

Use of Rudder



The use of rudder by the flight crew on Airbus aircraft is limited to the takeoff and landing roll, crosswind landings, or to counteract the yaw effect caused by an engine failure until the rudder is trimmed. Several events have been reported where the flight crew used rudder inputs after encountering turbulence, causing unnecessary trajectory deviations and loads on the aircraft structure.

This article describes such an event and explains the two types of rudder design used on Airbus aircraft. It also provides recommendations to the flight crew on the use of rudder and emphasises the importance of reporting lateral loads events after an occurrence. It also provides guidance to maintenance personnel to ensure necessary inspections are performed following a reported high load event.

Check the latest version of this article on safetyfirst.airbus.com and on the Safety first app for iOS and Android devices.



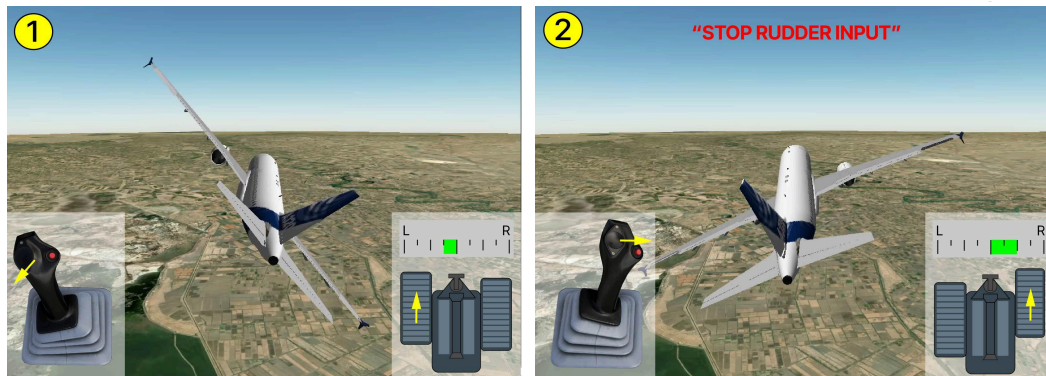
CASE STUDY

Event Description

An A320 aircraft was at 30 000 ft, climbing towards its cruise altitude of 36 000 ft with autothrust and autopilot ON in **MACH I V/S +1000 I NAV** modes.

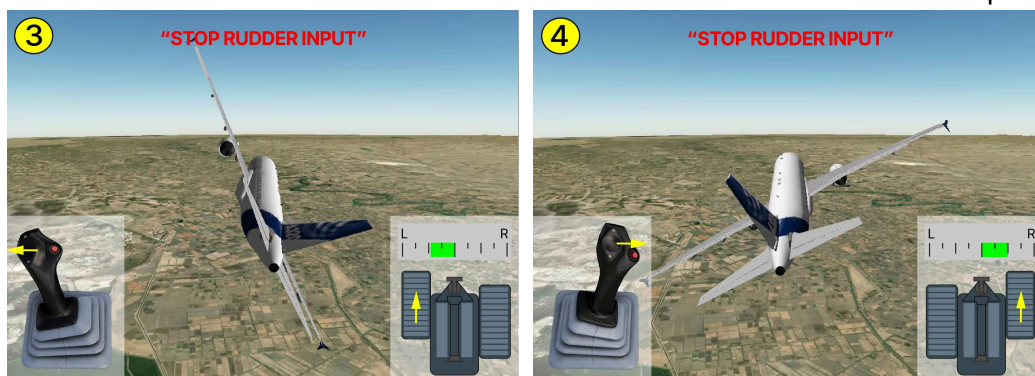
When crossing 31 200 ft, the aircraft started to roll to the right and reached 52° in a few seconds. ① The PF reacted with full left and nose-up sidestick input that disengaged the autopilot, and a light left rudder input. These combined control inputs led the aircraft to bank to the left. ② The PF reacted quickly by applying a full right sidestick input and pressing the right rudder pedal to approximately halfway of its travel. This caused the aircraft to bank severely to the right and the **STOP RUDDER INPUT** warning to trigger.

