Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Schweizerische Sicherheitsuntersuchungsstelle SUST
Service suisse d'enquête de sécurité SESE
Servizio d'inchiesta svizzero sulla sicurezza SISI
Swiss Transportation Safety Investigation Board STSB

Aviation Division

Final Report No. 2257 by the Swiss Transportation Safety Investigation Board STSB

concerning the serious incident involving the Airbus A320 aircraft, registration HB-IJU,

operated by Swiss International Airlines under flight plan call sign SWR 2140

on 12 September 2013

60 NM north of Marseille

Aéropôle 1, CH-1530 Payerne
Tel. +41 58 466 33 00, Fax +41 58 466 33 01
info@sust.admin.ch
www.stsb.admin.ch

Ursachen

Der schwere Vorfall ist darauf zurückzuführen, dass während des Reiseflugs des Verkehrsflugzeuges ein Kabinendruckverlust auftrat, was einen Notabstieg (*emergency descent*) erforderte.

Die Untersuchung hat folgende kausale Faktoren ermittelt:

- Der Flug wurde mit nur einem funktionsfähigen pneumatischen System begonnen;
- Unklare Verfahrensvorgaben führten dazu, dass dieses pneumatische System nicht optimal betrieben wurde;
- Dieses pneumatische System wies Eigenschaften auf, die dazu führten, dass es zu einer Überhitzung kam und sich selber abschaltete;
- Eine mögliche Verbesserung des Herstellers (*service bulletin*) war noch nicht umgesetzt worden;
- Eine vom Flugzeughersteller vorgenommene Revision des MEL-Verfahrens stand dem Flugbetriebsunternehmen noch nicht zur Verfügung.

Der folgende Faktor hat die Entstehung und den Verlauf des schweren Vorfalls begünstigt:

- Die notwendigen Informationen und Verfahren zur Handhabung eines Systemfehlers während des Fluges sind für die Besatzungen nicht übersichtlich dargestellt.

General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the serious incident which is the subject of the investigation.

In accordance with Article 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident/incident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All information, unless otherwise indicated, relates to the time of the serious incident.

All times in this report, unless otherwise indicated, are stated in coordinated universal time (UTC). At the time of the serious incident, Central European Summer Time (CEST) applied as local time in Switzerland. The relation between LT, CEST and UTC is:
LT = CEST = UTC + 2 h.

Contents

Final report

Synopsis

Owner	Wells Fargo Bank Northwest, 30, route de Chêne, 1208 Geneva, Switzerland
Operator	Swiss International Airlines PO Box, 4002 Basle, Switzerland
Manufacturer	Airbus S.A.S., Toulouse, France
Aircraft type	Airbus A320-214
Country of registration	Switzerland
Registration	HB-IJU
Location	60 NM north of Marseille
Date and time	12 September 2013, 05:54 UTC

Investigation

The serious incident occurred on 12 September 2013 at 05:54 UTC. Notification was received on 14 September 2013 at 12:41 UTC. The investigation was opened on 3 October 2013 by the former Swiss Accident Investigation Board (SAIB), after the handling of this incident had been delegated to the latter by the French *Bureau d'Enquêtes et Analyses* (BEA). The BEA named an authorised representative, who, together with his advisers, contributed to the investigation.

The present final report is published by the Swiss Transportation Safety Investigation Board (STSB).

Summary

At 05:18 UTC on 12 September 2013 an A320-214 aircraft, flight plan call sign SWR 2140 and registration HB-IJU, took off from Zurich (LSZH) on a scheduled flight to Valencia (LEVC). For the flight the left-hand pneumatic system was deactivated in accordance with the minimum equipment list (MEL).

In cruise at flight level (FL) 370 the flight crew sensed a certain pressure change in their ears. On their system display (SD) the engine 2 bleed air valve was indicated as in the closed state and the cabin pressure altitude was increasing. Shortly afterwards, at 05:51:00 UTC, the master caution AIR ENG 2 BLEED FAULT was triggered.

The flight crew requested a descent, and when the air traffic control officer (ATCO) did not react to this request, the flight crew decided on a PANPAN message. This resulted in clearance to descend to FL 350. Shortly afterwards the crew declared an emergency situation. In the intervening time the cabin pressure altitude had risen further, and in the cockpit the master warning CAB PR EXCESS CAB ALT was displayed. The flight crew donned their oxygen masks and initiated an emergency descent.

Clearance was then given for the flight to descend in stages to FL 100. After the auxiliary power unit (APU) had been started and a successful bleed system 2 reset, the flight crew decided to climb to FL 210 and continued their flight to Valencia. There the landing took place uneventful at 07:05 UTC.

Causes

The serious incident is due to the fact that during cruise a loss of cabin pressure occurred on the passenger aircraft which required an emergency descent.

The investigation has determined the following causal factors:

- The flight commenced with only one functional pneumatic system;
- A lack of clarity in the procedures meant that the use of this system was not optimised;
- This pneumatic system had characteristics that led to overheating and the system switching itself off;
- An optional improvement provided by the manufacturer (service bulletin) had not yet been implemented;
- A revision of the MEL procedure provided by the manufacturer was not available to the operator at that time.
- The following contributing factor was determined for the occurrence and the history of the serious incident:
- The necessary information and procedures for handling a system fault during the flight are not clearly presented to the flight crew.

Safety recommendations

In the context of the investigation no safety recommendation was pronounced.

1 Factual information

1.1 Preflight history and history of the flight

1.1.1 General

The radiocommunication transcripts and the statements of flight crew members were used for the following description of the preflight history and history of the flight. For the entire flight the copilot was the pilot flying (PF) and the commander was the pilot not flying (PNF). The recordings from the flight recorders were no longer available to the investigation (cf. chapter 1.11).

The flight took place under instrument flight rules. The flight was a scheduled flight from Zurich (LSZH) to Valencia (LEVC).

The serious incident occurred in the Marseille flight information region (FIR). Sector M123 on the 133.880 MHz frequency and Sector ML (MOML) on the 128.850 MHz frequency were involved.

1.1.2 Preflight history

On the evening before the serious incident of 12 September 2013 the aircraft HB-IJU made a scheduled flight from Zurich (LSZH) to Hamburg (EDDH). During the descent into Hamburg a fault occurred in the pneumatic system, which was displayed to the flight crew as AIR ENG 1 BLEED FAULT. The flight crew performed the appropriate procedure in the operations engineering bulletin (OEB) from the quick reference handbook (QRH).

After landing the responsible technician determined a fault in the precooler of the pneumatic system No. 1. After consultation with the responsible Swiss maintenance operator in Zurich the decision was made to deactivate the pneumatic system No. 1 in accordance with the minimum equipment list (MEL) and to undertake the return flight to Zurich. The corresponding entry in the tech log stated inter alia: *"A/C dispatched acc. MEL. ATTN crew please observe operation procedure"* (cf. Annex 4).

After the return to Zurich the following actions were planned:

- *„Functional test of the opening of the eng 1 fan air valve 9HA1 with the bleed test set*
- *Leak test of the sense lines*

If the FAV opens properly and the sense line has no leaks, replace the eng 1 FAV thermostat 7170HM1."

After evaluating the respective data, these actions were also planned for pneumatic system 2.

Since the maintenance company did not have FAV thermostat available, it was decided not to execute these tests and to put the aircraft in service again the next morning according to the MEL and with the pneumatic system 1 still deactivated.

1.1.3 Flight preparations

In the course of flight planning the flight crew were already aware that they were subject to restrictions with regard to the pneumatic system. For reasons of time they discussed the consequences of the reduced system availability after flight planning were complete and they had completed the flight deck preparations for the forthcoming flight.

These preparations included a study of the relevant MEL procedures and of the QRH, which indicated that in the event of a fault also occurring in the pneumatic system No. 2, the electronic centralised aircraft monitor (ECAM) procedures should not be used, but instead the procedure published by the aircraft manufacturer in the operations engineering bulletin (OEB) (cf. Annex 7).

The flight crew came to the conclusion that the flight plan did not have to be adapted with regard to either fuel or cruise altitude, and thus the flight could be undertaken as planned.

1.1.4 History of the flight

At 05:18 UTC on 12 September 2013 an A320-214 aircraft, flight plan call sign SWR 2140 and registration HB-IJU, took off from Zurich (LSZH) on a scheduled flight to Valencia (LEVC). On board were two pilots, four cabin crew members and 153 passengers.

After an uneventful flight the flight crew transmitted a message at 05:47:54 UTC to the Marseille A3 Sector (AB) air traffic control officer (ATCO) as follows: *„Marseille bonjour, Swiss two one four zero, flight level three seven zero."* The ATCO returned the greeting and cleared the flight crew to fly directly to waypoint Martigues (MTG), which was confirmed by the flight crew.

Subsequently the flight crew detected a certain pressure change in their ears. On the pressurization page on their system display (SD) they recognized a rise in cabin pressure altitude with a rate of climb of approximately 1700 feet per minute (ft/min). Somewhat later this value reduced to 500 ft/min. The engine 2 bleed air valve was indicated as being in the closed state and shortly afterwards, at 05:51:00 UTC, the alert AIR ENG 2 BLEED FAULT appeared on the electronic centralised aircraft monitor (ECAM). At the same time a chime sounded and the master caution light illuminated. The PNF briefly studied the procedure in the relevant operations engineering bulletin (OEB). However, he found that this procedure was not appropriate to the situation, and decided to initiate a descent.

At approximately the same time, at 05:51:58 UTC, the ATCO requested the flight crew to call Marseille on the 133.880 MHz frequency, which the flight crew promptly confirmed. On this Sector M123 frequency, the flight crew transmitted a message at 05:52:10 UTC to the air traffic control officer as follows: *„Marseille bonjour, Swiss two one four zero, level three seven zero, request descent."* The ATCO answered promptly with: *„Swiss two one four zero bonjour, direct BISBA."* Since the ATCO did not respond to the descent request, the flight crew of SWR 2140 acknowledged this clearance as follows*: „Direct BISBA request descent to flight level three two zero initially, Swiss two one four zero."* Subsequently the ATCO communicated with the flight crew of another aircraft and at 05:52:38 UTC the flight crew of SWR 2140 transmitted a new message to the ATCO with the request: *„Marseille Swiss two one four zero, request descent",* to which the ATCO responded with: *„Swiss two one four zero descend level".* After this incomplete message the ATCO replied to a call from another aircraft.

The flight crew then decided to emphasise their descent request with a PAN PAN message and at 05:53:04 UTC transmitted: *„Swiss two one four zero PANPAN PANPAN request descent at least level three zero zero."* The ATCO responded promptly with: *„Swiss two one four zero descend level three five zero initially",* whereupon the flight crew initiated the descent (cf. Annex 3) and said: *„Three five zero and we've got a pressurisation problem, request further descent Swiss two one four zero."* The ATCO responded with *„Roger"*, prompting the flight crew to ask the question: *„Did you copy the PAN Swiss two one four zero?"* The ATCO responded promptly with: *„Swiss two one four zero, call you back."* Since the

flight crew wished to descend to a lower flight level without delay, they intervened immediately as follows: *„Did you copy my PAN PAN Miss, Swiss two one four zero?"* Since the ATCO responded with *„Say again your request"*, the flight crew now transmitted a message with emphasis as follows: *„Swiss two one four zero PANPAN PANPAN PANPAN requesting lower",* which the ATCO acknowledged with *„Roger".*

As the ATCO issued the following instruction to the flight crew at 05:53:46 UTC: *„Swiss two one four zero, squawk two zero zero zero"* the latter initiated their descent and responded with: *"Thank you two thousand Swiss two one four zero approaching flight level three five zero requesting lower."* There was no response to this message from the ATCO.

The flight crew then wanted to give additional emphasis to their descent requests and at 05:54:10 UTC transmitted: *„Swiss two one four zero MAYDAY MAYDAY MAYDAY request descent!"* The ATCO then responded promptly at 05:54:16 UTC with *„Swiss two one four zero squawk seven seven zero zero, descend flight level three zero zero",* which the flight crew confirmed without delay.

In the intervening time the cabin pressure altitude had risen further, and at 05:54:18 UTC the alert CAB PR EXCESS CAB ALT was displayed in the cockpit at the same time as the aural master warning sounded. The flight crew donned their oxygen masks without delay and initiated an emergency descent.

