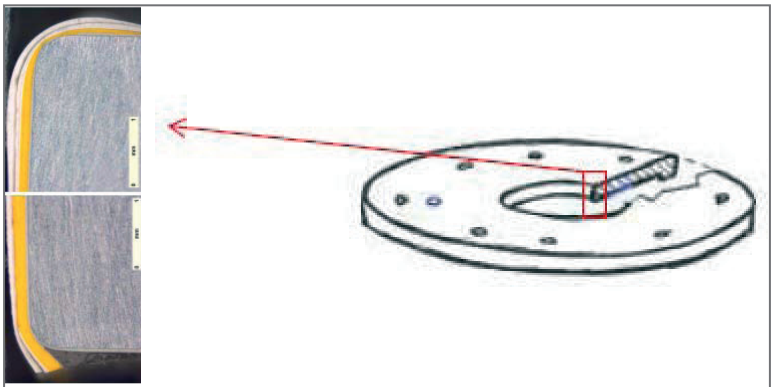
Yellow paint was also present, in a very fine layer, under the white paint around the circular base of the vane.

Top of the sensor after removal of the vane shaft



Locally abraded sensor environment

The radial micrographic section performed on the circular attachment plate, ending at its central hole, revealed the presence of yellow paint in two layers, covered with white paint. This yellow paint was not part of the range of paints applied by EAS Industries.



Circular attachment plate covering the top of the sensor with paint under the white finishing paint

This yellow paint came from the previous livery of the aeroplane when it was in the colours of Freedom Air Limited (see photo paragraph 1.6.3).

2 - Examination of the angle of attack sensor 2

General Examination

Angle of attack sensor 2 was completely ripped out of its place on the aeroplane. The sensor vane was sheared off at its base. Rotation of the whole was blocked.

The upper face of the body was cut off over 360 degrees along the cylindrical profile of the housing. This circular shearing was the result of blunt force under the effect of the pressure generated on impact. The casing was distorted from the rear to the front. The cut on the upper face and the distortion of the body created a large opening over a 90 degree sector, thus exposing the inner sensor components to the outside. The base of the 32-pin electrical connector was crushed into the housing.

A deposit of white paint covered the upper face of the body, making a ring of about 5 mm wide, around the base of the broken vane and locally going over onto the bottom of the base.

The water escaping from the housing was filtered. No significant items, except fine sand were recovered from this water.

General view of the sensor

Observations on disassembly

The housing distorted by the impact was compeletely cut off during the examination to expose the components.

The seal ring, between the upper plate and the edge of the housing, had been sheared off by a straight cut by the housing metal on impact. It showed no signs of damage prior to the impact.

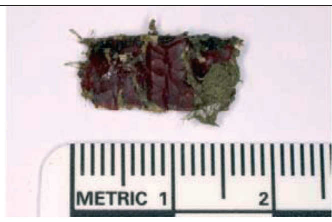
Several fragments of composite were stuck inside the housing. They were forced inside during the accident by the edge of the metal:

- two fragments of composite (glass fibre and phenolic resin) painted white were stuck under the upper edge of the housing distorted by impact. The white paint was different from the aeroplane's finishing paint;

Particles of white composite, recto and verso

- a fragment of composite (made of kevlar – aramide fibres – and of phenolic resin), dark red in colour and stuck to a fragment of plastic film (terephtalate type plastic) was stuck on the upper part of the housing, near the O seal.

Particle of « red » composite stuck under to top of the housing that was sheared off on impact



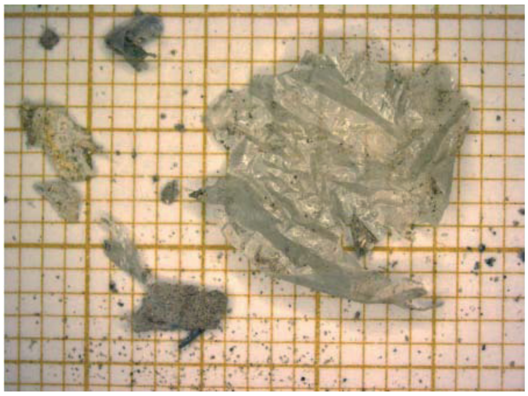
Particle of red composite

Sand and mud had entered the housing via the opening created impact. The general condition of the components inside the housing was well preserved and showed no signs of significant corrosion, apart from steel parts and screws that were parly corroded.

The general distortion of the equipment had misaligned the various walls and their spacers. The end of one of these spacers was separated from the wall. The four driven pinions, attached to the resolvers and the damper, were no longer exactly in line with the central pinion linked to the vane shaft. The examination of various pinions did not reveal any damage to their teeth despite their forced displacement during the accident.

After separation of the vane and its shaft from the sensor, it seems that the ring deposit of white paint on the top of the sensor was limited to the area of the conical base of the vane. The thickness of this ring deposit varied between 0.08 and 0.15 mm. During separation of the vane and its shaft from the sensor, a thin transluscent film was found in the sensor recess under the base of the vane.

Flexible film in the sensor recess, under the base of the vane



View of the film

This film was about 10 mm square and around 0.01 mm thick. It was flexible and light, slightly crumpled, with a few clear parallel folds. Other smaller particles of the same type were recovered from the same zone. All of these particles were of polyester (terephtalate type).

The lower bearing turned with difficulty. The upper bearing's rotation was blocked. The two bearings were extracted by pulling without difficulty. The ball bearings on each of them had no identifying marks and their rotation was blocked. The removal of the lateral flanges showed that the rolling bodies of the two bearings were stuck with mud.

The lower bearing, cleaned with ultra-sound, could be rotated almost normally. Inside the upper bearing, a transluscent film similar to that found under the base and also made of polyester, was located between the lower flange and the ball race, in the middle of the mud. After cleaning, the upper bearing turned freely with slight friction points.

Upper bearing after removal of flanges, with 2 mm transluscent particle

The components of the two bearings showed no significant damage, traces of seizing or of corrosion pitting. The inner and outer rings of the upper bearing bore some ball marks, just on the edge of the track. This brinelling, outside of the bearing strip, were due to the bending of the upper part the shaft, under the effect of the impact that caused the shearing of the vane.

3 - Circuits and electrical functions of angle of attack sensors 1 and 2

The impact (and the distortion of the angle of attack sensor 2 housing) cut off several electrical cables at the attachment point. This cutting and the contamination of moving parts by the mud made it impossible to test the circuits and the electrical function of the two angle of attack sensors. Electrical tests on the resolvers, both removed from their mountings, showed that they were still capable of delivering power with induced voltage that varied according to the rotation of the shaft copying the movement of the vane. Equally, the tests on the cables brought to light no discontinuity.

Appendix 8
Protocol for the Goodrich tests

5 - PRE-COMBINED ENVIRONMENTAL TESTING

5.1 - Test Description and Requirements

The purpose of the PRE-CET tests is to determine the operational status of the sensor during bench level ATP functional testing and the vane static friction levels during a low temperature cold soak.

5.2 - Test Procedure

1- Conduct a full ATP on all test units and record results on the ATP data sheets located in document D9520709.
2- Place all tests units in a temperature chamber.
3- Attach a monitoring thermocouple on the housing near the connector of each test unit to minimize any influence from the vane heater.
4- Attach a second monitoring thermocouple on the external surface of the faceplate of each test unit to measure the influence from the vane heater.
5- Verify vane heater power off of each test unit and decrease the chamber temperature to -20°C at a transition rate of 3ºC/minute.
6- Allow the units to cold soak for 15 min for the first step (then 10 min for each step).
7- With the units stabilized at -20°C, open the chamber door and without removing the units from the chamber conduct a vane static friction measurement.
8- If necessary, repeat step 5 to 7 for different T°(-30°C and -54°C)
13- Increase the chamber temperature back to room ambient conditions
14- With the test units stabilized at +21ºC, with the units in the chamber. Within 2 minutes conduct a vane static friction measurement.
15- Record the static friction levels on the data sheet
16- If required conduct an internal visual examination of the in-service unit to determine its general condition.
17- Complete a full teardown of the in service unit if necessary.
18- Perform and provide a separate failure analysis report for the in service unit.

6 - COMBINED ENVIRONMENTAL TEST

6.1 - Test Description and Requirements

The purpose of the CET tests is to determine if the operational status of the sensor will be compromised at extreme low temperature and atmospheric pressure following an aircraft washing event where the fluid spray is directed at the sensors most vulnerable axis (exposed vane axis of rotation).

6.2 - Test Set-Up

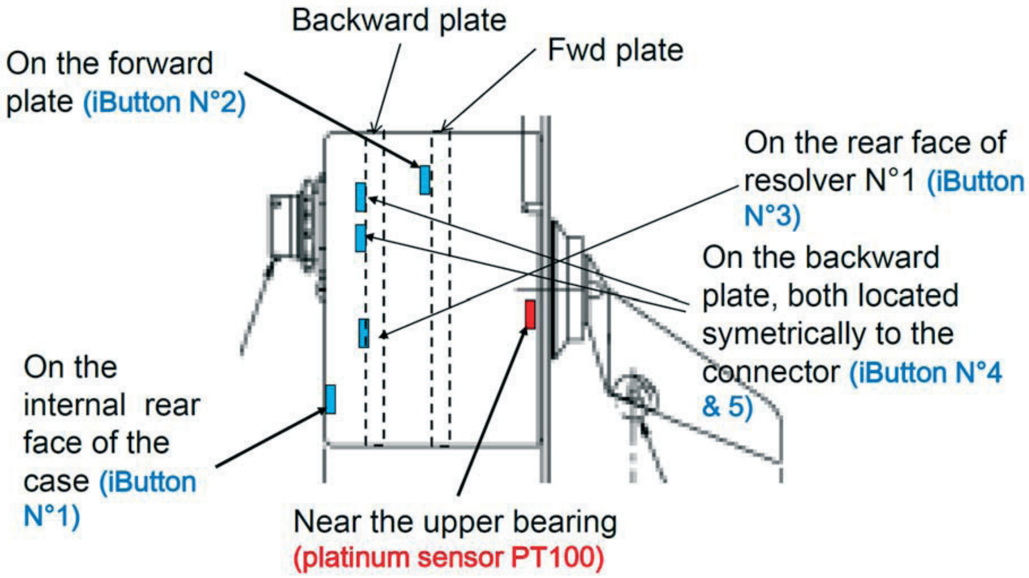
The production test unit shall be installed onto a simulated aircraft fuselage in its normal operating position as shown in Figure 4-1. No covers or other materials shall be used to mask the AOA surfaces that are expose and normally external to the aircraft.