(fig.1) Event description part 1

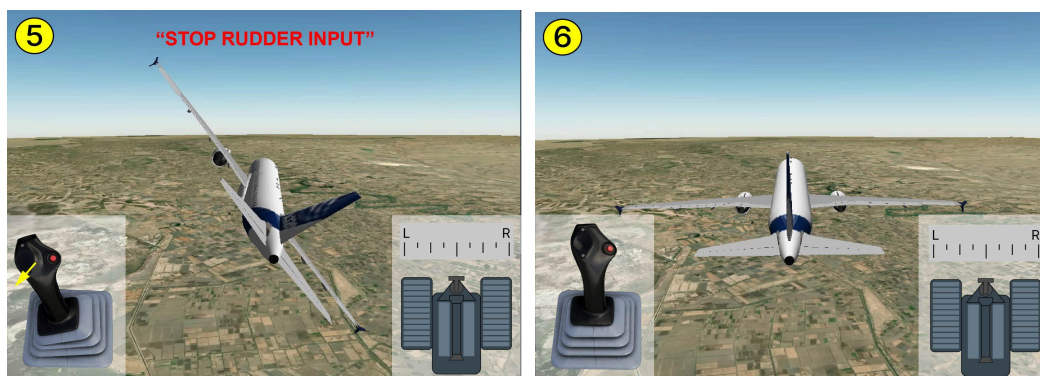


③ The PF then applied full left sidestick input and pressed the left rudder pedal to approximately halfway of its travel. The **STOP RUDDER INPUT** warning triggered again and the aircraft banked left. ④ The PF then applied full right sidestick and pressed the right rudder pedal causing the **STOP RUDDER INPUT** warning to trigger a third time and the aircraft to bank right.

(fig.2) Event description part 2



⑤ The PF briefly applied full left sidestick input and moved rudder pedals back to neutral position. The **STOP RUDDER INPUT** warning triggered for the fourth time. ⑥ The PF then managed to stabilize the aircraft using only light sidestick inputs.



The PF re-engaged the autopilot. The aircraft reached its cruise altitude 7 minutes later and the flight continued to its destination airport.

When the aircraft landed, the flight crew reported heavy turbulence to the maintenance but made no report of the **STOP RUDDER INPUT** warnings.

The Maintenance performed the **AMM task 05-51-17 "INSPECTION AFTER FLIGHT IN EXCESSIVE TURBULENCE OR IN EXCESS OF VMO/MMO"**, found no issues, and released the aircraft back into service.

Event Analysis

The event was not immediately reported after occurrence. Almost one year later, during routine data analysis, the unusual flight parameters were detected, prompting communication with the operator. Subsequently, a report was filed, allowing a detailed analysis to be performed.

Missed high lateral loads inspection

Analysis of the data confirmed a maximum lateral acceleration of 0.41 g during the event. This acceleration corresponds to a "red" level event according to **AMM task 05-51-44 "INSPECTION AFTER FLIGHT WITH HIGH LATERAL LOADS"**. However, only the **AMM task 05-51-17 "INSPECTION AFTER FLIGHT IN EXCESSIVE TURBULENCE OR IN EXCESS OF VMO/MMO"** was performed after the event based on the flight crew's report after the flight.

No excessive loads found

The load analysis performed by Airbus using acceleration data concluded that flight loads were in the vicinity of design limits loads but did not exceed them. The correct maintenance tasks were subsequently performed, including **AMM task 05-51-17 "INSPECTION AFTER FLIGHT IN EXCESSIVE TURBULENCE OR IN EXCESS OF VMO/MMO"** and **AMM task 05-51-44 "INSPECTION AFTER FLIGHT WITH HIGH LATERAL LOADS"**. With no issues identified, the aircraft was confirmed as safe for return to service. ■

(fig.3) Event description part 3

RUDDER DESIGN ON AIRBUS AIRCRAFT

Two types of rudder are installed on Airbus aircraft: mechanical rudder or electrical rudder.

