



Flight control checks

Flight Control Events

Customer Services



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- Typical Flight Control Events
- Enhanced SOP F/CTL CHECKS
- Conclusion



Introduction

- Several F/CTL surface failure events occurred during the pre-flight F/CTL checks, and without any ECAM warning.
- Failures mainly caused by :
 - Premature corrosion of the components, or
 - Improper maintenance
- In most cases, the failure was detected on ground, by the flight crew.



**Emphasize the importance of
SOP F/CTL Checks**

Typical Flight Control Events

- Introduction
- **Typical Flight Control Events**
 - ▶ A320 In-flight Turnback, due to Reduced Ability to Turn Left
 - ▶ A320 In-flight Turnback, due to Inverted Aileron Deflection
 - ▶ A340 Undue High Speed Travel Limitation on Ground
 - ▶ A330/A340-200/300 Elevator Control Loss on Ground
- Enhanced SOP F/CTL Checks
- Conclusion

Typical Flight Control Events – Roll Control

A320 In-flight Turnback due to Reduced Ability to Turn Left ...

- **Event Description:**

- ▶ Just after Takeoff: Reduced ability to turn left.
- ▶ Almost full left sidestick inputs were required in order to laterally control the aircraft.
- ▶ At 1500ft, **F/CTL SPLR FAULT** with all R.H roll spoilers (from 2 to 5) shown inoperative.
- ▶ First attempt to land with CONF 2 was aborted, during the final approach.
- ▶ Aircraft landed successfully after a right-hand, curving, second approach in CONF 1.

Typical Flight Control Events – Roll Control ...

A320 In-flight Turnback due to Reduced Ability to Turn Left ...

• Event Analysis:

- ▶ During a previous maintenance task: R/H spoilers 2 to 5 were left in the maintenance position.
- ▶ After lift-off: They were deployed to the zero hinge moment positions.
- ▶ During the F/CTL Check: The spoilers remained retracted upon full-right sidestick input.
- ▶ On ground, with pre-SEC L98: The ECAM warning was only able to trigger for sidestick demands longer than 3 seconds.



Typical Flight Control Events – Roll Control ...

A320 In-flight Turnback due to Reduced Ability to Turn Left ...

• Actions:

- ▶ AMM Maintenance tasks have been modified to systematically require an operational test of the spoilers, when the servo-control has been reselected to the operational position.
- ▶ Spoiler in “maintenance position” is now identified by a red flag on the maintenance tool.
- ▶ Development of a new SEC L98 (retrofit worldwide) monitoring logic. This logic is able to detect, on ground and within ½ second, a spoiler that has remained in the maintenance position.

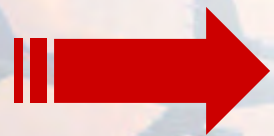
But it could also have been detected by carefully performing the existing SOP F/CTL Check

Typical Flight Control Events – Roll Control ...

A320 In-flight Turnback due to Inverted Aileron Deflection

- **Event Description:**

- ▶ F/CTL Check performed on one side only.
- ▶ At Takeoff: The Captain applied a lateral sidestick input to the right. But, the aircraft banked to the left.
- ▶ The left wing banked down 21 degrees:
 - Wing tip clearance: Estimated to be 50 cm
- ▶ The F/O took over, and successfully landed the aircraft.



Not detected by F/CTL Computers

Typical Flight Control Events – Roll Control ...

A320 In-flight Turnback due to Inverted Aileron Deflection ...

• Event Analysis:

- ▶ Before the flight: A wiring inversion between the CAPT ROLL Sidestick Transducer Unit and the ELAC 1 (both COMMAND & MONITOR channels of ELAC 1)
- ▶ Two independent units of each computer monitor sidestick inputs (COM & MON): The failure could not have been detected.
- ▶ The functional check, required after performing AMM tasks, was only performed on the PNF side.

Typical Flight Control Events – Roll Control ...

A320 In-flight Turnback due to Inverted Aileron Deflection ...

- **Actions:**

- ▶ Enhancement of the AMM Task Procedures, and
- ▶ FCOM SOP changes (Flight Control Check performed by both the PF and PNF)

But it could also have been detected by performing the existing SOP F/CTL Check

Typical Flight Control Events – Yaw Control

A340 Undue High Speed Travel Limitation on Ground

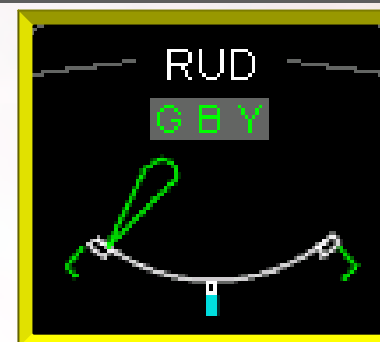
- **Event Description:**

- ▶ During the Preflight Check: Full rudder deflection was not achieved.

