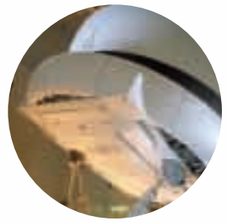
Safety First

The Airbus Safety Magazine

 # 01 | January 2005



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EDITORIAL

 # 01 | January 2005

Yannick MALINGE
Vice President
Flight Safety

Dear Customers and Aviation Safety Colleagues,

Flight Safety has permanently improved from one aircraft generation to another and this trend continues.
There are several factors that have led to these positive results, one of them being the flow of information between the key actors of the aviation community. Even though it is extremely difficult to quantify the benefit of information sharing, no one can dispute the positive effect it has.

To further develop this information sharing, we re-launch our safety magazine. This is the objective of this first issue of the Airbus Safety Magazine called “Safety First” (which replaces the previously named “Hangar Flying” magazine).
It is intended to issue this on a regular basis as a hard copy and we also intend to send it electronically.

This is not just a forum for Airbus to pass information to you. We want your participation. Send us articles that you think are worth sharing. We will de-identify the information if requested.

I hope you will find useful information in this first issue but we rely on your feedback to tell us what you think and what you would like to see included.

Yours sincerely,

Yannick MALINGE
Vice President Flight Safety

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SAFETY FIRST

The Airbus Safety Magazine
For the enhancement of safe flight through increased knowledge and communications.

Safety First is published by the Flight Safety Department of Airbus. It is a source of specialist safety information for the restricted use of flight and ground crew members who fly and maintain Airbus aircraft. It is also distributed to other selected organisations.

Material for publication is obtained from multiple sources and includes selected information from the Airbus Flight Safety Confidential Reporting System, incident and accident investigation reports, system tests and flight tests. Material is also obtained from sources within the airline industry, studies and reports from government agencies and other aviation sources.

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Safety First
 # 01 January 2005

Safety First is published by Airbus S.A.S
1, rond point Maurice Bellonte
31707 Blagnac Cedex / France

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Concept Design by HCSM
Production by CITYCompo

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Printed in France

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The plan is to issue a magazine on a regular basis but for those who have e-mail contacts some articles could be sent out in between the full magazine issues.

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Let us know what you think and do you have inputs?

As already said this magazine is a tool to help share information. Therefore we rely on your inputs. If you have ideas or desires for what is in the magazine please tell us. If you have information that we can share between us then please contact us. We are ready to discuss directly with you.

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Flight Safety Conference

Airbus' annual flight safety conference was held in Toulouse from 11th to 14th October 2004, bringing the aircraft manufacturer and its customers together in a confidential forum that allows them to share experiences learned through in-service events.

Now in its eleventh year, the conference was also an opportunity for Airbus to raise awareness of general issues relating to the safe operation of its aircraft. This year's conference is the largest to date with 135 representatives from 83 airlines. Alain Garcia, executive vice-president, Airbus engineering, opened the three-day safety conference for operators of all aircraft types.

As in previous years, a spirit of trust and openness prevailed throughout the conference, despite the sensitive nature of some of the topics being discussed. The open exchange of information by both airlines and Airbus has proved to be a significant contributor to safety enhancement.

Safety representatives from airlines who will be operating the A380 when it enters service in 2006 also received a special briefing related to the aircraft.

The questionnaires returned from the participants were very positive with 100% of the returns believing the conference objectives were achieved. There were comments on some points and these are being reviewed for next year's conference.
One of the main concerns was the conference facilities. This point has been taken and as a result the date and venue for the next conference are confirmed:

LISBON, Portugal
17th to 20th October 2005

There will be more news on the conference in the next issue of the magazine.

Go-Arounds at Addis Ababa due VOR Reception Problems

By: Jean Daney
Director of Flight Safety
As reported by an Airbus Operator and reproduced with their permission

The following article was provided by the involved Airbus operator and has been reproduced with their agreement but has been de-identified. At the end of the article there is information on the Airbus policy concerning the use of GPS position for Terrain Awareness and Warning System (TAWS). This policy was issued in an OIT/FOT (ref: SE 999.0015/04/VHR dated 05 February 2004).

The same crew and aircraft had been scheduled to operate the flight from **** to Addis Ababa Bole Airport (HAAB) with a single en-route stop at****.

The first sector was operated without incident and, after disembarking passengers and refuelling, continued to HAAB. On arrival overhead the Addis Ababa VOR/DME (ADS 112.90 MHz), the flight was cleared to carry out a standard VOR/DME approach to runway 25L at Bole. Touchdown elevation at Bole was 7593' amsl and the MDA for the procedure 8020' amsl. There were no civilian radar facilities.

The VOR/DME indications had appeared normal up to the start of the procedure, but during the outbound leg, ADS 092° radial, an unexpected large correction left was required to acquire the radial. After flying the ADS DME 13nm arc, a left turn was made to intercept the 249° inbound QDM and descent from 11200' amsl commenced in accordance with the procedure. The VOR radial started fluctuating during the descent and eventually the indications disappeared. With no adequate visual reference, a standard missed approach was flown from a minimum altitude of 8922' amsl and the aircraft entered the hold over the ADS. Once in the hold and after confirming with Bole ATC that the VOR/DME was serviceable the crew carried out a navigation accuracy check that appeared normal and elected to carry out a further approach. Once again, the VOR indication fluctuated during the inbound leg and another missed approach was flown from a minimum altitude of 8866' amsl after which the aircraft diverted to Djibouti. A brief EGPWS "Terrain Ahead" warning occurred as the go-around was initiated.

After refuelling at Djibouti, the commander elected to use his discretion to extend the flying duty period and return to HAAB. On arrival at Bole, a daylight visual approach was flown to runway 25L and a successful landing made. It was noted during this approach that the VOR bearing information was in error up to 30° and that any attempt to fly the procedural inbound QDM would have displaced the aircraft to the North of the required track.

The commander filed an Air Safety Report (ASR) as required by the company in the event of any go-around. Normal company procedures also required an inspection of flight data from the Quick Access Recorder (QAR) as part of the follow up to any ASR and the company Flight Safety Manager carried this out.

The analysis revealed that at some point on both approaches the aircraft had passed over a ridge of high ground not normally encountered on the 25L approach. At the point at which the second go-around had been initiated the aircraft had passed over the ridge with a clearance of 55' as shown by the radio altimeter recording. At no time were the crew aware of this close proximity to the ground.