Mechanical rudder

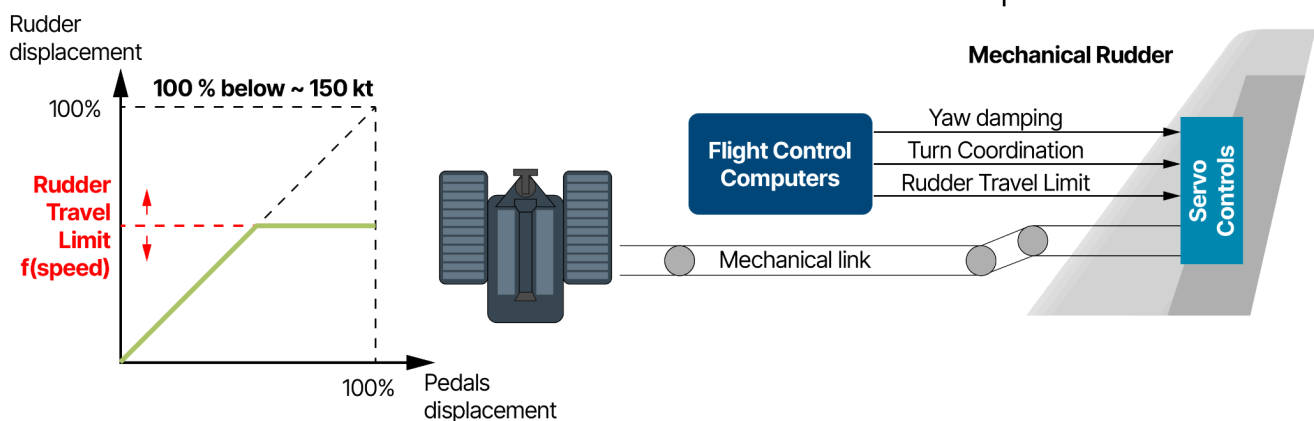
A mechanical rudder is installed on:

- **A300** aircraft,
- **A310** aircraft,
- **A320 family** aircraft (except **A321 XLR**)
- **A330-200/300** and **A340-200/300** aircraft built before July 2003 (mod 49144 not installed)

The rudder pedals are mechanically linked to the rudder servo controls (**fig.4**). Flight controls computers add correction inputs to the servo controls ensuring yaw damping, turn coordination, and a rudder travel limitation function to reduce rudder travel amplitude at high speed.

The rudder displacement is proportional to the pedals displacement until the rudder travel limit value is reached. Therefore, a limited rudder input at high speed can lead the rudder to reach its maximum travel limit.

(fig.4) Mechanical rudder



Electrical rudder

An electrical rudder is installed on:

- **A220** aircraft
- **A321 XLR** aircraft
- **A330-200/300** and **A340-200/300** aircraft built after July 2003 (mod 49144 installed)
- **A330neo**
- **A340-500/600** aircraft
- **A350** aircraft
- **A380** aircraft

The rudder pedals send an electrical signal to the flight control computers (**fig.5**). There is no mechanical link between the rudder pedals and rudder servo controllers.

On A220, A330neo, A330 & A340 e-rudder and A340-500-600 aircraft, the pedal input is converted into an equivalent rudder deflection command to the servo controls. This command is adjusted to ensure yaw damping, turn coordination and rudder travel limitation.

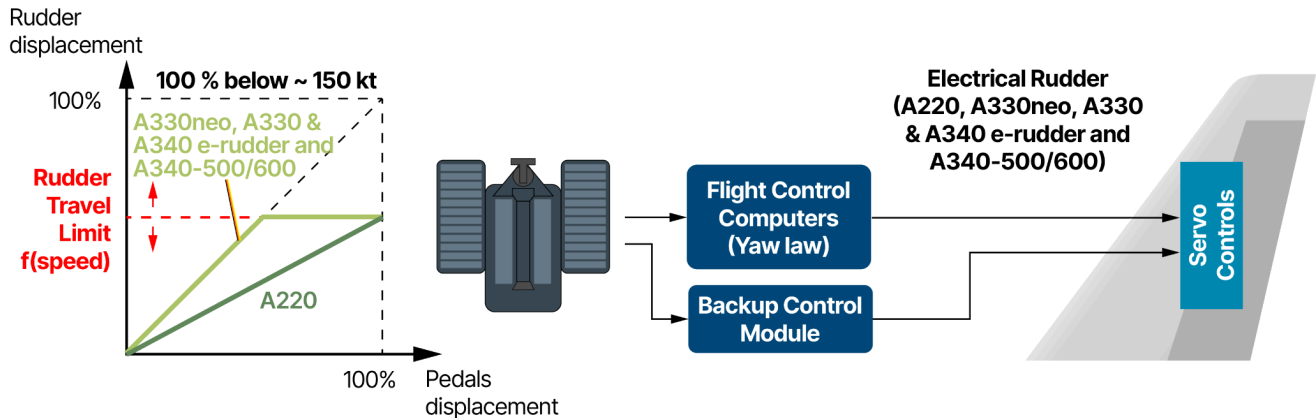
On A330neo, A330 & A340 e-rudder and A340-500-600 aircraft, the rudder displacement is proportional to the pedals displacement until the rudder travel limit value is reached - the same design principle as aircraft with the mechanical rudder.

