
Autopilot malfunction, Serious incident occurring on December 3, 2002 near Munich, involving an Airbus A300-600.

Micro-summary: This A300-600 experienced serious autopilot trim malfunctions.

Event Date: 2002-12-03 at 1040 local

Investigative Body: Federal Bureau of Aircraft Accidents Investigation (BFU), Germany

Investigative Body's Web Site: <http://www.bfu-web.de/>

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Investigation Report

5x011-0/02
August 2004

Identification

Type of Occurrence: Serious Incident
Date: 3 December 2002
Location: near Munich
Aircraft: Transport Aircraft
Manufacturer / Model: Airbus Industry / A300-600
Injuries to Persons: 1 crew member slightly injured
Damage: Aircraft not damaged
Other Damage: None
Source of Information: Investigation by BFU

Factual Information

History of the flight

The airplane had 189 passengers and 8 crew members on board and took off at 10:40 hrs¹ in Munich for a scheduled flight to Frankfurt.

While climbing to cruise level with autopilot (AP2) engaged the crew noticed during a routine check of the instruments that the allowed airspeed (V_{MO}) would be exceeded. As a countermeasure the preset speed was reduced and a higher climb rate selected on the AP panel. The AP was disengaged after it was noted that the airspeed increased further and the nose started to drop.

Once the pilot took control of the airplane it was trimmed nose down. It was no longer in climb and the

maximum allowed airspeed was exceeded by 16 kt. A great amount of control forces had to be applied until the wrong trim could be corrected by means of the electrical trim device. Vertical acceleration was so great during the re-establishment of the original flight attitude that one crew member fell and injured herself slightly. The flight was continued with disengaged AP and no further incidents.

Personal Information

Pilot in Command:

The PIC, age 53, held an ATPL and was licensed to fly multi-engine aircraft with a MTOW of more than 5 700 kg. The license also granted permission to fly the A300-600 as PIC. He had about 6 764 hours of flight experience, 3 423 hours of which on the A 300-600.

Copilot:

The copilot, age 33, held an ATPL and was licensed to fly multi-engine aircraft with a MTOW of more than 5 700 kg. The license granted permission to fly the A300-600. He had about 3 845 hours flight experience, 3 214 of which on the A300-600. At the time of the occurrence the copilot was the PF.

Aircraft Information

The Airbus A300-600 is a twin-engine transport aircraft with a MTOW of 165 000 kg. The aircraft concerned was registered in April 1987 for the first time and has had an airworthiness certificate and a German registration ever since. It was not equipped with a trim tank but with the "Theta Trim" flight augmentation computer (FAC). At the time of the incident total operating hours were 53 021 hrs with 18 917 flights.

¹ Unless otherwise specified, all times are indicated in local time

At the A300-600 the automatic elevator trim occurs because the AP deflects the elevator in order to correct the altitude and then the trim system 1 (PTS1) adjusts the horizontal stabilizer (THS) with a short delay. According to the Aircraft Maintenance Manual (AMM) the aim of this function is an AP-flight operation where the horizontal stabilizer is in the neutral position at all times.

The airplane has two independent systems (PTS 1 and PTS 2) for the control of the THS. Although both systems are active at all times, only PTS 1 handles the tasks. In cases where PTS 1 is not available or fails PTS 2 takes over immediately and without limitation. According to the AMM the system architecture is such that by signal failure or wiring malfunction it is not possible that both systems fail at the same time.

During the night of 1 to 2 December 2002 both APs were checked at a periodic check of the aircraft. A detected malfunction was corrected by changing components. On 2 December 2002 the following irregularities occurred on the flights from Frankfurt to Malaga and back:

- It was only possible to adjust the THS if PTS 1 was disengaged
- If AP 2 was engaged the THS was always set to "pitch down"

Both irregularities were noted in the technical log book (TLB).

The fault concerning PTS 1 could not be eliminated during the night of 2 December 2002 because of lack of time until scheduled flight operations started again on 3 December 2002. It was postponed with reference to the MEL.