A full company investigation into the circumstances of the incident continued independently of the official investigations initiated by the state authorities concerned and with the assistance of the Airbus Flight Safety Department. Following the outcome of the company investigation, the company has put in place measures to minimise the risk of similar incidents which include:

- HAAB to be treated as a Category 'C' airport,
- Operations to HAAB to be conducted by GPS equipped aircraft only,
- Approach to be discontinued if VOR indications differ from GPS derived FMGS indications by more than 5°,
- The MDA for the 25L VOR/DME procedure raised to 9380' amsl (1790' aal) in association with a minimum visibility of 5KM,
- Approach to be discontinued if no visual contact with the runway approach lights at ADS DME 5nm (FAF). (ie MAP is ADS 5DME)

Note: The last two restrictions have since been relaxed as confidence in the "ADS VORDME was regained. The airport authorities have also installed an ILS on this runway and a new DVORDME facility in the area since this incident took place.

The incident aircraft has also been fitted with a GPS engine in the EGPWS computer as an interim measure, with a full GPS MMR upgrade scheduled for early 2005.

Navigational Considerations

All Airbus A320 aircraft are fitted with triple Inertial Reference Systems (IRS). The navigation function is performed by the dual Flight Management & Guidance Computers using the outputs from the IRS and refining the combined IRS position with radio navigation aid or GPS satellite information. The involved aircraft is not fitted with GPS satellite navigation equipment and the position refinement is taken from ground radio navigation aids only, typically DME/DME, VOR/DME or VOR/VOR crosscuts depending on local availability.

In the area of Addis Ababa the only suitable radio navigation aid was the "ADS" VOR/DME located between the two runways at Bole Airport at position N08 58.7 E038 47.9. It follows, therefore, that any error in the transmitted data from this VOR would result in a corresponding error in the computed FMGC position. Such errors could result from faulty operation of the VOR/DME facility, radio frequency interference with the transmitted data or anomalous radiation caused by local terrain (sometimes referred to as "scalloping").

The possibility of faulty airborne equipment had to be considered but this is unlikely as similar anomalous VOR indication behaviour was observed during a subsequent approach by another A320 fitted with a GPS. This latter occurrence was witnessed by the Flight Safety Manager.

The incident was discussed with the Director of the Air Operations and Navigational Aids Department (DONAD) and the Head of Safety Investigations of the Ethiopian CAA. The former stated that he was not aware of any other reports of problems with the ADS VOR but that an investigation would be carried out in response to this particular report. On the following day a verbal report was received that an examination of the VOR transmitter had revealed a 2°error in the radiation pattern and that an alternative transmitter was in service. Calibration of the alternative transmitter appeared to have been by pilot report from GPS equipped inbound aircraft and it was stated that the pattern was correct.

At a subsequent meeting with the Flight Safety Officer of Ethiopian Airways it was stated that there had been concerns from Ethiopian Airways pilots that the inbound leg of the 25L VOR/DME procedure was "taking aircraft too far north of the ideal track". It was not clear whether these concerns had been relayed to the Ethiopian CAA, although it was stated that Ethiopian Airlines was putting pressure on the CAA too install an ILS for this runway prior to the rainy season that starts around July/August.

The following day, the company Flight Safety Manager was subsequently contacted by Bole ATC and advised that the ADS VOR had been taken out of service following a fault caused by the heavy rain that had occurred during that evening. The company flight for that day had already departed and was diverted to Khartoum. A further call from Bole ATC confirmed that the VOR was back in service and fully serviceable. The diverted flight arrived at HAAB with no reported problems.

Addis Ababa Bole International Airport (HAAB)

Bole Airport is located on the south western outskirts of the city of Addis Ababa, Ethiopia. The airport reference co-ordinates shown on the EAG Aerad chart are: N08 58.7 E038 47.9

Addis Ababa is situated on the Ethiopian plateau at an elevation of 7600' amsl and is surrounded by areas of high ground rising to approximately 11000' amsl.

The airport has been undergoing significant development in recent years and has recently seen the construction of a new terminal building and the new 07R/25L runway. The new runway lays parallel to and approximately 400m south of the original 07L/25R. The ADS VOR was moved to its current location south of the two runways during the development.

In current operations 07R/25L is used as the main runway with the old runway designated as taxiway "Foxtrot". However, 07L/25R is still used as an active runway by local traffic.

The only instrument approach procedures currently available to the operator at the time were the VOR/DME procedures for 25L and 25R. Landings on runway 07R are achieved by carrying out the 25L VOR/DME procedure and breaking left for a visual circling approach to 07R. The Ethiopian CAA has promulgated a GPS/RNAV procedure for runway 07R and will shortly promulgate one for 25L. The involved operator does not currently hold an approval for GPS/RNAV approaches. Full ILS procedures for both 25L and 25R are now promulgated.

In addition to the ADS VOR, there were two MF locator beacons, 'AB' 333 KHz and 'BL' 352 KHz, situated on the original ILS approach path to 25R. There were no ILS procedures promulgated for the airport at the time, although the original 25R ILS localiser was believed to be still radiating on 110.3 MHz. New aids have now been installed as stated above.

Terrain Considerations

The airport is situated on a relatively flat plain at 7600' amsl. The level of the plain rises gradually to the east attaining an elevation of approximately 8500'amsl 15nm from the airport. There are significant high peaks around the airport as follows:

- 10535' amsl 010°T / 8nm
  Bearings and distances are approximate
- 9646'amsl 025°T / 11nm
  from VOR/DME position
- 10167' amsl 120°T / 11.5nm
- 9200' amsl 230°T / 9nm

There is a significant ridge running approximately 135°T from the first of the above peaks and running out into the plain at about 6nm from the VOR. This ridge is the one referred to in later sections of this report. A further ridge runs approximately 215°T from the same peak towards the eastern outskirts of the city. This runs out into the plain approximately 3.5nm north of the airport.

Terrain information is provided for the crew by the following:

• EAG Aerad charts N1/N2
these show "safety contours" and Sector Safe Altitudes for the four prime sectors within 25nm of the aerodrome reference point. At Addis, the SSA for all sectors is shown as 13500'. No detailed terrain information is shown.

• EAG Aerad Terrain Chart
A large scale chart showing the main features in a large area around Addis. No fine detail of terrain around the airport is shown.

• Military ONC Chart
A 1:1000000 scale chart of the region

The involved aircraft is fitted with a Honeywell Enhanced Ground Proximity Warning System (EGPWS) with software to standard 428. The EGPWS computer has been removed from the aircraft and an attempt made to download event data from it. This was initially unsuccessful due to a fault condition at the time of removal. The unit was returned to the OEM who achieved a download in his workshop. During the subject approaches and go-arounds the crew heard only one EGPWS alert, a "Too Low Terrain" call just after initiation of the second go-around believed to have been triggered by the Terrain Clearance Floor mode. The QAR recorded a short duration Mode 4 "Too Low Terrain" warning at about the same time.