The pedals can be further pressed but the rudder will remain at its travel limit. At high speed, a very limited rudder pedal input can result in the rudder reaching its maximum travel limit.

On A220 aircraft, full pedal application needs to be used to reach the rudder travel limit.

A backup control module acts as a backup in the case of an electrical failure or a failure of the flight control computers.

(fig.5) Electrical rudder (A220, A330neo, A330 & A340 with e-rudder and A340-500/600 aircraft)

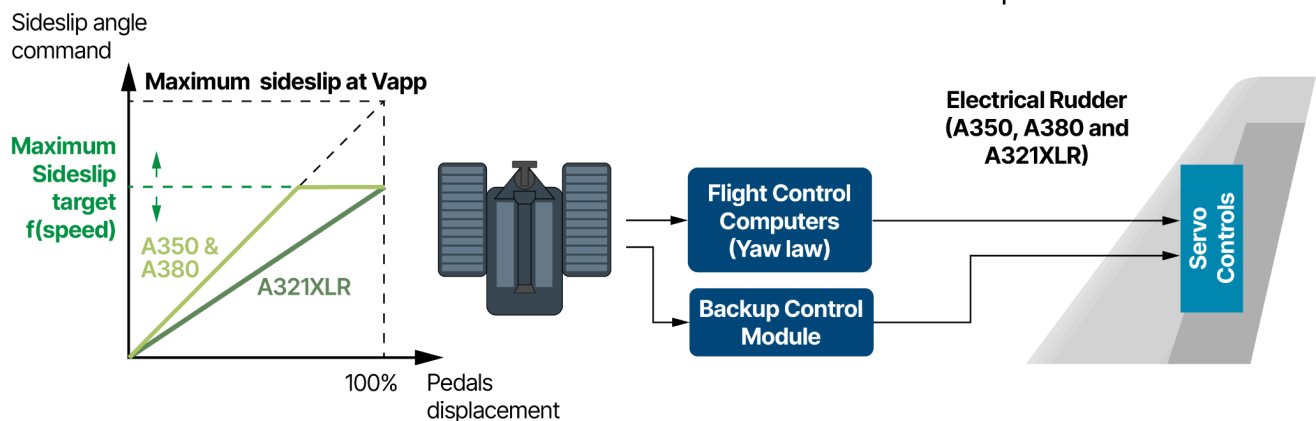


On A350, A380 and A321XLR aircraft, the rudder pedal input is converted into a **sideslip angle target** that varies depending on the flight phase (e.g. maximum sideslip on A350: 2° of sideslip at VMO and 15° in CONF 3 and FULL at approach speed (Vapp)). The yaw control law then sends a command to the servo controls to adjust the rudder position to achieve this sideslip angle target.

On A350 and A380, the sideslip target is proportional to the pedals displacement until the maximum sideslip target is reached. The pedals can be further pressed but the sideslip target will remain at the maximum sideslip target.

On A321XLR aircraft, full pedal application needs to be used to reach the maximum sideslip target.

(fig.6) Electrical rudder (A350, A380 and A321XLR aircraft)



Risks of Overload in the Case of Opposite Rudder Inputs

Aircraft structures are designed to sustain the loads caused by normal use of the rudder in a wide range of conditions and speeds. However, aggressive, rapid, full or nearly full travel, and rapidly pressing one rudder pedal then the other in opposite succession can lead to rudder inputs that will cause loads higher than the design limit, and can result in structural damage or failure. The rudder travel limit system is not designed to prevent potential structural damage or failure caused by such forceful rudder pedal inputs by the flight crew.

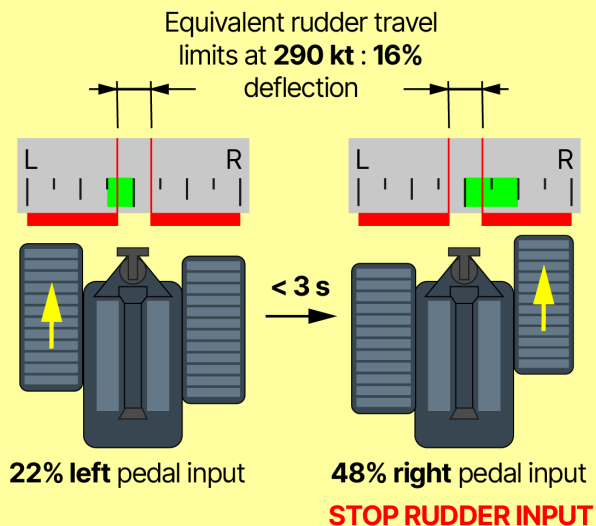
Even though aircraft with electrical rudder systems have flight control laws that may reduce the structural stress caused by forceful and alternating rudder pedal inputs, **this should not be considered as protection against structural damage** or failure due to such inputs. ■