The malfunction of the PTS 2 in connection with AP 2 was also checked. The test was done in accordance with the AMM and did not result in a fault identification. The fault was signed as fixed and classified with an "F". The airplane was cleared for operation on 3 December 2002 with a note in the TLB to observe and report again.

Flight recorders

The aircraft was equipped with a magnetic tape flight data recorder LORAL F 2100, P/N 2100-4043-02, S/N 182396. It recorded 300 parameters during a 25 hour period. The relevant parameters from take off until 950 seconds after take off were selected and are shown in Appendix 1.

The recording dated 3 December 2002 showed that with engaged AP 1 the flight from Frankfurt to Munich occurred without incident. On the flight back with AP 2 engaged and during climb a position change of the THS occurred at an altitude of about 17 000 ft. The THS continuously turned with a rate of 0,01 °/s in the direction of "nose down". At the same time the horizontal stabilizer deflected into the contrary position.

60 seconds after the beginning of the position change the nose dropped, climb rate decreased and airspeed increased. After 20 more seconds the power of both engines decreased and the nose dropped further. After another 20 seconds the AP 2 was disengaged and the nose dropped once more. The deflection of the elevator decreased for a short time whereas the reached position of the THS of 2.5° remained.

10 seconds after the disengagement of the AP the THS had almost reached its neutral position again. By the time the airplane was back into climb it had undergone an altitude loss of 1 000 ft, the airspeed had reached a maximum of 351 KIAS and vertical acceleration had been between 0.2 g and 1.5 g.

FDR data dated 2 December 2002 showed that twice on the flight from Frankfurt to Malaga and once on the way back to Frankfurt a slow position change of the THS into "pitch down" occurred. With all three incidents the AP 2 was disengaged after about 80 seconds and the aircraft remained in climb.

Wreckage and impact information

The fault finding process on PTS 1 determined that a new part installed on 2 December 2002 was defective again. After the replacement of this part the system test according to the AMM was passed. While testing the PTS 2 together with the AP 2 on ground no situation could be established where the THS changed its position. Therefore the wires of the system were checked. In the rack for FAC 2 a wire disconnection was determined. Inside the pin connector to the flight control computer (FCC 2) of the AP 2 a contact for the FAC 2 was pushed back.

FCC 2 and FAC 2 were removed and sent to the manufacturer to be examined. A test at a flight simulator facility with both parts showed that FAC 2 was defective. Further tests at the manufacturer of the computer showed that during a modification of the software ("Theta Trim") deviations from the former but still valid software specifications occurred. According to statements of the aircraft manufacturer all delivered modified FAC's had these deviations. A total of about 50 aircraft were affected.

In the software the autorim function was not changed. Therefore this function was not verified. The examinations of the FAC 2 showed that the computer worked without fault as long as no other (outside) error occurred. Therefore the software change had passed verification. Only the investigation of this incident made aware of the fault.

Test and research

In order to assess the incident both the FCC 2 and FAC 2 were removed from the affected airplane and installed in a A300-600 simulator. Under supervision of French and German Aircraft Accident Investigators (BEA/BFU) a mixed crew (operator/aircraft manufacturer) conducted several climbs with different settings. After the simulator was set to the conditions found in the airplane (wire disconnection) the result could be reproduced.

The simulator test showed that the signal for the position change of the THS came from the FAC 2. The position change occurred only once a certain airspeed was exceeded. With the movement of the THS the trim wheel moved and so did the control column. The pitch shown in the primary flight display (PFD) decreased whereas the flight director (FD) commanded to climb. At almost the same time the speed trend vector showed a further speed increase. As the rate of climb decreased seriously the crew took over. The pilot of the operator was surprised by the required control forces.

