



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.

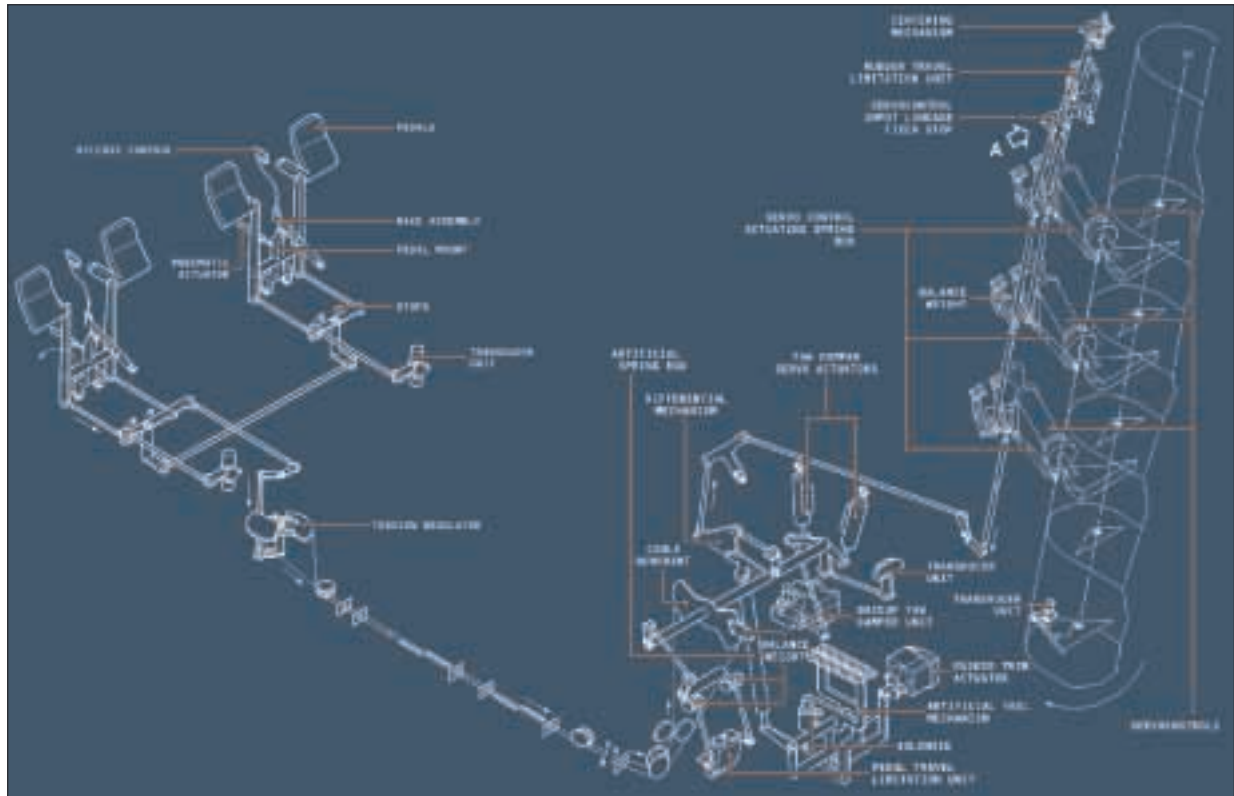
- 1- In direction;
- 2- In amount of travel;
- 3- In return to neutral;
- 4- In feeling.

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.

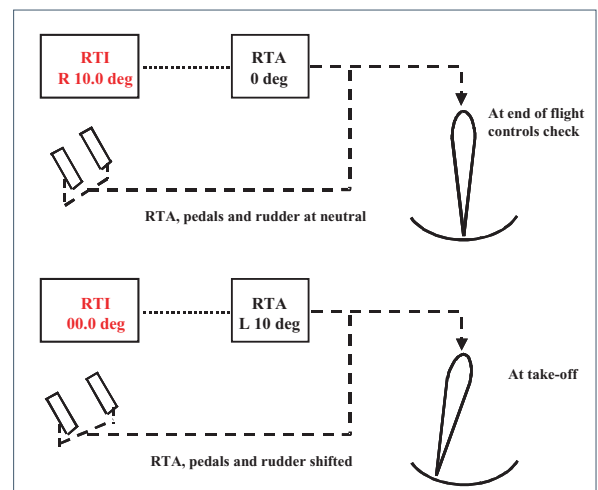


3 Take-off after F/CTL check failed

3.1 Surfaces not at neutral with controls not at neutral

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 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.



Safety first #01 January 2005 - 2



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).

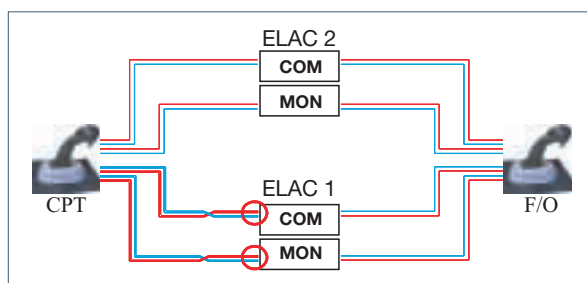


Figure 3: Cross connection of sidestick roll signals to F/CTL computer

The functional check required after performing AMM tasks had partially been performed on the F/O side only, and thus the anomaly was not 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).