At 05:55:23 UTC the ATCO enquired as to the flight crew's intentions: *„Swiss two ... Swiss two one four zero, what are your intentions?"* The flight crew of SWR 2140 answered at 05:55:33 UTC as follows: *„Marseille Swiss two one four zero, request further descent"*, to which the ATCO gave the following clearance: *„Swiss two one four zero, descend flight level two five zero."* The flight crew responded to this with: *„We need to descend at least flight level one four zero Swiss two one four zero, descending flight level two five zero for now."* At 05:55:49 UTC the ATCO immediately gave further clearance to descend to FL 140, which the flight crew promptly confirmed.

At 05:56:36 UTC the ATCO requested the flight crew to change to the 128.850 MHz frequency. On this Marseille ML sector frequency (MOML) the flight crew promptly transmitted the message: *„Marseille Swiss two one four zero MAYDAY MAYDAY MAYDAY descending flight level one four zero."* The air traffic control officer (ATCO) responded promptly with: *„Swiss two one four zero bonjour continue descent if you want you can descend flight level one one zero."* The flight crew immediately confirmed that they would descend to FL 110.

At 05:56:52 UTC the ATCO enquired as to the flight crew's intentions and at 05:57:22 UTC cleared them to descend to FL 100. The flight crew confirmed to the ATCO that FL 100 would be good for them, that at the present time they would continue the flight towards Valencia, but would also consider a diversion to Barcelona.

After the flight crew had brought the aircraft to FL 100, the commander called the head of the cabin crew into the cockpit. The latter told him that neither the cabin crew nor the passengers had noticed anything of the emergency descent. Since the commander had amongst others switched on the seat belt sign in accordance with the checklist for the emergency descent, the cabin crew had independently decided to discontinue the cabin service.

At 06:00:03 UTC the ATCO commented to the flight crew: *„Swiss two one four zero for your information you are overhead Marseille Provence the airport if you want you can divert to Marseille."* The flight crew thanked the ATCO and responded that at the present time they would prefer to continue the flight towards

Barcelona. They had previously ascertained that even at FL 100 this would not be a problem in relation to fuel reserves. In response the ATCO gave the flight crew a direct course to Barcelona.

On the flight towards Barcelona the ATCO asked the flight crew at 06:02:29 UTC whether they had the situation under control. The flight crew answered as follows: *„Affirm the situation is under control we're happy at flight level one hundred for the moment and Barcelona is a good option, we're checking with our company now if they ... if it's ok with them if we go there."* The ATCO confirmed this, and with mutual agreement the MAYDAY status was cancelled at 06:03:00 UTC.

The flight crew then started the APU, in order to have another source for compressed air and electrical power. In addition the flight crew had made contact with their operator and with the maintenance control centre (MCC) to obtain further information concerning the continuation of their flight. The operator expressed the desire that if possible they should continue the flight to Valencia, and from the MCC they obtained the advice to attempt a bleed system 2 reset, i.e. to depress the push button ENG 2 BLEED two times (cf. chapter 1.6.2). This reset took place successfully at 06:14:31 UTC. Together with the compressed air from the APU there were now two functional bleed systems available to the flight crew and the cabin pressure altitude was back under control. After a situation evaluation regarding weather and fuel, the flight crew decided to climb to a higher flight level and to continue the flight to Valencia.

The remainder of the flight at FL 210 was uneventful and the flight crew landed the aircraft in Valencia at 07:05 UTC.

1.1.5 Troubleshooting after the landing and return flight to Zurich

The flight crew described the incident to the responsible technician in Valencia, and after consultation with the maintenance operator in Zurich a functional test was performed. This so-called BMC 2 bite test[1] did not indicate a fault and the aircraft was again released for service. However, this was again subject to the restriction that the pneumatic system No. 1 was deactivated.

According to the commander's statement he received advice from the maintenance operator in Zurich to run the APU during the return flight. With this, the crew would have, assumed that the maximum cruise level would have been FL 200, available compressed air immediately in the event of another failure of the remaining pneumatic system No. 2. The flight crew was of the opinion that if there was another failure on the return flight they would in any case have to descend to FL 200 in order to be able to switch on the compressed air from the APU. During this descent they would have sufficient time to start the APU. They therefore decided not to run the APU during the flight.

After the commander had established from the copilot and the cabin crew that they felt able for the return flight, the flight crew decided to undertake the flight. With regard to any repeated failure of the pneumatic system No. 2, additional fuel was taken so that they would be able to cover any extra consumption at a lower flight level.

The return flight took place at a cruising altitude of FL 340 and was uneventful.

[1] The bleed monitoring computer (BMC) test does not include a functional test of the fan air valve or the fan air valve temperature control thermostat (TCT).

1.1.6 Location and time of the serious incident

Location	60 NM north of Marseille
Date and time	12 September 2013, 05:54 UTC
Lighting conditions	Daylight
Altitude	FL 370

1.2 Injuries to persons

None

1.3 Damage to aircraft

Not applicable

1.4 Other damage

None

1.5 Personnel information

1.5.1 Flight crew

1.5.1.1 Commander

Person	Swiss citizen, born 1966
Licence	Airline transport pilot licence aeroplane (ATPL(A)) in accordance with Joint Aviation Requirements (JAR)

All available evidence suggests that the commander started his duty well-rested and in good health. There are no indications that fatigue played a role.

1.5.1.1.1 Flying experience

Total	10 145:45 hours
Of which as commander	418:21 hours
On the type involved in the incident	4765:03 hours
During the last 90 days	198:10 hours
On the type involved in the incident	198:10 hours

1.5.1.2 Copilot

Person	German citizen, born 1987
Licence	Airline transport pilot licence aeroplane (ATPL(A)) in accordance with European Aviation Safety Agency (EASA).

All available evidence suggests that the copilot started his duty well-rested and in good health. There are no indications that fatigue played a role.

1.5.1.2.1 Flying experience

Total	1622:20 hours
On the type involved in the incident	1510:49 hours
During the last 90 days	251:12 hours
On the type involved in the incident	243:05 hours

1.6 Aircraft information

1.6.1 General

Registration	HB-IJU
Aircraft type	Airbus A320-214
Characteristics	Twin-jet short and medium range passenger aircraft
Manufacturer	Airbus S.A.S., Toulouse, France
Owner	Wells Fargo Bank Northwest 30, route de Chêne, 1208 Geneva, Switzerland
Operator	Swiss International Airlines PO Box, 4002 Basle, Switzerland
Technical limitations	In accordance with the minimum equipment list (MEL) 36-11-01A engine bleed air system No. 1 was deactivated (cf. chapter 1.6.2.2)
Mass and centre of gravity	The mass of the aircraft at the time of departure was 66 600 kg. Both the mass and centre of gravity were within the permitted limits according to the aircraft flight manual (AFM).

1.6.2 The pneumatic system of the aircraft

1.6.2.1 General

The pneumatic system supplies the two air conditioning packs, the wing anti-icing system and other consumers with compressed air, which is normally delivered by the two independent engine bleed systems. In the event of failure of one engine bleed system the remaining system is able to supply all consumers; in the event of failure of both systems the APU bleed system is still available, although its capacity is only sufficient to supply a single air conditioning pack at levels below FL 200 or both air conditioning packs below FL 150, and cannot be used to operate the wing anti-icing system.

The fan air valve regulates the cooling airflow rate through the precooler, which cools the bleed air to approximately 200 °C before onward delivery to the consumers. An increase of this precooler outlet temperature above 257 °C leads to the automatic closure of the corresponding bleed valve, which is displayed to the flight crew on the ECAM as AIR ENG 1/2 BLEED FAULT.

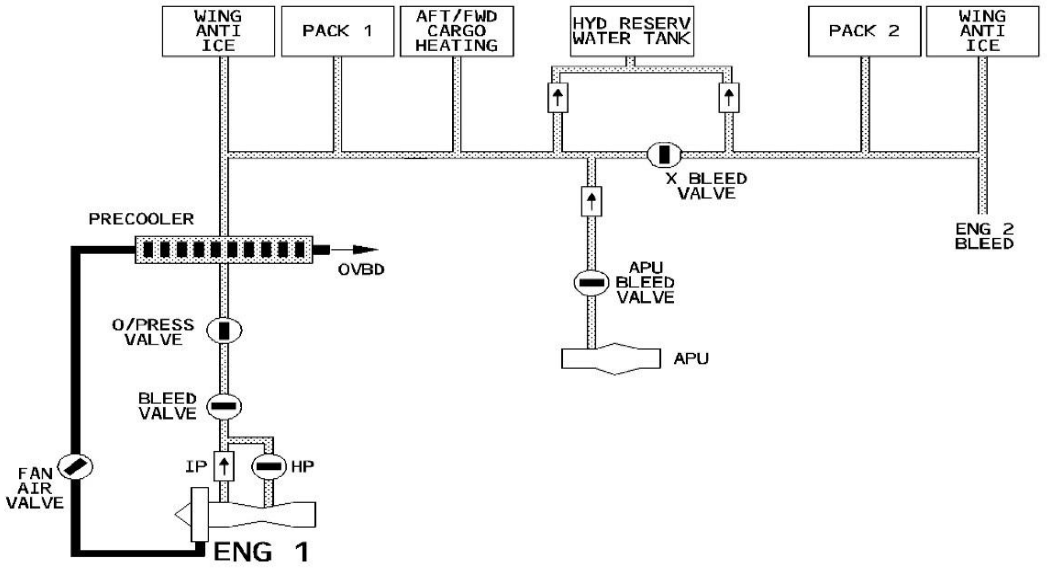


Figure 1: The pneumatic system of the Airbus A320-214

The pneumatic system supplies the two air conditioning packs, the wing anti-icing system and other consumers with compressed air, which is normally delivered by the two independent engine bleed systems. In the event of failure of one engine bleed system the remaining system is able to supply all consumers; in the event of failure of both systems the APU bleed system is still available, although its capacity is only sufficient to supply a single air conditioning pack below FL 225, and cannot be used to operate the wing anti-icing system.

The fan air valve regulates the cooling airflow rate through the precooler, which cools the bleed air to approx. 200 °C before onward delivery to the consumers. An increase of this precooler outlet temperature above 257 °C leads to the automatic closure of the corresponding bleed valve, which is displayed to the flight crew on the ECAM as AIR ENG 1/2 BLEED FAULT.

1.6.2.2 Restricted operation

If a bleed system (e.g. system 1) fails in flight, this is displayed to the flight crew on the ECAM as AIR ENG 1 BLEED FAULT. Further operation of air conditioning pack 1 is possible, if the engine 1 bleed valve is closed and the x-bleed valve is opened.

This state corresponds to the initial situation when operating the aircraft with only one engine bleed system functional, in accordance with the minimum equipment list (MEL) item 36-11-01.

Any subsequent failure of the remaining engine 2 bleed system signifies the simultaneous loss of both air conditioning packs and the wing anti-icing system. However, this is not explicitly displayed to the flight crew as a dual bleed fault, but only as AIR ENG 2 BLEED FAULT.

1.6.2.3 Findings after the serious incident

In an occurrence investigation report (OIR) by the maintenance operator it was summarized determined that the temperature in bleed system 2 increased steadily above the regulated range of 200 °C ± 15 °C. When the temperature limit of 257 °C ± 3 °C was exceeded, after a delay of 60 seconds the corresponding bleed pressure regulator valve (PRV) closed automatically (cf. chapter 1.6.2.1, the bleed valve shall mean the PRV).

Furthermore it is recorded in the OIR that the automatic closure of the PRV was a consequence of the intermittent not correctly regulating temperature control thermostat (TCT) of the fan air valve. Moreover it must be recorded that the BMC test performed in Valencia (cf. chapter 1.1.5) did not include any check on the functionality of the fan air valve or the TCT.

The return flight therefore took place under the same conditions as the incoming flight. The recordings showed that a precooler outlet temperature in excess of 240 °C also occurred on the return flight for a duration of several minutes.

The maintenance operator maintained that the replacement of the TCT on both bleed systems had resolved the problem. In addition a subsequent test in the workshop indicated that both replaced TCT had shown regulating pressures that were below the specified limit.