Organisational and management information

a) Regulatory Authority

For the preparation and certification of the MASTER MINIMUM EQUIPMENT LIST (MMEL) the following regulations apply since 1 May 2000:

JAR-MMEL/MEL SUBPART B-MMEL (excerpt)

JAR-MMEL/MEL.010 General

(a) The MMEL is a master list (including a preamble) appropriate to an aircraft type which determines those instruments, items of equipment or functions that, while maintaining the level of safety intended in the applicable JAR, may temporarily be inoperative either due to ...

b) Computer Manufacturer

During modification of the FAC the basis for certification of the software of the airplanes A300-600 and A310 from the year 1982 had to be applied. These are the design specifications for transport aircraft (JAR/FAR 25) and the preparation and certification recommendations of EUROCAE for aircraft software (DO-178/ ED-12 first edition – Software consideration in airborne systems and equipment certification).

The process makes provisions for tests in certain phases to check whether the requirements are met. The certification process of software contains a check where equipment and software is being tested in simulator and flight tests. The procedure for changes in already certified software is not directly addressed in the regulations.

c) Aircraft Manufacturer

The decision to defer fault fixing had to consider the following MMEL requirement:

Master Minimum Equipment List – MMEL (excerpt)

AUTOMATIC FLIGHT SYSTEM	
System and sequence numbers	Flight Augmentation Computer b) Pitch trim
Rectification Interval	C (10 days)
Number installed	2
Number required for dispatch	1
Remarks or exceptions	* One may be inoperative

d) Maintenance

The decision to defer fault fixing had to consider the following requirements of the maintenance organisation:

Procedure for the deferment of fault fixing (excerpt)

3. Policy / short description

Fixing of a determined fault on an aircraft can be deferred under certain circumstances which are defined in chapter 4 of these procedures. This makes it possible to have reliable and economically optimised flight operations...

4. Procedures and responsibilities

4.1 Deferment of fault fixing

4.1.1 Flow chart

4.1.2 Explanations to the flow chart

- Z1-fault: a fault where fixing cannot be conducted right away for different reasons such as insufficient work capacity, missing material, not enough ground time or fault fixing requires preliminary planning. ...
- Z4-fault: do the valid aircraft documents / manuals (MEL/CDL, whereas the MEL/CDL preamble is to be taken into account; AMM, SRM) allow that the fault is to be deferred? Particularly, it is to be considered whether the new deferred item will affect another already existing deferred item...

Minimum Equipment List – MEL (excerpt):

9.5 Preamble – Maintenance Action

- The MEL is intended to permit with equipment inoperative for that period of time necessary to organize repairs
- The MEL definitely is not intended as a tool prolonged or even permanent operation of airplanes in a configuration deviating from certification status
- Therefore every effort shall be made by maintenance to correct all technical irregularities as early as practicable and that the airplane be released from maintenance base in fully operational condition so that the effected airplane can be returned to its certification status (underlined in the original)
- In order to maintain this level, the MEL establishes limitations of the duration of operation with inoperative equipment (see..)

During fault fixing the following requirements were to be applied:

Procedures for fault fixing and scope of responsibility (excerpt):

4.3 Trouble shooting and the respective documentation

Step 1	Crew/Maintenance Report	Decision: a) Monitored Faults (displayed by Aircraft systems)... b) Non Monitored Faults -Crew or Maintenance Observations...
Step 2	Open Items	Check for Attention / Deferred item Listing
Step 3	EO	Check EO....
Step 4	Possible faults / causes	Look for correlated messages in...
Step 5	Fault confirmation Sometimes faults are generated and displayed without A/C System being faulty (nuisance messages)	Perform Functional test/ Ground test (Operate System; BITE Test; Self test) for possible faults. If test results confirm test OK/PASS/or equivalent- it is recommended to dispatch the aircraft. After 3 occurrences of the same phenomenon (even through the test is still OK) the other steps of the TSM procedure shall be
Step 6	Fault isolation	Perform fault isolation procedure action as...
Step 7	Corrective action	Do the corrective action in accordance...
Step 8	Operational-, function-, system test	Perform test after isolation procedure/ corrective action to make sure that the reported fault has been corrected
Step 9	Return to service/ Dispatch aircraft	- if reported faults have not been corrected, refer MEL/CDL to dispatch the aircraft - Perform....
Step 10	Certification and Maintenance Release	Report....