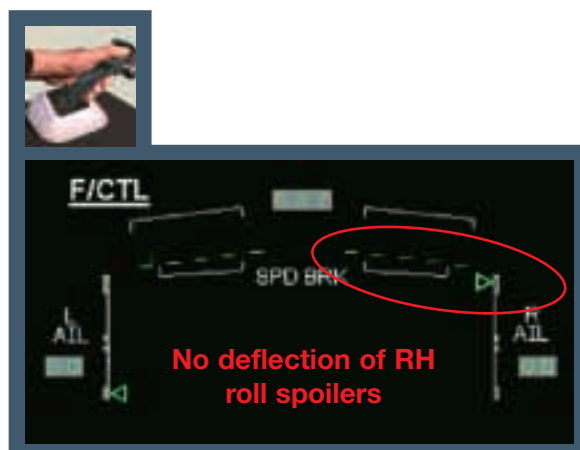
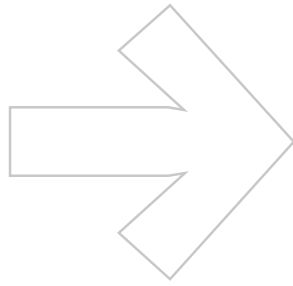


Figure 4: Lack of response from RH spoilers to sidestick inputs





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

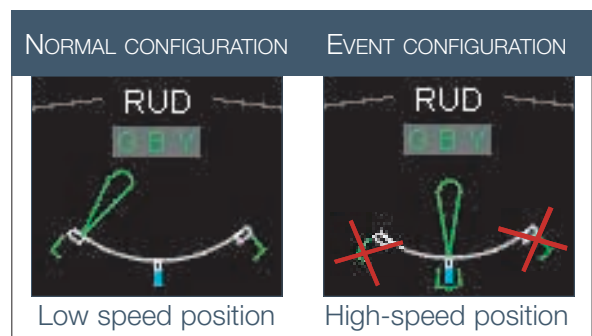
17 December 2003 entitled “ATA 27– elevator dropped down – Cracked mode selector valve transducer at servocontrol in damping position”;
- OIT Ref. SE 999.0066/04/BB Rev. 01 dated 11 June 2004 and FOT Ref. STL 999.0061/04 dated 10 June 04 entitled “ATA 27 – Right elevator stuck down in full pitch down 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 (RTL) had failed closed in the high-speed configuration. The ECAM warning “F/CTL TRAVEL LIM FAULT” dedicated to the monitoring of the RTL position was not displayed.

Indeed, at that time, FCSC which is the computer that controls the RTL 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 RTL closed during such a phase of no monitoring on ground. Monitoring has since been reviewed.



■ Figure 6: Full rudder deflection not achieved

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 <small>FLIGHT CREW OPERATING MANUAL</small>		STANDARD OPERATING PROCEDURES		3.03.10	P 3
		TAXI		SEQ 001	REV 19

— FLIGHT CONTROLS CHECK

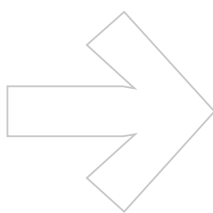
R 1. At a convenient stage, prior to or during taxi, and before arming the autobrake, the
R PF silently applies full longitudinal and lateral sidestick deflection.
R On the F/CTL page, the PNF checks full travel of all elevators and all ailerons, and the
R correct deflection and retraction of all spoilers.
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.



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.

All articles in Safety First are presented for information only and are not intended to replace ICAO guidelines, standards or recommended practices, operator-mandated requirements or technical orders.

The contents do not supersede any requirements mandated by the State of Registry of the Operator's aircraft or supersede or amend any Airbus type-specific AFM, AMM, FCOM, MEL documentation or any other approved documentation.

Articles may be reprinted without permission, except where copyright source is indicated, but with acknowledgement to Airbus. Where Airbus is not the author, the contents of the article do not necessarily reflect the views of Airbus, neither do they indicate Company policy.

Contributions, comment and feedback are welcome. For technical reasons the editors may be required to make editorial changes to manuscripts, however every effort will be made to preserve the intended meaning of the original. Enquiries related to this publication should be addressed to:

Airbus

Product Safety department (GS)
1, rond point Maurice Bellonte
31707 Blagnac Cedex - France
Fax: +33(0)5 61 93 44 29
safetycommunication@airbus.com



Safety First

01 January 2005

**Safety First is published
by Airbus S.A.S**

1, rond point Maurice Bellonte
31707 Blagnac Cedex / France

Editors:

Yannick Malinge,

Vice President Flight Safety

Christopher Courtenay,

Director of Flight Safety

Concept Design by HCSM

Production by CITYCompo

Copyright: El

Photos copyright Airbus

Photos by ExM:

Hervé Berenger

Philippe Masclet

Hervé Goussé

Printed in France

© Airbus S.A.S. 2005 – All rights reserved. Confidential and proprietary documents.

By taking delivery of this Brochure (hereafter "Brochure"), you accept on behalf of your company to comply with the following guidelines:

- › No other intellectual property rights are granted by the delivery of this Brochure than the right to read it, for the sole purpose of information.
- › This Brochure and its content shall not be modified and its illustrations and photos shall not be reproduced without prior written consent of Airbus.
- › This Brochure and the materials it contains shall not, in whole or in part, be sold, rented, or licensed to any third party subject to payment.

This Brochure contains sensitive information that is correct at the time of going to press. This information involves a number of factors that could change over time, effecting the true public representation. Airbus assumes no obligation to update any information contained in this document or with respect to the information described herein.

Airbus SAS shall assume no liability for any damage in connection with the use of this Brochure and of the materials it contains, even if Airbus SAS has been advised of the likelihood of such damages.