1.7 Meteorological information

1.7.1 General weather conditions

An extensive low over central Europe led to almost complete cloud cover north and west of the Alps, and locally to precipitation. Over the course of the morning the centre of the low tracked south south east.

1.7.2 Weather at the time of the serious incident and the return flight

The following information regarding the weather at the time and location of the serious incident is based on a spatial and chronological interpolation of the observations from various weather stations.

In the early morning France and central Europe were under a layer of dense cloud. The southern limit of the cloud ran through the departments of Drôme and Ardèche. Southern France was cloudless as a result of mistral divergence.

The cloud tops over western Switzerland and France had a temperature above minus five degrees and a maximum altitude of FL 100.

The cloud tops over German-speaking Switzerland had temperatures in the range from -10 to -20 degrees, with individual colder cloud tops possible. According to the midnight ascent of the Payerne radiosonde the airspace above FL 190 was cloudless.

At the time of the climb out of Zurich the height interval from FL 120 to FL 170 had the highest probability of icing conditions according to the Payerne radiosonde.

At the time of the landing in Zurich the height interval from FL 070 to FL 160 showed the highest probability of icing conditions according to GDAS[2] data. A comparison of the GDAS data for 06:00 and 09:00 UTC shows that the conditions in the vicinity of Zurich Airport did not alter significantly over the course of the morning. At the end of the morning the cloud tops were slightly lower than in the morning.

The significant weather chart (SWC) for 12:00 UTC on 12 September 2013 referred to thunder clouds with tops at FL 240. This trend was due to increased instability as a consequence of cold air at higher altitudes. Correspondingly high cloud tops occurred over Baden-Württemberg and Bavaria at the time of the landing of SWR 2141 at 09:50 UTC.

[2] GDAS: global data assimilation system

1.7.3 Weather at the location of the serious incident

Weather/cloud at FL370	Cloudless
Visibility	Over 70 km
Wind	55 kt from 330 degrees
Temperature/dew point	Around -53 °C / around -58 °C
Hazards	None according to SWC on 12 September 2013, 06 UTC

1.7.4 Astronomical data

Position of the sun at 05:45 UTC in the vicinity of Mont Ventoux	Azimuth: 89 °	Elevation: 5 °
Lighting conditions	Daylight	

1.7.5 Aerodrome meteorological reports

At the time of the landing at 07:10 UTC the following meteorological aerodrome report (METAR) was valid for Valencia airport:

METAR LEVC 120700Z VRB01KT CAVOK 21/17 Q1020 NOSIG=

This means:

On 12 September 2013 shortly before the issue of the 07:00 UTC meteorological aerodrome report the following weather conditions were observed at Valencia airport:

Wind	From a variable direction, 1 kt
Meteorological visibility	10 km or over
Cloud cover	No clouds below 5000 feet or the highest minimum sector altitude. No cumulonimbus or towering cumulus at any altitude. No significant weather phenomena.
Temperature	21 °C
Dew point	17 °C
Air pressure QNH	1020 hPa, pressure reduced to sea level, calculated using the values of the ICAO standard atmosphere
Trend	No significant changes expected in the next two hours

1.8 Aids to navigation

Not applicable

1.9 Communications

1.9.1 General

The radiocommunication between the flight crew and the air traffic control units involved took place in English and without any technical difficulties.

1.9.2 Procedures in the event of emergencies

If a flight crew finds itself in an emergency situation it must communicate this to air traffic control. In ICAO Doc. 4444, in Section 15: *Procedures Related to Emergencies, Communication Failure and Contingencies,* the relevant general guidelines are recorded inter alia, as follows:

„15.2.2.1 If an aircraft is unable to continue the flight in accordance with its ATC clearance, and/or an aircraft is unable to maintain the navigation performance accuracy specified for the airspace, a revised clearance shall be obtained, whenever possible, prior to initiating any action."

„15.2.2.2 The traditional distress signal (MAYDAY) or urgency signal (PAN PAN) preferably spoken three times shall be used as appropriate. Subsequent ATC action with respect to that aircraft shall be based on the intentions of the pilot and the overall air traffic situation."

This information is specified inter alia in ICAO Annex 10, Volume II in Section 5 *aeronautical mobile service – voice communications*, as follows:

„5.1.8 categories of messages

The categories of messages (...) shall be in accordance with the following table:

Message category and order of priority	*Radiotelephony signal*
a) Distress calls, distress messages and distress traffic	*MAYDAY*
b) Urgency messages, including messages preceded by the medical transport signal	*PAN, PAN or PAN; PAN MEDICAL"*

Here the distress and urgency messages in Section 5.3.1.1 are defined as follows:

„(...)

a) Distress: a condition of being threatened by serious and/or imminent danger and of requiring immediate assistance.

b) Urgency: a condition concerning the safety of an aircraft or other vehicle, or of some person on board or within sight, but which does not require immediate action."

The anticipated reaction to a distress message from the air traffic control unit that has been called is recorded inter alia in section 5.3.2.2.1:

„(...)

a) immediately acknowledge the distress message;

b) take control of the communications or specifically and clearly transfer that responsibility, advising the aircraft if a transfer is made;

c) take immediate action to ensure that all necessary information is made available, as soon as possible, to:

1) the ATS unit concerned;

2) the aircraft operating agency concerned (...)"

The anticipated reaction to an urgency message is recorded inter alia in Section 5.3.3.2.1, as follows:

„(...)

a) acknowledge the urgency message;

b) take immediate action to ensure that all necessary information is made available, as soon as possible, to:

1) the ATS unit concerned;

2) the aircraft operating agency concerned (...)"

1.10 Aerodrome information

Not applicable

1.11 Flight recorders

Since for various reasons the investigation of this serious incident was only delegated to the Swiss Accident Investigation Board at a late stage, the digital flight data recorder (DFDR) and the cockpit voice recorder (CVR) had already been overwritten and were no longer available to the investigation.

The records of the operator Swiss International Air Lines concerning flight SWR 2140 were available to the investigation. They included general records concerning the flight path and information concerning the warnings displayed. Detailed records concerning individual systems were no longer available.

1.12 Wreckage and impact information

Not applicable

1.13 Medical and pathological information

Not applicable

1.14 Fire

Not applicable

1.15 Survival aspects

Not applicable

1.16 Tests and research

Not applicable.

1.17 Organizational and management information

1.17.1 Operator

1.17.1.1 General

The various procedures are recorded in the relevant operating manuals (OM) of the operator. The generally applicable procedures are located in OM A and the aircraft-specific procedures are in OM B.

1.17.1.2 General procedures

In the operator's OM A the following is recorded inter alia with regard to terminology and communications in abnormal or emergency conditions:

„8.3.20.1 Terminology

8.3.20.1.1 Abnormal conditions

Abnormal conditions require increased attention to safety by the crew. They can be caused by technical, operational or other reasons such as passenger illness.

8.3.20.1.2 Emergency conditions

In emergency conditions safety is compromised or will be compromised within a critical time. The crew devotes all its attention to the safety of the aeroplane, its passengers and crew.

(...)

An emergency condition is classified in accordance with the degree of danger or hazard being experienced, as follows:

- ***Urgency*** *A condition concerning the safety of an aeroplane or other vehicle, or some person on board or within sight, which does not require immediate assistance. The appropriate phraseology is the word „PANPAN" repeated three times.*
- ***Distress*** *A condition of being threatened by serious and/or imminent danger and requiring immediate assistance. The appropriate phraseology is the word „MAYDAY" repeated three times."*

With regard to operation of the aircraft when the MEL is being applied the following is recorded in Section 8.6 of the OM A:

„8.6.1 Minimum Equipment List (MEL)

The MEL is approved by the FOCA and permits the operation with specific inoperative items of equipment for a period of time or a number of flights until repairs can be accomplished. For additional information refer to OM A § 8.7.6 [in this paragraph reference is made to a ferry flight, which has no significance in the serious incident under investigation].

The use of the MEL is described in detail in the respective OM B."

1.17.1.3 Aircraft-specific procedures for the flight crews

The flight crews do have the OM B only in electronic form. It consists of the following individual manuals:

- Flight crew operating manual (FCOM), also containing inter alia the operating engineering bulletins (OEB) of the aircraft manufacturer;
- Minimum equipment list (MEL) with MEL operational procedures;
- Quick reference handbook (QRH);
- Configuration deviation list (CDL).

In the FCOM, in addition to the system descriptions, all procedures for normal operation, abnormal operation and for emergency situations are also published.

Concerning the use of the documentation, with respect to the procedures in the FCOM the following definitions apply (FCOM, GEN P 5/32) [printed in colour in the original]:

WARNING	*An operating procedure, technique, etc. that may result in personal injury or loss of life if not followed.*
CAUTION	*An operating procedure, technique, etc. that may result in damage to equipment if not followed.*
NOTE	*An operating procedure, technique, etc. considered essential to emphasise. Information contained in notes may also be safety related.*

The abnormal and emergency procedures are published in the PRO-ABN part of the FCOM. Here the operator records inter alia the following:

„The presentation of procedures is, as far as practicable, identical to the presentation on ECAM [electronic centralised aircraft monitoring]*. The abbreviations are identical to those used on the cockpit panels."*

Furthermore the FCOM records as follows how the task sharing should take place:

„The Pilot Flying (PF), is responsible for the:

- *Thrust levers*
- *Control of flight path and airspeed*
- *Aircraft configuration (request configuration change)*
- *Navigation*
- *Communications*

The Pilot Not Flying (PNF), is responsible for:

- *Monitoring and reading aloud the ECAM and checklists*
- *Performing required actions, or actions requested by the PF, if applicable*
- *Using the engine master switches, cockpit C/Bs, IR and guarded switches, with PF's confirmation"*

The procedures that apply for an emergency descent are located in the FCOM under PRO-ABN-80 P8/40 and P9/40 (cf. Annex 5).

Similarly reference is made in the FCOM to the various additional items of information for the flight crew. With reference to operating engineering bulletins (OEB) the following is recorded:

„Operations Engineering Bulletins (OEB) are issued, when it is necessary, to transmit complementary technical or operational information."

1.17.1.4 MEL procedures

1.17.1.4.1 General

In the introduction to the electronic MEL manual it is recorded that the MEL has been approved by EASA and contains all the information that is necessary for a flight under MEL restrictions.

Furthermore it should be noted that under *repair interval* the MEL records how long an aircraft may be operated under MEL conditions until the relevant repair must be performed. The repair intervals are defined as follows:

„Repair Interval A	*No standard interval is specified, however, items in this category shall be rectified in accordance with the dispatch conditions stated in the MEL.* *Where a time period is specified in calendar days, it shall start at 00:00 on the calendar day following the day of discovery.* *Where a time period is specified in number of flights or flight hours, it shall start at the beginning of the first flight following the discovery of the failure.*
Repair Interval B	*Items in this category shall be rectified within three (3) consecutive calendar days, excluding the day of discovery. For example, if it were recorded at 13:00 on January 26th, the 3-day interval begins at 00:00 on January 27th and ends at 23:59 on January 29th.*
Repair Interval C	*Items in this category shall be rectified within ten (10) consecutive calendar days, excluding the day of discovery. For example, if it were recorded at 13:00 on January 26th, the 10-day interval begins at 00:00 on January 27th and ends at 23:59 on February 5th.*
Repair Interval D	*Items in this category shall be rectified within one hundred and twenty (120) consecutive calendar days, excluding the day of discovery."*

In addition, with reference to its application the MEL differentiates between relevant items which determine whether a flight must be performed in accordance with ETOPS[3] rules.

1.17.1.4.2 MEL procedures for flight SWR 2140

During flight preparations the flight crew was made aware that the pneumatic system 1 had been deactivated on the aircraft for the impending flight, and that they must therefore consult the appropriate information in the MEL. In the Tech Log (cf. Annex 4) the flight crew was referred to the MEL item 36-11-04A, and to the corresponding MEL operational procedure.

