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A320 Family / A330 Prevention and Handling of Dual Bleed Loss

1. Introduction

Dual Bleed Loss (DBL) may impact flight operations, as it often results in either in-flight turn back or emergency descent followed by flight diversion.

Many of these DBL events could be avoided by applying currently available solutions, which include design modifications, as well as maintenance and operational procedures. In-service experience shows that the introduction of these mitigation measures have led to a clear decrease in the number of occurrences.

A DBL requires a quick identification of the situation and a rapid reaction. To simplify the crew's task, a new standardized procedure has been introduced, that covers all cases of Dual Bleed Loss.

The aim of this article is to:

► Remind maintenance/engineering personnel and pilots of the existing solutions and

► Present crews with the new DBL ECAM/QRH procedure.

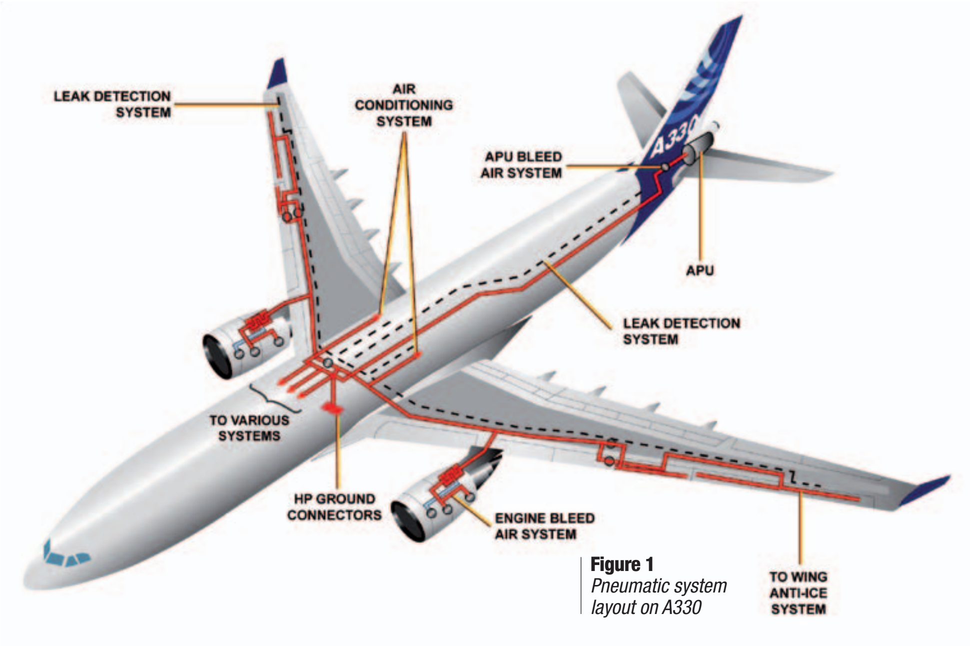

Figure 1
Pneumatic system layout on A330

2. The Bleed System in a Few Words

The bleed system supplies pressure and temperature regulated air to the aircraft systems. The main users are the air conditioning system, which ensures air regulation for both cabin pressurization and temperature, and the wing anti-ice system (fig. 1).

On the A320 Family and A330, the regulation of the bleed system is purely pneumatic and operates automatically. Under normal operating conditions, air is taken from the engines and the flight crew has no action to perform on the system.

On ground, under normal operation, the APU can supply bleed air for cabin comfort or for engine start. In flight, under abnormal procedure when the engine bleed systems are no longer available, the APU bleed can also supply air for cabin pressurization (below the APU ceiling).

3. Failure Scenarios and Mitigations

A Dual Bleed Loss situation corresponds to the loss of both engine bleed air systems. The non availability of the first bleed system may be triggered by various causes, including dispatch under MMEL, and is monitored and investigated as part of the bleed system reliability. A single remaining engine bleed system is capable of supplying all the bleed functions. Under these circumstances, a fault on this second system triggers the DBL situation. The analysis of DBL events is focused on the loss of the second engine bleed system.