This photograph shows the NW to SE ridge running down towards the approach path. It was taken from near the village of Leghedadi 10nm NW of the airport looking WSW from a range of approximately 5nm.

This picture shows the same ridge from a range of about 8nm from the NW of Leghedadi.

Terrain Profiles

The following approach and terrain profiles were derived using the data from the QAR. The pressure altitudes recorded have been corrected for a QNH of 1027 HPa for Figure 1 and 1029 HPa for Figures 2 & 3.

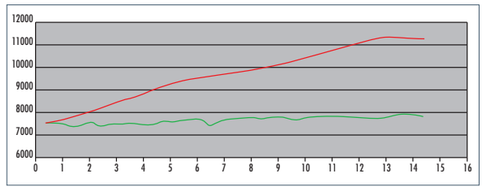


Figure 1

Figure 1 shows the profiles for the approach carried out on the return from Djibouti which was carried out visually. The terrain profile is typical for a correct approach path with the characteristic gentle slope of the plain from west to east. Other characteristic features are the river valley at 6.5D and the double depression on the final approach to the threshold.

The distance scale on this figure can be directly related to DME distance from the "ADS". In Figures 2 & 3, the 13nm marker can be taken as 13D from the "ADS", but other distances do not relate to DME as the aircraft was not flying towards the DME facility. The distances have been corrected to take account of the varying groundspeed during each approach.

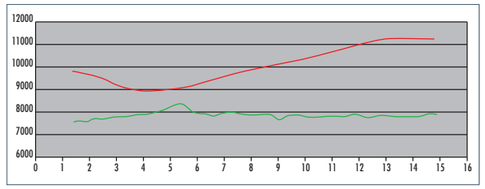


Figure 2

Figure 2 shows the profiles for the first approach at HAAB. Notable points are the non-sloping nature of the terrain between 15nm and 6nm and the high point at just over 5nm. There is also a marked valley at 9nm and a lesser one at 6.5nm.

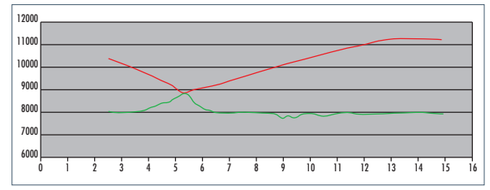


Figure 3

Figure 3 shows the profiles for the second approach at HAAB. Here, the notable points are again the flat terrain between 15nm and 7.5nm and the high point at just over 5nm. The river valley is still apparent at 9nm, but has split into two. The terrain clearance at the point of go-around is 55'.

Aircraft Position

The only position information available from the QAR was the recorded FMGC latitude and longitude. Since the FMGC position was IRS position corrected by radio position and the only radio position was based on the suspect VOR/DME facility, no reliance can be placed on the accuracy of the recorded position information.

One point of interest was the behaviour of the recorded FMGC position immediately after each go-around. The standard missed approach procedure for the 25L VOR/DME approach states "Left (max 185kt) as soon as practicable onto ADS 193R to 13500 5910 then right to ADS and hold or as directed". (EAG Aerad Chart N1 dated 20 FEB 03). On both go-arounds the recorded heading information suggests that the aircraft followed this procedure. The FMGC position data, however, indicates a right turn immediately after each go-around followed later by an abrupt left turn onto a southerly track.
The crew report stated that during each approach the VOR indications were lost just prior to the go-around, but came back as the go-around proceeded. During the approach made by the GPS fitted aircraft the following behaviour was observed:

- During the outbound leg of the procedure, the VOR bearing information correlated with the GPS derived FMGC data on the Navigation Display (ND).
- As the aircraft turned left to intercept the 249°M track inbound to the VOR, the beam bar initially moved in as expected to near centre.
- As the wings were levelled on a heading that should have followed the correct track, the beam bar moved back out to the right and settled at about half to two thirds full scale deflection.
- The crew flew by visual reference to the runway using the GPS derived navigation data to follow the correct inbound track and the VOR indication remained steady at the deflection stated above.
- At about 3.5D, the beam bar quickly moved back to the central position.

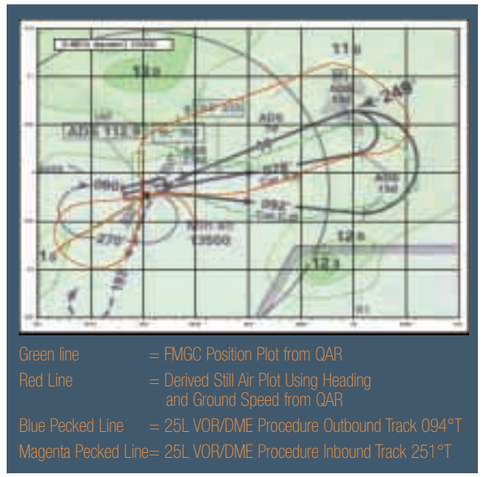


Figure 4

The two approaches flown during the incident flight were both conducted in IMC with only one glimpse of ground lights during the first approach.

Figure 4 on shows the track for the second approach.

Initially, as the procedure is commenced, the FMGC track and still track appear to be following the procedural 094°T track. The FMGC track then starts to deviate to the south and the aircraft is turned left to correct taking the still air track to the north of the required track. This correction brings the FMGC position slowly back to the required track, but the still air track is moving well north.

Airbus Policy

This Airbus policy is concerning the use of GPS position for TAWS operations. Note that the TAWS is also known as EGPWS (Enhanced Ground Proximity Warning System) or T2CAS (Traffic and Terrain Collision Avoidance System).

The TAWS computer has an internally loaded terrain database and uses position information from the FMS. The FMS uses ADIRU position and radio position update. It can also use a GPS position source when available.
The use of the GPS with multimode receivers (MMR) provides improved navigation and surveillance functions. Therefore Airbus strongly recommends the use of a GPS source in the global architecture of the TAWS system.

Airbus offers an upgrade package that includes installation of 2 multimode receivers (MMR) and 2 GPS antennas.
However some aircraft configurations may need upgrade of other aircraft equipment to make full benefit of the MMR system. The Airbus upgrade services will define everything needed during the RFC/RFO process.

For more information see OIT/FOT ref SE 999.0015/04/VHR, dated 05 Feb 2004

The importance of the pre-flight, flight controls check

By: Albert Urdiroz
Flight Safety Manager

1 Introduction

As far as aeronautics systems are concerned, the pre-flight flight controls (F/CTL) check has existed since before the first powered flight. It aims at ensuring that flight controls respond to the pilot inputs, i.e. with no jamming, or movement limitation, or stiffness, or delayed or inadequate response. It is thus a key factor in the safe operation of the aircraft.
The pre-flight F/CTL check has been made on a flight basis by pilots since they flew an airplane for the very first time.
Being so familiar with it, one may fall in the trap of routine and neglect the importance of it. One may also believe that the aircraft's self-monitoring capabilities are sufficient to provide the adequate information, but they are not. Improper maintenance or components failure are to be considered also.
Here we review the scope of the pre-flight F/CTL check, and demonstrate based on in-service examples, how topical it still is.

2 Scope of the F/CTL check

An efficient F/CTL check ensures that the systems respond adequately:

1- In direction – for instance elevator moves down when the control column or the sidestick is pushed;
2- In amount of travel, up to full deflection;
3- In return to neutral;
4- In feeling.

On any Airbus aircraft, the F/CTL check involves the elevators, ailerons, spoilers and rudder control systems. Not only the components activated with the control wheel, control column and pedals, but the whole system. Let us refer to figure 1 and take the rudder axis of an A310 as an example in order to illustrate this comment.

Consider now each of the 4 items we have mentioned and review which systems are involved.

1- In direction;
2- In amount of travel;
3- In return to neutral;
4- In feeling.

The majority of the components represented in figure 1 are involved:

- Obviously rudder pedals, mechanical linkage and servocontrols;
- Any inopportune rudder trim that would shift the rudder from neutral would be detected with criteria 3;
- Artificial Feel Mechanism with criteria 4;
- Detection of any offset from Yaw Damper system with criteria 3;
- Rudder Travel Limiting Systems with criteria 2.

We may come to similar conclusions on other axis, and/or other aircraft types. Note on fly-by-wire systems, it would be electrical wiring instead of mechanical linkage.

The F/CTL check is thus not limited to the relationship in between the servocontrols, observed with the surface position indicators, and the controls at cockpit. The whole system is checked.

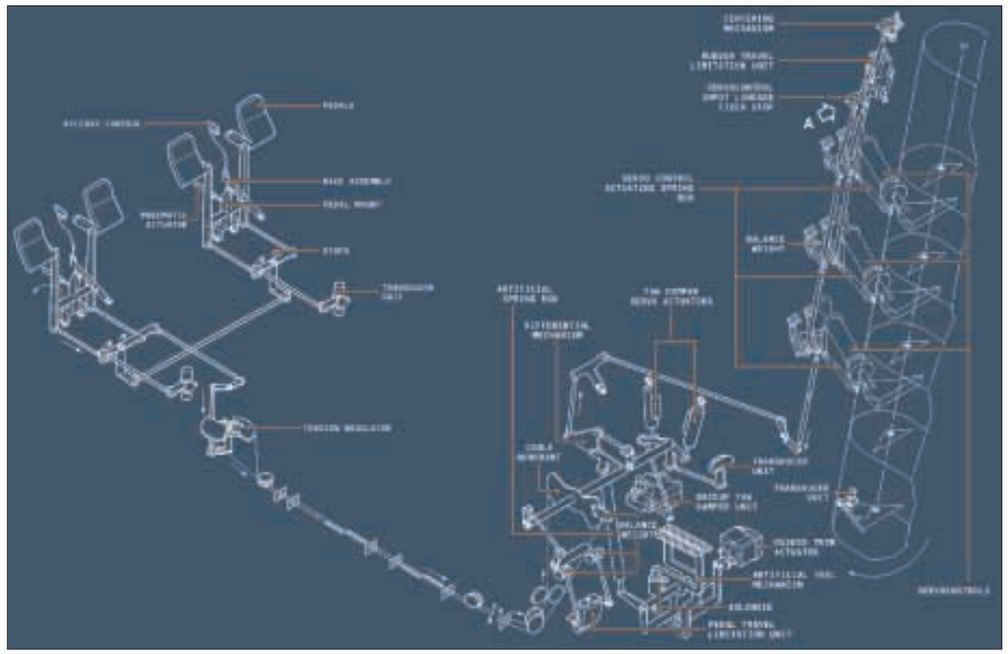


Figure 1 : A330 moder system schematic

3 Take-off after F/CTL check failed

We will here go through some examples gathered from in-service experience, when crew did not strictly adhere to the golden rules of F/CTL check.

3.1 Surfaces not at neutral with controls not at neutral

Let's come back on an event that was evoked in issue 7 dated October 2001 of Hangar flying under title "A310/A300-600 – Rudder trim incorrect indication – ATA 27", and also commented in OIT/FOT Ref. AI/SE 999.0030/00/CL dated 14 February 2000.
At the end of the F/CTL check, rudder trim indicator (RTI) was showing some rudder trim input. However rudder and rudder pedals were at neutral. Pedals and rudder trim are linked. Rudder trim actuator (RTA) had to be at neutral also. Indication was erroneous.

Rudder trim indication was manually brought back to neutral with no further check. This shifted the rudder, the rudder trim actuator and the pedals out of neutral.

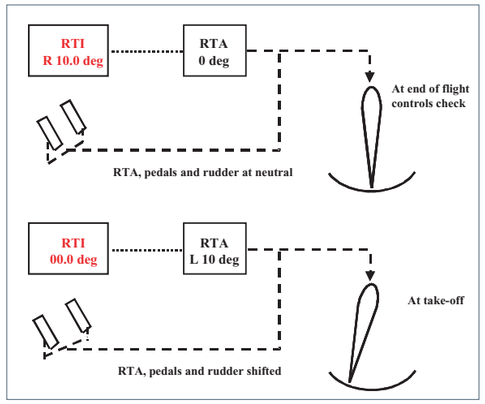


Figure 2 : incorrect rudder trim indication

Take-off was performed with the shift first compensated by inputs on the pedals and then by the autopilot yaw actuator once autopilot was engaged. But the rudder moved sharply to the rudder trim position once the autopilot declutched and the aircraft experienced an unexpected and sudden bank.

Such an event is covered with criteria 3, rudder at neutral with controls (what includes rudder trim) at neutral. There was no warning triggered to the crew, but it could have been detected by carefully performing the existing Standard Operating Procedures (SOP) F/CTL Check.

3.2 Response in opposite direction

We will here discuss an in-flight turn back due to Inverted Roll Command experienced with an A320.

