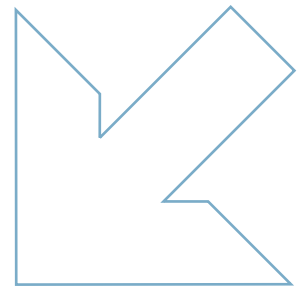




A320/ Prevention of tailstrikes



By: Michel PALOMEQUE

*A320 Flight Safety Director & Chief Engineer Advisor
A320 Program*

1 | Introduction

Like the preceding paper on VMO/MMO exceedance, this article is a follow up on the presentation titled "A320 ELAC" given at the last Flight Safety Conference in Barcelona on October 2007.

It will look as well at the safety improvements brought to the ELAC in the form of the latest L84 and L93 standards, which bring additional prevention means against tailstrikes during landing. Two other modifications will also be described, concerning the pilot awareness of a too high pitch in the landing phase.

2 | Description of typical tailstrike scenario

Most of the tailstrikes on A320 family aircraft occur during landing in manual mode (Auto Pilot OFF), when the sidestick is maintained in the aft position after touch down (Fig1).

The importance of this subject is obviously correlated to the fuselage length. It is, therefore, particularly important to A320 and A321 operators.

	A318	A319	A320	A321
Pitch attitude limit with MLG fully compressed	15.7°	13.9°	11.7°	9.7°
Pitch attitude limit with MLG fully extended	17.3°	15.5°	13.5°	11.2°

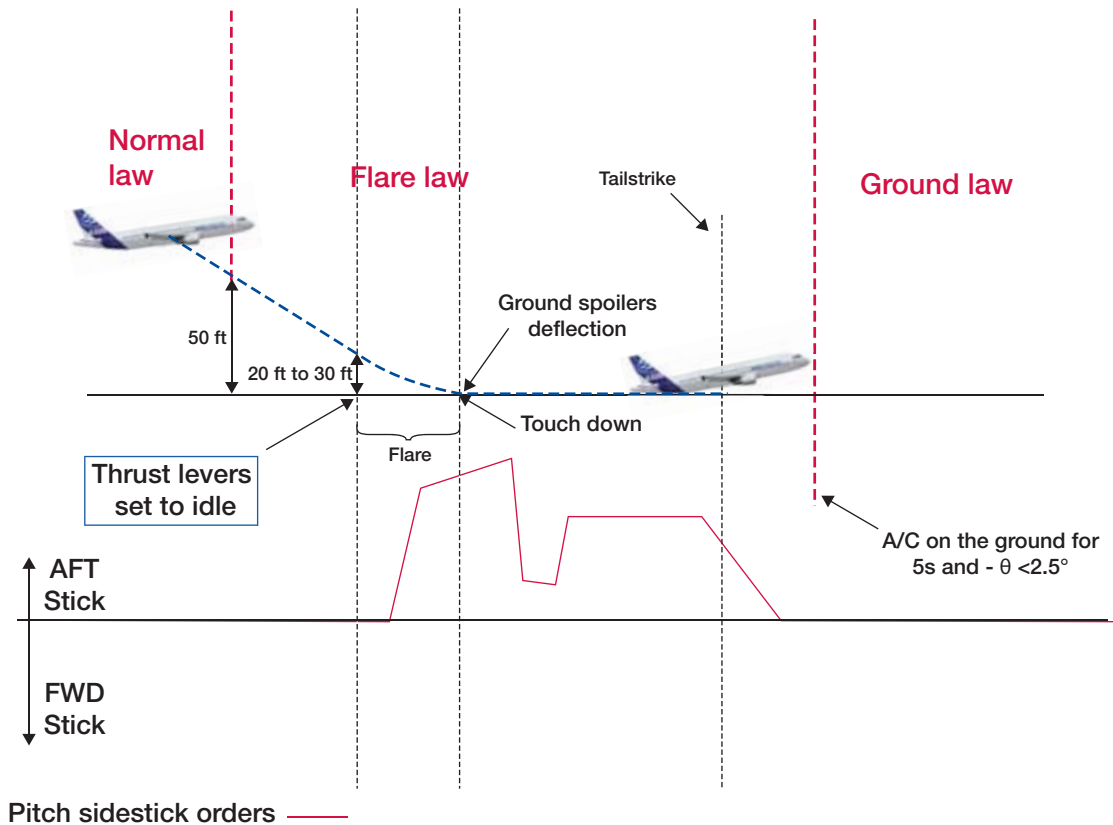


Figure 1: Normal landing with sidestick maintained AFT after the touch down.

3 | Flight control law improvement

In order to avoid the above scenario, it was decided to improve the flare law of the flight control law of the A320 and A321. This was done by introducing a limitation of the side stick nose up inputs during landing.

3.1 Flare law before L84 and L93 standards

The principle is as follows:

- A pitch sidestick deflection corresponds to a commanded pitch attitude.
- The maximum commanded pitch attitude with full back stick is 18 degrees (fig. 2).

