Pitot Probes Obstruction on Ground

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1 Introduction

Airspeed is such a key parameter in aerodynamics, that the systems and indicators of Airbus aircraft use 3 independent airspeeds as inputs to the pilots' displays as well as to the standby indicator. Aircraft systems also use these 3 data.

At the source of the information chain are the pitot probes. Feedback from in-service experience indicates that:

- Incorrect maintenance of these probes is the most common cause for unreliable airspeed information;
- Take-offs are sometimes pursued in spite of one or two airspeed indications being unreliable.

Consequently, this article aims at reminding ground staffs of the efforts to be made in order to protect pitot probes on ground, and at recommending crews to accurately check the condition of pitot probes before flight, and to abort their take-offs when airspeed indication is detected unreliable.

2 Investigation of an in-service occurrence

For the purpose of this review we will refer to an event that was recently experienced on an A330. However, this type of event could have happened on any other Airbus aircraft.

Prior to the flight, the aircraft spent a few hours on the stand. Storm conditions prevailed during the ground time. Pitot probes were not protected with covers and became obstructed. This was not noticed before take-off.

During the take-off run, CAS1 (Computed Air Speed) and CAS2 were indicating too low speed. However, the take-off was continued.

Later investigation of the flight data recordings and crew report resulted in the following information about the lift-off speeds:

- Ground speed was above 160kt;
- CAS1 was about 60kt;
- CAS2 was estimated to be below 80kt;
- CAS 3 was reportedly reliable.

Note: V1 and Vr of the flight are unknown to Airbus.

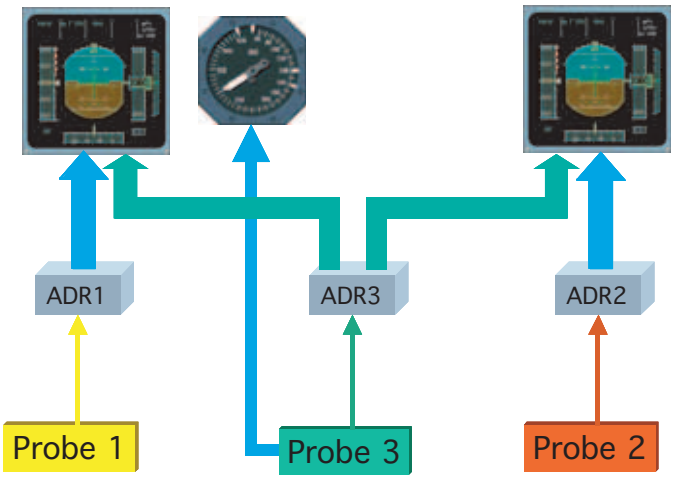
After lift-off, the following cockpit effects occurred:

- «NAV ADR DISAGREE» warning triggered;
- EFCS (Electrical Flight Control Systems) reverted to alternate law;
- Auto-thrust disengaged;
- Flight directors became unavailable;
- Later in flight, with slats and flaps still extended, VFE was exceeded, so that OVERSPEED warning triggered.

Eventually, an in-flight turn back was initiated and an uneventful landing completed.

3 | Systems architecture and response

The following sketch presents the typical architecture valid for all Airbus aircraft.



Normal Display

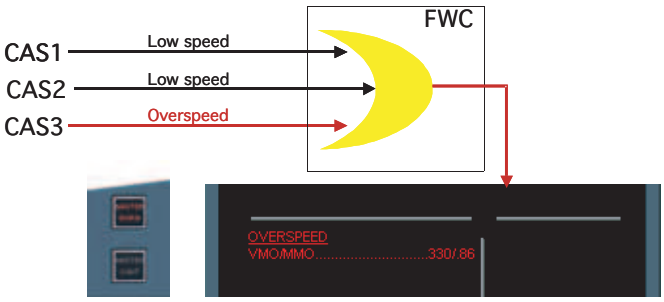
Reconfigurations

In the event referred to above, no reconfiguration to ADR3 was reported, and the information displayed on the standby indicator was the sole reliable.