The F/CTL check was performed with no anomalies noticed by the crew. At take-off, the Captain applied a lateral sidestick input to the right, but the aircraft banked to the left. The F/O took over, and successfully landed the aircraft.

Upon troubleshooting, a maintenance error was found. A wiring inversion had been made between the transducer unit of Captain roll sidestick and ELAC 1, on both the COMMAND & MONITOR channel. With this double inversion, ELAC 1 was receiving consistent signals, and thus could not detect the anomaly and could not trigger a warning to the crew (Figure 3).

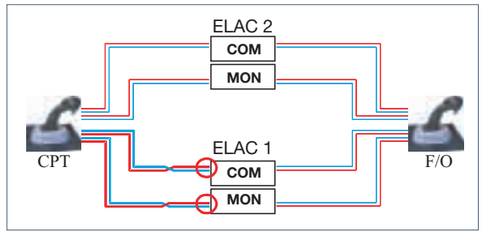


Figure 3: Cross connection of sidestick roll signals to F/CTL computer

The functional check required after performing AMM tasks had partially been performed on the F/O side only, and thus the anomaly was no detected by mechanics. Crew missed the last opportunity to detect it by not carefully performing the existing SOP F/CTL Check.

This event was presented during the 8th flight safety conference held in October 2001 (Item 15 entitled "A320 crossed roll controls"). It was also covered with an OIT/FOT entitled "ATA 27 – In-flight turn back due to inverted aileron deflection after take-off", Ref. AI/SE 999.0069/01/CL REV 01 dated 15 June 2001.

3.3 Lack of response

Another example is an in-flight turn back due to reduced ability to turn left experienced just after taking off with an A320. Almost full left sidestick inputs were required in order to laterally control the aircraft. At 1500ft, ECAM warning "F/CTL SPLR FAULT" came up with all right hand roll spoilers shown inoperative.

During a previous maintenance task, R/H spoilers 2 to 5 were left in the maintenance position. After lift-off, they deployed to the zero hinge moment positions and would not respond to inputs.

Preventive instructions have been added in AMM, and monitoring has been improved to trigger an ECAM warning in such condition. But it could also have been detected by carefully performing the existing SOP F/CTL Check (Figure 4).

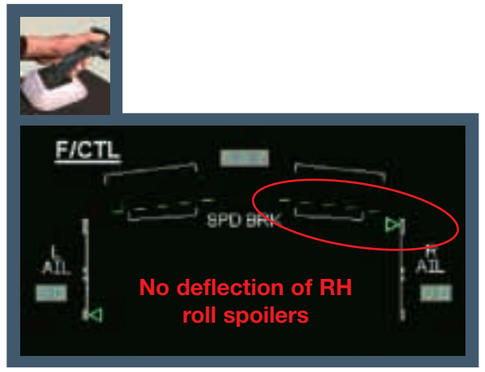


Figure 4: Lack of response from RH spoilers to sidestick inputs

4 Efficiency of the F/CTL check

Some events, including recent ones, have highlighted the importance of the F/CTL check. Indeed anomalies were detected which required correction before flight, when aircraft systems did not trigger any failure warning to the crew. Here after are some of them.

4.1 Lack of response

A few events of this kind have been experienced with aircraft of the A340 family. The crew detected during the pre-flight F/CTL check that one elevator was stuck down (Figure 5). The loss of the elevator control was not indicated to the crew by any warning.

Figure 5

These events resulted from failure of the servo-control in damping mode failed. Investigating these events has allowed definition of modifications to both the servocontrols and the F/CTL computers in order to prevent similar events. Appropriate ECAM warnings are triggered for crew annunciation. For these events, detection was ensured by carefully performing the existing SOP F/CTL Check only.
Additional information about these event is available with
- OIT/ FOT Ref. SE 999.0149/03 dated 17 December 2003 entitled “ATA 27– elevator dropped down – Cracked mode selector valve transducer at servocontol in damping position”;
- OIT Ref. SE 999.0066/04/BB Rev. 01 dated 11 June 2004 and FOT Ref. STL 999.0061/04 dated 10 June 04 entitled “ATA 27 – Right elevator stuck down in full pitch down position caused by double failure.

4.2 Limited deflection

One last example is an event of undue rudder travel limitation on ground.

The Rudder Travel Limitation Unit (RTLU) had failed closed in the high-speed configuration. The ECAM warning “F/CTL TRAVEL LIM FAULT” dedicated to the monitoring of the RTLU position was not displayed.

Indeed, at that time, FCSC which is the computer that controls the RTLU and PTLU did not monitor their behaviour during phases when they are not electrically supplied and thus not supposed to move. However the RTL system failed and RTLU closed during such a phase of no monitoring on ground. Monitoring has since been reviewed.

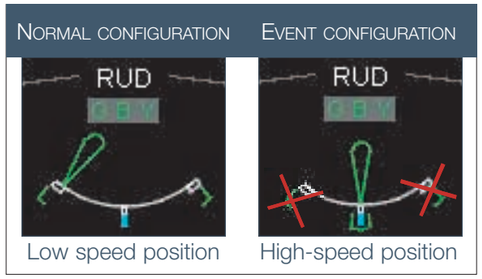


Figure 6: Full rudder deflection not archieved

The failure was thus detected only by performing the existing SOP F/CTL Check, and the right decision to return to the gate could be taken.

5 Completion of the F/CTL check

All of the above-mentioned events have confirmed that the crew properly performing Flight Control Checks remains the last safety net. However, training feedback and line observations have revealed that the F/CTL checks were not always performed properly because:
- Checks were routinely performed;
- The PF moved the sidestick too quickly and the PNF had insufficient time to efficiently perform the checks;
- The PNF may be out of the monitoring loop.

SOP F/CTL checks have been reviewed with a reinforcement of the role of the PNF who now calls out the results of his/her visual check of each of the PF’s sidestick/rudder pedal stops inputs. This allows the PNF to still closely monitors the correct sense, full deflection and return to neutral of all surfaces as previously recommended, and in addition:
- Avoids the PNF from being influenced by the PF callouts
- Ensures that the PNF efficiently checks all surface motions
- Obliges the PF to pause the sidestick/rudder pedals at each stop
- Allows the PF to detect a failure, if callout is not in line with the PF’s input.