3.1 A320 Family

Historically, as indicated in the Safety First article "A320: Avoiding Dual Bleed Loss" published in issue n°7 (February 2009), the overwhelming majority of second bleed losses on the A320 Family were caused by an overtemperature condition.

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 (fig. 3). A specific retrofit policy has been offered to support a prompt in-service implementation. The few DBL events reported on this upgraded fleet were due to installation issues, such as senseline leakage between TCT and FAV or TCT filter clogging (ref. B).

Importance of Logbook Recording

Dual Bleed Loss events are generally preceded by single bleed fault occurrences. Recurrent and unsolved single bleed faults increase exposure to Dual Bleed Losses.

Any fault in flight reflects an abnormal system behaviour and must be taken into account, even if cleared by a reset. Proper troubleshooting of the fault is necessary in order to reduce the probability of reoccurrence.

An early investigation of each single bleed fault is the most efficient action to prevent a dual bleed fault. This therefore requires a systematic logbook recording to allow timely troubleshooting of each single bleed fault detected in flight.

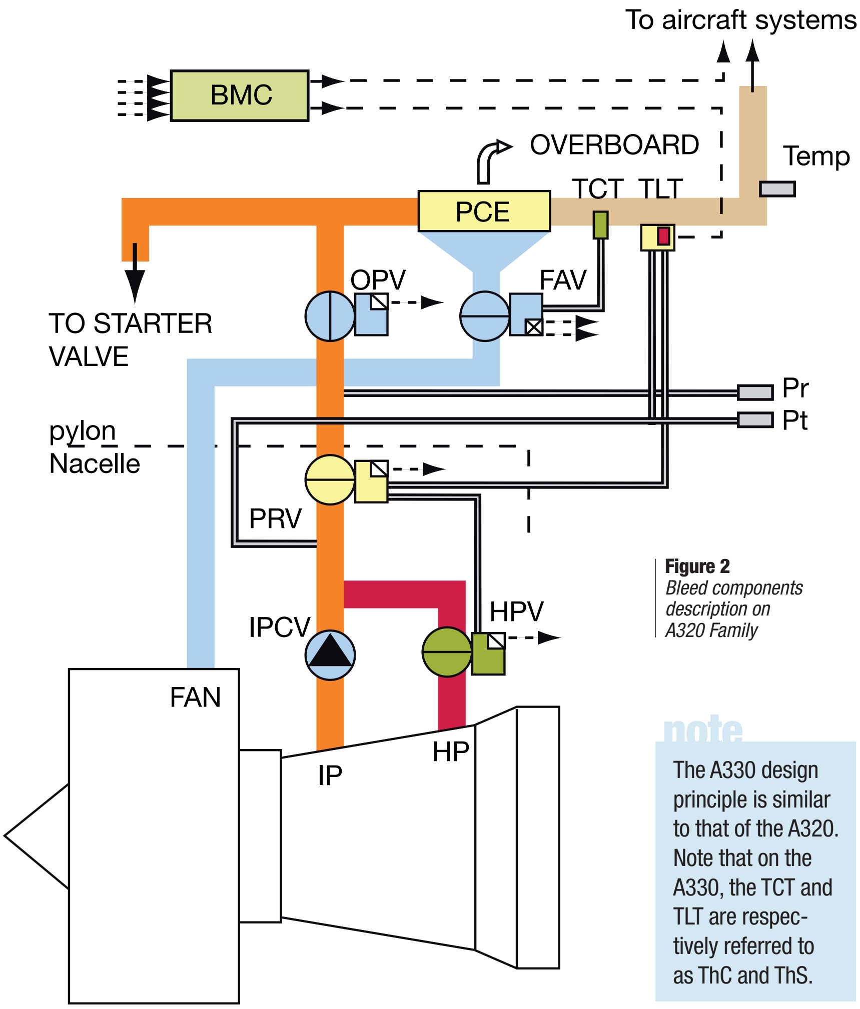

Figure 2
Bleed components description on A320 Family

Temperature Regulation	PCE	Precooler
	FAV	Fan Air Valve
	TCT	Temp. Control Thermostat
Pressure Regulation	TLT	Temp. Limitation Thermostat
	OPV	Overpressure Valve
	PRV	Pressure Reg. Valve
	HPV	High Pressure Valve
	IPCV	Intermediate Pressure Check Valve
Monitoring	BMC	Bleed Monitoring Computer
	Pr	Regulated Pressure Transducer
	Pt	Transfered Pressure Transducer

note

The A330 design principle is similar to that of the A320. Note that on the A330, the TCT and TLT are respectively referred to as ThC and ThS.

3.1.2 Operational improvements

The Operational Engineering Bulletin (OEB) 40 (former OEB 203/1 issued in March 2010) was introduced to provide recommendations to monitor the temperature on the remaining engine bleed in order to prevent overheat from occurring. If the temperature increases above 240°C, the flight crew has to reduce the demand on this bleed by switching OFF one pack or the wing anti-ice system.

The Flight Warning Computer (FWC) F6 standard, planned for certification beginning 2012, will include a new ECAM AIR ENG 1(2) BLEED HI TEMP caution that triggers when one engine bleed is OFF and the temperature of the remaining engine bleed exceeds 240°C. The associated ECAM procedure calls for one pack or the wing anti-ice to be switched OFF (fig. 4). Embodiment of the FWC F6 standard will cancel the OEB 40.

