

INCIDENT

Aircraft Type and Registration:	Airbus A320-232, G-MIDW	
No & Type of Engines:	2 International Aero Engines V2527-A5 turbofan engines	
Year of Manufacture:	2000	
Date & Time (UTC):	8 October 2006 at 0340 hrs	
Location:	En-route Kos to Glasgow International Airport	
Type of Flight:	Commercial Air Transport	
Persons on Board:	Crew - 6	Passengers - 156
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	47 years	
Commander's Flying Experience:	10, 600 hours (hours on type - unknown) Last 90 days - 260 hours Last 28 days - 70 hours	
Information Source:	Aircraft Accident Report Form submitted by the airline's flight safety department and additional inquiries by the AAIB	

Synopsis

The aircraft was established in the cruise at FL380. A warning of excessive cabin altitude was displayed on the ECAM (Electronic Centralised Aircraft Monitoring) screen. However, the display showed the pressurisation parameters, including the cabin altitude, as normal so the crew believed that the warning was spurious, although they donned oxygen masks as a precaution. Eighteen minutes later they were advised by the cabin crew that the passenger oxygen masks had deployed and they initiated an emergency descent to FL100, at which level the flight continued to its destination without further incident.

A fault was later found within the System 1 Cabin

Pressure Controller and the manufacturer is reviewing the system architecture to establish how misleading information was displayed to the crew.

History of the flight

The aircraft was on a flight from Kos to Glasgow and was established in the cruise at FL380. Two hours and six minutes after takeoff, the CABPREXCESSCABALT (cabin pressure excess cabin altitude) caption illuminated on the ECAM, followed by the Master Warning. The crew had not experienced any of the physiological symptoms they would expect with a pressurisation fault. Nevertheless, they donned their oxygen masks and established

communications with each other, in accordance with the first item in the Flight Crew Operating Manual (FCOM) procedures for this warning.

The System Display (SD) Pressurisation page indicated that System 1 (SYS 1) was in operation with a cabin altitude of 7,800 feet. The commander also recalled other pressurisation parameters showing a cabin differential pressure of 8.0 psi and zero cabin vertical speed. Given that these values appeared normal for an aircraft in cruise, and the lack of physiological symptoms, the crew decided to remain on oxygen but not to initiate an emergency descent.

The cabin crew were contacted and told to prepare for a possible decompression and emergency descent although the commander found it necessary to remove his oxygen mask temporarily while he spoke to a cabin crew member. The co-pilot remained on oxygen throughout and the two flight crew discussed their available options.

Approximately 2 minutes after the first ECAM message had appeared, the commander elected to switch pressurisation from SYS 1 to SYS 2. This was in accordance with the FCOM which advised:

'If the pilot suspects that the operating pressurisation system is not performing properly, he can attempt to select the other system by switching the MODE SEL pushbutton to MAN for at least 10 seconds, then returning it to AUTO.'

The selection remained on SYS 2 for about 5 to 15 seconds during which time the commander recalled that the ECAM displayed a cabin altitude of 10,400 feet, a cabin pressure differential of 8.0 psi and zero cabin vertical speed, although he had some difficulty in viewing the screen through the oxygen mask visor. He

returned control to SYS 1, believing SYS 2 to be at fault. The cabin crew then reported that the cabin lights had illuminated full bright and that the seat belt signs had come on.

After a few minutes, the commander reselected SYS 2 and recalled seeing a cabin altitude of 14,000 feet and he reselected SYS 1, now believing that there was definitely a fault in SYS 2. The cabin crew then called to say that the passenger oxygen masks had deployed and the co-pilot reported the sensation of pressure change in his ears. The crew declared a MAYDAY and carried out an emergency descent to FL100. During the descent the CAB PR SYS 1 fault caption illuminated and the crew reselected SYS 2.

The flight continued to Glasgow at FL100 without further incident, landing some 50 minutes later.

Recorded information

The aircraft's Digital AIDS (Airborne Integrated Data System) Recorder (DAR) was downloaded. The data showed that an excessive cabin altitude warning occurred at 0308 UTC, followed one second later by a master warning. The 'cabin altitude sys 1 ZCB 1' parameter recorded 7,800 feet. Shortly after the warning, the Systems Display page on the ECAM changed from CRUISE to PRESS. At 0326, a step change in cabin altitude from 7,800 feet to 14,400 feet was recorded, followed six seconds later by initiation of the emergency descent.