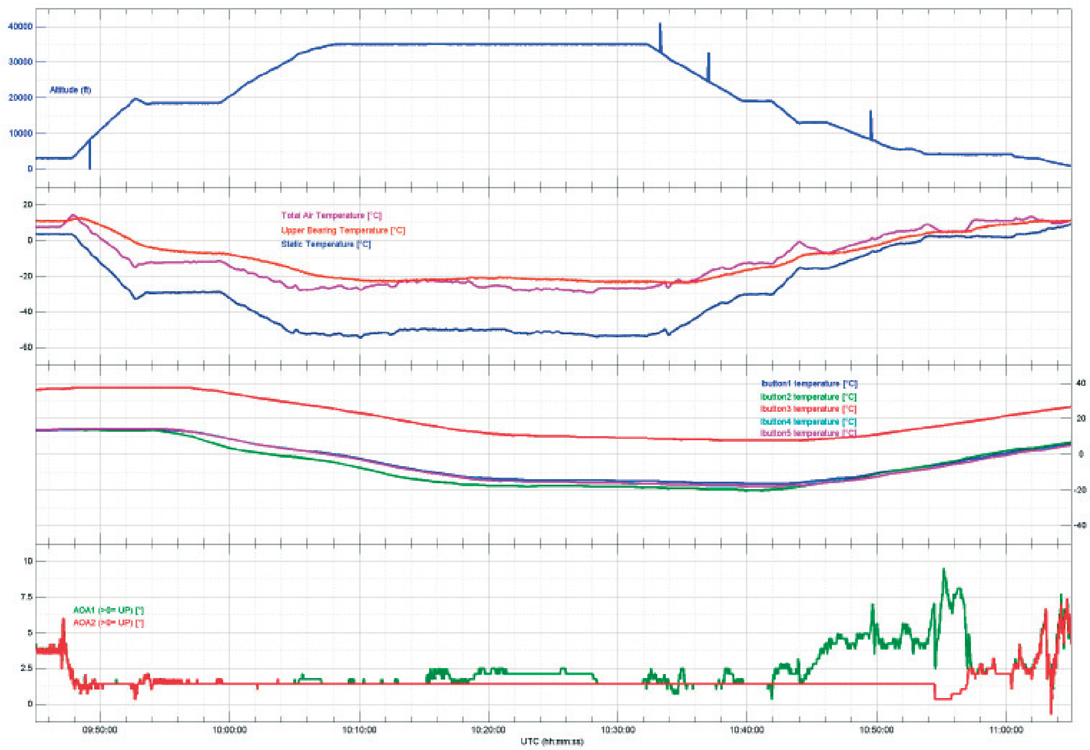
If needed, materials maybe used to cover the AOA housing that is internal to the aircraft fuselage.

6.3 - Test Procedure (Washing – Water Only)

1. Install the production test unit onto the simulated aircraft fuselage per the test set-up.
2. Prepare the water stream for a DO160 category R shower head nozzle minimum pressure of 40 PSI (approximately 2.7 bars).
3. With the test unit not operating, subject the exposed areas of the AOA to a continuous stream of water from a distance of 0.3meters and direct the flow from multiple directions (within a cone of +/- 45°) into the vane.
4. Direct the water stream at the vane axis of rotation (exposed vane and slinger area) for a total water exposure period of 5 minutes.
5. Immediately following the simulated washing event, without attitude disturbance, place the test unit in a temperature/altitude chamber.
6. Attach a monitoring thermocouple to on the housing near the connector and on the faceplate of the test unit
7. Verify vane heater power off and decrease the chamber temperature to -54ºC at a transition rate of 3ºC/minute. Decrease simultaneously the chamber pressure to 7.04 in Hg (35,000 ft) at an approximate rate of 1,500 ft/min.
8. When chamber temperature is stabilized, increase chamber pressure at the rate of 3000 ft/min until ambient pressure conditions, open the chamber door and without removing the production test unit from the chamber conduct a vane static friction measurement.
9. If the vane is found to be jammed, go to step 12
10. If the vane is not jammed, continue testing by increasing the chamber temperature to room ambient conditions.
11. With the test unit stabilized at room ambient conditions, remove the test unit form the chamber and within 2 minutes conduct a vane static friction measurement.
12. Heater power on until faceplate and cover thermocouple stabilized and conduct a vane static friction measurement and resolver continuity.
13. Increase chamber temperature to -20°C
14. With the test unit still stabilized at room ambient pressure, conduct a vane static friction measurement.
15. Repeat step 12 for -10°C, -2°C, +2°C
16. When chamber temperature is stabilized at +2°C turn vane heater power off (to prevent hypothetic vaporization of contained water due to heater conduction) and conduct a vane static friction measurement.
17. Decrease temperature chamber to -5°C to maintain negative temperature condition (conserve ice if any)
18. Disconnect test cable and record the static friction levels on the data sheet.
19. Remove the test unit from the simulated fuselage and remove the AOA housing
20. Visually examine and record on the data sheets the static friction levels, the condition of the internal surfaces and if water intrusion is present;
21. Perform a complete teardown of the test unit if necessary.

Appendix 9
Parameters of the second test flight





Appendix 10

Functioning of systems during flight

Estimation of weight calculated by the FAC

Calculation of the weight by the FAC was simulated from the recorded parameter values. This weight was compared to the weight recorded by the FDR (which came from the FMS). The weight calculated by the FAC was underestimated at the end of the flight because of the blocked values of angle of attack sensors 1 and 2. The estimated difference between these two weights reached seven tons at about 15 h 41.

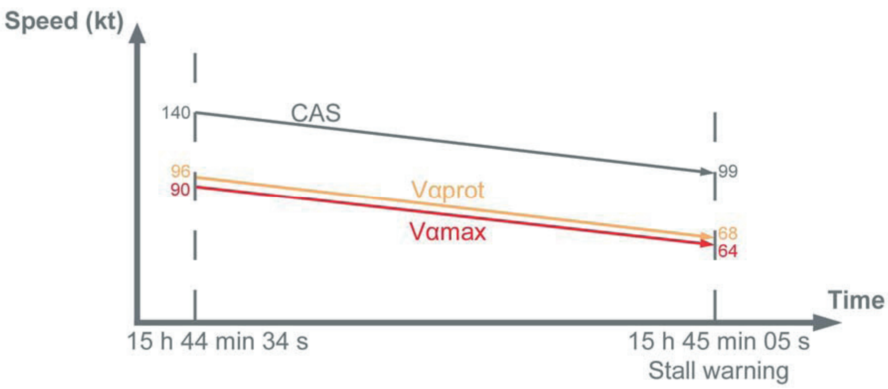
Rejection of ADR 3 by the FAC and the ELAC

The stall warning was triggered at 15 h 45 min 05 s when the calculated angle of attack was between 21.7 and 23.2 degrees, very close to the theoretical angle of attack for the warning in FULL configuration. This indicates that the corrected angle of attack values supplied by ADR 3 were valid at that moment. Taking into account the corrected angle of attack values supplied by ADR 1 and 2, ADR 3 was necessarily rejected by the FAC and the ELAC (see 1.6.9 Surveillance of angle of attack values) at that moment at the latest.

Shortly after 15 h 37, the crew undertook the check of the aeroplane's behaviour in alternate law. They then shut down the two FAC's and the Captain made some inputs on the sidestick. In case of normal performance by angle of attack sensor 3, the comparison between the corrected angle of attack values 1 and 2 and the value of the calculated angle of attack shows that ADR 3 could have been rejected by surveillance of the angle of attack in the ELAC during these manoeuvres, at 15 h 37 min 50 s. The two FAC's were reconnected at 15 h 37 min 52 s, when the difference had dropped below the rejection threshold. ADR 3 could have been rejected by the FAC's a few seconds later, at 15 h 38 min 00 s, when the spoilers extended in descent.

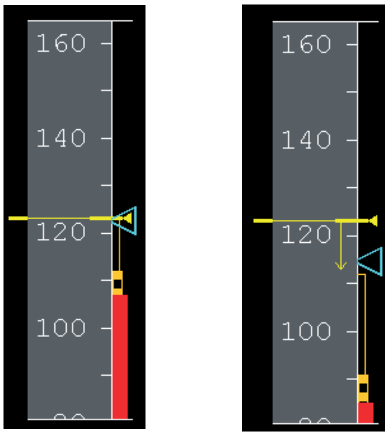
Calculation of limit speeds

The limit speeds presented to the crew during the accident flight were recalculated on the basis of the recorded parameters. By way of comparison, the limit speeds in the case where the angle of attack values were not blocked were also recalculated (normal operation). These calculations made it possible to reconstitute the speed tapes in normal operation and for the event flight.