e) Flight Operations

In case of an abnormal pitch behaviour and pitch trim runaway were according to the A300-600 operations manual, Abnormal Procedures the following measures to be taken:

Aeroplane Operating Manual (AOM) (excerpt):

ABNORMAL PITCH BEHAVIOUR or PITCH TRIM RUNAWAY	
CONTROL WHEEL.....	HOLD FIRMLY
TRIM WHEEL.....	HOLD FIRMLY
AP (if engaged).....	DISCONNECT
PITCH TRIM.....	USE PITCH TRIM WHEEL
PITCH TRIM LEVERS.....	CHECK BOTH OFF
PROC: HIGH PITCH FORCE (6.09).....	CONSIDER

Additional information

The interview of the crew regarding the events on 3 December 2002 showed that they had read the comments and reports in the technical log book (TLB) but had not delved into it any further when they took over the aircraft. Because of the mark "F" in the respective column there was no doubt or uncertainty for them that the fault had been dealt with.

On the return flight the crew initially noticed that because of the speed trend vector an exceedance of the V_{MO} might be possible. After reducing the set airspeed and choosing a higher rate of climb it was noted that the nose dropped and the AP was immediately disengaged.

At the time of the disengagement of the AP the control column moved suddenly forward and the PF lost control. This led their attention to the trim of the horizontal stabilizer and they noted that the trim was in the direction of 2.5° pitch down. The PF had to invest a great amount of control forces in order to control the aircraft until the electrical trim kicked in and the aircrafts attitude was readjusted.

After the aircraft had regained its original flight attitude the AP 2 was engaged one more time in order to find out whether the error was reproducible or not. The trim once again changed to pitch down. Therefore the AP 2 was disengaged and the aircraft flown to the destination without an operating AP.

The interview of the previous flight crew of 2 December 2002 showed that they had on the first flight that day noticed an increase in airspeed only. After that the pitch down movement was noted and the AP disengaged immediately. Acoustical or optical warnings did not occur.

Only when the AP was switched on again could trim wheel movement be observed indicating that the trim permanently shifted toward "pitch down". Therefore they engaged AP 1 and continued their flight without incident. On the return flight they engaged the AP 2

once more in order to test for the reproducibility of the error. Neither pilot could recall the indication of the FD on the PFD during the time of the incident.

Analysis

General

The prevention-oriented investigation of an incident previously considered to be almost safely precluded by the existing type design must cover both the product including its repair, and the procedures and instructions for action to be taken as established to ensure the safety of flight operation.

It is important that at manufacture, maintenance and operation of an aircraft safety measures are present in order to minimise the affects of errors no matter where they occurred.

Registration

Registration authorities and aircraft manufacturers have developed a Master Minimum Equipment List (MMEL) for each type of aircraft so that the aircraft is not grounded for any kind of small irregularity. The MEL establishes limitations of the duration of operation with inoperable safety-related systems or equipment. International regulations (Jar MMEL/MEL) require also that during such periods the safety level determined in the design requirement should be maintained.

Even though the design requirement demands a high reliability (10^{-9}) a safety relevant system fails world wide several times a year. Without redundancy a system failure would immediately lead to an emergency. The demand for maintaining the safety level can only be fulfilled by maintaining redundancy.

In AP aircraft operations the abandonment of the PTS involves the loss of redundancy. The still existing resources for the elevator control are only available after the disengagement of the AP. Therefore flight operations with one PTS allowed by the MMEL do not meet the demanded safety level. In order to meet the required safety level it should not be allowed to use the AP when one PTS failed.

The MMEL did not take into account that usually both APs use PTS 1 primarily and errors in PTS 2 show up only after PTS 1 is disengaged. The incident showed that the decision to fly with a disengaged PTS 1 can be taken only after it was checked and ensured that PTS 2 is working properly.