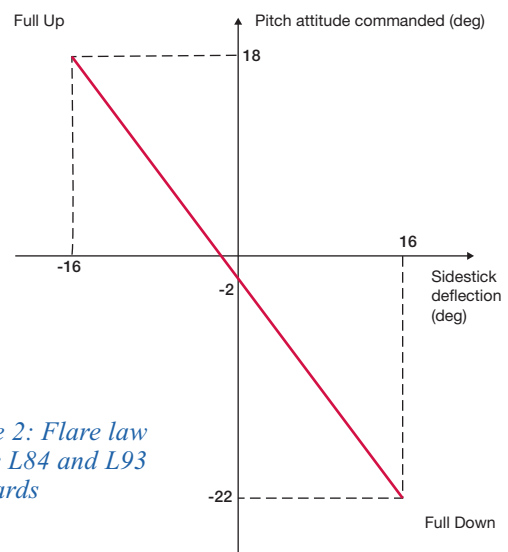
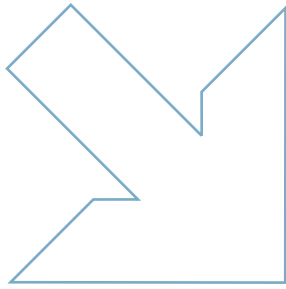


Figure 2: Flare law before L84 and L93 standards



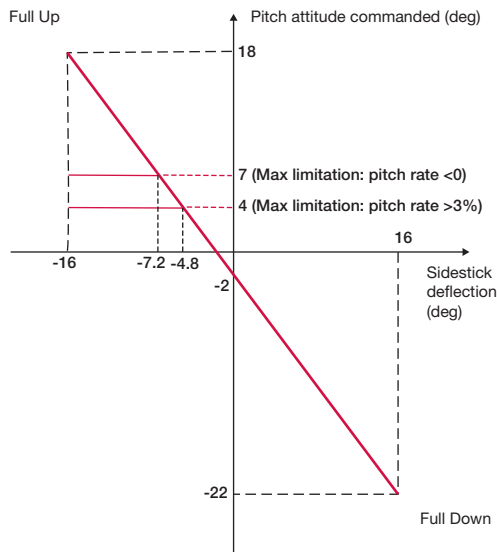


3.2 Flare law in L84 and L93 standards

With the new law introduced in the latest ELAC standards (*fig. 3*), the maximum commanded pitch attitude on ground is limited to the values indicated in the table below:

Pitch rate change		
	< 3°/s	>3°/s
A320	9°	6°
A321	7°	4°

This limitation is triggered by the ground spoiler extension, thus ensuring that it will be active only during landing. It is therefore deactivated during the take off and go-around phases.



Simulations with the improved control laws have confirmed the following:

- No impact on the landing performance
- The usual flare is not modified
- No interference in case of go-around or during take off due to the ground spoiler condition

Figure 3: A321 pitch attitude control law on ground

ELAC hardware	ELAC software	Mod. number	Service Bulletin
A or A'	L84 standard	38105	Not yet available
B	L93 standard	38008	27-1182

4 | Additional alerts to impending tailstrike

In order to further increase pilot awareness to an impending tailstrike, the following modifications have been developed for the A320 and A321:

- A pitch limit indicator on the Primary Flight Display, which is displayed at landing (below 400 feet AGL in both manual and automatic modes) when the thrust levers are below the FLEX/MCT setting.

Note: due to the below FLEX/MCT condition, the pitch limit indicator is not displayed during the T/O phase.

(This modification is available only for aircraft with the EIS2 standard)

- A “PITCH, PITCH” call out, activated when the pitch is greater than a certain threshold and if TOGA is not selected.

(The call out is available on the following standards : FWC H2F3 or H2F3P and FAC 618 or 619).

		Mod. number	Service Bulletin
Pitch limit indicator on PFD	Activation (only on A320/A321)	37444	No std SB RFC/RMO process
	EIS2 S7 standard	36725	31-1276 or 31-1271
“Pitch, Pitch” audio call-out	Activation (only on A320/A321)	37445	No std SB RFC/RMO process
	FAC 618 standard	35522	22-1226
	619 standard	36766	22-1226
	FWC H2F3 standard H2F3P standard	35220 38425	31-1267 31-1300

5 | Conclusion

In order to avoid excessive pitch up demand at landing when on ground, the ELAC flight control laws have been enhanced in the new ELAC L84 and L93 standards.

Associated to this modification, a pitch limit indicator on the PFD and a “PITCH, PITCH” call out have been developed, to further increase pilot awareness. We are confident that these modifications will help to minimize the number of tailstrikes during landing.



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.

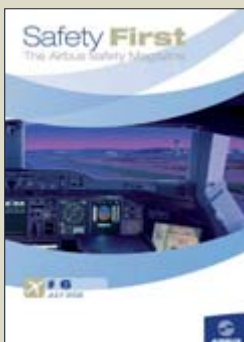
All articles in Safety First are presented for information only and are not intended to replace ICAO guidelines, standards or recommended practices, operator-mandated

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
06 July 2008

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

Editor:
Yannick Malinge,
Vice President Flight Safety

Concept Design by
MUTI MEDIA SUPPORT 20080635

Computer Graphic by Quat'coul

Copyright: GSE 420 0279/08

Photos copyright Airbus
Photos by
ExM: Hervé Berenger, Philippe
Masclat, Hervé Goussé.
Photo copyright Germanwings

Computer rendering by ABAC

Printed in France by GWLNSD

© Airbus S.A.S. 2008 – 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.