A330 FLIGHT CREW OPERATING MANUAL

STANDARD OPERATING PROCEDURES	3.03.10	P 3
TAXI	SEQ 001	REV 19

— **FLIGHT CONTROLS . . . . . CHECK**

R 1. At a convenient stage, prior to or during taxi, and before arming the autobrake, the
R PF silently applies full longitudinal and lateral sidestick deflection.
R On the F/CTL page, the PNF checks full travel of all elevators and all ailerons, and the
R correct deflection and retraction of all spoilers.
R The PNF calls out “full up”, “full down”, “neutral”, “full left”, “full right”, “neutral”, as
R each full travel/neutral position is reached.
R The PF silently checks that the PNF calls are in accordance with the sidestick order.

R *Note : In order to reach full travel, full sidestick must be held for a sufficient period*
R *of time.*

R 2. The PF presses the PEDAL DISC pushbutton on the nosewheel tiller, and silently
R applies full left rudder, full right rudder, and neutral. The PNF calls out “full left”, “full
R right”, “neutral”, as each full travel/neutral position is reached.
R 3. The PNF applies full longitudinal and lateral sidestick deflection, and silently checks
R full travel and the correct sense of all elevators and all ailerons, and the correct
R deflection and retraction of all spoilers, on the ECAM F/CTL page.

R *Note : The F/CTL page is automatically displayed for 20 seconds.*

Figure 7: Extract of A330 SOP – FCOM 3.03.10 Rev. 19

6 Conclusion

In comparison with conventional aircraft, "Fly by wire" architecture provides an additional flight controls systems monitoring in order to ensure flight controls availability and safe aircraft operation.

Airbus' priority is to continuously meet these objectives, if possible, via monitoring enhancements. However, EFCS monitoring features cannot possibly detect all failure cases.

A comprehensive flight controls integrity check relies on the crew's accurate completion of pre-flight control checks.

The new SOP procedure increases the efficiency of the F/CTL checks, in association with the F/CTL monitoring systems: The PF and PNF are definitively in the monitoring loop.

The key message Airbus
would like to convey is:
TAKE YOUR TIME
PROPER F/CTL CHECKS = SAFER FLIGHT

Note: The F/CTL checks have been discussed during the 11th Flight Safety Conference held in Toulouse in September 2004. CD's of this conference may be requested to the Nuria Soler, nuria.soler@airbus.com.

A320 In-flight thrust reverser deployment

By: Thierry Thoreau
Director of Flight Safety

The in-flight thrust reverser deployment is one of the most feared situation by all pilots. It has always been under the extensive scrutiny of both the engines and airframe manufacturers as well as by the Airworthiness Authorities. This particular attention was even reinforced after the tragic accident which occurred on Lauda Air B767 flight NG004 in May 1991. This has lead to the implementation of additional modifications to further decrease the probability of occurrence of such event.

Despite all protective measures in place, the event described hereafter occurred in March 2004 on an A320 aircraft equipped with IAE V2500-A1 engines.

Sequence of events:

- While the aircraft was on a transit check for a scheduled flight, airline's maintenance found an hydraulic leak from the engine N° 1 inboard lower thrust reverser actuator.

- Airline's maintenance deactivated the reverser for an aircraft dispatch under M.E.L.

- In climb phase, approximately 15 nm from the departing airport, engine N° 1 reverser got deployed.

- As per check-list, engine N° 1 was shutdown by the crew

- Crew then made a safe precautionary landing back to departing airport.

Findings:

- Upon landing, the engine N° 1 reverser was found almost fully deployed.

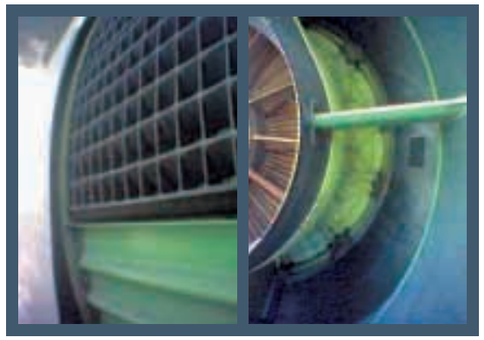


Figure 1

- The thrust reverser sleeve locking pins (2) were not found, while the lock-out assembly was intact.
- After opening the fan cowls, both locking actuators were found lock wired in the unlock position. The HCU was properly deactivated.

Flight data analysis:

GMT:14.16.30 A/C takes off TLA are set to TOGA position - EPR reach 1.4 A/THR engages

GMT: 14.17.30 A/P 1 is engaged Altitude is 1,700 ft AGL, TLA are set to CLB

GMT: 14.18.30 SLAT/FLAP conf clean is selected

GMT: 14.20.22 ENG 1 thrust suddenly drops down

ALT is about 6500 ft AGL – CAS = 250kts
The a/c was in a left commanded turn. The roll angle was decreasing from around 10° with a rate of 2°/sec.
EPR actual, EPR command and EPR target decrease from 1.24 to 1.0 in 10 seconds (auto-idle logic activated due to a reverse deployment beyond 10%)
A/THR disengages
Concurrently, VRTG decreases to 0.99g. Roll rate which was about 2°/sec (aircraft was in left turn) reduces to 0.4°/sec ; LATG increases to 0.05g. Rudder moves from 0 to -3DA (right input)

GMT: 14.20.32 ENG 1 TLA increases
When Engine 1 reaches Idle, crew moves TLA1 up to 31DA, ENG1 intends to follow TLA1 position (short thrust increase) but continues to decrease down to Idle (auto-idle logic)

GMT: 14.20.45 ENG 1 TLA decreases
Crew elects to retard TLA1 to Idle and increases TLA2 to 35DA (MCT)

GMT: 14.21.25 Aircraft levels off Altitude is 8000ft ; CAS increases to 262kts (maximum reached during this flight)

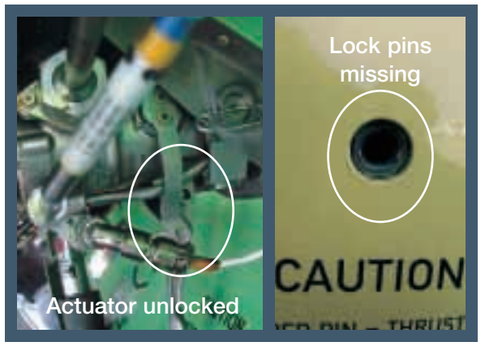
GMT: 14.21.59 ENG1 shut down Main ENG1 parameters start to toggle, NCD parameters

GMT: 14.22.27 Auto thrust is reactivated

GMT: 14.42.25 Crew performs a manual single engine landing

Maintenance actions analysis:

- The HCU deactivation was done properly following the AMM procedure:
  • “A. Deactivation of the Thrust Reverser HCU” procedure.
- The following AMM procedure steps were not performed , because it was not possible to do so while the thrust reverser actuators were lock wired in the unlocked position:
  •“B. Manually move the translating sleeves to the fully retracted position”
  •“C. Lock the Left and the Right Translating sleeves”
- Finally the last AMM procedure step was not done.
  • “D. Put the locking actuators in the locked position”



Due to the combination of having:

- The HCU deactivated (leading to no hydraulic power to the actuators)
- And the actuators not locked
- And the lock-out bolts not properly installed on the translating sleeves,

the translating sleeves were not locked and were free to move under aerodynamic loads.