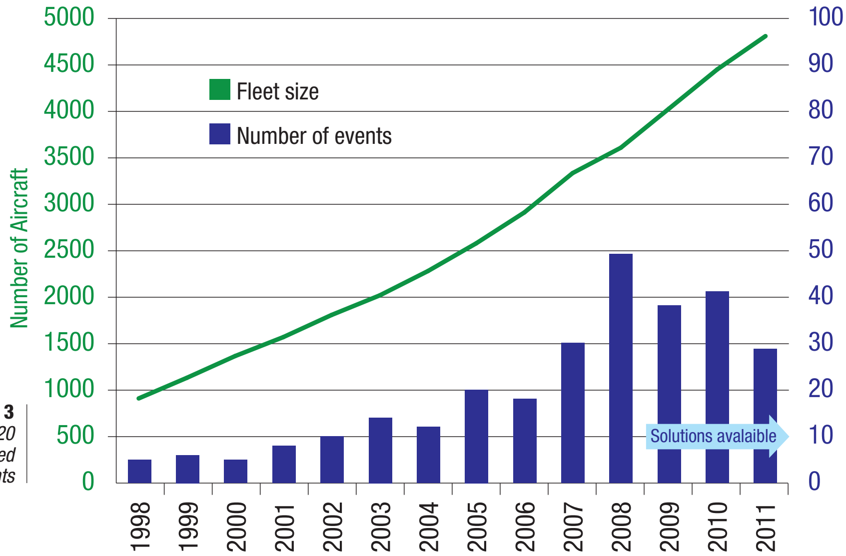

Figure 3
Evolution of A320 Family Dual Bleed Loss events

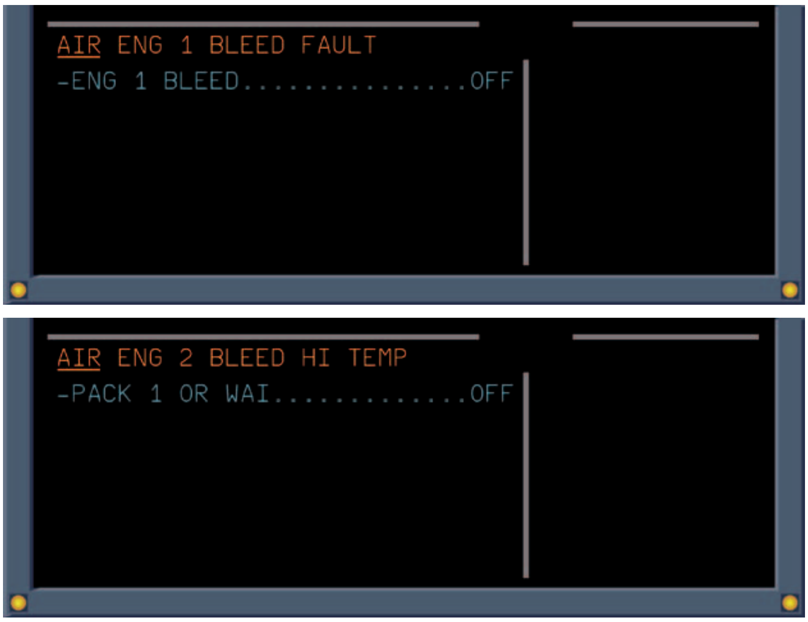

Figure 4
ECAM AIR ENG 1(2) BLEED HI TEMP caution

3.2 A330

3.2.1 Bleed Overpressure

In contrast to the A320, the main cause for Dual Bleed Loss on the A330 is bleed overpressure (ref. C). GE mounts are particularly affected by this phenomenon. The two most common scenarios are as follows:

- **Pressure overshoot at thrust increase** during takeoff, due to degraded reactivity of the Pressure Regulating Valve (PRV). The overpressure peak increases if the takeoff is performed with the air conditioning packs selected OFF, due to the no flow (demand) condition (refer to adjacent notes).
- **Erroneous measurement of regulated pressure (Pr)** due to frozen condensed water in the pressure transducers, leading the Bleed Monitoring Computer (BMC) to shut off the affected bleed system. This failure mode typically occurs in cruise or at the start of descent after a long cruise period at very low temperature (Static Air temperature lower than -60°C).

Operational note

a) The AIR ENG 1(2) BLEED FAULT caution generally appears when passing 1500ft as it is inhibited by the Flight Warning Computer during phase 5.

b) Exposure to this failure mode may be reduced by taking off with packs ON. (FCOM PRO-NOR-SOP-Before Takeoff) and by complying with the Standard Operating Procedure for two-step takeoff thrust setting (FCOM PRO-NOR-SOP-Takeoff).

Engineering note

