



Dual Side Stick Inputs



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1 | Introduction

One of the basic task sharing principle for any aircraft operation is that one pilot is Pilot Flying at a time. Therefore, if the Pilot Not Flying disagrees with the Pilot Flying inputs, he/she has to verbally request corrective actions or, if deemed necessary, to take over the controls by clearly announcing "I have controls".

This will mean that he/she becomes Pilot Flying from that moment and the other Pilot Not Flying. Nevertheless, the feedback gained from line operations monitoring indicates that dual inputs still occur and are also sometimes involved in operational incidents analyzed by Airbus.

This was the case for the below described event, experienced on an A320 during turbulence

2 | Summary of the event

While climbing to FL 320 at about Mach 0.78, an A320-200 encountered significant turbulence that led roll to increase up to 40°.

The Pilots reacted to this roll departure by various dual sticks inputs in pitch and roll. The Auto Pilot disconnected consequently to stick input.

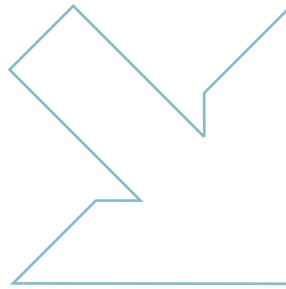
Before the event the aircraft was in climb to FL 320. The airplane had a weight of 61,2t. and was in the following configuration:

- Clean with AP 2 engaged (CLIMB / NAV) and ATHR Engaged & Active in Thrust mode.
- Managed Mach target was 0,78
- Both ND CPT & FO were selected in ARC Mode with a range of 160NM

The aircraft began an uncommanded roll to the right, which was initially counteracted by the Auto Pilot. However, at a speed above 250 kts, Auto Pilot orders on ailerons are limited at 8°. Therefore, due to the high turbulence the roll reached a value of 40° to the right.

Both pilots reacted with full LH stick orders and 10° LH rudder pedals.

This induced the disengagement of the Auto Pilot. During the next 20 seconds, the Captain and First Officer applied dual stick inputs, which lead to roll values oscillating between 33° to the left and 49° to the right, as well as to a loss of 2400 feet altitude. The Captain then re-engaged the Auto Pilot, selected Flight Level 310, and the flight resumed without noticeable event.



3 | Types of dual stick input

Analysis of reported dual side stick inputs events, reveals that there are three types of occurrences:

The “Spurious” Dual Stick inputs

Typically due to an inadvertent movement of the stick by the PNF.

For example when grabbing the FCOM or when pressing the R/T.

A spurious dual stick input only marginally affects the aircraft behavior due to only time limited & small inputs.

The “Comfort” Dual Stick inputs

Typically due to short interventions from the PNF who wants to improve the aircraft’s attitude or trajectory:

These are generally experienced in approach, during a capture (altitude localizer), or in flare, and have minor effects on the aircraft’s altitude/trajectory. However, as the PF is not aware of the PNF’s interventions, he may be disturbed and may counteract the PNF’s inputs.

The “Instinctive” Dual Stick Inputs

Typically due to a “reflex” action on the part of the PNF on the stick. This instinctive reaction may come about when an unexpected event occurs, like for example an AP disengagement, an overspeed situation or a dangerous maneuver. Such interventions are more significant in terms of stick deflection and duration. Usually in such situations, both pilots push the stick in the same direction, which may lead to over control, a situation illustrated by the above occurrence.

4 | Operation of the sidestick

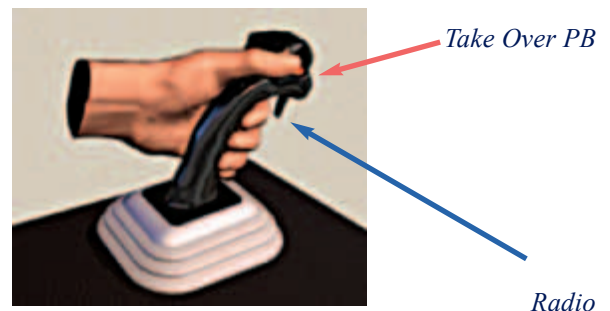
The two sidesticks are not mechanically linked as they are on older types of aircraft.

This means that both sticks may be operated independently one of the other.

When one sidestick is operated it sends an electrical signal to the Fly By Wire computers. When both sticks are moved simultaneously, the system adds the signals of both pilots algebraically.

The total is limited to the signal that would result from the maximum deflection of a single sidestick.

To avoid both signals being added by the system, a priority P/B is provided on each stick. By pressing this button, a pilot may cancel the inputs of the other pilot.



An audio signal will indicate which sidestick has priority,



and a red light comes on in front of the pilot whose stick is deactivated



A green light will come on in front of the pilot who has taken control if the other stick is not in neutral position.

With autopilot (AP) engaged, the sidesticks are kept in the neutral position, with no possibility of simultaneous inputs from either pilot.

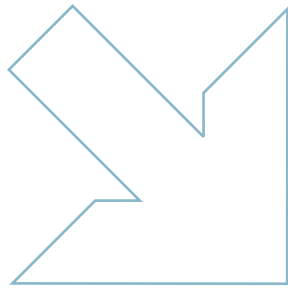
Indeed, when the A/P is engaged, it is normally disconnected by pressing the priority P/B (the pilot takes priority over the A/P) or instinctively at any time by a firm action on the stick: typically 5kg in pitch, 3.6kg in roll.

5 | Operational procedures

Simultaneous inputs by both PF and PNF on the sidesticks must be avoided. Thus, if the PNF feels he must intervene, he must do so by pressing the Priority P/B while saying “I have controls”.

These rules are reminded in the Flight Crew Training Manual 01.020 – Flight Controls and Flight Crew Operating Manual 1.27.40 – Flight Controls: Controls and Indicators”





6 | Dual Sidestick inputs warning system

In order to warn the crew in case of dual sidestick operations, Airbus has designed a package of dual input indicators and audio warning.

These operate when both side sticks are deflected simultaneously by more than 2°.

These visual and aural warnings have proved to be efficient means to inform the pilot of dual inputs.

Visual indication

When a dual input situation is detected, the two green priority lights located on the cockpit front panel flash simultaneously.

The visual indication is an **ADVISORY** of a dual input situation



Aural Indication

After the visual indication has been triggered, a synthetic voice “DUAL INPUT” comes up every 5 sec, as long as the dual input condition persists.

The synthetic voice is a **WARNING** of a dual input situation

Note: This audio has the lowest priority among the synthetic voice audio alerts.



The visual and audio indications are designed to provide the crew with a progressive alert.

Experience has shown, that these warnings are very effective to:

- “Educate” the pilots to respect the basic task sharing principle;
- Reduce drastically the number of dual input occurrences.

The activation of these dual input warnings has no repercussion in term of :

- Crew training;
- Mixed fleet flying.

HOW TO UPGRADE YOUR SA AND LR AIRCRAFT ?

- The light and aural indicators are basic, and free of charge on retrofit, on the A320 family and A330/A340.
- It requires **FCDC** and **FWC** to be at a given standard already available on production line:
 - A320: FWC E2 Standard - FCDC 53 Standard
 - A330/A340: FWC K3/L7 Standard - FCDC M11/L14 Standard
- **Pin programs are activated on Operator request**



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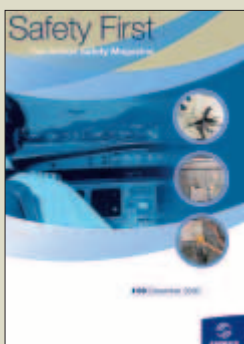
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