In the electronic manual the flight crew firstly has to enter the aircraft registration in order to access the MEL tailored to the aircraft. If in a further step, as specified in the Tech Log, the MEL item 36-11-04 is clicked on, they obtain the following information:

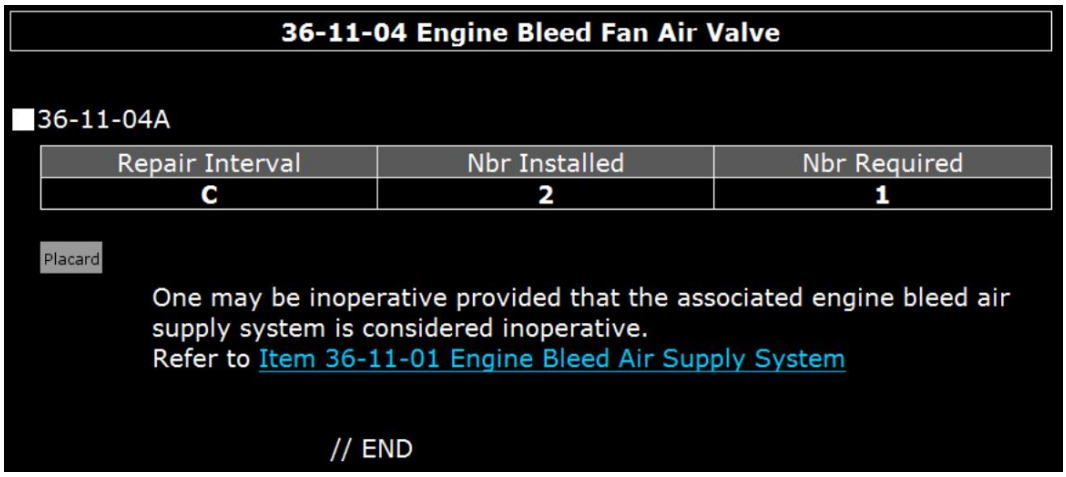


Figure 2: Display of the first page of MEL item 36-11-04A

The flight crew is then requested to: *„Refer to item 36-11-01 Engine Bleed Air Supply System."* If they click on the relevant blue text, the following page appears:

[3] ETOPS stands for „extended range twin operations". In the OM A, in Section 8.5: „Extended range twin operations (ETOPS)", the operator records the relevant conditions that apply for the three phases of „pre-flight", „in-flight until passing ETOPS entry point", and „in-flight after passing ETOPS entry point".

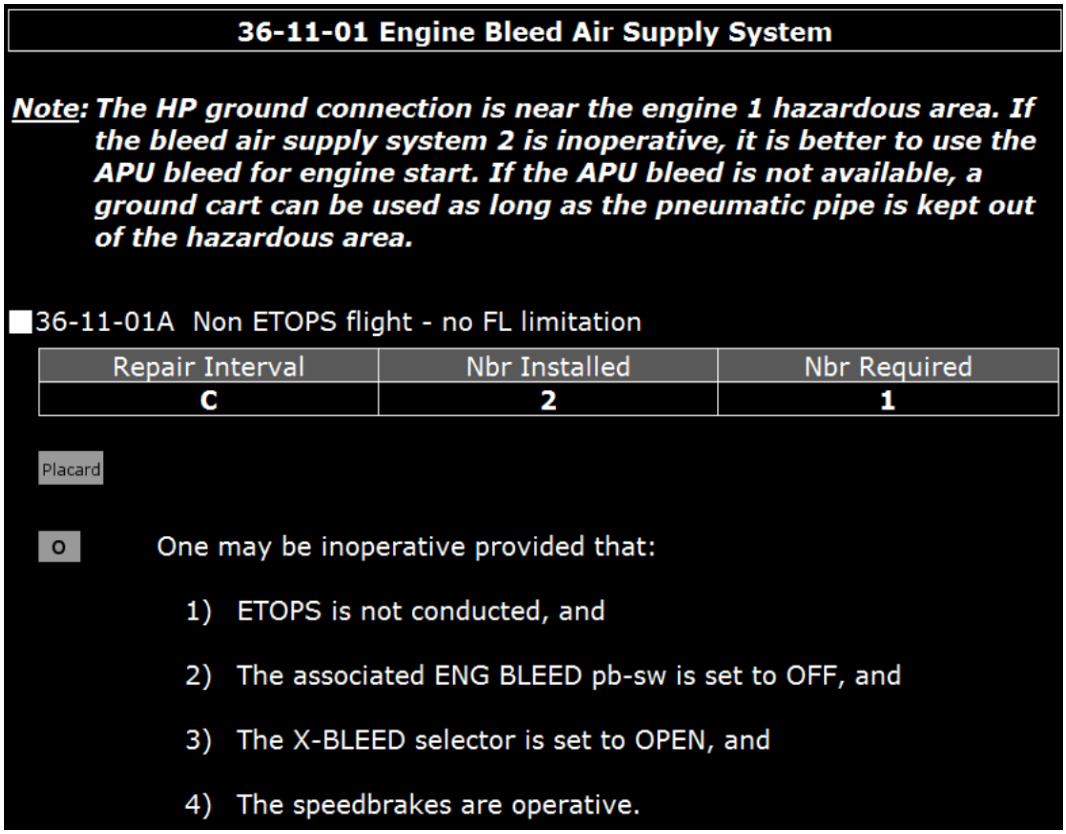


Abbildung 3: Display of the following page of MEL item 36-11-04A

Since flight SWR 2140 to Valencia was not an ETOPS flight, and the speed brakes were functioning, item 36-11-01A applied for the flight crew. The symbol o tells the flight crew that for this item there is another operational procedure that they must take into account. If the flight crew clicks on this symbol the following information is displayed:

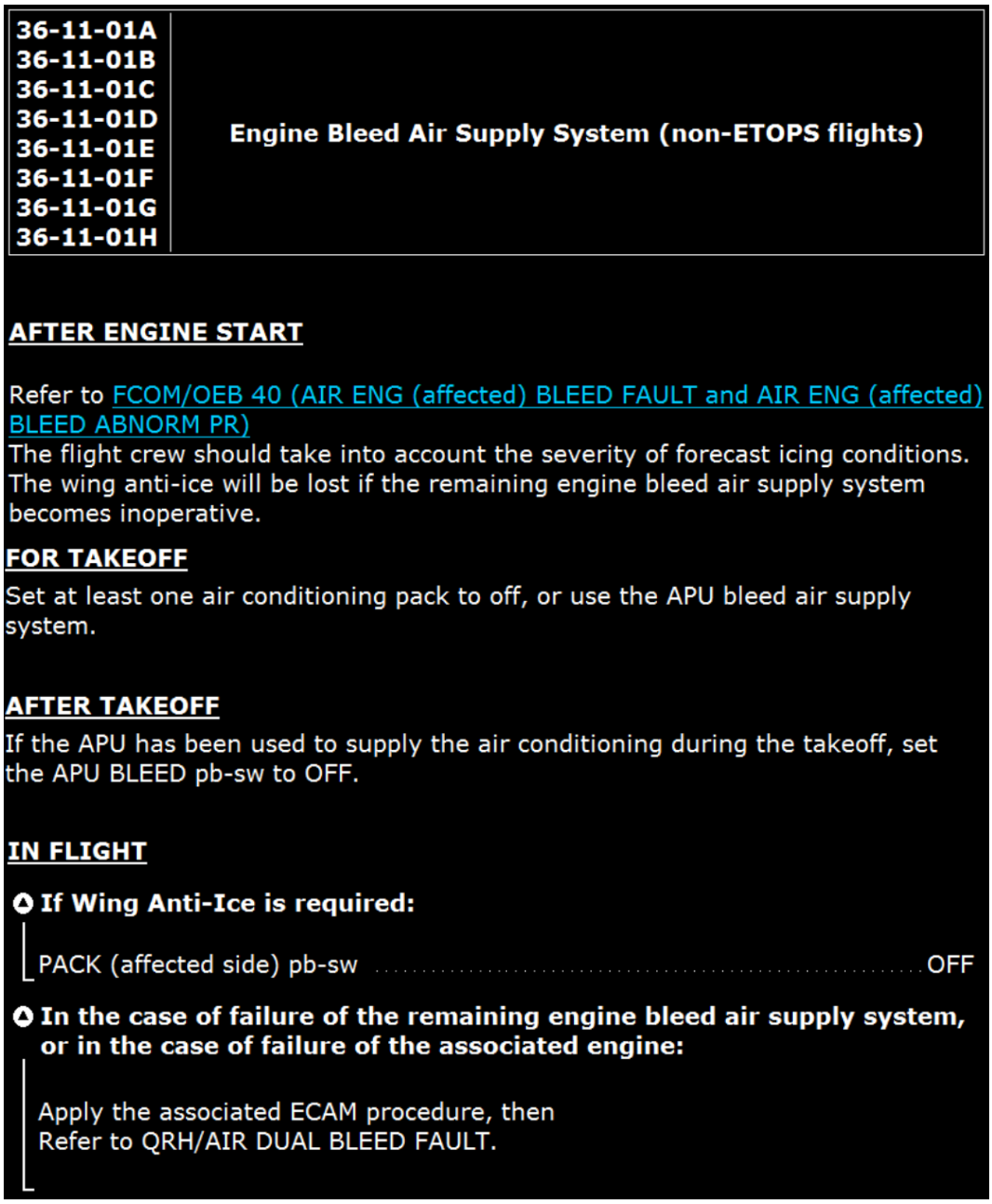


Abbildung 4: Display of the operational procedure to MEL item 36-11-04A

Here blue text refers to the existence of FCOM/OEB 40 for the phase after engine start. If the flight crew clicks on the blue text, they obtain general information concerning the reasons for publishing the operating engineering bulletin (OEB) (cf. Annex 7).

For the procedure itself the flight crew must consult the corresponding OEB in the FCOM respectively in the QRH (cf. Annex 8). As in the blue text (cf. Figure 4) as well as in the OEB 40 it is pointed out again that this procedure applies if one of the following warning is displayed: AIR ENG 1(2) BLEED ABNORMAL PR or AIR ENG BLEED FAULT (cf. chapter 1.18.3). In the serious incident currently under investigation none of the two warnings was displayed after engine start. After engine start the amber message AIR BLEED OFF was displayed on the ECAM and on the respective synoptic page a green continuous horizontal line showed an open crossbleed valve.

If the remaining system fails in flight (IN FLIGHT), the operational procedure then states: *„Apply the associated ECAM procedure"* first and subsequently the AIR DUAL BLEED FAULT procedure published in the QRH (cf. Annex 9).

1.18 Additional information

1.18.1 The aircraft manufacturer

The problems associated with a dual bleed fault have been known to the manufacturer for a long time. As early as 1998 it had published a relevant Technical Follow Up Document (TFU reference 36.11.43.005). In its issue No. 7 of *„The Airbus Safety Magazine"* of February 2009 the aircraft manufacturer also addresses this issue, and records inter alia the following: *„(...) the overwhelming majority of second bleed losses on the A320 Family were caused by an over-temperature condition."*

In the same magazine, issue No. 13 of January 2012, the aircraft manufacturer, once again addresses the issue under the title: *„A320 Family / A330 Prevention and Handling of Dual Bleed loss"*. In what follows the core statements from *„The Airbus Safety Magazine"* are listed:

„3.1.1 Maintenance and Design Enhancements

In 2008, Airbus introduced new maintenance procedures and designed a "Dual Bleed Loss package" (ref. A). This package includes a new Temperature Control Thermostat (TCT), a new Fan Air Valve (FAV) and a new Temperature Limitation Thermostat (TLT).

Today, this DBL package equips more than 70% of the A320 family fleet (either from production or by retrofit) and no reported Dual Bleed Loss has been due to the failure of these new components. (...)"

In Figure 3 of the relevant article the aircraft manufacturer shows statistically the decline in the number of AIR DUAL BLEED FAULT incidents since the availability of the modification, which is described in detail in Service Bulletin No. A320-36-1061.

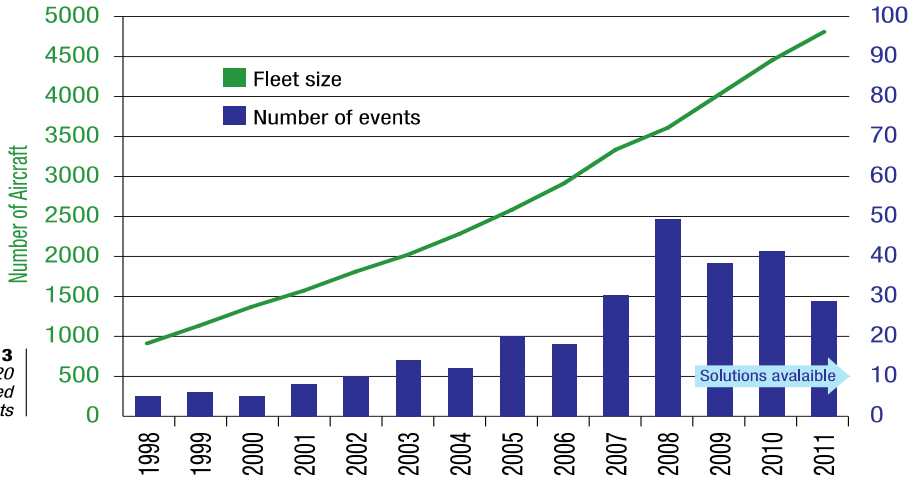


Figure 3
Evolution of A320 Family Dual Bleed Loss events

Figure 5: Figure 3 from the *„Airbus Safety Magazine"*, issue No. 13 of January 2012

Service Bulletin No. A320-36-1061, dated 30 May 2008, records inter alia the following reason for its publication:

"In order to significantly improve the rate of "dual bleed loss" in service due to overtemperature conditions, several actions have been considered (improvement of Fan Air Valve (FAV), improvement of TLT setting, improvement of

AMM/Trouble Shooting Manual (TSM) procedure; Maintenance Planning Document (MPD) for TCT filter cleaning/change) and one particularly is to improve and increase the performance of the temperature regulation function of the TCT.

A new TCT PN 342B050000 has been developed which is an evolution of TCT PN 342B040000.

The TCT is modified in order to ensure that maximum muscle pressure is provided to the FAV in case of high temperature."

"This Service Bulletin is published to advise all operators of A320 family aircraft of the issue of LIEBHERR Service Bulletin No. 342-36-08, which describes the modification that changes TCT, from PN 342B040000 to PN 342B050000."

Service Bulletin No. A320-36-1061 had not been implemented on aircraft HB-IJU.

1.18.2 Investigation report of the United Kingdom Air Accidents Investigation Branch

On 9 November 2001 a serious incident occurred on an Airbus A320 registration G-MEDA. This serious incident had the same origins as that currently under investigation. As a result of a technical fault the bleed system 1 could no longer be switched on, and bleed system 2 subsequently supplied both air conditioning packs with compressed air. The onward course of the flight is described by the United Kingdom Air Accidents Investigation Branch (AAIB), in AAIB Bulletin No. 2/2003 inter alia as follows:

„(...) At approximately 0845 hrs the No 2 engine HP bleed valve started to cycle between the open and closed positions but appeared to stop cycling after about five minutes. At 0852 hrs, however, an ECAM warning AIR ENG 2 BLEED FAULT was annunciated to the crew. The crew declared an emergency and began an emergency descent to FL100. (...)"

In relation to this serious incident the AAIB refers to the *„Recommendation Bulletin"* BR 2001/56(B) of the French DGAC (*Direction générale de l'aviation civile*) published on 31 October 2001, in which it is stated inter alia:

„Investigations revealed that the consecutive loss of both temperature control thermostatic switches (TCT No1 and TCT No2) was the root of this situation. The failure of the first circuit (whichever the cause) generated the failure of the second circuit due to an over temperature resulting to the "as per design" increasing of the air flow associated to the "as per design" increasing of the temperature of the second circuit."

1.18.3 Detailed investigation

The investigation showed that regarding applying the procedures in the MEL and the OEB 40 a lack of clarity exists. Therefore the STSB has asked Airbus to comment on. Based on the recorder data provided by the SUST, the manufacturer has carried out an own investigation. The results of this investigation are identical to those of the STSB.

Regarding applying the OEB 40 procedure the manufacturer states the following: *„to prevent from the loss of the remaining engine bleed by reducing the bleed air demand, when the first engine bleed has been already lost. In order to trigger its applicability in flight, it has been linked o the two ECAM alerts AIR ENG 1(2) BLEED FAULT and AIR ENG 1(2) BLEED ABNORM PR."*

The manufacturer further states that in case of a dispatch according to the MEL, the OEB 40 procedure also has to be applied even if neither of the two warnings is displayed (cf. chapter 1.17.1.4.2). However, since this is not explicitly apparent the manufacturer states the following: *„We understand however that the OEB 40*

procedure application in that case could be considered with room for interpretation in a situation when ECAM alerts are not triggered (as it results from an OEB procedure originally designed to cover the case of a bleed in-flight failure."

In order to improve this situation the manufacturer states that in April 2013 (five months before the serious incident) he has revised the MEL procedure in a way that he has implemented the respective OEB 40 into the MEL procedure (cf. Figure 4 and Annex 7). He states: „The purpose was to have a self-content procedure within the MMEL and avoid having the flight crews switching from one manual to another to put the aircraft in dispatch condition before the flight."

The new MEL procedure (cf. Annex 10) has been available to the operator on 27 November 2013 (two and a half month after the serious incident). The manufacturer states: *„Under the condition of manual revision dispatch to SWR, this version was only made available to SWR from 27-Nov-2013, hence after the event."*

1.19 Useful or effective investigation techniques

Not applicable.

2 Analysis

2.1 Technical aspects

As the subsequent investigation revealed, the trigger for the failure of bleed system 2 was the relevant fan air valve's (FAV) temperature control thermostat (TCT), which at overtemperature conditions did not produce the necessary regulating pressure for the FAV. The fact that this regulation of temperature had already caused problems on many occasions was known to the aircraft manufacturer and the maintenance operator for a long time. The aircraft manufacturer had already addressed this issue in 2009 (cf. chapter 1.18.1) in *„The Airbus Safety Magazine"*.

Likewise Service Bulletin No. A320-36-1061 was published on 30 May 2008, in which reference is made inter alia to the LIEBHERR Service Bulletin No. 342-36-08, which describes the modification to the TCT designed to help reduce the high rate of dual bleed loss as a consequence of overtemperature conditions.

However, this Service Bulletin was planned to execute on aircraft HB-IJU, but was not yet carried out. This circumstance provided the essential preconditions for the serious incident.

2.2 Human and operational aspects

2.2.1 Flight crew

After completion of the flight planning procedures and flight deck preparations the flight crew addressed the study of the minimum equipment list (MEL) and the corresponding consequences. They were therefore of the view that if the remaining pneumatic system 2 would fail they had to use the procedure published in the operations engineering bulletin (OEB).

This meant that when the alert AIR ENGINE 2 BLEED FAULT appeared on the electronic centralised aircraft monitor (ECAM), the commander immediately turned to the procedure in the aircraft manufacturer's operations engineering bulletin (OEB). However, since he did not find this relevant to the situation, he decided to undertake a descent.

This decision was accurate to the situation because neither the OEB procedure nor the ECAM procedure could lead to success. In both procedures a single failure is assumed, in which the remaining system is able to overtake the bleed air demand. In case of a dispatch according to the MEL the result of this single failure however results in a double failure because only one system is available from the very beginning.

The flight crew was thus confronted with a dual bleed loss, which according to the appropriate checklist (cf. Annex 9) requires at least a rapid descent to FL 200 and the starting of the auxiliary power unit. Even an emergency descent to FL 100 is not ruled out; this would be appropriate for a dual bleed loss scenario.

The request for clearance to descend without giving reasons or a particular flight level was not appropriate to the situation. As a result the ATCO was not aware of an abnormal situation and therefore did not react immediately. Only the declaration of the transmitted message as an urgency message with the words PAN PAN finally led to a clearance to descend.

An immediate declaration of an emergency situation aids an appropriate assessment of the situation by air traffic control. Thus the flight crew did receive full support from the ATCO when they gave further emphasis to their descent request with the distress message wording MAYDAY MAYDAY.

As the cabin pressure altitude increased further and the warning message CAB PR EXCESS CAB ALT was subsequently displayed, the flight crew donned their oxygen masks without delay and initiated an emergency descent. This behaviour was goal-oriented and safety-conscious. The crew did not explicitly inform air traffic control about the emergency descent. From the point of view of flight safety, it is useful to orientate air traffic control about an upcoming emergency descent. This moreover allows the flight crew to descend to each of their desired flight levels without further communication, since after a distress call the flight crew is no longer dependent on clearances given by air traffic control.

The flight crew subsequently made contact with the maintenance operator in order to be able to decide on the further course for the flight; this was appropriate to the situation and helped them to continue the flight to the intended destination airport.

For the return flight the flight crew took on board additional fuel in order to cover the possibility of a lower cruise altitude, which was appropriate. Against the advice of the maintenance operator to run the auxiliary power unit during the flight in order to have immediate access to compressed air from the auxiliary power unit in the event of another failure of the bleed system, the flight crew decided not to do this. They justified this by stating that in this event they would have to descend from the planned cruise altitude of FL 380, and would therefore have sufficient time to start the auxiliary power unit.

With this reasoning, and the associated intention of using the planned cruise altitude, the flight crew accepted, consciously or unconsciously, the risk to experience the same scenario as on the previous flight. It should be noted that data subsequently read out from the return flight shows a precooler outlet temperature of over 240°C for a duration of several minutes (cf. chapter 1.6.2.3), which indicates that the possibility of overheating and thus another failure of the bleed system 2 was also present on this flight. Flying with the auxiliary power unit running, at a cruise altitude of less than FL 200, would have significantly eased the situation in the event of another failure of the bleed system (cf. chapter 1.6.2.1). This also corresponded to the deliberations of the maintenance operator, who recommended to the flight crew that they should have the auxiliary power unit running during the flight.

2.2.2 Operator

An operator is free to decide whether it wishes to continue to operate an aircraft in accordance with the MEL or not. The relevant requirements for ongoing operation are published by the aircraft manufacturer in the MEL. However, this does not prevent the operator of an aircraft from prescribing additional restrictions based on its field of deployment and its operating philosophy, such as are made by the aircraft manufacturer with regard to ETOPS.

With regard to the present serious incident it must be recorded that when the aircraft is operated with only one bleed system, the failure of the remaining system leads to a double failure. The consequences can be of importance, as highlighted by the present serious incident.

The decision not to execute the tests due to missing FAV thermostat and to put the aircraft in service again according to the MEL was in regard to the known problems in the bleed system (cf. chapter 1.18 and 2.1) in particular with respect to the demanding operation in accordance with the MEL, not suited to the situation.

This momentous decision was a further essential preconditions for the serious incident.

2.2.3 Air traffic control

As the radiocommunication transcripts confirm, the air traffic control officer on the Marseille M123 Sector frequency answered the first „request descent" call of the flight crew with only clearance for a direct course to waypoint BISBA. The ATCO gave an incomplete response to the second call and answered the call from another aircraft. This behaviour is comprehensible insofar as the pilots, up to this point in time, gave no indication that they were in an abnormal situation.

When the flight crew transmitted the urgency message PAN PAN and requested descent to at least FL 300, they received clearance to descend to FL 350. The flight crew persisted with their urgency message and the ATCO once again requested a repetition of the message. To the repeated requests by the flight crew to descend to a lower FL the ATCO merely responded with *„Roger"*, which indicated little situational awareness. Although the flight crew in the first instance only requested a descent, it is astonishing that the ATCO did not listen attentively, at the latest by the transmission of the PAN PAN message and the reference to pressure problems. The behaviour of the ATCO provided little assistance to the flight crew in this phase. Apparently the ATCO only became conscious of the situation when the flight crew gave further emphasis to their request for further descent by using the distress message MAYDAY. The behaviour of the ATCO altered immediately and the flight crew then received optimal support.

After the change in frequency to the Marseille ML Sector the flight crew also was well supported by the ATCO.

2.2.4 Aircraft manufacturer

In principle the intention of the aircraft manufacturer is that in the event of a fault when operating its aircraft, the flight crews should follow the procedure displayed on the electronic centralised aircraft monitor (ECAM). Since alterations in procedure require a software update, this cannot always be implemented within a reasonable time period. For this reason, as the example of the present serious incident exemplifies, additional so-called operations engineering bulletins (OEB) are published by the aircraft manufacturer which supplement or replace the ECAM procedure.

These OEBs are components of the flight crew operating manual (FCOM) and must be referred to in the FCOM by the flight crew as appropriate. In the FCOM/OEB additional references can sometimes be found to further procedures in the quick reference handbook (QRH).

In the event of operation in accordance with the MEL it must also be taken into account that additional references to operational procedures (MEL operational procedures) can be found in the MEL (cf. chapter 1.17.1.4.2). For the present case the MEL contained information regarding the AIR DUAL BLEED FAULT procedure in the QRH; this information, which can be located via two intermediate steps in a list divided according to flight phases, would have been relevant to the situation.

Against the background of the fact that the information concerning the procedure that should be used for the present case was scattered over various sources such as the MEL, ECAM, FCOM/OEB and QRH, it is not surprising that the flight crew did not immediately apply the AIR DUAL BLEED FAULT procedure published in the QRH.

If one considers all this information, which had to be consulted, for example, in the present serious incident (cf. Annexes 5 to 8 and chapter 1.17.1.4.2) it is clear that this way of dealing with a fault is not very fault-tolerant and not user-friendly.

There is also the fact that according to the containing description in the OEB 40, the respective procedure should only be applied if the respective alerts are triggered. This alerts however will not be triggered after engine start if a dispatch takes place according to the MEL. As a result, it is therefore understandable that a flight crew does not see any reason to do switchings that are based on those alerts. The manufacturer however considers that the OEB procedure has to be applied also when dispatching according to the MEL. Obviously, there exists a lack of clarity. This might have led to the revision, done by the manufacturer in April 2013 (cf. Annex 10), in which the required steps in the OEB 40 procedure were implemented in the MEL procedure. With this a procedure was published that left no room for interpretation anymore.

Regarding the serious incident currently under investigation the flight crew would have, according to the new MEL procedure, after engine start turned the pack flow selector to the LO position and supervised the precooler outlet temperature on the respective synoptic page. A precooler overtemperature and a subsequently switch off of the remaining system would have much probably been avoided.

From the point of view of flight safety it is alarmingly that the revision of the MEL procedure, dated 13 April 2013 was only available to the operator a little more than seven months later.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The aircraft was authorised for VFR and IFR flights.
- Both the mass and centre of gravity of the aircraft were within the permitted limits according to the aircraft flight manual (AFM).
- The pneumatic system 1 was deactivated in accordance with the minimum equipment list (MEL).
- The failure of the remaining pneumatic system 2 occurred as a result of overheating of the fan air valve's (FAV) temperature control thermostat (TCT).
- The Liebherr Service Bulletin No. 342-36-08 published in 2008 describes a modification to improve the temperature regulation of the TCT.
- This service bulletin was planned to execute on aircraft HB-IJU but was not carried out yet.

3.1.2 Flight crew

- The pilots were in possession of the licences necessary for the flight.
- There are no indications that the pilots suffered any health problems during the flight in which the incident occurred.

3.1.3 History of the flight

- At 05:47:54 UTC, when at flight level (FL) 370, the flight crew transmitted a message to the air traffic control officer (ATCO) of the Marseille A3 Sector (AB).
- Subsequently the flight crew established on their system display (SD) that the cabin pressure altitude was increasing at 1700 ft/min.
- The engine 2 bleed air valve was indicated as closed and at 05:51:00 UTC the alert AIR ENG 2 BLEED FAULT appeared on the electronic centralised aircraft monitor (ECAM).
- The flight crew decided on a descent and transmitted a message at 05:52:10 UTC to the ATCO as follows: *„Marseille bonjour, Swiss two one four zero, level three seven zero, request descent."*
- The ATCO did not react to this descent request and at 05:52:38 UTC the flight crew transmitted again: *„Marseille Swiss two one four zero, request descent."*
- The ATCO replied to this message without giving a clearance.
- The flight crew decided to transmit their descent request as an urgency message and at 05:52:56 UTC transmitted the message: *„Swiss two one four zero PANPAN PANPAN PANPAN request descent at least level three zero zero."*
- The ATCO responded to this request with clearance to descend to FL 350 but did not acknowledge the PANPAN.
- The flight crew acknowledged this clearance and at the same time requested clearance to descend to a lower FL, which the ATCO acknowledged with *„Roger".*

- The flight crew intervened and asked whether the ATCO had not understood their PAN PAN message, to which the ATCO responded with: *„Say again your request."*
- The flight crew repeated their descent request, to which the ATCO again responded with *„Roger".*
- At 05:54:10 UTC the flight crew gave greater emphasis to their descent request as follows: *„Swiss two one four zero MAYDAY MAYDAY MAYDAY request descent!"*
- The ATCO responded promptly with: *„Swiss two one four zero, descend flight level three zero zero."*
- In the intervening time the cabin pressure altitude had risen further, and at 05:54:18 UTC the master warning CAB PR EXCESS CAB ALT was triggered in the cockpit.
- The flight crew donned their oxygen masks without delay and initiated an emergency descent, without informing the ATCO of the latter.
- The ATCO gave further clearance to descend in stages to FL 140.
- In accordance with a request to change frequency the flight crew reported to the air traffic control officer of the Marseille ML Sector and subsequently received clearance from the latter to descend to FL 100.
- At FL 100 and with a course towards Barcelona the MAYDAY status was cancelled at 06:03:00 UTC at the request of the ATCO.
- Subsequently the flight crew made contact with their operator and the relevant maintenance control centre (MCC), and started the auxiliary power unit (APU).
- On the advice of the MCC, at 06:14:31 UTC the flight crew performed a successful bleed system 2 reset.
- The flight crew decided for a climb and to continue the flight to their destination airport.
- The remainder of the flight at FL 210 was uneventful and the flight crew landed the aircraft in Valencia at 07:05 UTC.

3.1.4 General conditions

- The pneumatic system 1 was deactivated in accordance with the MEL and only the pneumatic system 2 was available for the two air conditioning packs during the flight.
- In the event of failure of the remaining pneumatic system, the compressed air generated by the APU can only be switched on below FL 200.
- The weather had no influence on the serious incident.

3.2 Causes

The serious incident is due to the fact that during cruise a loss of cabin pressure occurred on the passenger aircraft which required an emergency descent.

The investigation has determined the following causal factors:

- The flight commenced with only one functional pneumatic system;
- A lack of clarity in the procedures meant that the use of this system was not optimised;
- This pneumatic system had characteristics that led to overheating and the system switching itself off;
- An optional improvement provided by the manufacturer (service bulletin) had not yet been implemented;
- A revision of the MEL procedure provided by the manufacturer was not available to the operator at that time.

The following contributing factor was determined for the occurrence and the history of the serious incident:

- The necessary information and procedures for handling a system fault during the flight are not clearly presented to the flight crew.

4 Safety recommendations, safety advices and measures taken since the serious incident

Safety recommendations

According to the provisions of Annex 13 of the International Civil Aviation Organization (ICAO) and Article 17 of Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC, all safety recommendations listed in this report are intended for the supervisory authority of the competent state, which must decide on the extent to which these recommendations are to be implemented. Nonetheless, any agency, any establishment and any individual is invited to strive to improve aviation safety in the spirit of the safety recommendations pronounced.

Swiss legislation provides for the following regulation regarding implementation in the Ordinance on the Safety Investigation of Transport Incidents (OSITI):

„Art. 48 Safety recommendations

[1] The STSB shall submit the safety recommendations to the competent federal office and notify the competent department of the recommendations. In the case of urgent safety issues, it shall notify the competent department immediately. It may send comments to the competent department on the implementation reports issued by the federal office.

[2] The federal offices shall report to the STSB and the competent department periodically on the implementation of the recommendations or on the reasons why they have decided not to take measures.

[3] The competent department may apply to the competent federal office to implement recommendations."

The STSB shall publish the answers of the relevant Federal Office or foreign supervisory authorities at www.stsb.admin.ch in order to provide an overview of the current implementation status of the relevant safety recommendation.

Safety advices

The STSB may publish safety advices in response to any safety deficit identified during the investigation. Safety advices shall be formulated if a safety recommendation in accordance with Regulation (EU) No. 996/2010 does not appear to be appropriate, is not formally possible, or if the less prescriptive form of a safety advices is likely to have a greater effect. The legal basis for STSB safety advices can be found in Article 56 of the OSITI:

"Art. 56 Information on accident prevention

The STSB may prepare and publish general information on accident prevention."

4.1 Safety recommendations

None

4.2 Safety advices

None

4.3 Measures taken since the serious incident

In a letter dated 29 June 2015 the operator informed about the following measures taken since the serious incident:

- „Review des *ORE vom 3.10.2012 (Beilage 12: Swiss Operational Risk Evaluation / ORE: „Risk Evaluation document for <A32F: cabin decompression resulting from a system failure or uncommanded drop-out of Pax oxygen masks> effective 21.3.2014).*
- *Ersatz der verbleibenden TCT PN ...B04 ab November 2013 bis August 2014 gemäss ORE (Umsetzung Airbus SB36-1061 vom 30. Mai 2008)*
- *Einführung des MEL "Redundancy Check of the Remaining Bleed System" (Beilage13: Expérience Sheet Doc. No. 3184)*
- *Einführung des MEL "Redundancy Check of the Remaining Pack" (Beilage 14: Expérience Sheet Doc. Nr. 3185)*
- *Modifikation des Flight Warning Computers (FWC) von Standard H2F5 auf H2F7 und damit Integration des OEB40 in den FWC.*

Präsentation des und umfassende Auseinandersetzung mit dem Vorfall unter Einbezug operationeller, technischer und Schnittstellen Aspekte in der Weiterbildung für Commander (WB Command).”