The closure threshold of the Over-Pressure Valve (OPV) is being optimized to prevent early closure in case of PRV pressure overshoot at takeoff and subsequent loss of bleed system. The new OPV setting will be introduced through a VSB to be released by Q1 2012 (follow-up through ref. C).

The geometry of the pressure measurement chamber has been redesigned (improved drainage and bigger chamber volume) to allow more robustness. The new part number ZRA691-00 is installed in production by MOD 202028 from MSN 1254. For in-service aircraft a specific retrofit policy already applies to aircraft fitted with GE mounts (ref. D).

3.2.2 Bleed Overtemperature

The overtemperature occurrences are mainly driven by the ageing of the:

► Thermostat Controller (ThC) and/or

► Fan Air Valve (FAV)

The following technical solutions (ref. E) have significantly reduced the number of bleed losses due to overtemperature (fig. 5):

► Improved maintenance and design of the Thermostat Controller

A key parameter to maintain an optimum serviceability of the component is to adjust the interval for ThC filters cleaning or replacement, depending on the severity of the operating environment. Implementation of this preventive maintenance procedure and customization of the interval are available from MPD and via specific SIL (ref. B).

The ThC has also been redesigned with a new clapper/guide material in order to further improve its reliability. This improvement is covered by a Part Number change and is fitted in production starting at MSN 1274. For the in-service fleet, the Liebherr VSB 398-36-05 released in Nov 2011 applies.

