

Incident Investigation Report

5X002-0/98
January 1999

Factual Information

Kind of occurrence:	Serious incident
Date:	05.04.1998
Location:	near Frankfurt/Main Airport
Aircraft:	transport category aeroplane
Manufacturer/type:	Airbus / A320-200
injuries to persons:	none
material damage	aircraft not damaged
other damage:	no other damage

History of the flight

On a scheduled flight from Lyon to Frankfurt in a holding pattern the airspeed indications in both primary flight displays (PFD) and for a short time in the standby indication system failed. In conjunction with this failure, the automatic flight control systems switched off and the electronic centralized aircraft monitor showed several warning and error messages. The pilot-in-command immediately took over the controls from the candidate captain who up to the moment of the occurrence was the pilot flying. When he had stabilized the aeroplane manually at an altitude of 10000 ft on the basis of pitch angle and powerplant output (PITCH and POWER), the airspeed indications reappeared on all three instruments. As a precaution, the PIC manually switched the pitot tube heating on (PROBE/WINDOW HEAT on the overhead panel from AUTO to ON).

At the moment of the incident, IMC with severe icing, rain showers and turbulence were prevailing. For the

landing, the autopilot and autothrottle were available again.

Investigation

The incident was reported to the BFU (Federal Bureau of Aircraft Accidents Investigation) by the operator on April 7th, 1998 by telefax. In the following, the Director of the BFU charged a staff member with the investigation. The investigation by the BFU was accomplished in cooperation with the operator and the maintenance organisation. During the investigation the BFU was in contact with the aircraft manufacturer and the manufacturer of the pitot tubes installed.

Since the aeroplane had already been returned to flight service by the operator, first of all, the documents/evidence concerning the complaints entered in the flight log were inspected and the flight data recorder was evaluated. The FDR had recorded only the system 1 airspeed indication, and in the ECAM system (MAINTENANCE POST FLIGHT REPORT = MPFR) only the error messages of system 1 and the standby system had been stored. These recordings do not directly confirm the reported course of the incident. According to the FDR recordings, the function of the autopilot had been interrupted for 59 seconds, whereas the system 1 airspeed signal had been interrupted only for 14 seconds.

On April 14th, 1998, the BFU made an enquiry of the PIC at the operator's. The pilot expressly affirmed that the duration of the interruption of the airspeed indications on both PFDs was quite exactly identical with that of the interruption of the autopilot function. Concerning the weather, he stated that only light to medium icing and turbulence had been expected, however, the icing turned out to be relatively severe.

Within a few seconds 2 - 3 cm of ice had accumulated on the ice accretion meter. The official weather expertise by the Deutsche Wetterdienst (German Meteorological Service) proves that in showers and thunderstorm cells at flight level FL 100 there were conditions for severe turbulence and icing.

The operator had immediately arranged for a thorough inspection of the aeroplane and the evaluation of the FDR. This order was carried out by the contractual maintenance organisation working for the operator in accordance with the Service Information Letter 34-047. When carrying out the a.m. instruction, the maintenance organisation found out that the systems concerned functioned properly. Thus, the aeroplane was released to flight service. The maintenance organisation informed the operator, the aeroplane manufacturer, the supervising authority and several internal departments of this inspection result.

After the inspection of the aeroplane had been concluded and on the basis of the evaluation of the FDR/ECAM recordings, the investigation team elaborated a joint catalogue of questions on April 21st, 1998 and transmitted it to the aeroplane manufacturer. Furthermore all pitot tubes were removed and sent to the component manufacturer for the purpose of inspection. For the inspection of the pitot tubes, the manufacturer requested in addition the associated computers. Because of the relevance to the error search on the aeroplane, on 27.4.1998 also the staff members of the Trouble Shooting and Maintenance departments who were involved in this matter were heard by the Investigation Team.

Assessment

The non-appearance and/or differing storage of warnings is to be explained by the conception on which the ECAM system is based. The ADR ECAM warnings are designed only for the technical availability of the **ADR computer system. The pitot tube as the input sensor** does not belong to the monitoring circuit of the computer system. During the system comparisons by the computer program, varying input conditions (pressures) may result in differing messages from the three independent ADR systems. These messages may thus have been stored also under different menus (POST FLIGHT REPORT, LAST LEG REPORT). According to the information by the aeroplane manufacturer the total air temperature recorded is originating with system no. 2. From the assessment of this recorded parameter it is obvious that the airspeed signal in system 2 was available again almost at the same time as that in system 1. Thus the failure of both systems is confirmed.