"STOP RUDDER INPUT" Warning

A **STOP RUDDER INPUT** aural alert combined with a message displayed on the PFD is **available on A300/A310, A320 family aircraft (including A321 XLR), and A330/A340 aircraft equipped with mechanical rudder**. It warns the flight crew when:

- Rudder pedals are at, or above, the position corresponding to the rudder travel limit
- AND**
- Rudder pedals are then moved within a short timeframe (e.g. 3 s on A320 family) back to an almost neutral position and moved again in the same or opposite direction.

Taking the example of the event described previously, the PF first applied 22 % of left pedal input, which was above the 16 % position equivalent to the rudder travel limit at 290 kt (**fig.6**). The PF then applied 48% of right pedal input within 3s, causing the first **STOP RUDDER INPUT** warning.



(fig.7) Example showing the conditions that caused the first **STOP RUDDER INPUT** warning during the previously described event involving an A320 family aircraft with a mechanical rudder

OPERATIONAL CONSIDERATIONS

Use of Rudder

On all Airbus aircraft, regardless of the type of rudder installed on the aircraft (mechanical or electrical) **yaw damping and turn coordination are automated in normal law.**

The appropriate use of rudder pedals should be limited to the following situations:

- During the takeoff roll or landing roll: to maintain the aircraft trajectory on ground,
- When landing in crosswind conditions: to decrab the aircraft during flare,
- In the event of an engine failure: to counteract the thrust asymmetry until the rudder is trimmed.

The rudder pedals SHOULD NOT BE USED on Airbus aircraft for the following:

- to induce roll,
- to counter roll induced by any type of turbulence, including wake vortices.



INFORMATION

For more information on the handling of wake vortex encounters, refer to the "[Wake vortices](#)" article published in January 2016 and updated in August 2024 and to the "[What about Wake Vortex in cruise?](#)" video available on the WIN website.

Why Pilot Reporting of any High Load Event is Critical for Safety

Pilots are the primary detectors of high load events, with their awareness and experience identifying potential loads that could lead to structural stress or damage concerns. Every pilot has the responsibility to document these events through appropriate logbook entries.

Detailed information enables proper maintenance actions

When reporting a high load event, whether caused by an excessive turbulence encounter or an excessive manoeuvre, the flight crew must provide comprehensive information to maintenance personnel. This detailed reporting is essential as it enables maintenance teams to select and perform the appropriate inspections.

If the rudder was used during the manoeuvre, it must be specifically documented, particularly if the **STOP RUDDER INPUT** warning triggered during the flight. This critical information enables maintenance personnel to properly assess lateral loads and conduct necessary inspections, potentially preventing more serious structural issues from developing. ■



INFORMATION

For more information on the reporting of high load events, refer to the "[High Load Event Reporting](#)" article published in March 2018.



MAINTENANCE CONSIDERATIONS

Ask for more information when needed

Maintenance personnel should pay particular attention to pilot reports after an excessive turbulence or maneuver event. If these reports lack sufficient information, maintenance personnel should actively seek additional details from the flight crew. This follow-up is crucial to ensure that the appropriate AMM/MP/AMP is applied, unlike in the previously described event where **AMM task 05-51-44 "INSPECTION AFTER FLIGHT WITH HIGH LATERAL LOADS"** application was missed.

Specific A220 Maintenance Action

On A220 aircraft **AMP task BD500-A-J05-51-37-01AAA-284A-A "Extreme maneuver/severe turbulence event analysis (Technical data) - Special irregular inspection"** requests that the maintenance team check both vertical and lateral acceleration loads are within limits.

Aircraft may not generate a LOAD<15> report

A320 family, A330 and A340 aircraft are equipped with LOAD<15> report capability that triggers in the case of a high load event. However, **on A320 family aircraft, not all FDIMU standards are capable of detecting high lateral loads.** Therefore on aircraft with FDIMU only capable of detecting vertical loads, a LOAD<15> report may not be triggered when only lateral loads occur. Additionally, even when both vertical and lateral loads are experienced, a generated LOAD<15> report might mention only the vertical loads. This limitation reinforces the critical importance of comprehensive pilot reporting.