► Enhanced Fan Air Valve test procedures

New functional test procedures have been developed to allow an earlier detection of the drift as well as an easier detection of faulty components. Specific health monitoring of the FAV is also recommended at the same interval as the ThC filters cleaning.

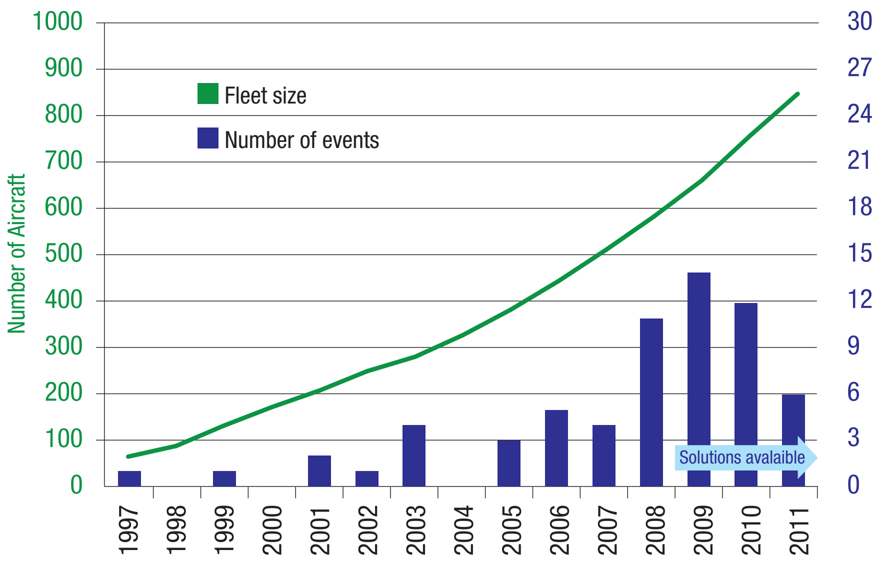

Figure 5
Evolution of A330 Dual Bleed Loss events.

4. A320 Family/A330 New Operational Procedure

A Dual Bleed Loss requires a quick identification of the situation and a rapid reaction.

Airbus has performed an operational review of in-service events, which led to the standardization of the existing Dual Bleed Loss procedures. In order to simplify the crew's task, the DBL procedures now give similar instructions whatever the cause of the Dual Bleed Loss.

In essence the new procedure calls for:

► A single reset of each engine bleed (provided there is no bleed leak*)

A reset may clear a fault on a bleed system if that fault was as a result of a temporary parameter fluctuation. Typically, this can be due to a failure of the system to properly regulate the bleed pressure or temperature due to engine thrust variation. In such a case, a bleed reset may allow recovery of normal operation provided the parameter is back within its normal regulation range.

Performing more than one reset would unnecessarily delay the initiation of the descent.

► If the reset is unsuccessful, rapid initiation of the descent, when above FL100

In case of Dual Bleed Loss at or close to cruise altitude, the typical fuselage leak rate leads to a cabin altitude increase of up to around 1000 ft/min. Any delay in the descent initiation will increase exposure to an ECAM CAB PR EXCESS CAB ALT warning, which requires a mandatory emergency descent.

► APU start

In case of dual engine bleed failure, the backup bleed source is the APU.

► APU bleed selection when within the APU bleed envelope

At lower altitude (FL220/200 depending on APU standard) the APU bleed enables supply of the air conditioning system, thus ensuring cabin pressurization and preventing a descent to FL100.

** In case of bleed leak, a specific procedure will apply.*

► **A second reset at lower altitude**

A QRH procedure (called at the end of the ECAM procedure) will provide the flight crew with a second reset procedure. The reason for this second attempt is that a reset is more likely to be successful at lower altitude.

4.1 New ECAM AIR ENG 1+2 Bleed Fault Procedure

A new ECAM AIR ENG 1+2 BLEED FAULT caution and procedure was designed (fig. 6).