Description of the cabin pressurisation system

The A320 uses two identical, independent automatic systems to control cabin pressurisation. Only one system controls at any one time – the other being in 'hot standby'. The systems alternate between flights or, if one system fails, control should automatically

switch to the other system. Alternatively, the pilots can select the other system manually as described in the FCOM (as quoted above). The main component of each pressurisation system is the Cabin Pressure Controller (CPC), which contains a pressure sensor both for indication and control.

Each system generates its own values of cabin pressure, cabin vertical speed, differential pressure and excess cabin altitude for the warning system. Other parameters, such as outflow valve position and fault logging, are also generated. The EXCESS CABIN ALT warning is generated when cabin altitude reaches 9,550 feet in the cruise.

The passenger oxygen automatic supply uses a pressure switch which is independent of the CPC indications. The switch is set to deploy the masks at a cabin altitude of between 13,500 and 14,000 feet. As this altitude is approached, the cabin lights are switched to full bright and the seatbelt signs are automatically illuminated. A pre-recorded announcement can also be selected to play automatically as the masks deploy.

The FCOM for this aircraft gives the following instructions in the event of a CAB PR EXCESS CABIN ALT warning:

'CREW OXY MASK (if above FL100).....ON'

and also:

'If above FL 160:
EMER DESCENT FL 100/MEA (or minimum obstacle clearance altitude)'

Maintenance actions post-incident

Both SYS 1 and SYS 2 CPCs, and the single discharge valve, were replaced. All items were despatched to the manufacturer for investigation.

Analysis

The DAR data generally bears out the crew's account of events, particularly with regard to the figures of cabin altitude, but the time elapsed (18 minutes) between receipt of the excess cabin altitude warning and commencement of the emergency descent was longer than the crew later recalled. It would appear that the cabin altitude was slowly climbing whilst SYS 1 was controlling pressurisation but it was only displaying about 7,800 feet on the ECAM. The Aircraft Maintenance Manual (AMM) suggests that each CPC generates separate signals for cabin altitude numerical values and to trigger the EXCESS CABIN ALT warning. In this case, it appears that the numerical values were incorrect but the 'excess cabin altitude' output signal was functioning correctly. It is unclear from the AMM whether the warning is generated solely from the system controlling pressurisation or whether the standby system can also trigger the warning). Although the DAR does not record SYS 2 data, the pilot's recollection that it was showing 10,400 feet (and later 14,000 feet), whilst SYS 1 was still indicating 7,800 feet, suggests that SYS 2 was reflecting the true condition.

Unfortunately, the lack of physiological symptoms seems to have convinced the crew that the situation was reversed - that SYS 1 was indicating correctly and SYS 2 was faulty (and probably responsible for the EXCESS CABIN ALT caption). Thus the crew did not initially follow the FCOM instructions to commence an emergency descent. This was compounded by

the expectation that, if the controlling system was defective, control would automatically pass to the standby system.

From the crew's recollection, a caption for SYS 1 FAULT did not appear until the emergency descent was underway (it is not a parameter recorded on the DAR). Prior to that was the sudden step change, from 7,800 feet to 14,400 feet, in the Cabin Altitude (SYS 1) reading. It can be assumed with confidence that this was now the correct value and therefore the nature of the fault had changed at least as far as this parameter was concerned, although the SYS 1 CPC now recognised that there was still a fault and generated the appropriate warning. It is probable that this earlier inability to detect a fault had prevented automatic transfer of control to SYS 2.

Manufacturer's investigation

The removed items were sent to Airbus for examination. They confirmed an unspecified fault within the SYS 1 CPC but advised the following:

'The failure scenario has been reviewed by the Airbus PSC (Product Safety Committee) in Feb 07.

This scenario is rare (only one case reported up to now) but the information provided to Crew was confusing. This subject will be therefore further investigated by this Safety Committee to review possible improvement in the current architecture. (next screening end of May 07).'

Any actions arising from the PSC review will be advised in a future edition of the AAIB Bulletin.