If in doubt, check lateral loads using recorder's data

On all aircraft types, when there is uncertainty about the presence of lateral loads during an excessive turbulence event reported by flight crew, the maintenance personnel should apply the **AMM/MP task 05-51-44 "INSPECTION AFTER FLIGHT WITH HIGH LATERAL LOADS"** or the **AMP task BD500-A-J05-51-37-01AAA-284A-A "Extreme maneuver/severe turbulence event analysis (Technical data) - Special irregular inspection"**. These tasks guide how to assess the recorded lateral load, enabling appropriate maintenance actions to be taken if needed. ■

Contributors:**Stephane DELANNOY**

Flight Controls
Development
Design Office

Christophe DELMAS

Aircraft Safety
Enhancement Manager
Design Office

Maxime LANSONNEUR

Director Safety - Training
and Flight Operations
Customer Support

**Pierre-Henri
MARCHETTI**

Abnormal Events &
Multi-ATA Technical
Leader

Damien GLEIZES

Handling Qualities
Engineer
Design Office

**With thanks to Laurent
BUFFEL from the Flight
Operations Data
Analysis team, Tonino
Colombo from the A220
Loads & Aeroelastics
Engineering, Florence
LE MARCHAND from
Aviation Safety, Francis
MEUNIER from the A220
Flight Characteristics
and Louis THERIAULT
from the A220 Flight
Operations.**

The use of rudder pedals by the flight crew on Airbus aircraft should be limited to the takeoff and landing roll, crosswind landings, or in the case of an engine failure until the rudder is trimmed. Using rudder inputs in other flight phases or during a turbulence encounter may cause unnecessary trajectory deviations and excessive loads on the aircraft structure.

The rudder travel limiter installed on Airbus aircraft protects the aircraft against static overload when the aircraft speed increases. However, aggressive, full or nearly full, opposite rudder pedal inputs can lead to loads exceeding the design limits, potentially resulting in structural damage or failure. While flight control laws on aircraft equipped with an electrical rudder may reduce the risk of overload in these situations, it should not be considered as comprehensive protection against potential damage from aggressive rudder pedal inputs.

It is essential that flight crews report excessive turbulence or excessive manoeuvre events through detailed logbook entries. These reports must provide sufficient information to enable maintenance teams to assess the need for appropriate inspection procedures to confirm airworthiness. If rudder was used during the manoeuvre, it must be specifically mentioned in the report, particularly if a "STOP RUDDER INPUT" warning occurred, so that the maintenance personnel can perform the AMM/MP/AMP inspection for high lateral loads.

In case of uncertainty about the presence of lateral loads during an excessive turbulence event reported by flight crew, the maintenance personnel should apply the AMM/MP task 05-51-44 "INSPECTION AFTER FLIGHT WITH HIGH LATERAL LOADS" or AMP task BD500-A-J05-51-37-01AAA-284A-A "Extreme maneuver / severe turbulence event analysis (Technical data) - Special irregular inspection" to analyse the recorded lateral loads and determine the appropriate actions to be carried out.

Safety first, 2025. Safety first is published by Airbus S.A.S. 1, rond point Maurice Bellonte - 31707 Blagnac Cedex/France.

Editor: Yannick Malinge, SVP Aviation Safety.

Editorial team: Guillaume Estragnat, Vanessa Sadi, Gwyneth Duggan, Javier Martinez Marina, Tim Roach.

Photos by Airbus.

© Airbus S.A.S. 2025 – All rights reserved. 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, affecting 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 S.A.S. shall assume no liability for any damage in connection with the use of this Brochure and of the materials it contains, even if Airbus S.A.S. has been advised of the likelihood of such damage.

Safety first

The Airbus Safety magazine

The Airbus magazine contributing to the enhancement of the safety of aircraft operations by increasing knowledge and communication on safety related topics.

Safety first is published by the Aviation Safety department. It is a source of specialist safety information for the use of airlines who fly and maintain Airbus aircraft. It is also distributed to other selected organizations and is available on digital devices.

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, MMEL 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, nor do they indicate Company policy.

Contributions, comments and feedback are welcome. Enquiries related to this publication should be addressed to:

Airbus - Aviation Safety department (W)
1, rond point Maurice Bellonte
31707 Blagnac Cedex - France
safetycommunication@airbus.com

Visit us at safetyfirst.airbus.com or install the Safety first app:

