Avoiding Dual Bleed Loss

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1 | Introduction

Over the past years, the A320 family fleet experienced a significant number of dual air engine bleed losses. The consequences of these losses ranged from in-flight turn backs shortly after take-off, to full blown cabin depressurization events and flight diversions.
The aim of this article is to present the typical causes of the dual bleed losses and to explain how:

- The crew may mitigate the operational consequences of this type of occurrence by applying the pertinent procedures
- New maintenance and design improvements should reduce the number of such events in the future.

We are confident that the correct application of the above procedures and improvements should help airlines to limit occurrences of dual bleed loss incidents.

2 | Description of the pneumatic system

The main purpose of the dual bleed air system is to provide the air conditioning system with air regulated in both pressure and temperature.
They also supply various air system consumers such as :

- Wing anti-ice protection
- Engine starter
- Hydraulic reservoir and water tank pressurization.

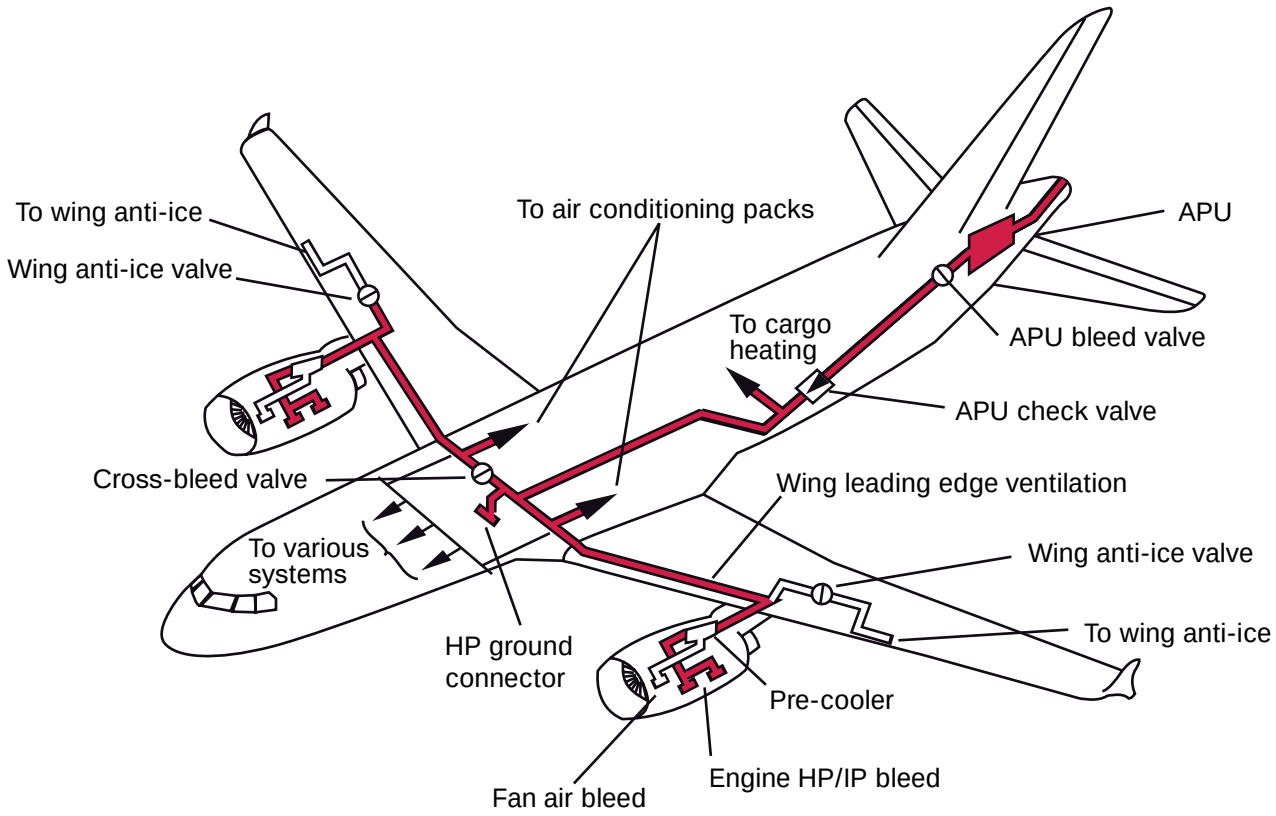


Figure 1: Pneumatic system layout

The bleed air system is installed in the nacelle and pylon of each engine and includes:

- For the pressure regulation:
  - An Intermediate Pressure Bleed Check Valve (IPCV)
  - A High Pressure Bleed Valve (HPV)
  - An Over Pressure Valve (OPV)
  - A Pressure Regulator Bleed Valve (PRV), which is commanded by a Temperature Limitation Thermostat (TLT).
    The TLT will order the PRV to reduce the pressure in the system in case of over-temperature.
- For the temperature regulation:
  - A precooler exchanger (PCE)
  - A Fan Air Valve (FAV), which is commanded by a Temperature Control Thermostat (TCT)
  - The TCT will order the FAV to increase air flow from the fan in case of over-temperature.
- For the system monitoring:
  - A Bleed Monitoring Computer (BMC).

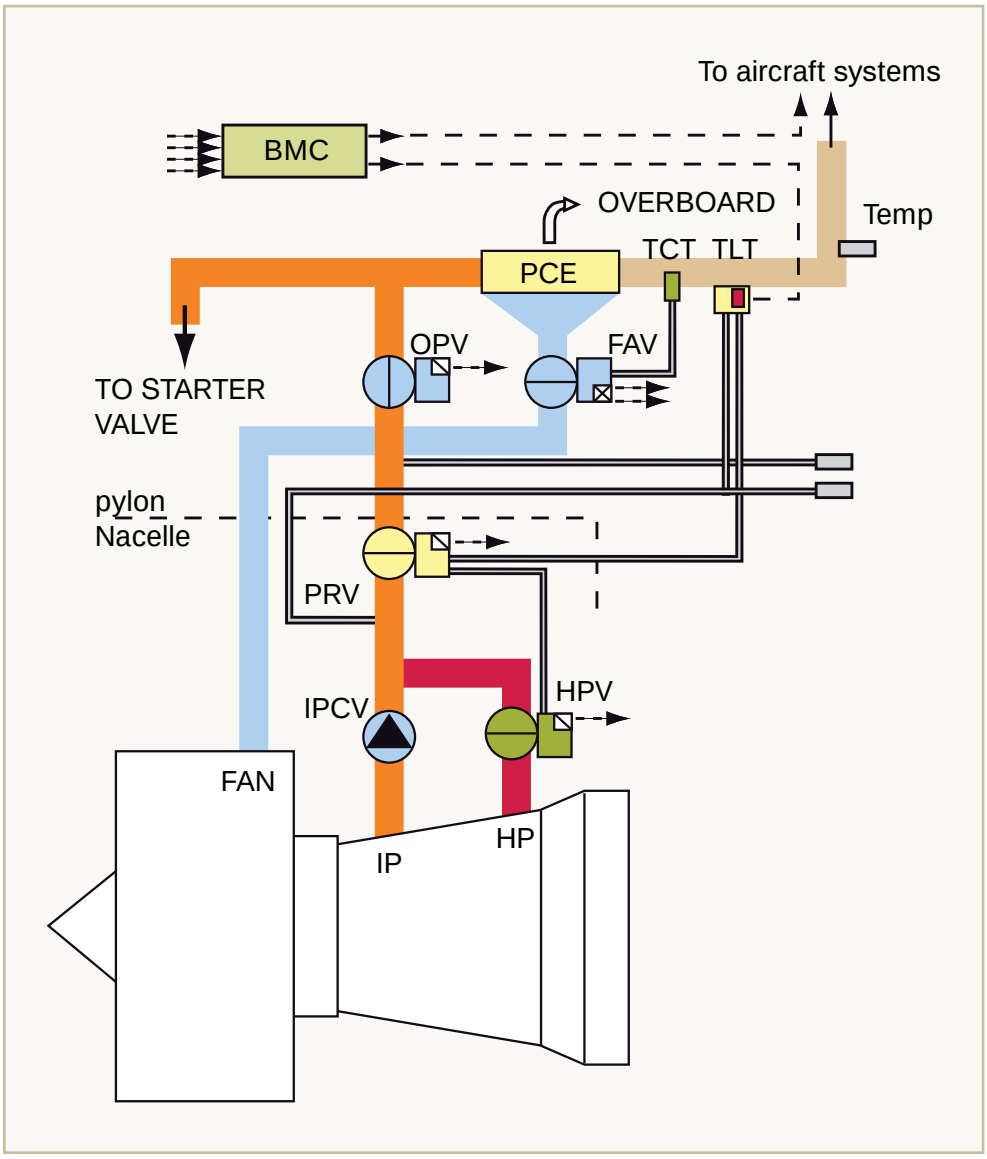


Figure 2: Main components description

3 Typical failure scenario

The dual bleed loss events usually happen when one bleed fails, resulting in the remaining bleed on the other engine to compensate for it.