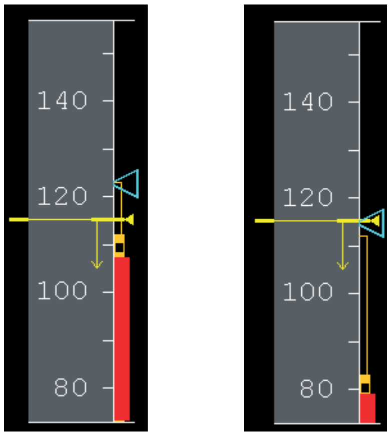
Evolutions of limit speeds on the accident flight (for information)

Normal function | Accident flight



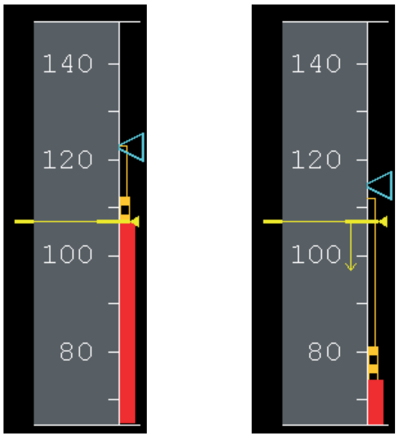
15 h 44 min 44 s
CAS = 123 kt
(corresponding to VLS)

Normal function | Accident flight



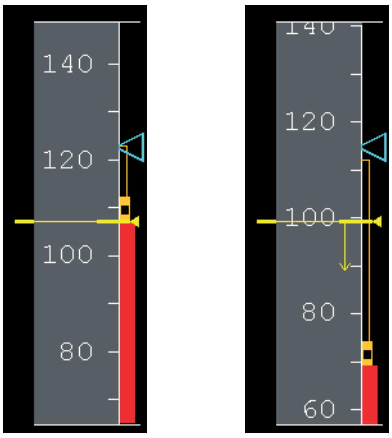
15 h 44 min 51 s
CAS = 115 kt

Normal function | Accident flight



15 h 44 min 58 s
CAS = 107 kt
(corresponding to V alpha max)

Normal function | Accident flight



CAS = 107 kt[1]

15 h 45 min 05 s
CAS = 99 kt

[1] With normal functioning of the high angle of attack protection, the speed cannot go below Vαmax

Limitations and loss of FAC functions

Between 15 h 45 min 09 s and 15 h 45 min 11 s (see 1.11 Flight Recorders):

- The rudder travel limiter (RTL) function became unavailable,
- The yaw damper function's authority was limited to plus or minus five degrees,
- The limit speeds were no longer calculated (they were thus no longer displayed on the speed tapes and a red SPD appeared on the PFD).

Due to the functioning of the slats and flaps and the triggering of the unusual attitudes law in the following part of the flight, the non-availability of the limit speed calculation function and of the RTL function as well as the limitation in the yaw damper authority function could only be due to rejection of the ADR by the FAC's.

N.B.: The only other possible reason to explain the unavailability of the RTL function could be the malfunction of an internal control loop in each FAC. These malfunctions would have to be simultaneous, which makes this hypothesis highly improbable.

ADR 3 was rejected by the FAC between 15 h 38 min 00 s and 15 h 45 min 05 s (see “Rejection of ADR 3 by the FAC and the ELAC“). The rejection of the two remaining ADR’s was the consequence of a difference of 10 kt between the CAS’s calculated by ADR’s 1 and 2.

Reconfiguration of flight control laws

At 15 h 45 min 15 s, the flight control laws in pitch and roll passed from normal to direct. The availability of radio-altimeters and of the yaw damper function shows that it was an alternate law with landing gear extended (see 1.6.6).

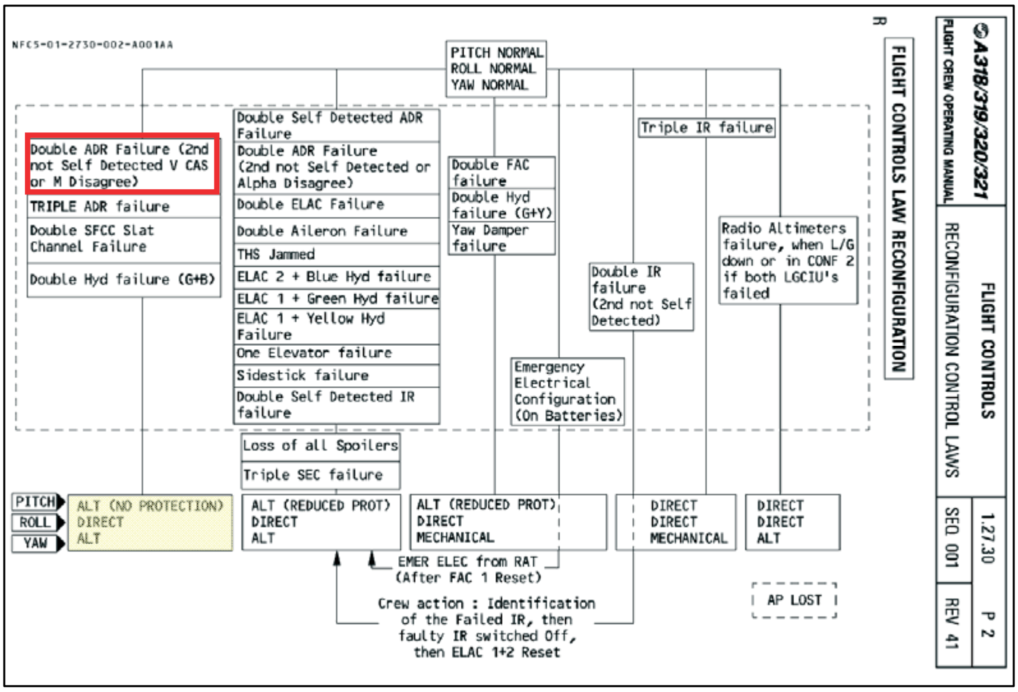
All of the causes of the reconfiguration of laws shown in the cause tree reproduced below can be eliminated, except one: Double ADR Failure (2nd not self detected V CAS or M disagree).

This indicates that:

- ❒ One of the three ADR’s was rejected by the ELAC,
- ❒ The two remaining ADR’s were then rejected due to an inconsistency in the speed or in the Mach.

This case is thus equivalent to the rejection of the three ADR’s by the ELAC, which can be explained by:

- ❒ The rejection of ADR 3 by the ELAC through surveillance of the angle of attack parameter between 15 h 37 min 50 s and 15 h 45 min 05 s (see “Rejection of ADR 3 by the FAC and the ELAC“),
- ❒ The rejection of the two remaining ADR’s through a difference of more than 16 kt or a difference in Mach of more than 0.05 (which, in the conditions in which the aeroplane was flying, represented more than 16 kt).



At 15 h 45 min 40 s, the pitch flight control law passed from direct to alternate. The recorded pitch angle was then above 50 degrees, which indicates a change to unusual attitudes law (phase 1). The load factor then not being between 0.9 and 1.2 g over a sufficiently long period, phase 2 of this law was not subsequently triggered.

Surveillance of the speeds

The CAS is calculated from the static and total pressure measurements.

Beyond about 25 degrees angle of attack (beyond the stall angle of attack), the relation between the measured total pressure and the true total pressure begins to drop rapidly. Sideslip can also cause a difference in measured total pressure between the Pitot probes, particularly from one side of the fuselage to the other.

N.B.: As an example, if the aeroplane is in positive sideslip (wind coming from the right), the total pressure on Pitot probe 1 (left) is greatly under-estimated (very high local angle of attack), the associated CAS measurement is then greatly under-estimated. The total pressure on Pitot 2 (right) is for its part much less under-estimated, as is the corresponding CAS. There may thus be, between the left and right sides, differences in measured total pressure and thus in speed at very high angles of attack and in the presence of sideslip.

At 15 h 45 min 11 s, the 10 kt CAS gap between ADR 1 and 2 detected by the FAC had an effect while the aeroplane angle of attack was greater than 30 degrees. At 15 h 45 min 15 s, the CAS gap between these same ADR's detected by the ELAC was 16 kt. The angle of attack was then still very high and the aeroplane roll movements suggest that there was sideslip.

The high angle of attack and sideslip values certainly caused a situation in which the measurements of total pressure between Pitot probes 1 and 2 were disturbed, generating CAS gaps between ADR 1 and 2 that were sufficient to lead to their rejection by the FAC's, then by the ELAC.

Position of the elevator in the last seconds

From 15 h 46 min 00 s and until the end of the flight, the position of the Captain's sidestick was at the pitch-up stop with a median transitional position of one second at 15 h 46 min 02 s. At the same time, the elevator position remained in a nose-down position.

Two factors can explain this phenomenon while the law in the longitudinal axis is a load factor law (the sidestick at the stop commands a normal load factor of 2 g):

- A rapid increase in the pitch is offset by the flight control law,
- A load factor higher than the value commanded leads to a nose-down movement of the elevator.

Appendix 11
Undersea searches

1- Detection and localisation of recorders

N.B.: Each flight recorder is equipped with a ULB[1] transmitter designed to broadcast a signal for a theoretical period of at least thirty days when immersed. The use of a hydrophone allows the signal broadcast by the transmitter to be detected and thus to define the search area.

[1]Damage to the recorders at the time of impact can lead to the separation of the transmitter.

The means used for the detection, localisation and recovery of the flight recorders were:

- A minesweeper from the French Navy used as a support vessel. This ship had two light inflatable boats that made it possible to deploy the directional hydrophones;
- Omnidirectional and directional detection equipment from CEPHISMER (French Navy);
- The BEA's directional detection equipment, used on the surface or by divers down to sixty metres;
- Support ships and teams of divers from the Gendarmerie.

The localisation operations took place from 28 to 30 November 2008.

On 29 November, the CVR (chassis and protected unit, without the ULB transmitter) and the chassis of the DFDR were found and brought to the surface.

The next day, the DFDR protected unit with its ULB transmitter was recovered.

2 - Distribution of wreckage

The wreckage zone was east of the town of Canet en Roussillon, five nautical miles from the coast. The centre line of the zone was aligned north-south and the zone measured about 650 metres long by 400 metres wide. The seabed was flat, with clay and sand, covered with a layer of volatile mud about twenty centimetres thick. The depth was between 38 and 40 metres. The visibility was poor, less than 2 metres. The current on the bottom was often weak.

The initial definition of the zone was made by a French Navy ship (minesweeper) using a sonar that made it possible to identify the most notable echoes and to mark them with buoys. In total, thirty-seven buoys were positioned in the zone.

3 - Cartography of the wreckage zone

A systematic squared cartography and wreckage identification on the seabed in the search area, with the aim of raising the wreckage, was proposed as the working model. This method was based on the use of an ROV and a surface support ship. The latter would make it possible to determine the absolute position of the ROV in relation to the seabed. The transfer of the video from the ROV to the surface would make it possible to identify wreckage in real time and establish its position on the chart. This solution, which was difficult to implement considering the meteorological and visibility conditions, was not used by the judicial authorities.

The gendarmerie divers located the debris and proceeded to document it with photographs, using as reference points the buoys positioned via the most significant sonar returns and by recording the position of debris located on the edges through a magnetic and distance measurement methodology. A radius of 5 to 15 metres was defined in relation to the density of the debris present in each zone. The largest debris was marked with the aid of plastic markers. About 150 dives of 20 minutes duration on the seabed were required to carry out this task. This work lasted several weeks. During this time, a storm struck the region, causing very extreme tidal conditions. Some debris was moved a few metres on the seabed, which made it impossible to use the site cartography reliably.

4 - Identification of the debris

Taking into account the photos and the absence of depth of field (low visibility), the divers had to focus on identifying any reference or inscription (PN, SN, trademark, etc.) to facilitate identification of the debris. This was only possible when the references were clear and the parts were unique or present in small numbers on the aeroplane.

The photographs were also geo-referenced and this made it possible to define the positions of the main parts of the aeroplane on the seabed: cockpit zone, engine zone, forward fuselage zone, landing gear zone, partial wing zone.

5 - Recovery of part of the wreckage

Based on the flight recorder data, priority was given to searching for the three angle of attack sensors, the CFDIU, the FCDC and the FAC. Their position in the forward part of the aeroplane in relation to identified debris zones made it possible to define a reduced search zone (A, B, C, D of 40 x 40 m) from which the systematic raising of the debris was undertaken.

It was also decided to recover the engines as well as elements that were identified as allowing confirmation of the aeroplane's configuration at the moment of impact.

The small debris was recovered in four one-cubic-metre boxes. The larger pieces of wreckage were attached and brought to the surface with the aid of a lifting system on board the support ship. They were transported to port where they were taken out of the water, rinsed and treated before being stored in a hangar that housed the rest of the wreckage.

Appendix 12

Broadcast of the accident message

CORRESPONDENT	Start Time
BROADCAST by the approach controller :	
Runway duty office	15 h 47
CODIS(1)	By SAMU call
SSLIA	15 h 48
ATC	15 h 49
CRNA	CRNA sud-est 15 h 55
BROADCAST by the runway duty officials :	
Perpignan BGTA POLICE	15 h 57 16 h 03
Chamber of Commerce and Industry BTIV / SAR	16 h 19
SLBA	16 h 17
BEA ACCIDENT MESSAGE	

(1) The departmental fire and rescue centre (CODIS) is the organisation responsible for coordinating the operational activity of the fire and rescue services in the department.

Appendix 13

Airbus cleaning procedure

A320

AIRCRAFT MAINTENANCE MANUAL

EXTERNAL CLEANING - SERVICING

TASK 12-21-11-615-002

External Cleaning

WARNING : THERE IS A POSSIBLE HEALTH RISK TO PERSONNEL WHO DO MAINTENANCE TASKS AFTER A BIRD STRIKE. THE SAFETY MEASURES THAT FOLLOW ARE RECOMMENDED:
- USE DISPOSABLE GLOVES.
- USE A DISPOSABLE COVERALL IF THERE IS A RISK OF BODY CONTACT WITH THE BIRD REMAINS.
- DO NOT USE PRESSURIZED AIR OR WATER TO CLEAN THE PARTS WHICH WERE IN CONTACT WITH THE BIRD.
- REMOVE THE BIRD REMAINS AND PUT THEM IN A PLASTIC BAG.
- DO NOT TOUCH YOUR FACE, EYES, NOSE, ETC. WITH YOUR GLOVES.
- REMOVE THE GLOVES AND THE DISPOSABLE COVERALL AND PUT THEM IN THE SAME PLASTIC BAG AS THE REMAINS. SEAL THE BAG.
- DISCARD THE BAG AS YOU DO FOR USUAL GARBAGE.
- CAREFULLY WASH YOUR HANDS WITH SOAP AND WATER.

WARNING : BE VERY CAREFUL IF YOU GO ON WET AIRCRAFT SURFACES. IF YOU SLIP, THERE IS A RISK THAT YOU WILL FALL.

WARNING : WEAR AND ATTACH A SAFETY HARNESS WHEN YOU WORK ON HIGH SECTIONS. A FALL CAN INJURE OR KILL YOU.

CAUTION : DO NOT USE HIGH-PRESSURE JETS OR VAPOR TO DO THE CLEANING PROCEDURE. THIS TYPE OF EQUIPMENT CAN PUT WATER AND MOISTURE IN PARTS, AND CAN CAUSE DAMAGE TO EQUIPMENT, SPECIALLY TO:
- ELECTRICAL EQUIPMENT SUCH AS HARNESSES, PROXIMITY SENSORS AND CONNECTORS (WITH SHORT CIRCUITS OR INCORRECT INDICATIONS AS A RESULT)
- EQUIPMENT SUCH AS GEAR BOX SEALS, STEADY BEARINGS, ROTARY ACTUATORS AND UNIVERSAL JOINTS.

CAUTION : DO NOT USE A COMPRESSED AIR SUPPLY OF MORE THAN 10 PSI (0.70 BAR) PRESSURE:
- IF YOU USE A SPRAY GUN OR
- WHEN YOU USE COMPRESSED AIR TO DRY THE CLEANED PARTS.
AN IMPACT PRESSURE OF MORE THAN 10 PSI (0.70 BAR) WILL CAUSE DAMAGE TO THE PARTS.

CAUTION : DURING THE ANTI-ICING/DE-ICING AND WASHING PROCEDURES, MAKE SURE THAT THE HOT WATER OR HOT WATER/FLUID MIXTURES DO NOT CAUSE THE TEMPERATURE OF THE AIRCRAFT SKIN TO INCREASE TO MORE THAN +70°C.

NOTE : This task can contribute to fuel savings.

EFF : ALL

ANZ

12-21-11 Page 301
Feb 01/07

Printed in France

1. Reason for the Job

This task gives the procedure for:
- external cleaning procedures of the aircraft,
- cleaning of the windows,
- cleaning of the landing gears and landing gear bays.

2. Job Set-up Information

A. Fixtures, Tools, Test and Support Equipment

REFERENCE	QTY	DESIGNATION
No specific	1	BOOT - RUBBER
No specific	1	BRUSH - BRISTLED, SOFT
No specific	6	CHOCK - WHEEL
No specific	1	CLEANING EQUIPMENT HEIGHT 12M (40FT) - MOBILE
No specific	1	FILM - POLYETHYLENE
No specific	1	GLOVES - RUBBER
No specific	1	GOGGLES - PROTECTIVE
No specific	1	OVERALL WITH HOOD - WATERPROOF
No specific	1	SCRAPER - PLASTIC
No specific	1	SPRAYING EQUIPMENT - LOW PRESSURE
No specific	1	TAPE - ADHESIVE
No specific	1	SPONGE

B. Consumable Materials

REFERENCE	DESIGNATION
Material No. 05-005	USA MIL-C-16173 GRADE II CORROSION PREVENTIVE (Ref. 20-31-00)
Material No. 05-027	RUST INHIBITOR(FOR CORROSION USE 15-004) (Ref. 20-31-00)
Material No. 10-001	USA AMS 1424 DE-ICING FLUID AEA/ISO TYPE I ISO 11075 (Ref. 20-31-00)
Material No. 11-001	USA MIL-D-16791 TYPE I R NO LONGER AVAILABLE (Ref. 20-31-00)

REFERENCE	DESIGNATION
Material No. 11-002	USA MIL-PRF-680 DRY CLEANING SOLVENT (VARSOL/WHITE SPIRIT) (Ref. 20-31-00)
Material No. 11-026	GB DEF-STAN 68-148/1 SOLVENT GENERAL PURPOSE (Ref. 20-31-00)
Material No. 19-003	USA AMS 3819 LINT-FREE COTTON CLOTH (Ref. 20-31-00)

C. Referenced Information

	REFERENCE	DESIGNATION
	09-10-00-584-002	Towing with the Nose Gear from the Front
	09-10-00-584-006	Towing with the Towbarless Tractor
R	10-11-00-555-013	Installation of the Aircraft Protection Equipment
R	10-11-00-555-014	Removal of the Aircraft Protection Equipment
	12-31-12-660-002	De-icing of the Aircraft Parked in an Open Area (Engines Stopped)
	12-34-24-869-002	Aircraft Grounding for the Maintenance Operations
	24-41-00-861-002	Energize the Aircraft Electrical Circuits from the External Power
	24-41-00-862-002	De-energize the Aircraft Electrical Circuits Supplied from the External Power
	32-11-00-100-002	Cleaning of the Main Landing Gear
	32-12-00-010-001	Open the Main Gear Doors for Access
	32-12-00-410-001	Close the Main Gear Doors after Access
	32-21-00-100-002	Cleaning of the Nose Landing Gear
	32-22-00-010-001	Nose Gear Doors - Ground Doors Opening
	32-22-00-410-001	Nose Gear Doors - Ground Doors Closing
	56-10-00-110-001	Cleaning of the L/R Windshields
	56-10-00-110-002	Cleaning of the L/R Fixed Windows
	56-10-00-110-003	Cleaning of the L/R Sliding Windows
	56-21-13-100-002	Cleaning the Outer Surface of the Outer Window Panes

R 3. Job Set-up

R Subtask 12-21-11-941-054

R A. General

R (1) Quality of water for aircraft external cleaning. We recommend that
R you use potable water that has these qualities:
R - pH between 5 and 8.5,
R - chloride level less than 100 ppm.

R NOTE : Water that contains a high level of chloride and/or is
R acidic-alkaline can cause corrosion.
R Treated water from city drainage can cause a risk of
R bacteriological contamination.
R Refer to the local regulations.

R (2) The persons that do the cleaning must put on BOOT - RUBBER, GLOVES -
R RUBBER, GOGGLES - PROTECTIVE and OVERALL WITH HOOD - WATERPROOF.

R Subtask 12-21-11-860-052

R B. Aircraft Maintenance Configuration

R (1) Tow the aircraft to the cleaning area (Ref. TASK 09-10-00-584-002) or
R (Ref. TASK 09-10-00-584-006).

R (2) Electrically ground the aircraft (Ref. TASK 12-34-24-869-002).

R (3) Put the CHOCK - WHEEL in position in front of and behind the wheels
R of the nose and main landing gears.

R (4) Energize the aircraft electrical circuits
R (Ref. TASK 24-41-00-861-002).

R (5) Make sure that the slats, flaps, spoilers, ailerons and thrust
R reversers are retracted.

R (6) On the panel 25VU, push the DITCHING pushbutton 13HL switch to close:
R - the outflow valve 10HL,
R - the skin air inlet valve 15HQ,
R - the skin air outlet valve 22HQ.

R (7) De-energize the aircraft electrical circuits
R (Ref. TASK 24-41-00-862-002).

(8) Make sure that all landing gear doors, passenger/crew doors, cargo compartment doors, emergency exits, service panels, access panel, sliding windows are closed and the engines are cold.

(9) Install aircraft protection equipment (Ref. TASK 10-11-00-555-013).

R **WARNING** : DO NOT APPLY ADHESIVE TAPE ON THE PROBES, DUCTS, SENSORS
R (STATIC, PITOT, TAT, AOA). USE ONLY THE SPECIFIED TOOLS FOR
R THE PROTECTION OF THE AIRCRAFT. THE SPECIFIED TOOLS:
R - GIVE THE CORRECT PROTECTION TO THE AIRCRAFT EQUIPMENT,
R - ARE EASY TO SEE FROM THE GROUND,
R - ARE EASY TO REMOVE.
R IF YOU USE TAPE, THERE IS A RISK THAT SOME TAPE, OR
R ADHESIVE FROM THE TAPE, WILL STAY ON THE PROBES, DUCTS OR
R SENSORS. THIS CAN CAUSE INCORRECT INDICATIONS ON THE
R RELATED COCKPIT INSTRUMENTS.

(10) Install a FILM - POLYETHYLENE or equivalent on each landing gear wheel/brake.

(11) Put TAPE - ADHESIVE on all remaining joints and openings where the cleaning products can go in and cause damage. Record the locations where you put the TAPE - ADHESIVE.

Subtask 12-21-11-941-055

C. Job Set-up

WARNING : CLEANING FLUID IS CLASSIFIED AS A HAZARDOUS MATERIAL WHICH MAY CAUSE INJURY OR ILLNESS IF NOT PROPERLY USED.
THIS PRODUCT SHOULD BE USED ONLY IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFIC SAFETY AND HEALTH RECOMMENDATIONS.
PRIOR TO USE OF THIS PRODUCT, CAREFULLY READ THE APPLICABLE "MATERIAL SAFETY DATA SHEET" AND OBEY ALL LISTED SAFETY AND HEALTH PRECAUTIONS.

(1) Put CLEANING EQUIPMENT HEIGHT 12M (40FT) - MOBILE in position

(2) Prepare the SPRAYING EQUIPMENT - LOW PRESSURE and the cleaning solution with CLEANING AGENTS (Material No. 11-001). Obey the manufacturer instructions. In very dirty areas, increase the concentration but obey the manufacturer instructions for use. If the temperature is less than or equal to 0 deg.C (32.00 deg.F) , use hot water between 38 deg.C (100.40 deg.F) and 43 deg.C (109.40 deg.F) with ANTI-ICING AND DE-ICING MATERIALS (Material No. 10-001). Obey the manufacturer instructions.

R 4. Procedure

R Subtask 12-21-11-615-065

R A. Aircraft External Cleaning

R **CAUTION** : DO NOT USE A COMPRESSED AIR SUPPLY OF MORE THAN 10 PSI (0.70 BAR) PRESSURE:
- IF YOU USE A SPRAY GUN OR
- WHEN YOU USE COMPRESSED AIR TO DRY THE CLEANED PARTS.

AN IMPACT PRESSURE OF MORE THAN 10 PSI (0.70 BAR) WILL CAUSE DAMAGE TO THE PARTS.

R **CAUTION** : DO NOT USE STEAM AT MORE THAN THE SPECIFIED PRESSURE. BE CAREFUL TO HOLD THE SPRAY GUN AT THE SPECIFIED DISTANCE AND ANGLE FROM THE SURFACE.
IF YOU DO NOT OBEY THESE PRECAUTIONS, YOU CAN CAUSE DAMAGE TO THE SURFACE.

R (1) If the temperature is less than or equal to 0 deg.C (32.00 deg.F) do the de-icing of the aircraft (Ref. TASK 12-31-12-660-002).

R (2) Adjust the SPRAYING EQUIPMENT - LOW PRESSURE
- adjust water steam, cleaning solution and the temperature controls to the required settings.
- set the steam pressure to less than 10 psi (0.6894 bar), the steam pressure must not cause damage to materials.
- set the temperature so that the cleaning solution is not more than 50 deg.C (122.00 deg.F)

R (3) Hold the spray gun approximatively 1 m (3.28 ft.) from the surface and inclined at 45 degrees to the surface, never at 90 degrees. Move the spray head over the surface and be careful not to stay at one spot for more than 5 seconds.

R **NOTE** : If the weather temperature is hot , clean small areas so that the cleaning solution does not become dry on the external skin.

R (4) Apply the cleaning solution from the bottom to the top of the aircraft (this prevents scratches and runs) in the sequence below:
- lower forward fuselage from the leading edge of the wing to the nose of the aircraft.
- lower aft fuselage from the wings, to the leading edge of the horizontal stabilizer.
- upper wing surface between the fuselage and the engine pylon.
- upper fuselage from the nose to the horizontal stabilizer.

- lower center fuselage, engine nacelles and wing bottom skin.
- tail cone, rudder, bottom and top skins of the horizontal stabilizer.

NOTE : In the THS apron area, it is important to point the spray from the front to the the rear.
If you point the spray in the other direction (rear to front), the cleaning solution can go into the rear fuselage non-pressurized compartment.

- wing top skin between the engine pylon and the wing tips.

(a) If there are signs of asphalt, remove them with a SPONGE lightly soaked with CLEANING AGENTS (Material No. 11-026) or CLEANING AGENTS (Material No. 11-002).

(b) To remove mud or other unwanted material (insects,...), make it soft with water, and scrape it off with a SCRAPER - PLASTIC and a SPONGE soaked in water. Be very careful not to scratch the surface. If there are stains on the painted area, do not try to remove them.

(5) Flushing of the aircraft

CAUTION : MAKE SURE YOU FLUSH THE SURFACE SUFFICIENTLY TO REMOVE ALL THE CLEANING SOLUTION. CLEANING SOLUTION THAT STAYS ON THE AIRCRAFT SURFACE CAN CAUSE CORROSION.

(a) Let the cleaning solution have an effect, and after approximately 10 minutes, flush before it becomes dry.

(b) Flush with hot water at 65 deg.C (149.00 deg.F) maximum to remove signs of cleaning solution. Do not use steam.

(c) When you flush the wing and the horizontal stabilizer, always complete this step with the bottom skin.

(d) If there is ice after the flushing operation, do the de-icing of the aircraft (Ref. TASK 12-31-12-660-002).

(e) In the zones where access is not easy, use clean, dry compressed air that does not contain oil, to remove the remaining moisture.

R Subtask 12-21-11-615-066

R B. Cleaning of the Windows

R (1) Clean the windshield (Ref. TASK 56-10-00-110-001).

R (2) Clean the fixed windows (Ref. TASK 56-10-00-110-002).

R (3) Clean the sliding windows (Ref. TASK 56-10-00-110-003).

R (4) Clean the windows (Ref. TASK 56-21-13-100-002).

R Subtask 12-21-11-615-067

R C. Cleaning of the Landing-Gear Bays and Landing-Gear Components

R CAUTION : MAKE SURE YOU FLUSH THE SURFACE SUFFICIENTLY TO REMOVE ALL THE
R CLEANING SOLUTION. CLEANING SOLUTION THAT STAYS ON THE AIRCRAFT
R SURFACE CAN CAUSE CORROSION.

R (1) Opening of the landing-gear doors:
R - open the nose landing-gear doors (Ref. TASK 32-22-00-010-001).
R - open the main landing-gear doors (Ref. TASK 32-12-00-010-001),

R (2) Make sure that the openings in the landing-gear bays are correctly
R closed .

R (3) Cleaning of the landing-gear bays.

R NOTE : As there are many components in the landing-gear bays that can
R be easily damaged. We recommend that you clean the
R landing-gear bays only when you do maintenance procedures.

R (a) Make sure that each landing-gear wheel/brake has protection.

R (b) Apply CLEANING AGENTS (Material No. 11-001) with a SPONGE only on
R the applicable parts of the landing-gear bays, and in the
R internal surfaces of the landing-gear doors.

R (c) In the zones where access is not easy, apply CLEANING AGENTS
R (Material No. 11-001) with a BRUSH - BRISTLED, SOFT, to remove
R all signs of grease and oil.

R (d) Flush the applicable parts of the landing-gear bays to remove all
R signs of cleaning solution.

(e) In the zones where access is not easy, use clean, dry compressed air that does not contain oil, to remove the remaining moisture.

(4) Cleaning of the landing-gear

CAUTION : DO NOT APPLY CLEANING SOLUTION ON THE CHROME-PLATED SURFACES AND ON THE LOCATION OF THE HINGES.

CAUTION : MAKE SURE YOU FLUSH THE SURFACE SUFFICIENTLY TO REMOVE ALL THE CLEANING SOLUTION. CLEANING SOLUTION THAT STAYS ON THE AIRCRAFT SURFACE CAN CAUSE CORROSION.

(a) Clean the Main Landing Gear (Ref. TASK 32-11-00-100-002).

(b) Clean the Nose Landing Gear (Ref. TASK 32-21-00-100-002).

ıbtask 12-21-11-916-052

D. Corrosion Prevention in Landing Gear Bays

(1) Remove SPECIAL MATERIALS (Material No. 05-005):
To all threads of studs on clamp blocks, the washers and the nuts of the landing-gears bays.

(2) Apply SPECIAL MATERIALS (Material No. 05-027)
On the painted surfaces of the landing-gear bays.

NOTE : The painted surfaces must be in the correct condition (no damage, marks, scratches and/or signs of corrosion) before you apply the material.

(3) Apply SPECIAL MATERIALS (Material No. 05-005):
To all threads of studs on the clamp blocks, the washers and the nuts of the landing gears bays.

ıbtask 12-21-11-210-059

E. Visual Inspection

(1) Make sure that the paint on the components is in the correct condition and that there are no signs of corrosion.

(2) Make sure that the bond is correct and that none of the rubber sealant is missing.

(3) Make sure that there is no unwanted material in the holes, water drain and threads.