The preamble of the MEL indicates that flight operations with inoperable systems and equipment should principally be an exception. The use of the MEL procedure because of reasons of time at a place where the best preconditions for the elimination of a fault existed did not meet that claim. The result shows that it was not questioned if the effect on the system would allow for a deferment.

The present MMEL is not clear enough regarding the procedures for its use. It has become an instrument for scheduled flights with known safety-related faults.

Aircraft systems

Because of the wire disconnection between the computer of the engaged AP (FCC 2) and the active trim system (FAC 2) defects in the FAC 2 became obvious. The signal disruption in connection with the software error in FAC 2 caused a malfunction of the autotrim and self-deactivation did not work anymore. That is the reason why a trim signal from the FAC 2 could slowly change the trim in direction of pitch down.

The system description in the AMM (22-27-00) regarding the automatic PTS states that based on the system architecture error in signals or wires are noticed and that such errors will not lead to a failure of both systems. This would mean that only the active PTS would be disengaged and remains in the current position.

The system description requires that all system components fulfil the specifications. Here, this was not the case. A defective software prevented the recognition of the cable disconnection thus the trim signal from the autotrim function had an unchecked effect.

The examination of the faulty computer at the manufacturer showed that the software error was generated during a modification. In the scope of quality assurance at the aircraft and equipment manufacturer it was realized that deficiencies concerning cooperation of both companies existed. Measures were taken to eliminate such errors.

According to the description of the AMM the system should have been able to deal with such wire disconnections. As a means of minimising the effects of errors this requirement should be verified for all functions but not just at registration but also after modifications. Such a mandatory regulation could not be found in the design regulation for transport aircraft (Jar/FAR 25) nor in the procedures for development and registration of aircraft software (DO-178B).

The description that errors in the signal are recognised by the system architecture obviously just describe signals from the FAC. The defective trim signal from the FAC 2 was not recognised as such by the system architecture. The attempt of the AP to correct the effects of the THS change was not a malfunction. Normally the AP controls the intended altitude and tracks the trim as long as the horizontal stabiliser needs to get into neutral. In this case a reversal of the normal procedures occurred.

The faulty trim signal and the resulting activity of the AP were clear indications of the malfunction of the automatic trim function of the elevator control. An indication from the electronic centralized aircraft monitor (ECAM) could not be derived because such a case was not part of the design. A warning that a dangerous situation is in progress would have been issued at the very beginning and would have given a time saving of 60 seconds. For the recognition of an abnormal situation such a warning is imperative.

Because of the existing software error a monitoring of the THS was not given anymore. Therefore an automatic switch over from PTS 1 to PTS 2 would not have taken place. Since the modification of both FACs was identical it was a matter of coincidence which one would be affected. In retrospect it was not possible to determine when the detected signal disconnection occurred because the malfunction became obvious only with PTS 2 being active in connection with AP 2 whereas normally PTS 1 is active.

Maintenance

Under reference to the MEL of the operator resulting from the MMEL and a company procedure the elimination of the fault on PTS 1 was deferred. The company procedure just contained specifications for the use of MEL procedures regarding the different work stations of the company. For the significantly better equipped maintenance bases specifications regarding the MEL preamble were missing.

In order to identify and eliminate the PTS 2 malfunction and possibly defective components, in this case a wire disconnection, as a cause for the runaway on 2 December 2002 a check of PTS 2 and AP 2 was necessary. The test procedure in the AMM described the check with both APs only for PTS 1. Already during the investigation the aircraft manufacturer changed the MMEL and AMM so that in the future the safe functionality of the remaining PTS is to be verified before a decision of deferment can be made.

The check of the reports in the TLB regarding PTS 2 occurred according to the procedure stated in the manufacturer's AMM. These instructions did neither result in a confirmation of the reported item nor in the identification of an error. The reported item was signed as fixed (letter "F"). Furthermore, the message was added: Please, observe and report again.

Maintenance of an aircraft shall occur according to the instruction given by the designer of the aircraft. In order to comply with this principle the designer has to be notified in case of difficulties. The handling of such a situation must be established in order to comply with this maintenance principle and the consideration of further use of the aircraft.