The augmented flow of warm air from the engine core leads to a corresponding increase in the flow of cold air from the Fan to the Precooler.

In case of one engine bleed loss, the remaining bleed fails when the Fan Air Valve (FAV) does not let enough cold air reach the Precooler (PCE). This causes the temperature downstream of the PCE to reach the 260°C (500°F) over-temperature threshold, which induces the automatic closure of the bleed system.

This excessive rise in temperature is caused mainly by either:
- Leakage of the TCT to FAV sense line
- TCT drift / failure
- Or FAV leakage / failure.

NOTE: In-service experience has shown that the root cause of over-temperature is often linked to a combination of the above factors.

Other possible causes are:
- Temperature sensor failure
- Wiring failure.

4 Operational procedure to be applied

In the above scenario, the failure of the first bleed system leaves the second engine bleed to supply all the aircraft consumers. This bleed, in turn, is lost due to excessive demand.
After the failure of both bleed systems, the AIR DUAL BLEED FAULT paper procedure (QRH page 2.02 and FCOM 3.02.36 page 3) therefore recommends to initiate a rapid descent to FL200 and to reduce air demand, before attempting the recovery of the second bleed system.

Assuming that both PACKS are operative, the air demand is reduced by shutting OFF the PACK on the side of the first affected bleed system.
The flight crew should then press twice the ENG BLEED pushbutton on the overhead panel associated to the second engine bleed, in order to reset it.

– DESCENT. . . . . .INITIATE
Descend rapidity to FL200 so that the bleed supply may be supplied by the APU, if the bleed system recovery is not successful.*

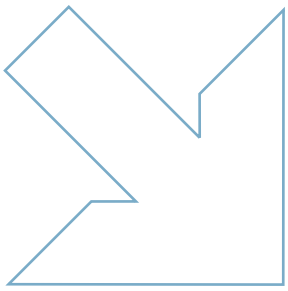
- **If both packs are available:**
If both packs are operative, it can be suspected that the second bleed system failed due to excessive demand. Recovery of the second failed engine bleed may be attempted.

■ **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

* FL225 for APU Honeywell 131-9 (A)

Figure 3: Extract of Quick Reference Handbook page 2.02



The bleed should recover, and the flight should be able to resume to the destination airport with one engine bleed supplying one PACK (that automatically delivers high flow).

5 | Maintenance and design improvements

Following laboratory and flight tests, enhancements have been introduced in the domains of maintenance and design.

- Maintenance
  - Improved FAV leak check procedure in the Aircraft Maintenance Manual (AMM) (ref A)
  - Test of the engine bleed system performance. The AMM includes a new test of the capacity of the bleed system to function properly in a one bleed/two packs configuration (ref B)
  - Periodic cleaning of the TCT filter
    As the clogging of the filter is considered to be a major contributor to the TCT temperature drift, a new mandatory MPD task has been introduced (ref C).

NOTE: The Aircraft Condition Monitoring System (ACMS) may be customized to monitor bleed temperature levels. This allows preventive troubleshooting to be performed before the bleed actually fails.

- Design
  - The TCT has been modified to react faster to excessive temperatures, thereby ordering the FAV to increase the cold air supply earlier than before (ref D)
  - In order to address the leakage issue, the FAV has been modified to include a seal between the actuator and actuator cover (ref E)
  - The pressure limitation function has been shifted. Even though the TLT function is not a root cause of bleed failure, it is considered to be an aggravating factor for an already degraded system (ref F)
  - New tooling is being developed to allow bleed air system health checks and to improve trouble shooting efficiency.
    These tools are expected to be available by the end of 2009.

6 | Conclusion

The root causes of the dual bleed loss scenario have been identified. Necessary prevention and design improvements have been put in place to address this issue.

Incorporation of the below enhancements should address the large majority of dual bleed loss occurrences. This will have a positive impact on our customer airlines' operations. We therefore highly recommend their timely application.

REFERENCES
A) AMM task 36-11-54-720-001-01
B) AMM task 36-11-00-710-003
C) MPD Task 361143-01-1
D) AIRBUS SB A320-36-1061 and LIEBHERR VSB 342-36-08
E) LIEBHERR VSB 6730F-36-01 & 6730-36-03
F) LIEBHERR VSB 341-36-06

Please consult the Retrofit Information Letter (ref. SEOT2 916.0468/08) issued in July 2008 for logistical advice on the completion of the A320 family dual bleed loss improvement action plan.

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