Payerne, 2 December 2015 Investigation Bureau STSB

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

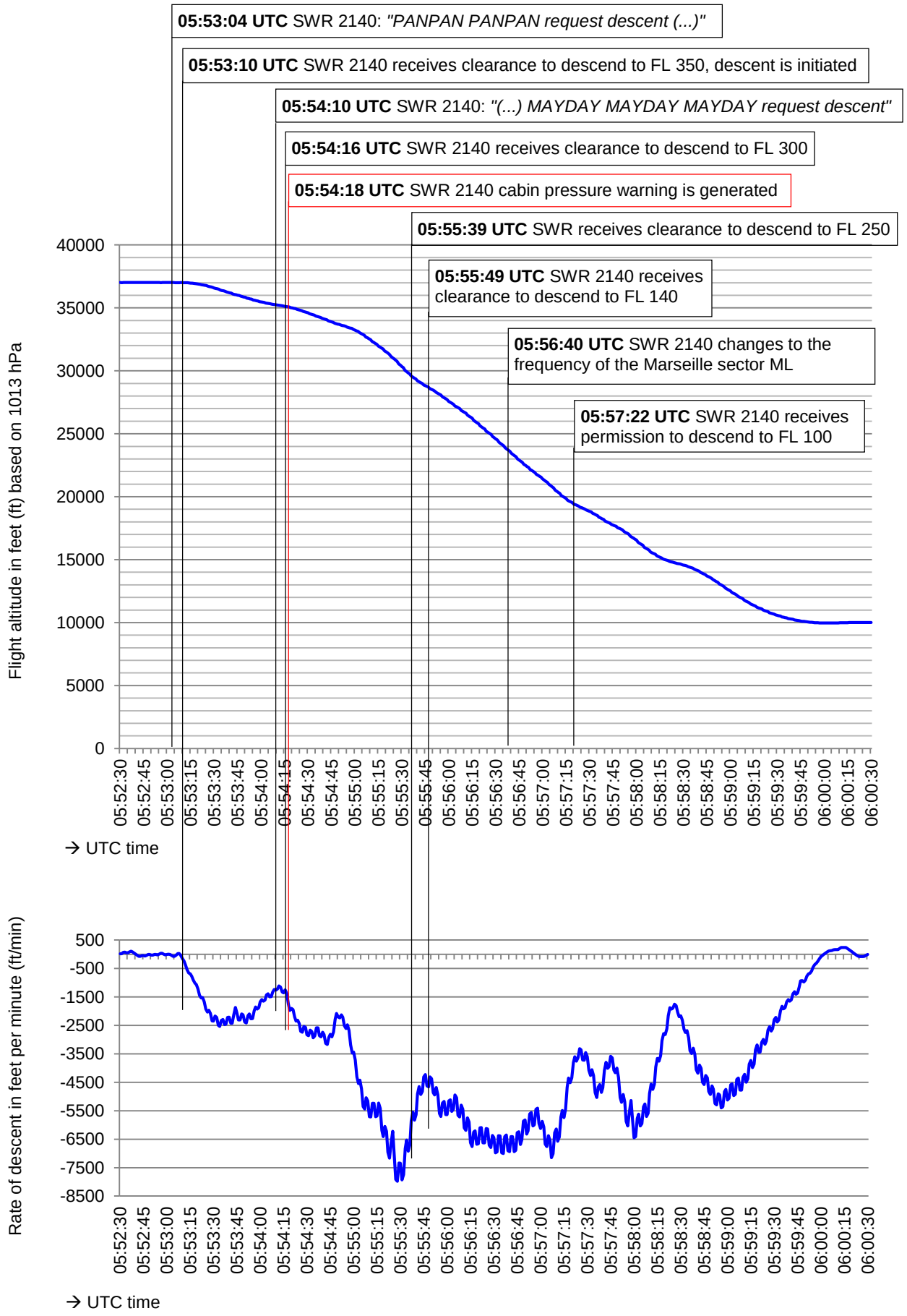
Berne, 10 November 2015

Annexes

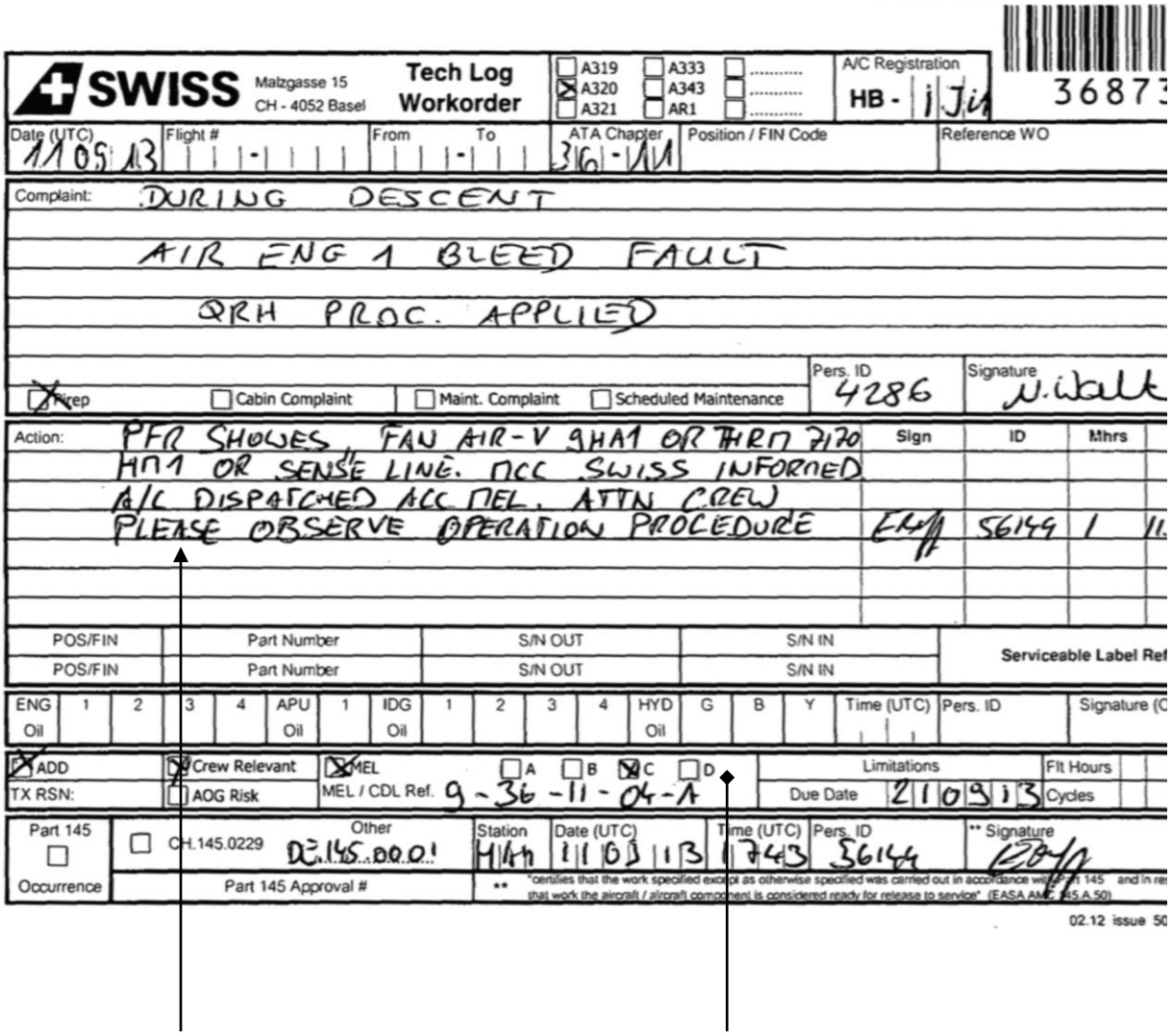
Annex 1: SWR 2140 flight path from Zurich (LSZH) to Valencia (LEVC)

Annex 2: Flight path SWR 2141 from Valencia (LEVC) to Zurich (LSZH)

Annex 3: Vertical flight path SWR 2140



Annex 4: Entry in the tech log



SWISS Malzgasse 15 CH - 4052 Basel — Tech Log Workorder

A319 ☐ A333 ☐ .....
A320 ☒ A343 ☐ .....
A321 ☐ AR1 ☐ .....

A/C Registration: HB - IJU

36873

Date (UTC)	Flight #	From	To	ATA Chapter	Position / FIN Code	Reference WO
11 05 13	-			36 - 11		

Complaint: DURING DESCENT
AIR ENG 1 BLEED FAULT
QRH PROC. APPLIED

☒ Firep ☐ Cabin Complaint ☐ Maint. Complaint ☐ Scheduled Maintenance

Pers. ID: 4286 Signature: N. Walk

Action:	Sign	ID	Mhrs
PFR SHOWES FAN AIR-V 3HA1 OR THRM 7170 HM1 OR SENSE LINE. NCC SWISS INFORMED A/C DISPATCHED ACC MEL. ATTN CREW PLEASE OBSERVE OPERATION PROCEDURE	EM	56144	1

POS/FIN	Part Number	S/N OUT	S/N IN	Serviceable Label Ref
POS/FIN	Part Number	S/N OUT	S/N IN	

ENG Oil	1	2	3	4	APU Oil	1	IDG Oil	1	2	3	4	HYD Oil	G	B	Y	Time (UTC)	Pers. ID	Signature (C

☒ ADD ☒ Crew Relevant ☒ MEL ☐ A ☐ B ☒ C ☐ D — Limitations — Flt Hours
TX RSN: ☐ AOG Risk — MEL / CDL Ref. 9 - 36 - 11 - 04 - A — Due Date 21 09 13 — Cycles

Part 145 ☐ Occurrence ☐ CH.145.0229 Other DE.145.0001 — Part 145 Approval # — Station HAM — Date (UTC) 11 05 13 — Time (UTC) 1743 — Pers. ID 56144 — ** Signature EM

** "certifies that the work specified except as otherwise specified was carried out in accordance with Part 145 and in respect that work the aircraft / aircraft component is considered ready for release to service" (EASA AMC 145.A.50)

02.12 issue 50

Reference to the relevant MEL operational procedure (cf. chapter 1.17.1.4.2)

Reference to the MEL item 36-11-04-A

Annex 5: Procedure for an emergency descent in accordance with FCOM

EMER DESCENT

Applicable to: ALL

IMMEDIATE ACTIONS

CREW OXY MASKS.....ON
SIGNS.....ON

Descend with the autopilot engaged:
- *Turn the ALT selector knob and pull.*
- *Turn the HDG selector knob and pull.*
- *Adjust the target SPD/MACH.*

Use of the autopilot is also permitted in EXPEDITE mode

THR LEVERS (if A/THR not engaged).....IDLE

- *If autothrust is engaged, check that THR IDLE is displayed on the FMA.*
- *If not engaged, retard the thrust levers*

SPD BRK.....FULL

Extension of the speedbrakes will significantly increase Vls.
To avoid autopilot disconnection and automatic retraction of the speedbrakes, due to possible activation of the angle of attack protection, allow the speed to increase before starting to use the speedbrakes.

WHEN DESCENT ESTABLISHED

EMER DESCENT FL 100 or minimum allowable altitude

SPEED.....MAX/APPROPRIATE

CAUTION	*Descend at the maximum appropriate speed. If structural damage is suspected, use the flight controls with care and reduce speed as appropriate.*

Landing gear may be extended below 25 000 ft. Speed must be reduced to VLO/VLE

ENG MODE SEL.....IGN
ATC.....NOTIFY

Notify ATC of the nature of the emergency, and state intention. if not in contact with ATC, transmit a distress message on one of the following frequencies: (VHF) 121.5 MHz , or (HF) 2 182 kHz , or 8 364 kHz.

ATC XPDR 7700.....CONSIDER

Squawk 7700 unless otherwise specified by ATC.

- *To save oxygen, set the oxygen diluter selector to the N position.*

Continued on the following page

EMER DESCENT (Cont'd)

- *With the oxygen diluter selector left at 100 % , oxygen quantity may be insufficient to cover the entire emergency descent profile.*
- *Ensure crew communication is established with oxygen masks. Avoid continuous use of the interphone to minimize interference from the oxygen mask breathing noise*

MAX FL.....100/MEA

● **IF CAB ALT > 14000 feet:**

PAX OXY MASKS.....MAN ON

This action confirms that the passenger oxygen masks are released.

Note: *Notify the cabin crew, when the aircraft reaches a safe flight level, and when cabin oxygen is no more necessary.*

Annex 6: Procedure for loss of cabin pressure in accordance with FCOM

CAB PR EXCESS CAB ALT

Applicable to: ALL

L2 Rely on the CAB PR EXCESS CAB ALT warning even if not confirmed on the CAB PRESS SD page. The warning can be triggered by a cabin pressure sensor different from the one used to control the pressure and display the cabin altitude on the SD.

L1 CREW OXY MASK (IF ABOVE FL100)..... ON

■ **If above FL 100, and under FL 160:**

DESCENT.....INITIATE
MAX FL..... 100/MEA

■ **If above FL 160:**

SIGNS.....ON

EMER DESCENT
DESCENT.....INITIATE
THR LEVERS (IF A/THR NOT ENGAGED).....IDLE
SPD BRK.....FULL

L2 *Extension of speedbrakes will significantly increase VLS.*
In order to avoid autopilot disconnection and automatic retraction of speedbrakes due to possible activation of angle of attack protection, allow the speed to increase before starting to use speedbrakes.

L1 SPD.....MAX/APPROPRIATE

L2 *Descend at maximum appropriate speed. However, if structural damage is suspected use the flight controls with care and reduce speed as appropriate. Landing gear may be extended below 25 000 ft. In this case, speed must be reduced to VLO/VLE.*

L1 ENG MODE SEL.....IGN
ATC..... NOTIFY

L2 *Notify ATC of the nature of the emergency, and state intention. If not in contact with ATC, transmit a distress message on one of the following frequencies: (VHF) 121.5 MHz, or (HF) 2.182 kHz, or 8 364 kHz.*
Squawk 77000 unless otherwise specified by ATC.
To save oxygen, set the oxygen diluter selector to N position.
With the oxygen diluter left to 100 %, oxygen quantity may not be sufficient for the entire descent profile.
Ensure that the flight crew can communicate wearing oxygen masks. Avoid the continuous use of the interphone position to minimize the interference from the noise of the oxygen mask.