- ▶ No **F/CTL RUD TRV LIM FAULT**

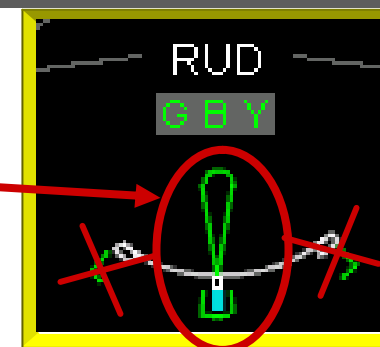
- ▶ The RTLU failed closed in the high-speed position.

NORMAL CONFIGURATION



LOW SPEED POSITION

EVENT CONFIGURATION



HIGH-SPEED POSITION

Typical Flight Control Events – Yaw Control ...

A340 Undue High Speed Travel Limitation on Ground ...

- **Event Analysis:**

- ▶ The “full opening demand” of the RTL_U takes 19 seconds to reach the low speed position
- ▶ After this delay, there is no position monitoring since the RTL_U actuator is no longer supplied and thus, not supposed to move
- ▶ In case of subsequent RTL_U failure, the monitoring does not detect the RTL_U returning to its high speed position (failed “closed”).

Typical Flight Control Events – Yaw Control ...

A340 Undue High Speed Travel Limitation on Ground ...

- **Corrective Actions:**

SEC L14/M11

A340: Modification 45873 SB 27-4064

A330: Modification 45873 SB 27-3057

(Retrofit worldwide)

- The TLU Control System has been improved, in order to permanently monitor the Rudder Travel Limiter Unit.

Typical Flight Control Events – Pitch Control

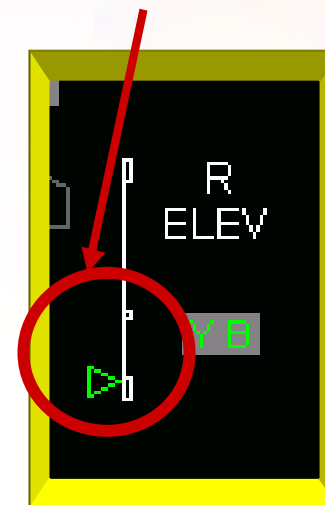
A330/A340 Elevator Control Loss on Ground

- **Event Description:**

- ▶ During the Flight Control Check:
The flight crew detected that the RH elevator was in the full-down position, with no response to the “full-up” sidestick order.

- ▶ No ECAM warning or failure indication

- ▶ While taxiing back: **HYD Y RSVR LO LVL** was triggered. The fluid loss was confirmed on the SD.

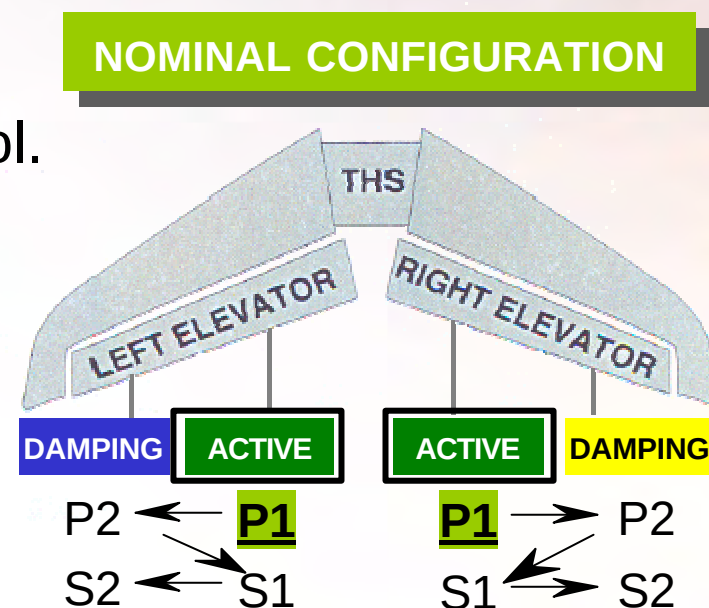


Typical Flight Control Events – Pitch Control ...

A330/A340 Elevator Control Loss on Ground...

• Event Analysis:

- ▶ PRIM1 controls each G servo-control. The adjacent servo-control is in damping mode.
- ▶ PRIM1 continuously monitors the status mode of the damped servo-control, via through a dedicated feedback transducer.



Typical Flight Control Events – Pitch Control ...

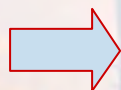
A330/A340 Elevator Control Loss on Ground...

• Event Analysis:

- ▶ After engine start: Cases of cracks found at the attachment lug of the “Status Mode” feedback transducer.