After the statements of the PIC had been confirmed in the course of the investigation to a large extent, there is no reason to doubt the statements of the PIC relating to the duration of the interruption of the airspeed indications on the PFDs. However, it was not possible to come to an agreement. The aeroplane manufacturer is of the opinion that the interruption itself lasted only 14 seconds and that the PIC due to heavy work load just was not earlier in a position to switch the autopilot on again. In the Airplane Operating Manual it is stated that if a comparison between both ADR computer systems (ADR DISAGREE) is not possible and also the standby system is not available, **the crew should act at their own discretion/on the basis of their experience**. Even if a time of reaction to the indications re-appearing is accounted for, it may be considered proved that the interruption of the airspeed indications on the PFDs was considerably longer than the duration recorded by the FDR. A definite assessment would be possible if either the System Status Mode or the airspeed information would be recorded directly by the indication in the PFD.

Unstable airspeed indications under certain meteorological conditions have been reported already by several A 320 operators. In July 1993, the aeroplane manufacturer issued the Technical Information TFU no. 34.10.00.011 dealing with this problem and thus informed all operators of A 320, A 321, A 330 and A 340. With this Information and on the basis of experience gathered in daily flight operations, all operators and maintenance organisations in principle had knowledge of weather related malfunctions in the airspeed indication systems of certain AIRBUS types.

Failure or malfunction of **one** system will normally be eliminated by actions according to instructions given by the aeroplane manufacturer (AIRCRAFT MAINTENANCE MANUAL, SERVICE BULLETIN). With the SERVICE INFORMATION LETTER no. 34-047, the aeroplane manufacturer issued an instruction which took into account the fact that normal trouble shooting according to the TROUBLE SHOOTING MANUAL provided for this purpose was not suitable for this special complaint. When accomplishing the actions described, obstructed drain holes or residuals have not been found in any of the three pitot tubes. The Service Information Letter provides that the aeroplane manufacturer is to be informed by the maintenance organisation about all results of the actions. Instructions as to further actions had not been given to the maintenance organisation. The aeroplane manufacturer was also kept informed about findings made in the framework of the investigation. The aeroplane manufacturer did not suggest further investigations.

The hearing of the personnel charged with the technical inspection of the aeroplane revealed that the actions of these staff members were determined to a very large extent by the special knowledge gained from experience. Since for the case of **asynchronous**

failure of more than one system of the same kind (loss of redundancy, total loss of all systems) the aeroplane manufacturer has issued only flight operational instructions but no instructions for repair, knowledge gained from experience was very useful. The inspection and also the release to service of the aeroplane was performed on the basis of the normal procedure, i.e. with all three systems functioning properly, the aeroplane was serviceable again and thus was returned to the operator for flight operations. The total failure of all airspeed indication systems has not caused the aeroplane manufacturer and the operator to charge the maintenance organisation with special actions. The inspection of the aeroplane had not led to definite findings.

Failure of one system cannot be avoided. This fact is taken into account by technical designs (REDUNDANCY, FAIL SAFE DESIGN). Also cases of repetition cannot be excluded by normal repair procedures, they can only be minimized at best. This problem is being monitored in the framework of RELIABILITY considerations and solved, if necessary. But if the safety reserves of a flight had considerably been reduced by the synchronous failure of several systems of the same kind, this should be a reason to deviate from normal procedures or to change them. In order to avoid cases of repetition or, as in this case, to confirm the assumption which is based on the knowledge gained from experience, the accomplishment of special actions should be normal or be prescribed.

Conclusions

The investigation has revealed that **all airspeed indication systems** had failed for a short time due to an occlusion of the pressure ports as a result of ice formation on the pitot tubes. The result of the investigation confirms the assumption based on past reports by several operators on varying/failed airspeed indications that the design of the pitot tubes does not allow unrestricted flight operations with the aeroplane type in heavy rain and under severe icing conditions. Since the AOM and other documents for the aeroplane type A 320 do not define restrictions for flights under severe icing conditions, the incident is finally due to a type design problem.

Safety Recommendations

The result of the investigation has prompted the BFU to issue the following safety recommendations:

01/99 The specification for the pitot tubes should be changed so as to allow unrestricted flight operations in heavy rain and under severe icing conditions. The installation of the improved pitot tubes already designed should subsequently be prescribed for all types concerned by the SIL no. 34-0147 (A 320, A 321, A 330, A 340).

02/99 In case of a synchronous failure or malfunction of systems of the same kind (loss of redundancy, total failure) the accomplishment of special actions (e.g. an assessment of the finding) prior to release of the aeroplane to service should be prescribed in the Air Operators' Licences or in the instructions for maintenance and inspection of the aeroplane types.

A draft investigation report had been submitted to the operator concerned and the JAR 145 organisation charged with the maintenance of the aeroplane for comments. As has been stated by the operator, the maintenance organisation will retrofit the aeroplanes concerned with the technically improved pitot tubes, and also the internal procedures will be examined.

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