(4) Make sure that there is no hydraulic fluid on the hydraulic pipes.

5. Close-up

Subtask 12-21-11-860-053

A. Aircraft Maintenance Configuration

R (1) Remove the aircraft protective equipment (Ref. TASK 10-11-00-555-
R 014).

(2) Remove all FILM - POLYETHYLENE

(3) Remove all signs of TAPE - ADHESIVE with a MISCELLANEOUS (Material No. 19-003) soaked in CLEANING AGENTS (Material No. 11-002).

(4) Energize the aircraft electrical circuits (Ref. TASK 24-41-00-861-002).

(5) On the panel 25 VU, release the DITCHING pushbutton switch 13HL to open:
- the outflow valve 10HL,
- the skin air inlet valve 15HQ,
- the skin air outlet valve 22HQ.

(6) Visually make sure that:
- the outflow valve 10HL is in the open position before you apply air in the open the air conditioning packs,
- the avionics compartment ventilation operates correctly.

Subtask 12-21-11-410-051

B. Put the aircraft back to its initial configuration

(1) Remove the tag from the Captain side stick or write in the log book that the protection covers/devices are not installed.

(2) Close the nose landing-gear doors (Ref. TASK 32-22-00-410-001).

(3) Close the main landing-gear doors (Ref. TASK 32-12-00-410-001).

(4) Remove the ground support and the maintenance equipment, the special and standard tools and all other items.

(5) De-energize the aircraft electrical circuit (Ref. TASK 24-41-00-862-002).

TASK 10-11-00-555-013

R Installation of the Aircraft Protection Equipment

R **WARNING** : DO NOT APPLY ADHESIVE TAPE ON THE PROBES, DUCTS, SENSORS (STATIC,
R PITOT, TAT, AOA). USE ONLY THE SPECIFIED TOOLS FOR THE PROTECTION OF
R THE AIRCRAFT. THE SPECIFIED TOOLS:
R - GIVE THE CORRECT PROTECTION TO THE AIRCRAFT EQUIPMENT,
R - ARE EASY TO SEE FROM THE GROUND,
R - ARE EASY TO REMOVE.
R IF YOU USE TAPE, THERE IS A RISK THAT SOME TAPE, OR ADHESIVE FROM THE
R TAPE, WILL STAY ON THE PROBES, DUCTS OR SENSORS. THIS CAN CAUSE
R INCORRECT INDICATIONS ON THE RELATED COCKPIT INSTRUMENTS.

WARNING : YOU MUST BE CAREFUL WHEN YOU DO WORK ON THE ENGINE PARTS AFTER THE ENGINE IS SHUTDOWN. THE ENGINE PARTS CAN STAY HOT FOR ALMOST 1 HOUR.

1. Reason for the Job

Self Explanatory

2. Job Set-up Information

A. Fixtures, Tools, Test and Support Equipment

REFERENCE	QTY	DESIGNATION
No specific	1	ACCESS PLATFORM 5M (16 FT)- ADJUSTABLE
No specific	1	WARNING NOTICE
IAE1N20008	2	COVER-COMMON NOZZLE
IAE1N20400	2	COVER-INLET COWL
98A10001005000	3	COVER-PITOT PROBE
98A10001013000	2	COVER-SLIP-ON,TOTAL TEMPERATURE SENSOR
98A10001500000	3	COVER-SLIP ON,ANGLE OF ATTACK SENSOR
98D10003001000	2	COVER-INLET COWL ENGINE
98D10003003000	3	COVER-SLIP-ON,AOA
98D10007512000	1	COVER-EXHAUST DUCT,APU
98D10007513000	1	COVER-OILCOOLER OUTLET,APU
98D10103500001	6	COVER-STATIC PROBE

B. Referenced Information

REFERENCE	DESIGNATION
R 10-11-00-991-001	Fig. 201
R 10-11-00-991-004	Fig. 202
R 10-11-00-991-007	Fig. 203
R 10-11-00-991-006	Fig. 204

R

3. Job Set-up

Subtask 10-11-00-941-056

A. Safety Precautions

R (1) On the panel 115VU:

R - Make sure that the **ENG/MODE** selector switch is in the **NORM** position.

R - Make sure that the **ENG/MASTER 1(2)** control lever is in the **OFF** position.

R (2) On the panel 25VU:
R - make sure that the **PROBE/WINDOW HEAT** pushbutton switch is released (the **ON** legend is off).

(3) Put a **WARNING NOTICE** in position in the cockpit to tell persons not to operate the systems while you install the protective devices on the aircraft.

(4) Put an **ACCESS PLATFORM 5M (16 FT)- ADJUSTABLE** in position near the aircraft.

R (5) Before installation of protection devices, make sure that the probes, the engines and the APU are cool.

4. Procedure

Subtask 10-11-00-555-069

A. Installation of the Protection Devices on the Fuselage
R (Ref. Fig. 201/TASK 10-11-00-991-001)

(1) Protection of the 2 total temperature sensors
- Put the COVER-SLIP-ON,TOTAL TEMPERATURE SENSOR (98A10001013000) in position.

(2) Protection of the 3 pitot probes
- Put the COVER-PITOT PROBE (98A10001005000) in position.

(3) Protection of the 3 angle-of-attack sensors
- Put the COVER-SLIP ON,ANGLE OF ATTACK SENSOR (98A10001500000) or COVER-SLIP-ON,AOA (98D10003003000) in position.

(4) Protection of the 6 static probes
- Put the COVER-STATIC PROBE (98D10103500001) in position.

Subtask 10-11-00-555-070

B. Installation of the Protection Devices on the Engines
R (Ref. Fig. 202/TASK 10-11-00-991-004, 203/TASK 10-11-00-991-007)

(1) Protection of the engine air intakes
- Put the COVER-INLET COWL (IAE1N20400) or COVER-INLET COWL ENGINE (98D10003001000) in position.

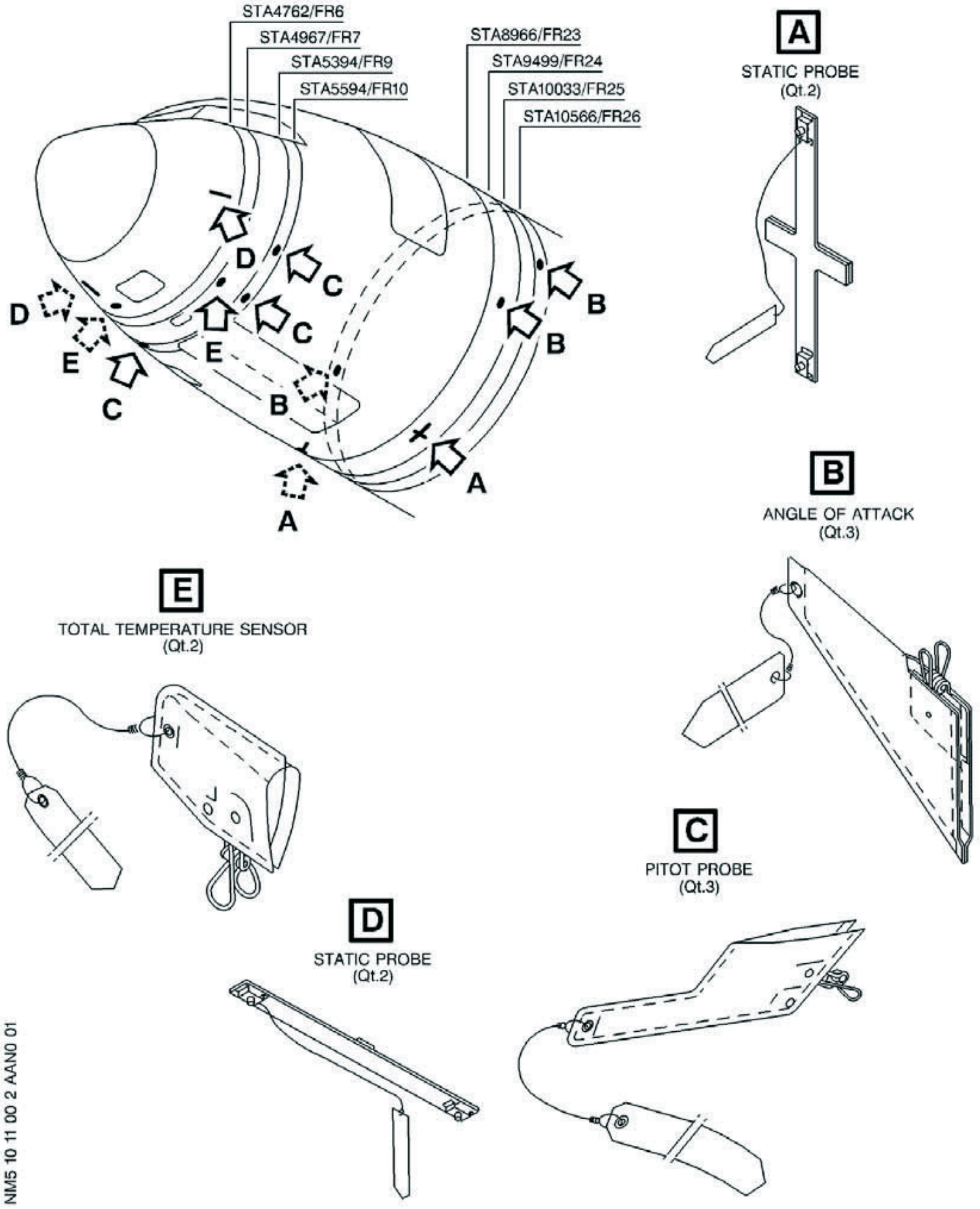
(2) Protection of the engine exhaust nozzles
- Put the COVER-COMMON NOZZLE (IAE1N20008) in position.