3.1. Systems behavior during the event

The behavior of the systems described in paragraph 2 resulted from the AFS (Auto Flight Systems) and EFCS detecting the discrepancy between the 3 airspeeds. Since the monitoring is based on a comparison of the different speeds, and since all 3 were different, the systems could not recognize CAS3 as being the reliable speed. CAS3 being the odd among the 3 airspeeds, it was rejected at first. In this case, however, all 3 data were rapidly rejected by EFCS for computation till the end of the flight.

CAS3 being accurate during subject event, and over speed warning being computed on the basis of an «OR» condition of CAS1, 2 & 3 versus VMO/MMO, the over speed situation indicated by the Flight Warning System was actual.



3.2. The particular case where 2 airspeeds are identically affected

A particular situation would arise if 2 pitot probes were identically affected, which would result in 2 of the 3 airspeeds being equally low to the detriment of the 3rd and sole accurate one. This hypothesis is not unrealistic, and was encountered in service when probes were clogged by dust or insects' nets. Besides, the above event was close to this situation, since CAS1 and CAS2 were "only" deviating of about 20 knots, while CAS3 was in the range of 80 knots higher.

For the sake of this demonstration, we will consider that CAS1 and CAS2 are identical and too low.

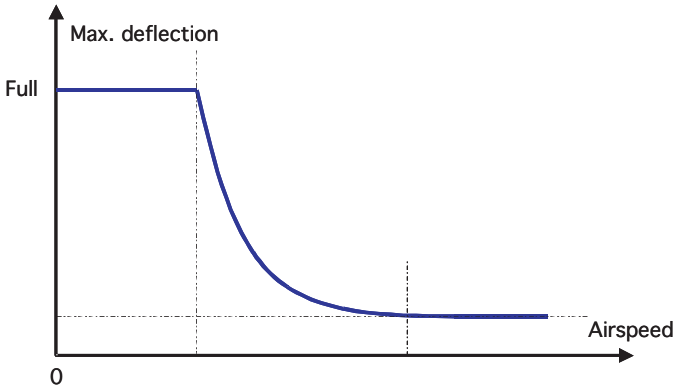
AFS and EFCS airspeed monitoring relies on a comparison of airspeeds. In our example, CAS3 would then be rejected, and computers would use the erroneous airspeeds from CAS1 & CAS2.

EFCS & AFS
CAS1 consistent with CAS2
CAS1 much lower than CAS3
CAS2 much lower than CAS3
} => **CAS3 considered unreliable**

Flight controls surfaces gain efficiency with speed. For instance, the roll rate achieved with 5 degrees of aileron deflection will be much higher if aircraft flies at VMO/MMO than at low speed. This implies that, when AFS and EFCS use a too low airspeed:

- Orders to the flight controls would be too strong and may cause over-reaction, either in manual or automatic flight;
- Limitation of rudder deflection will not be adapted to airspeed (Refer to sketch).

Possible consequences in this extreme situation are loss of control or exceedance of design loads. Given these risks, all efforts should be made to maintain reliable operation of airspeed indication systems, or flight should be cancelled as soon as unreliable airspeed condition is detected.



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AIRBUS

SERVICE INFORMATION LETTER

SUBJECT: **Erratic Airspeed Indication – Pitot Probes Maintenance Action**

ATA CHAPTER: 34-10

AIRCRAFT TYPE: A300 / A310 / A300-600 / A318 / A319 / A320 / A321 / A330 / A340 (all models)

APPLICABILITY: All Aircraft

REFERENCES: OIT SE-E/999.0009/99
TFU 34.10.00.028 for A320 family
TFU 34-11-15-003 for A300/A310 family
TFU 34-13-00-005 for A330/A340 family

SIL NUMBER:	34-084
PAGE:	1 of 7
DATE:	Nov 22/1999
REVISION:	2, Oct 20/2004

4 Maintenance and operational recommendations

4.1. Maintenance

Protecting pitot probes with covers any time foreign objects are likely to penetrate is the main precaution to be taken. As indicated in the introduction, the most recurrent reasons for obstruction of probes is accumulation of dust, animal's remains, insects' nets etc. This recommendation should not only be adhered to in case of long time parking. In sand storm conditions, for instance, covers should be placed even when parking for a few minutes.