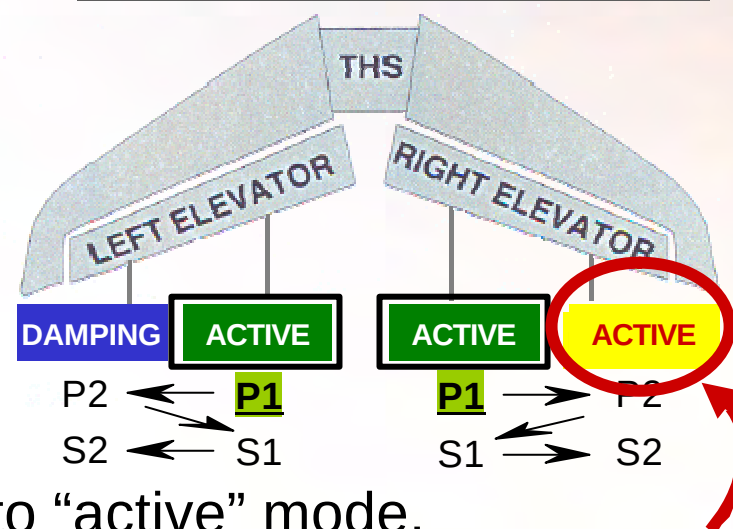
- Small hydraulic leak (no immediate HYD Y RSVR LO LVL)
- Undetected switching from “damping” to “active” mode, without control, inducing an adverse “force fighting.”



Elevator Control Loss

- On ground:
The weight of the elevator causes it to go the down position.

EVENT CONFIGURATION



Typical Flight Control Events – Pitch Control ...

A330/A340 Elevator Control Loss on Ground...



- **Interim Solution:**

- ▶ Repetitive maintenance inspection of the “Mode Status” Transducer: Every 350FC for each servo-control that is older than 1000FC.

- **Final Solutions:**

- ▶ New strengthened servo-control (MVT-102 – Will be available in mid-2004).
- ▶ PRIM Standard M16/P7/L17 (Enhanced A330/A340 only), and forthcoming M17/P8/L18 on basic A330/A340:
 - Introduction of an **elevator position monitoring** feature on ground.
 - L18 will be available in mid-2004
 - M17 will be available by October 2004, and
 - P8 will be available in early 2005

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- Typical Flight Control Events
- **Enhanced SOP F/CTL Checks**
- Conclusion

Enhanced SOP F/CTL Checks

- All of the above-mentioned events have revealed the importance of the crew performing Flight Control Checks.
- However, training feedback and line observations have revealed that, the F/CTL checks were not always performed properly, due to :
 - ▶ Routine tasks
 - ▶ The PF moved the sidestick too quickly
 - Insufficient time for the PNF to efficiently perform the checks.
 - ▶ The PNF may be out of the monitoring loop.

Enhanced SOP F/CTL Checks

- Consequently, Airbus recently decided to further enhance the SOP F/CTL Checks, as follows:

 A330 FLIGHT CREW OPERATING MANUAL	STANDARD OPERATING PROCEDURES TAXI	3.03.10	P 3
		SEQ 001	REV 19

— FLIGHT CONTROLS CHECK

1. At a convenient stage, prior to or during taxi, and before arming the autobrake, the PF silently applies full longitudinal and lateral sidestick deflection.

On the F/CTL page, the PNF checks full travel of all elevators and all ailerons, and the correct deflection and retraction of all spoilers.

The PNF calls out "full up", "full down", "neutral", "full left", "full right", "neutral", as each full travel/neutral position is reached.

The PF silently checks that the PNF calls are in accordance with the sidestick order.

- R applies full left rudder, full right rudder, and neutral. The PNF calls out "full left", "full right", "neutral", as each full travel/neutral position is reached.
- R 3. The PNF applies full longitudinal and lateral sidestick deflection, and silently checks full travel and the correct sense of all elevators and all ailerons, and the correct deflection and retraction of all spoilers, on the ECAM F/CTL page.

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

Enhanced SOP F/CTL Checks

- Reinforcement of the PNF's role to:
 - Still closely monitor the correct sense, and full deflection of all surfaces, as previously recommended....
-However, the PNF now calls out the results of his/her visual check of each of the PF's sidestick/rudder pedal stops. This helps to:
 - Avoid the PNF from being influenced by the PF callouts
 - Ensure that the PNF efficiently checks all surface motions
 - Oblige the PF to pause the sidestick/rudder pedals at each stop
 - Allow the PF to detect a failure, if callout is not in line with the PF's input
 - Harmonize the SOP F/CTL CHECKS for all AIRBUS aircraft.

Conclusion

- In comparison with conventional aircraft, FBW F/CTL architecture provides additional flight control monitoring.
 - ▶ Monitoring objectives are to ensure flight control availability and safe aircraft operation.
- Airbus' priority is to continuously meet these objectives, if possible, via EFCS monitoring enhancements. However, EFCS monitoring features cannot possibly detect all failure cases (Ex: Inadvertent aileron inversion case).
- A comprehensive flight control integrity check relies on the crew's accurate completion of pre-flight control checks.

Conclusion

- 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.

TAKE YOUR TIME :
PROPER F/CTL CHECKS = SAFER FLIGHT

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