Implementation is planned as follows:

► A320 Family: on the Flight Warning Computer (FWC) F8 standard, certification Q4 2015

► A330: on the FWC T5 standard, certification planned Q4 2012.

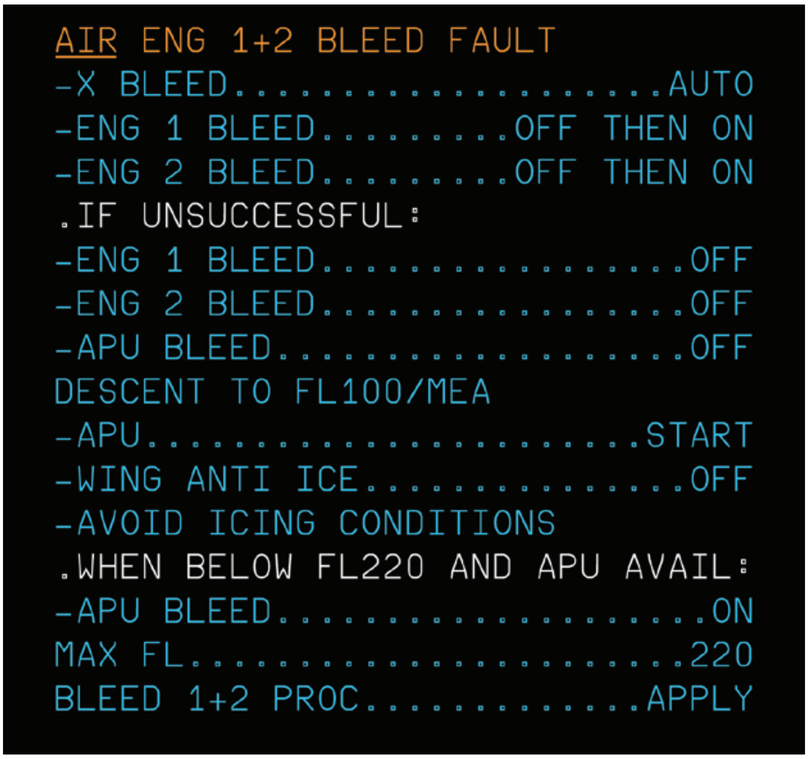

Figure 6
Typical new ECAM AIR ENG 1+2 BLEED FAULT caution and procedure

4.2 New QRH AIR ENG 1+2 Bleed Fault Procedure

Pending the implementation of the new ECAM procedure, the QRH current AIR DUAL BLEED FAULT procedure will be enhanced to be in line with the new ECAM and renamed as AIR ENG 1+2 BLEED FAULT (Q1 2012).

5. CONCLUSION

The consequences of Dual Bleed Loss occurrences range from in-flight turn backs to cabin depressurization events followed by flight diversions.

Technical solutions have been devised, which are summarized in this article. They include new maintenance and operational procedures as well as redesigned components available via retrofit. These solutions have proved efficient as the number of events has started to decrease, both for the A320 Family as for the A330, in the face of ever increasing fleets.

The handling of DBL events, should they occur, will now be made easier. A single and simple ECAM procedure will cover all cases of Dual Bleed Loss. This will assist crews in the identification and management of these events in the most appropriate manner (recovering bleed system when possible, avoiding excessive cabin altitude, continuing the flight to destination or to a most suitable diversion airport). An updated QRH procedure will be published pending the retrofit of the new FWC standards.

References

► Ref. A: A320 DBL Package (TFU 36.11.00.059 and SIL 36-057)

► Ref. B: A320/A330 Preventive Cleaning / Replacement of the Temperature Control Thermostat Filter (SIL 36-055)

► Ref. C: A330 Solutions for Overpressure (TFU 36.11.00.069)

► Ref. D: New Pressure Transducer (SB A330-36-3039 and RIL 36-3039)

► Ref. E: A330 Solutions for Overtemperature (TFU 36.11.00.065)

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A320
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