In addition, Airbus has improved the maintenance program with the reduction of the interval from 2C to 1C-check for draining and flushing the pitot pressure lines.

These recommendations are highlighted in a Service Information Letter (SIL 34-084) that Airbus has issued and which is regularly updated in order to optimize the maintenance of pitot probes.

4.2. Operations

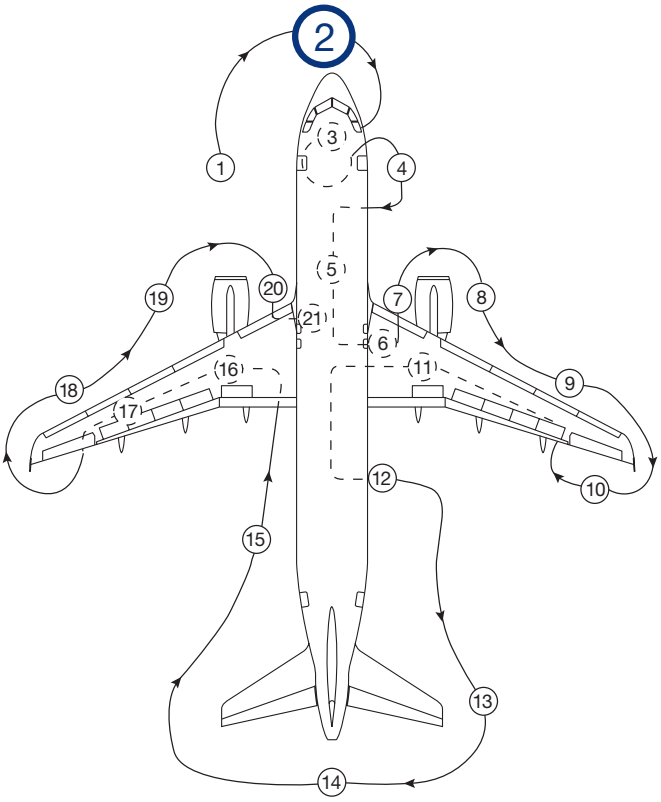
Precautions during operations start with the pre-flight exterior check, when pitot probes inspection is requested. Crews should pay particular attention to them, bewaring of any signs of obstructions.

Then, after take-off thrust setting, both crewmembers should scan airspeed indications. In case of detection of an unreliable condition of one of the airspeeds before V1, take-off should be aborted.

A319/A320/A321 FLIGHT CREW OPERATING MANUAL	STANDARD OPERATING PROCEDURES EXTERIOR INSPECTION	3.03.05 SEQ 001	P 2 REV 24

(2) NOSE SECTION

* - Pitot probes..... CONDITION



5 Conclusion

Airbus recommends that ground and flight crews be reminded of the possible consequences of flight with pitot probes obstructed:

- Loss of control;
- Exceedance of design loads.

Consequently, all efforts should be made to avoid flying in such conditions by:

- Protecting pitot probes with covers as soon as necessary;
- Adhering to improved pitot maintenance program;
- Checking pitot reliable condition during the pre-flight walk around check;
- Aborting take-off when unreliable airspeed condition is detected before V1.

To complete the subject of pitot probes obstruction, we will address the unreliable airspeed condition in flight in a future article.

Safety First

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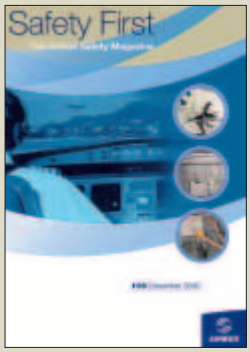

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