Faults, which cannot be reproduced on ground, of safety-related systems needed for flight guidance could only be cleared for operation with a restriction that the fault still needs to be clarified. A failure is finally fixed if the aircraft designer has given further recommendations to the operator and maintenance company and if they have been implemented.

The maintenance company has developed internal procedures regarding the maintenance of aircraft. These procedures are used regardless of the type, manufacturer and customer. They have special significance as part of error management because they are the last safety mechanisms before the beginning of operation of the airplane. They can help minimise errors no matter where they originated from.

The incident occurring immediately after fault fixing directed attention to the established regulations. The report in the TLB and the message "Please check again" did not match the statement "F=fixed". The classification was not a working error, however, it fit the internal regulations. The noted message for the next crew did not meet the internal procedures, though. The report in the TLB should have remained open than a message for the next crew could have been attached.

The conflict resulting from the process instructions directed attention to the regulations concerning elimination of faults. A system check on occasion of a fault where all tests produce no results cannot be a final fix for a report in the TLB. Releases for safety-related systems should not be given with an "F". Thus the contradiction in the process instructions in this instance would have been eliminated.

Measures in process instructions should take into account whether safety-related systems or equipment are concerned in order to better meet the claim of error

minimisation. Furthermore, it is to be considered, similar to JAR/FAR 25, which effects (catastrophic / hazardous / major / minor or critical / essential / non essential) the loss of such systems has on aircraft operations. By ATA specifications the concerned systems could be named and the threshold value for calling in the aircraft designer defined.

Operations

The repetition and the simulation of the incident in the simulator showed that the effects can only be limited if the AP is disengaged as soon as possible. Therefore it is necessary that the crew is sensitised that even in AP operations an unintended change of the THS (runaway) is possible and that this error is to be recognised as soon as possible. Only than is it possible to counteract such an incident by using the Abnormal Procedures from the AOM.

Since there was no warning or ECAM message the crew could have noticed the system malfunction only if they had monitored the PFD constantly and monitored the following values: pitch and power and pitch, FD and the actual flight status. A constant monitoring of the PFD without reason is unrealistic. Here, an ECAM message or some other device (like warning light) could be a significant improvement. Right at the beginning of the malfunction it would draw the PF's attention to the PFD. Therefore the PF would have enough time to evaluate the situation.

Last but not least, during AP operation a runaway was thought to be impossible and therefore neither crew had the necessary awareness for such a situation. Furthermore, they were not familiar with how the malfunction of the elevator control was visible on the PFD. According to the system description it was only to be expected that a system would deactivate itself. It is, therefore, very remarkable that the aircraft manufacturer had already designed a simulator program to raise awareness regarding incidents during AP operation. This program is a meaningful addition to the information on abnormal situations and should be added to the schooling and periodic training of A300/A310 pilots.

Conclusions

Causes for the serious incident

- As a result of the deferred elimination of a fault on PTS 1 the AP could be operated with PTS 2 only.
- There was a fault on PTS 2 for which there was no confirmation or elimination
- At a certain airspeed the signal interruption between engaged AP 2 and PTS 2 caused a continuous change of the THS in direction of pitch down.
- Because of a system deficiency caused by the software error in FAC 2 the continuous change of the THS did not result in a warning and the self-deactivation of the system.
- The prescribed procedure for abnormal functions (AOM) of the trimable horizontal stabilizer was not executed in time.

Systemic causes contributing to the serious incident:

- Approval of the MMEL did not take into consideration that during AP operations there is no redundancy once one PTS is inoperable.
- The MMEL of the aircraft manufacturer and the resulting MEL of the operator did not contain clear criteria for resource scheduling; especially whether an aircraft with inoperable systems and equipment can be released for flight by the maintenance base.
- The MMEL did not take into consideration that by surrendering PTS 1 normally both APs use this system and an unhindered function of PTS 2 with both APs was not ensured.
- The maintenance instructions and operation procedures contained no or insufficient regulations how to deal with such a situation where a PTS 2 complaint could not be reproduced on ground.
- Design and certification procedures of EUROCAE dated 1982 regarding software for aircraft in the scope of the certification process of changes did not include a function check for the whole system or module.
- Neither schooling nor periodic training educated pilots sufficiently on how difficult it is to recognise abnormal system functions during auto flight operations (pitch up/down).