L1 MAX FL..... 100/MEA

Continued on the following page

CAB PR EXCESS CAB ALT (Cont'd)

● **IF CAB ALT > 14 000 FT:**

PAX OXY MASKS.....MAN ON

L2 *This action confirms that the passenger oxygen masks are released.*

Note:
- *When descent is established and if time permits, check that the OUTFLOW VALVE is closed on the CAB PRESS SD page. If it is not closed and ΔP is positive, select the other CPC. If the OUTFLOW VALVE is still not closing set the cabin pressure MODE SEL pb to MAN and the V/S CTL sw to full down.*
- *Notify the cabin crew when the aircraft reaches a safe flight level, and when cabin oxygen is no more necessary.*

MAX FL..... 100/MEA

Annex 7: Information from the aircraft manufacturer concerning the OEB

OEB40 Issue 1.0
AIR ENG 1(2) BLEED ABNORMAL PR OR AIR ENG 1(2) BLEED FAULT

Approved by: -Head of Flight Operations Support and Services

This OEB covers a significant operational issue. Non-compliance with this OEB may have a significant impact on the operation of the aircraft.
Therefore, Operators must distribute this OEB, or the information contained in this OEB, to all flight crews without delay.
In addition, it is recommended that all Operators rapidly incorporate applicable corrective Service Bulletins as soon as they become available.

Reason for issue:	This OEB replaces the A320 OEB 203. Subsequent to several dual bleed loss cases reported by Operators, Airbus decided to develop different technical solutions to improve the robustness of the bleed system. These technical solutions, although significantly reducing the number of dual bleed loss occurrences, cannot fully avoid such occurrences. Therefore, this OEB is published in order to provide all SA Operators with operational procedures aiming at further reducing the number of dual bleed loss occurrences, whatever the bleed system solution installed.
Applicable to:	All A320 family aircraft.
Cancelled by:	FWC Standard H2-F6 (MOD 151269)

Note: The interchangeability code, given in the Illustrated Part Catalog (IPC), indicates the conditions for interchangeability of equipment. After installation of corrective modification(s)/SB(s), if an Operator reinstalls any equipment affected by this OEB, it is the Operator's responsibility to ensure that the recommendations given in this OEB are applied again for the applicable aircraft.

OEBs are issued by Airbus, as the need arises, to rapidly inform operators of any deviations from initial design objectives that have a significant operational impact.
Airbus distributes OEBs to all FCOM holders.
The information in the OEB is recommended by Airbus, but may not be approved by Airworthiness Authorities.
If the procedures contained in the OEB differ from the procedures in the AFM, the approved AFM remains the reference.

Annex 8: Procedure in accordance with OEB 40

AIR ENG 1(2) BLEED ABNORMAL PR OR AIR ENG 1(2) BLEED FAULT

Applicable to: ALL

EXPLANATION

In case of AIR ENG 1(2) BLEED ABNORMAL PR or AIR ENG 1(2) BLEED FAULT ECAM cautions, the current associated ECAM procedures, ask to open the crossbleed valve in order to supply both Packs (or one Pack and the Wing Anti-Ice system) with the remaining engine bleed. This leads to an increase in air demand on the remaining engine bleed. On ageing bleed equipment or due to undetected failure, the remaining bleed may not succeed in sustaining this increase in air demand. In that case, it can result in an overheat of the remaining engine bleed and subsequent loss of the entire engine bleed system, leading to possible emergency descents. The purpose of this OEB is, therefore, to prevent from the loss of the remaining engine bleed by reducing the bleed air demand, when the first engine bleed has been already lost.

PROCEDURE

Apply the corresponding procedures if one of the following ECAM caution is triggered:

- AIR ENG 1(2) BLEED ABNORMAL PR
- AIR ENG 1(2) BLEED FAULT

AIR ENG 1(2) BLEED ABNORMAL PR

■ **If Wing Anti-Ice is OFF**

PACK FLOW.....LO (A319/A320)
ECON FLOW.....ON (A321)
X BLEED.....OPEN
BLEED page.....SELECT and MONITOR

● **If the precooler outlet temperature of the remaining bleed exceeds 240 °C within 2 min after X BLEED valve opening:**

PACK (on the first affected bleed side).....OFF

Note: If Wing Anti-Ice is required (icing conditions) while operating with one PACK, consider switching OFF the remaining pack, if aircraft's altitude permits.

■ **If Wing Anti-Ice is ON**

● **If both PACKS are ON**

PACK (affected bleed side).....OFF

X BLEED.....OPEN
BLEED Page.....SELECT and MONITOR

Continued on the following page

AIR ENG 1(2) BLEED ABNORMAL PR OR AIR ENG 1(2) BLEED FAULT (Cont'd)

● **If the precooler outlet temperature of the remaining bleed exceeds 240 °C within 2 min after X BLEED valve opening:**
BLEED AIR DEMAND.....REDUCE
Consider reducing the bleed air demand, by, depending on the flight conditions:

- *Switching OFF the remaining pack (if aircraft's altitude permits), or*
- *Switching OFF the Wing Anti-Ice system (if no longer icing conditions).*

AIR ENG 1(2) BLEED FAULT

ENG BLEED affected.....OFF

■ **If Wing Anti-Ice is OFF**
PACK FLOW.....LO (A319/A320)
ECON FLOW.....ON (A321)
X BLEED.....OPEN
BLEED Page.....SELECT and MONITOR

● **If the precooler outlet temperature of the remaining bleed exceeds 240 °C within 2 min after X BLEED valve opening:**
PACK (on the first affected bleed side).....OFF

Note: If Wing Anti-Ice is required (icing conditions) while operating with one PACK, consider switching OFF the remaining pack, if aircraft's altitude permits.

■ **If Wing Anti-Ice is ON**

● **If both PACKS are ON**
PACK (affected bleed side).....OFF

X BLEED.....OPEN
BLEED Page.....SELECT and MONITOR

● **If the precooler outlet temperature of the remaining bleed exceeds 240 °C within 2 min after X BLEED valve opening:**
BLEED AIR DEMAND.....REDUCE
Consider reducing the bleed air demand, by, depending on the flight conditions:

- *Switching OFF the remaining pack (if aircraft's altitude permits), or*
- *Switching OFF the Wing Anti-Ice system (if no longer icing conditions).*

Continued on the following page

AIR ENG 1(2) BLEED ABNORMAL PR OR AIR ENG 1(2) BLEED FAULT (Cont'd)

OEB REMINDER

For aircraft that have the OEB reminder function activated, the AIR ENG 1(2) BLEED ABNORMAL PR and AIR ENG 1(2) BLEED FAULT ECAM cautions procedure and status may be flagged.
If the AIR ENG 1(2) BLEED ABNORMAL PR and AIR ENG 1(2) BLEED FAULT ECAM cautions procedure are flagged, the ECAM will display the REFER TO QRH PROC line or REFER TO QRH/OEB PROC line (depending on Flight Warning Computer (FWC) standard) instead of the procedure itself.
To flag the procedure and the status that corresponds to the AIR ENG 1(2) BLEED ABNORMAL PR and AIR ENG 1(2) BLEED FAULT ECAM cautions, the following code must be entered in the FWC OEB database:

CODE	WARN	STS
AIR ENG 1 BLEED ABNORMAL PR 36/11/150/081	Y	N
AIR ENG 2 BLEED ABNORMAL PR 36/11/160/083	Y	N
AIR ENG 1 BLEED FAULT 36/21/010/075	Y	N
AIR ENG 2 BLEED FAULT 36/21/020/077	Y	N

CORRECTIVE ACTION

The embodiment of FWC Standard H2-F6 (MOD 151269) cancels the need for this OEB.

Annex 9: Procedure in accordance with QRH

AIR DUAL BLEED FAULT

If ENG1 BLEED was lost due to a:

LEAK on side 1
ENG 1 FIRE
Start Air Valve 1 failed open.

DESCENT TO FL100/MEA — INITIATE

Descend rapidly to 100 FL/MEA, to prevent excessive cabin altitude.

AVOID ICING CONDITIONS

IF ICE ACCRETION

APPR SPD — VLS + 10 KT

LDG DIST PROC — APPLY

If ENG 2 BLEED was lost due to a:

LEAK on side 2
ENG 2 FIRE
Start Air Valve 2 failed open.

X BLEED — CHECK CLOSED

DESCENT TO FL200/MEA — INITIATE

Descend rapidly to 200 FL, to recover the bleed supply from the APU.

APU — START

Start the APU during the descent.

AT, OR BELOW, FL200 :

WING A.ICE — OFF

APU BLEED must not be used for wing anti-ice.

APU BLEED — ON

MAX FL200

AVOID ICING CONDITIONS

IF ICE ACCRETION

APPR SPD — VLS + 10 KT

LDG DIST PROC — APPLY

In all other cases :

DESCENT INITIATE

Descend rapidly to 200 FL, so that the bleed supply may be supplied by the APU, if the bleed system recovery is not successful.

If both packs are available :

If both packs are operative, it can be suspected that the second bleed system failed due to excessive demand. Recovery of the second failed engine bleed may be attempted.

If ENG 1 BLEED is lost first :

PACK 1 OFF

ENGINE 2 BLEED ON

If ENG 2 BLEED is lost first :

PACK 2 OFF

ENGINE 1 BLEED ON

If engine bleed recovery was not successful, or if one pack is inoperative :

X BLEED CHECK OPEN

DESCENT TO FL200/MEA CONTINUE

Descend rapidly to 200 FL, to recover the bleed supply from the APU

APU START

Start the APU during the descent.

AT, OR BELOW, FL200 :

WING A.ICE OFF

APU BLEED must not be used for wing anti-ice.

APU BLEED ON

MAX FL200

AVOID ICING CONDITIONS

IF ICE ACCRETION

APPR SPD VLS + 10 KT

LDG DIST PROC APPLY

Annex 10: Revised MEL procedure

36-11-01A **36-11-01C** **36-11-01E** **36-11-01G**	**Engine Bleed Air Supply System (non-ETOPS flights)**

Ident.: MO-36-11-00008868.0002001 / 26 NOV 13

6 **Applicable to: MSN 0545-0643, 0673-0782, 1762-2134, 4618-5069**

7 **FLIGHT PREPARATION/LIMITATIONS**

The flight crew should take into account the severity of forecast icing conditions. The wing anti-ice will be lost if the remaining engine bleed air supply system becomes inoperative.

8 **AFTER ENGINE START**

- ENG BLEED (AFFECTED) pb-sw..... OFF
- X BLEED rotary selector..... OPEN

■ **If both PACKs are operative:**

■ **If Wing Anti-Ice is not required:**

PACK FLOW selector..... LO

The PACK FLOW selector must be set to LO due to precooler performance.

AFT CARGO HOT AIR pb-sw..... OFF

■ **If Wing Anti-Ice is required:**

PACK (AFFECTED) pb-sw..... OFF

■ **If one PACK is inoperative:**

PACK FLOW selector..... HI

FOR TAKEOFF

Set at least one air conditioning pack to off, or use the APU bleed air supply system.

Continued on the following page

Continued from the previous page

9 **AFTER TAKEOFF**

● **If the APU has been used to supply the air conditioning during the takeoff:**

APU BLEED pb-sw..... Off

BLEED SD page..... SELECT and MONITOR

● **If the precooler outlet temperature of the remaining bleed exceeds 240 °C within 2 min after the selection of both PACKs or the APU BLEED OFF:**

PACK (affected side) pb-sw..... OFF

10 **IN FLIGHT**

● **If Wing Anti-Ice is required and both PACKs are operative::**

PACK (affected side) pb-sw..... OFF

BLEED SD page..... SELECT and MONITOR

● **If the precooler outlet temperature of the remaining bleed exceeds 240 °C within 2 min after the selection of the Wing Anti-Ice ON:**

BLEED AIR DEMAND..... REDUCE

Consider reducing the bleed air demand by, depending on the flight conditions:
- *Switching OFF the remaining PACK (if aircraft's altitude permits), or*
- *Switching OFF the Wing Anti-Ice (if no longer icing conditions).*

● **In the case of failure of the remaining engine bleed air supply system, or in the case of failure of the associated engine:**
- Apply the associated ECAM procedure, then
- *Refer to QRH/ABN-36 AIR ENG 1+2 BLEED FAULT*

Remark: the black vertical lines on the left of the procedure remind that those items have been revised (former procedure cf. Figure 4, chapter 1.17.1.4.2)