Operational aspect analysis:

Prior to engine start, the ECAM warning “ ENGX REVERSE UNLOCKED” was annunciated.

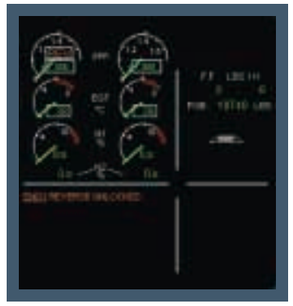


Figure 2

According to information received, maintenance personnel cancelled the “ENGX REVERSE UNLOCKED” message through the “EMER/CAN” button.
Upon engine start, the “ENGX REVERSE UNLOCKED” warning was then displayed under cancelled cautions, while the ECAM showed “REV” Amber in EPR gauge and “STS” indication.

Figure 3

Figure 4

However, the aircraft was dispatched with the thrust reverser unlocked and free to move under aerodynamic forces.

Less than 4 minutes after take-off, the engine N°1 auto-idle was activated. It activates once there is more than 10% opening of the reverser, and brings down the TRA to idle based on the initial TRA position. This reverser opening detection also triggered the Auto thrust disconnection. The Auto re-stow which is also normally triggered was not effective since there was no hydraulic power due to the proper de-activation of the HCU.

As described in the Flight data analysis, there was very little changes on aircraft flight characteristics. Based on the flight parameters evolution it is assumed that the thrust reverser deployed slowly due to the aerodynamic forces (there was no hydraulic power due to HCU de-activation).

The aircraft maintained control with no upset throughout the event.

The engine was shut-down, then the Auto thrust was re-engage, and an IFTB was made followed by an uneventful single engine landing.

Per FCOM Standard Operating Procedure “cockpit preparation”, the ECAM control panel STS page must be checked to ensure that INOP SYS display is compatible with MEL.
In this case for ENGX REVERSE UNLOCKED, the MEL says “NO DISPATCH”.

Maintenance recommendations:

It is absolutely necessary to strictly follow all steps of the relevant AMM Thrust reverser de-activation procedure.

Furthermore, only the required tooling must be used (appropriate locking pins,…)

Finally, “ENG X REVERSE UNLOCKED” warning should not be displayed following reverser deactivation.

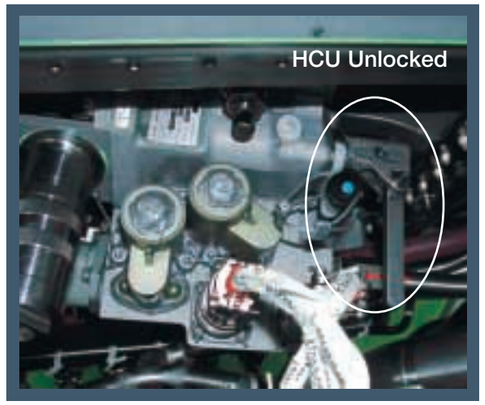


Figure 5: Normal Flight Condition

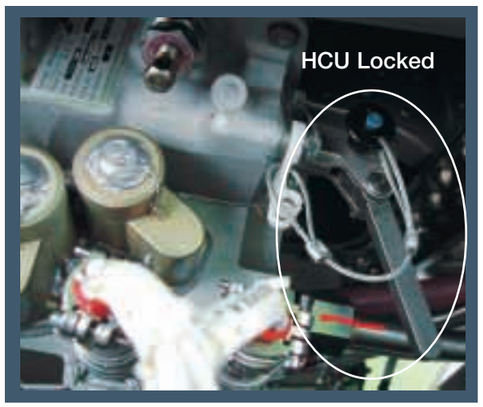


Figure 6: Deactivated Flight Condition

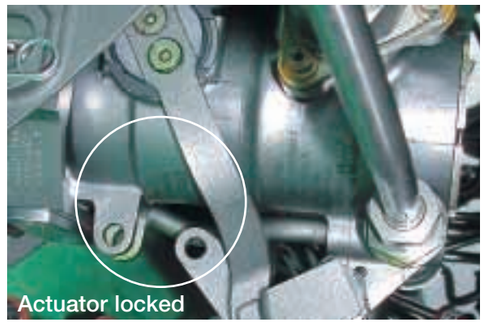


Figure 7: Normal Flight Condition & Deactivated Flight Condition

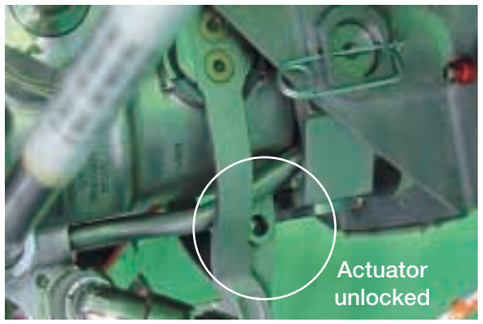


Figure 8: Maintenance Condition Only

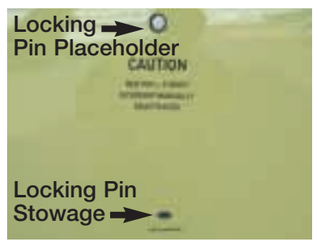


Figure 9: Normal Flight Condition

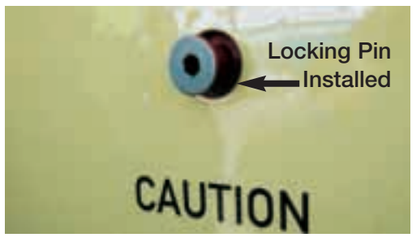


Figure 10: Deactivated Flight Condition

Operational recommendations:

The **“ENGX REVERSE UNLOCKED”** and the **“REV”** Amber messages should not be present on ECAM following a proper thrust reverser deactivation. **They are both NO DISPATCH warnings.**

In addition, the “EMER/CANC” button should only be utilized to kill a permanent spurious warning.

Airbus Flight Safety Manager's Handbook

By: Christopher Courtenay
Director of Flight Safety

On many occasions, the Flight Safety Dept in Airbus were receiving request from newly established and charter airlines for assistance in setting up a Flight Safety function.