Safety Recommendations

In order to prevent future accidents the aircraft manufacturer and the aeronautical authority have launched immediate actions even before the investigation ended so that the automatic monitoring function of the FACs is ensured again. An additionally present trim monitoring function was activated and then checked with a special test regulation. The following documents contain data on these actions:

- Service Bulletin:
AOT A300-22A6046 dated 6 March 2003
AOT A310-22A2055 dated 6 March 2003
AOT A300-22A6049 dated 12 June 2003
AOT A310-22A2057 dated 12 June 2003
Service Bulletin A300-22-6045
Service Bulletin A300-22A6048
Service Bulletin A310-22A2056
FOT (Ref STL 999.0033/03) ALL A300-600 AND A310 OPERATORS dated 14 March 2003
Revision MMEL and AMM dated 22 March 2003
- AD French authority:
DGAC CN 2003-110(B)R1 dated 30 April 2003
DGAC CN 2003-165(B) dated 30 April 2003
DGAC 2003-243(B)
- AD German authority:
LTA-Nr.: 2003-146/2 dated 9 May 2003

At the end of the investigation the BFU has released the following safety recommendation:

- 25/2004 EASA as the cognizant aircraft type certification authority should see that the Master Minimum Equipment List (MMEL) for Airbus A300/A310 aircraft does not permit flight operation with the AP engaged when only one PTS is serviceable.
- 26/2004 EASA as the cognizant type certification authority should see that the "Criteria for Dispatch" (JAR-MMEL/MEL, page 2-C-3, No. 3 dated 1 May 2000) are adopted in all aircraft manufacturers' Master Minimum Equipment Lists (MMEL), and that the latter are supplemented to clearly specify the circumstances where aircraft with unserviceable systems and/or unserviceable items of equipment may be used for flights departing from maintenance bases with appropriate maintenance facilities (home bases).

- 27/2004 LBA as the cognizant approval authority for the aircraft manufacturers' Minimum Equipment Lists (MEL) should see that the Criteria for Dispatch (JAR-MMEL/MEL, page 2-C-3, No. 3 dated May 1, 2000) are adopted, and that the MEL are supplemented to clearly specify the circumstances where aircraft with unserviceable systems and/or unserviceable items of equipment may be used for flights departing from maintenance bases with appropriate maintenance facilities (home bases).
- 28/2004 EASA as the cognizant aircraft type certification authority should see that a feature (electronic prompt or warning light) is installed in A300/A310 aircraft to indicate any abnormal position or positional shift of the THS (pitch up/down).
- 29/2004 LBA as the cognizant approval authority for the maintenance organisation should see that the maintenance organisation's written procedure covering the elimination of reported faults is revised to consider the potential impact on flight control of any system failure when subjecting vital flight control systems to trouble shooting. Any reported fault which cannot be verified upon repair of such systems shall not be deleted as fixed without taking additional investigative and corrective action.