Subtask 10-11-00-555-071

C. Installation of the Protection Devices on the APU Area
R (Ref. Fig. 204/TASK 10-11-00-991-006)

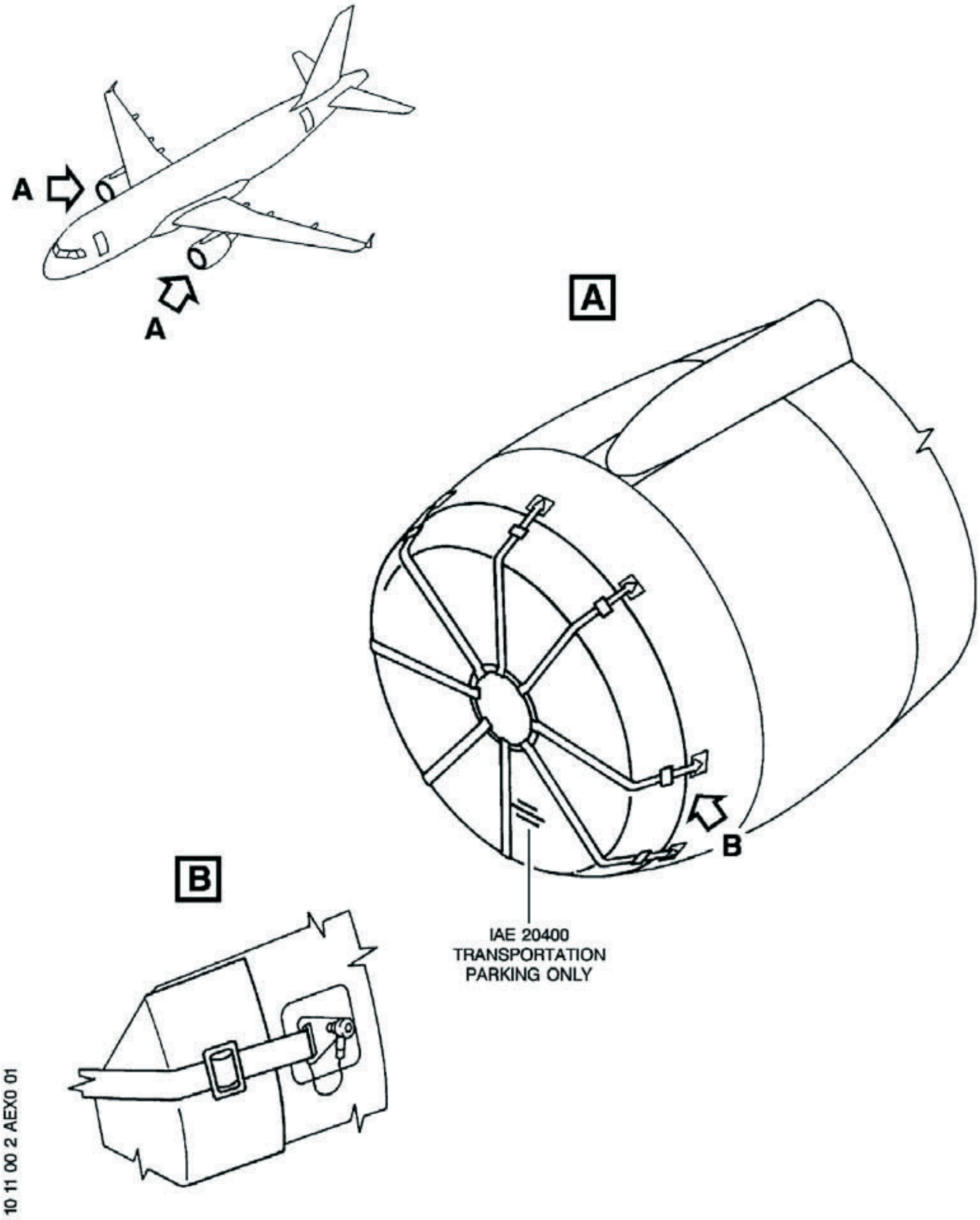
(1) Protection of the APU exhaust duct
- Put the COVER-EXHAUST DUCT,APU (98D10007512000) in position.

(2) Protection of the outlet duct of the APU oil cooler
- Put the COVER-OILCOOLER OUTLET,APU (98D10007513000) in position.

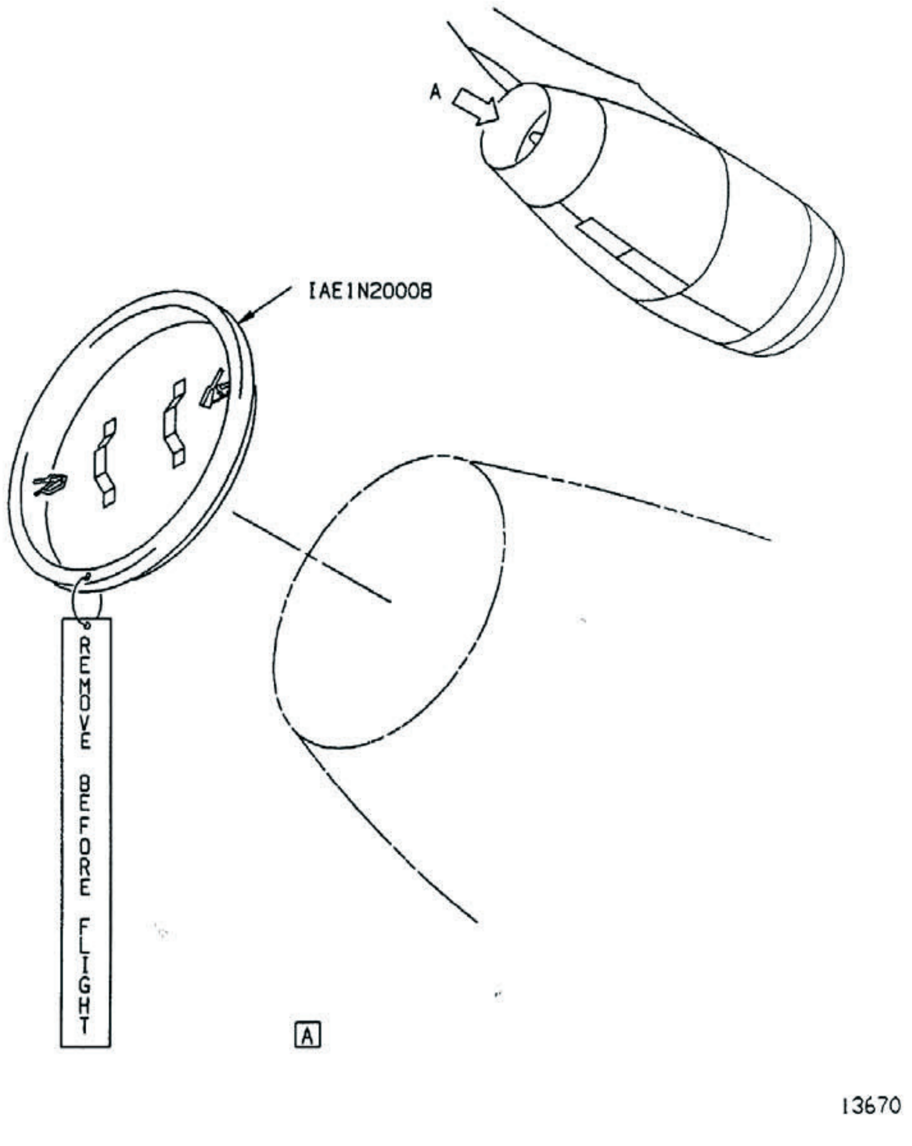


R

Protective Equipment
Figure 201/TASK 10-11-00-991-001



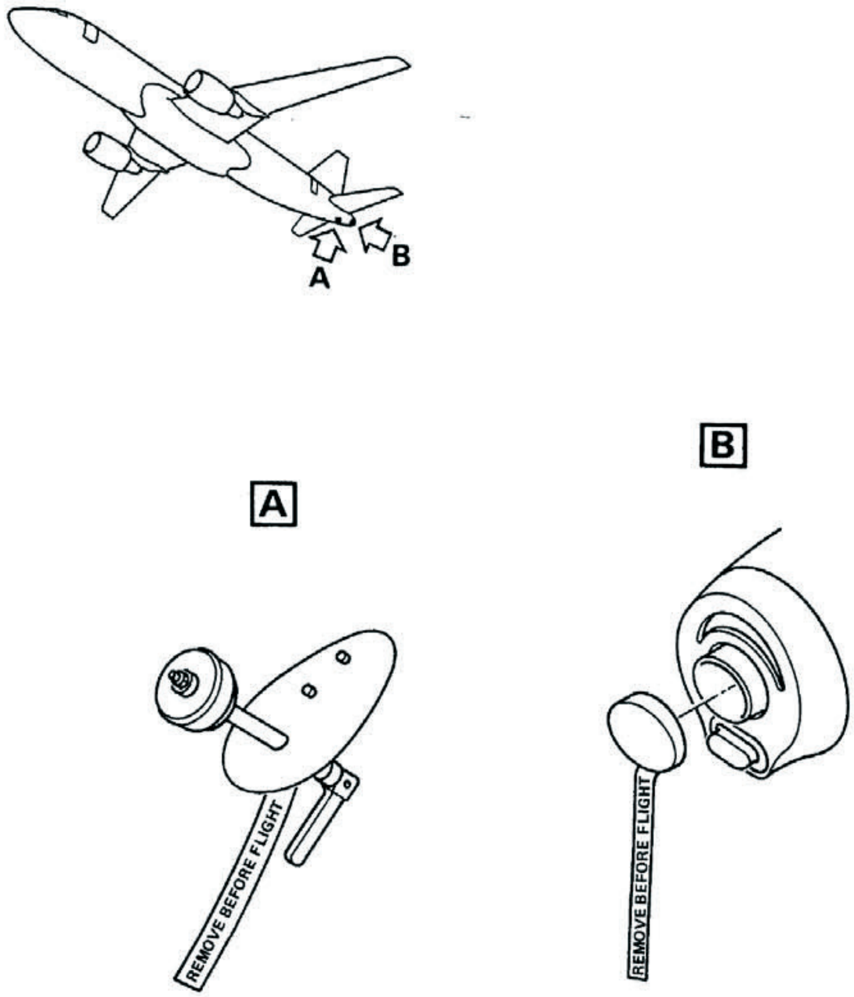
Protective Equipment
R Figure 202/TASK 10-11-00-991-004