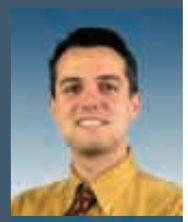
At that time, Airbus being a manufacturer rather than an operator, felt we did not have the competence to offer this experience. However, there were many airlines around the world that already had in place a well run Flight Safety function. So it was logical to request the well-established airlines to assist other airlines.

So the project was launched by Airbus to create a kind of guide book (a What to Do and How to Do) that would enable a newly appointed Flight Safety Manager to set up his function. We were quite fortunate at this time to recruit Mr Dennis Johnson who had just retired from Virgin Atlantic as their Flight Safety Manager. Dennis was the principle author of what later became the Airbus Flight Safety Manager's Handbook. During the drafting of this handbook, there were several round-the-table reviews of the contents with several airlines who were kind enough to actively participate; namely, Aer Lingus, Airtours International, Gulf Air, Royal Jordanian, Transaer together with many others (Airtours International, China Airlines, Costa Rica DGAC, Eyptair, TAM and TransAsia) sending in their comments.

The handbook was finally published in March 1999 and up until today we still receive many

requests for copies. This handbook was later used by GAIN as a basis to create an expanded version. The book was so successful it was a finalist in the Flight International Safety awards. The award judges considered the Airbus approach “as just what the industry needs providing a first class template for any new flight safety operation". One major airline's senior air safety investigator described it as "unique in its scope where all aspects of a flight safety management programme are addressed, from corporate commitment through accident/incident investigations, to listings of available safety resources".

If airlines wish to receive copies of this handbook, simply contact Airbus Flight Safety.
Contact: Mrs Nuria Soler
nuria.soler@airbus.com.



Flight operations briefing notes

A Tool For Flight Operations Safety Enhancement

By: Christophe LEMOZIT
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and: Michel TREMAUD
Senior Director Safety and Security, Customer Services

Flight Safety Enhancement – In Need of a Global Approach

Aviation safety, measured in terms of number of hull losses per departure, has reached a mature but stable level.

Any further enhancement of this achievement requires a systemic approach where the aircraft, the operations and the operating environment are considered globally.

Introducing the Flight Operations Briefing Notes Concept

The Flight Operations Briefing Notes have been designed to allow an eye-opening and self-correcting accident-prevention strategy.

The initial set of Approach-and-Landing Flight Operations Briefing Notes has been developed by Airbus in the frame of the Approach-and-Landing Accidents Reduction (ALAR) Task Force led by the Flight Safety Foundation (FSF).

The wide acceptance of the Approach-and-Landing Briefing Notes by the pilots’ community and the positive feedback received from customers have prompted Airbus to initiate the development of new sets of Briefing Notes, in order to cover the entire flight profile and address the main threats and hazards to flight operations safety.

Accident-prevention Strategy

To support this strategy, each Flight Operations Briefing Note:

- Presents the subject and its associated hazard to flight operations safety, using background information and statistical data;
- Emphasizes the applicable standards and best practices (e.g., standard operating procedures [SOPs], supplementary techniques, operational recommendations and training guidelines);
- Lists and discusses the operational and human factors that may cause flight crews to deviate from applicable standards;
  This section constitutes an eye-opener to assist the reader in assessing his/her own exposure;
- Provides or suggests company accident-prevention-strategies and/or personal lines-of-defense;

  This section will assist the reader in identifying company or personal prevention strategies and/or corrective actions;

- Establishes a summary of operational key points and training key points;
- Refers to associated or related Flight Operations Briefing Notes; and,
- References related ICAO, U.S. FAR and European JAR regulatory documents.

How to Use and Implement the Flight Operations Briefing Notes?

The Briefing Notes should be used by airlines to enhance the awareness of various operational and human factors, threats and hazards among flight crews and cabin crews.

Management pilots should review, customize (as required) and implement the recommendations, guidelines and awareness information, in the following domains:

- Operational documentation:
  - Standard operating procedures; and,
  - Procedures and techniques / supplementary techniques.

- Training:
  - Simulator Training, to develop new scenarios for line oriented flight training (LOFT) or special purpose operational training (SPOT); and/or,
  - Crew resource management (CRM) training, to develop new topical subjects to support CRM discussions.

- Safety-awareness Information:
  - Flight crew bulletins;
  - Airline's safety magazine articles;
  - Classroom lectures; and/or,
  - Stand-alone reading.

Line pilots should review and compare the recommendations, guidelines and awareness information with their current practices and enhance their techniques and awareness level, as required.

Other actors in the global aviation system, such as:
- Air traffic control services;
- Navigation state agencies;
- Operational authorities;
- Service providers; and,
- Flight academies / flying colleges;

…should use the provision of the Flight Operations Briefing Notes to evaluate their possible contribution to the enhancement of ground and flight safety.

What's coming up?

The release of the Briefing Notes will span over the years 2004-2006 and will cover the following domains:

- Standard operating procedures
  (e.g.: Conducting effective briefings, …),

- Human Performance
  (e.g.: Enhancing situational awareness, error management, …),

- Operating environment
  (e.g.: Bird strike threat awareness, …),

- Adverse weather operations
  (e.g.: Wind shear awareness, …),

- Runway and surface operations
  (e.g.: Preventing runway incursions, …),

- Supplementary techniques
  (e.g.: Preventing altitude deviations, …),

- Takeoff and departure operations
  (e.g.: Understanding takeoff speeds, Revisiting the stop or go decision, …),

- En-route climb and cruise management
  (e.g.: Managing buffet margin, overspeed prevention / recovery, …),

- Descent management
  (e.g.: Being prepared for go-around, …),

- Approach techniques
  (e.g.: Flying stabilized approaches, …),

- Landing techniques
  (e.g.: Preventing tail strike at landing, …),

- Ground handling
  (e.g.: Refueling with passenger on board, …),

- Cabin operations
  (e.g.: Managing smoke issues in cabin, emergency evacuation, …).

The Flight Operations Briefing Notes are progressively released on the Safety Library room of the Airbus Safety First website:
http://www.airbus.com/about/safetylibrary.asp
They should be also disseminated to customers once a year on CD-ROM and paper format.

Conclusion

Flight safety enhancement has been and will continue to be the result of technological developments.

However, 85 % of accidents today are operational events that involve human performance at every stage of the safety chain.

By developing the concept of Flight Operations Briefing Notes and by facilitating their wide dissemination to all actors of the aviation community, Airbus acknowledges that safety awareness information is a key element in further enhancing flight safety.

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