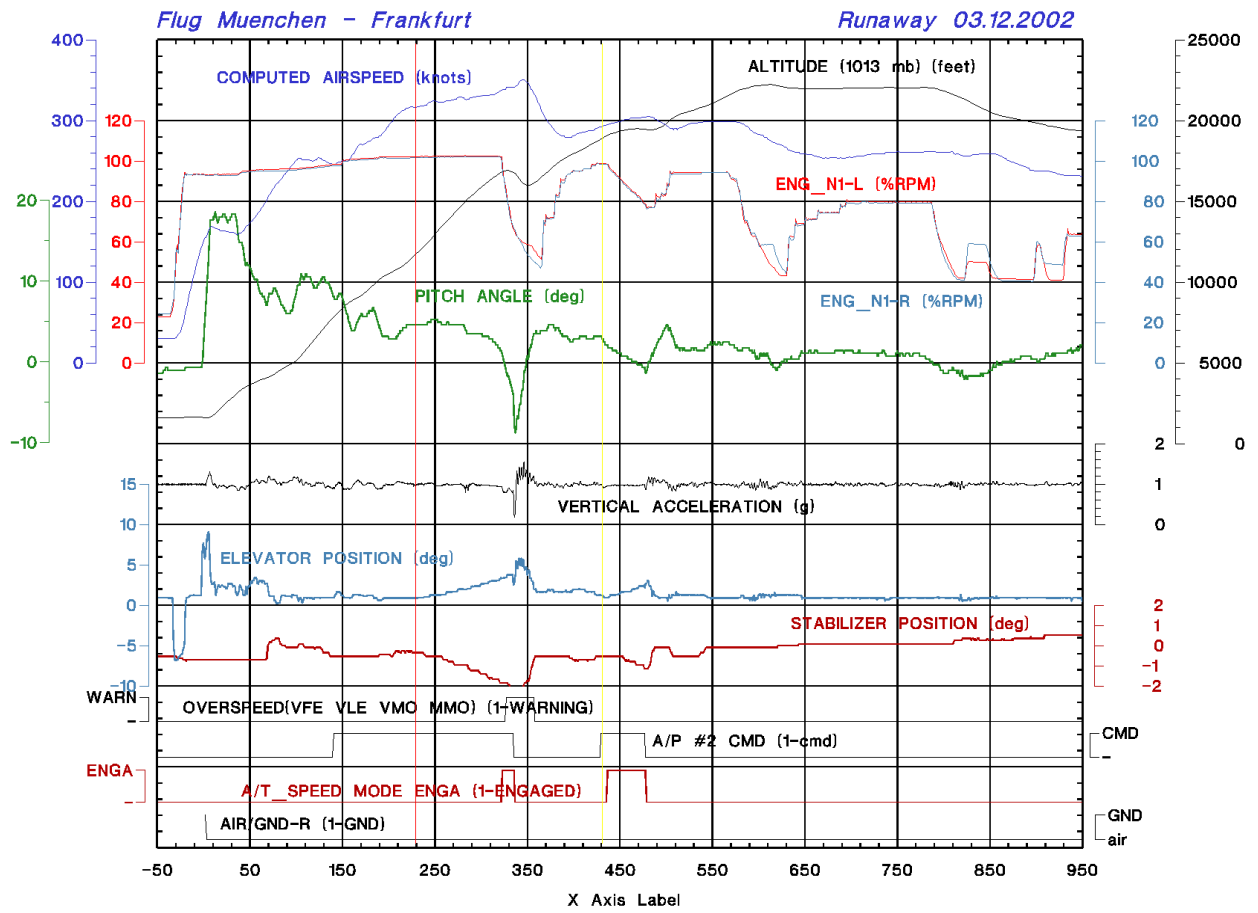
Investigator in charge	K. Büttner
Assistance	
Operations	L. Müller
Aircraft systems	U. Pitz; K. Büttner
Flight recorders	H.-W. Hempelmann

Appendices

FDR readout of the event

Abbreviations

FDR Readout



Preliminary Inc_Flight
Created: December 18, 2002

BFU Flight Recorders

Abbreviations

AOM AP AMM	Aircraft Operating Manual Autopilot Aircraft Maintenance Manual
ECAM	Electronic centralized aircraft monitor
FAC FDR FD FCC	Flight Augmentation Computer Flight Data Recorder Flight Director Flight Control Computer
PF PFD PTS	Pilot Flying Primary Flight Display Pitch Trim System
MEL MMEL	Minimum Equipment List Master Minimum Equipment List
THS TLB	Trimable Horizon Stabilizer Technical Log Book
V _{MO}	Maximum Operating Limit Speed
MTOW	Maximum take-off weight