NM5 10 11 00 2 AJMO - 00

R

Protective Equipment
Figure 203/TASK 10-11-00-991-007



NM5 10 11 00 2 ABM0 – 00

R

Protective Equipment
Figure 204/TASK 10-11-00-991-006

5. Close-up

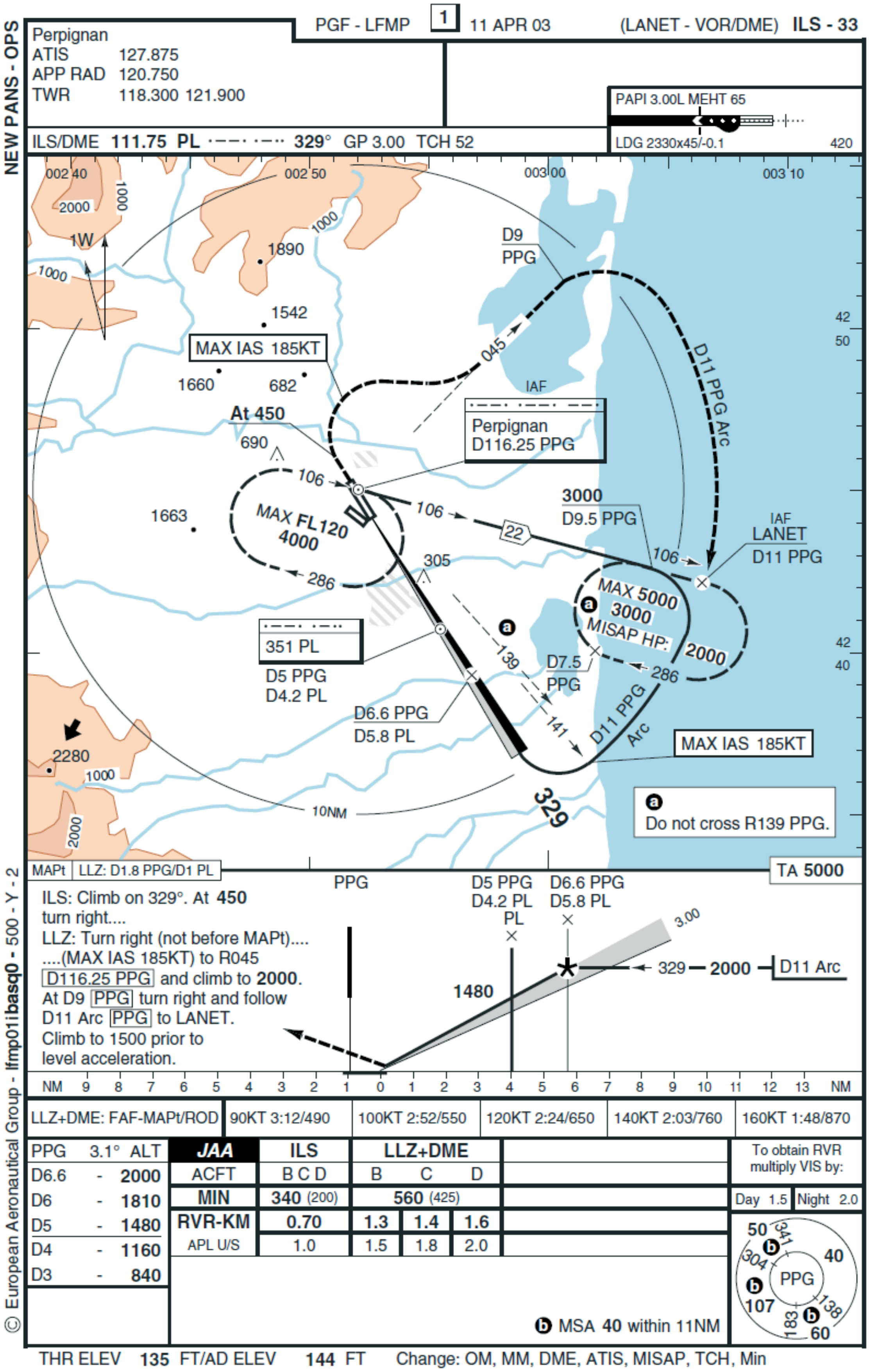
Subtask 10-11-00-942-058

A. Close-up

(1) Remove all the fixtures, tools, test and support equipment used during this procedure.

Appendix 14

ILS approach chart for runway 33 at Perpignan available on the crew's laptop computers



DESCENT FL 140 cont'd

LO SPEED – CONF FULL

Check of the A/C behaviour in Low Speed

LDG GEAR : **DOWN**

FLAPS : **FULL**

Adjust the engine power as required to stable frame the A/C speed at VLS

– When the A/C speed is stable framed :

– Set the engine power at idle ❑

– Adjust the A/C pitch to obtain a deceleration rate of about 1kt/sec ❑

During the deceleration, observe :

– The autotrim stops ❑

– The α floor activation ❑

Disconnect this α floor function at once

Note: The corresponding VLS and Vmin are :

x1000 Kg	A320 CFM VLS	Min
46.0	113	097
48.0	116	100
50.0	118	103
52.0	120	105
54.0	123	107
56.0	125	108
58.0	127	111
+/-	3	4

❑

Appendix 16
ATC flight plan

-TITLE ACK -MSGTYP IFPL -FILTIM 262003 -ORIGINDT 0811262003
-BEGIN ADDR
-FAC FRAXLXH
-END ADDR
-IFPLID BB82212902
-MSGTXT (FPL-GXL888T-IN
-A320/M-SERWY/S
-LFMP1230
-N0376F180 ORBIL G36 GAI G39 SECHE/N0440F380 UN863 MANAK UT183
DEGEX/N0436F390 UN490 TERKU UN864 DELOG/N0432F380 UM601 PPN UN976
LATEK UN871 GAI G36 ORBIL
-LFMP0235 LEGE
-EET/LFBB0006 LFMM0226 REG/DAXLA SEL/PRES OPR/GXL RMK/FERRY TRNG FLT
DOF/081127 ORGN/FRAXLXH)

Appendix 17

FAA Document - SAFO 08 024

U.S. Department
of Transportation

**Federal Aviation
Administration**

SAFO

Safety Alert for Operators

SAFO 08024
DATE: 12/10/08

Flight Standards Service
Washington, DC

http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo

A SAFO contains important safety information and may include recommended action. SAFO content should be especially valuable to air carriers in meeting their statutory duty to provide service with the highest possible degree of safety in the public interest. Besides the specific action recommended in a SAFO, an alternative action may be as effective in addressing the safety issue named in the SAFO.

Subject: Review of Flight Data Recorder Data from Non-revenue Flights

Purpose: This SAFO is issued to encourage all airlines operating under Title 14 of the Code of Federal Regulations (14 CFR) part 121, that have the capability to review flight data recorder (FDR) data, including in particular regional airlines, to review FDR data from non-revenue flights for safety analysis purposes.

Background: Approximately 25% of accidents involving turbine powered aircraft during the past decade have occurred during non-revenue flights (e.g.., ferry flights for maintenance purposes or re-positioning flights to pick-up passengers). During this same period, the technology needed for an airline to download and analyze FDR data has become significantly more accessible, either through the airline's acquisition of more affordable FDR data acquisition and analysis technology, or through the use of readily available vendor services.

Discussion: Two common factors found by the National Transportation Safety Board to have been contributory in non-revenue flight accidents are:

(1) the flightcrew's failure to adhere to standard operating procedures (SOPs) and,
(2) the flightcrew's failure to operate the airplane within its performance limitations.

Flight Operational Quality Assurance (FOQA) programs presently in operation by most major U.S. airlines have clearly established the capability of FDR data analysis to objectively identify the occurrence of both such factors.

Recommended Action: All air carriers operating under part 121 that have the capability to review FDR data, including in particular regional airlines, should place special emphasis on reviewing FDR data from non-revenue flights in order to verify that the flights are being conducted according to standard operating procedures (SOP). If FDR analysis indicates a potential trend of SOP non-compliance during such flights, that information should be communicated to appropriate airline management personnel for action to mitigate associated risks. If FDR data indicates noncompliance on the part of an individual crew, it is recommended that the information be communicated to the Chief Pilot and, if applicable, to Professional Standards group in the labor association, for the purposes of crew contact discussion, counseling and safety education.

Approved by: AFS-200 OPR: AFS-230

Appendix 18
Comment by the State of Registration and of the Operator

Bundesstelle für
Flugunfalluntersuchung
German Federal Bureau of Aircraft Accident Investigation

BFU

BFU, Hermann-Blenk-Str. 16, 38108 Braunschweig

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

Telephone:
+49 531 3548 0

Email:
box@bfu-web.de

Your Reference:
--

Our Reference:
U10-2X004/08

Date: 18/08/2010

Accident involving Airbus A320-232, D-AXLA 27 November 2008 off the coast of Canet-Plage (France)

Comment on Draft Final Report

In accordance to the provisions of ICAO Annex 13 the BFU representing the state of registry and operator requests to append the following statement to the Final Report:

It is the opinion of the BFU that the following aspect is not sufficiently discussed in the Final Report:

> A "CHECK GW" message does not ensure that line pilots will become aware of the fact the indicated lower speed limits are inaccurate. The blockage of two AoA sensors leads in specific circumstances to a "CHECK GW" message. If flight crew members recognize the message, they will check the values of the mass calculated by the FMS and the FAC. The most probable cause for a deviation would be input of erroneous data into the FMS at the beginning of the flight. If checking the entered data showed no discrepancy comprehensive system knowledge were required to realize that the indicated lower speed limits ($v_{\alpha prot}$ and $v_{\alpha max}$) could be inaccurate.

Sincerely

Accredited Representative

Phone:
+49 531 3548 0
Fax:
+49 531 3548 246
Email:
box@bfu-web.de

BEA Response

This aspect was not developed in the report since the atypical nature of the flight, the decision to perform a check of the angle of attack protections during the approach, as well as the crew's workload (increased during this phase of flight by this check, the preparation of the next leg and the absence of the approach procedure in the FMS) made it impossible to draw any general conclusions on the effectiveness of the CHECK GW message and consequently any safety lessons.

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

Zone Sud - Bâtiment 153
200 rue de Paris
Aéroport du Bourget
93352 Le Bourget Cedex - France
T : +33 1 49 92 72 00 - F : +33 1 49 92 72 03
www.bea.aero

Published September 2010

N° ISBN: 978-2-11-099128-7

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE