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#28

Safety first



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editorial



YANNICK MALINGE

SVP & Chief
Product Safety Officer

Dear Aviation colleagues,

Every pilot is likely to encounter an overspeed event during their career flying in aircraft operating at high altitude and close to their high speed limits. To better face such conditions resulting from significant wind changes, it is essential to remind all flight crew members on the importance of applying recommended procedures. It is also equally important to remind them to avoid large and abrupt control inputs.

As it was the case for the “Control Your Speed” series of articles previously published in Safety first, this edition reinforces the message that flight crews need to constantly monitor and manage their speed. This subject is one we revisit regularly, both in this publication and in our annual Flight Safety Conferences.

Accordingly, three of the enclosed articles describe the lessons learnt from an actual overspeed event:

- Consequences of large and abrupt control inputs
- Consequences of wrongly applying an OEB
- Importance of applying FCTM recommended techniques
- Effects of “negative training”.

Talking about “negative training”, we all have in mind examples of major events which amongst the contributing factors include the impact of “negative training”. This is why, like for the operational related lessons learnt, we shall also not forget the ones that are “negative training” related.

I trust you will find the recommendations and reminders in these articles useful.

I wish you all safe flying.

A handwritten signature in black ink, appearing to read 'Y Malinge', with a horizontal line extending to the right.

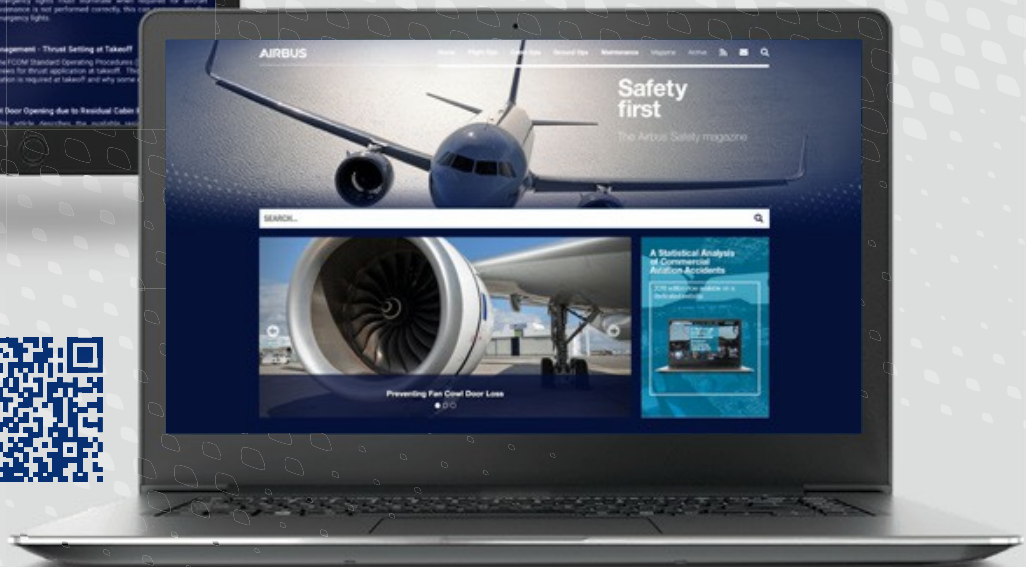
Safety first

The Airbus Safety magazine

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Overspeed Event with Crew Take-over and OEB49 Application

While flying at FL380, an A340 aircraft encountered a strong and abrupt tailwind decrease that triggered significant M_{MO} overshoot and overspeed warning.

The crew disconnected the AP, took over and inappropriately applied OEB49 (ADR2 & ADR3 set to OFF).

This article describes this event and presents two main aspects from its analysis: the management of an overspeed situation and the inappropriate OEB49 application.

It details the rationale for the OEB49 (on A330/A340 aircraft) and OEB48 (on A320 family) and their conditions of application. It explains why they must not be trained on simulator and recalls the aircraft modifications allowing to cancel the OEB.

ANALYSIS OF AN EVENT

Event Description

Overspeed in cruise due to a tailwind drop

An A340 aircraft was flying at FL380 with a managed Mach number of 0.82 and a tailwind of around 64 kt. Prior to reaching top of descent, a sudden drop in tailwind of 41 kt in 14 seconds caused a significant airspeed increase and triggered an OVERSPEED warning for 9s despite the thrust reduction commanded by the autothrust (A/THR) (**fig. 1**).

Manual AP disconnection with large pitch up sidestick input and selection of a low Mach target

The Captain reacted to the overspeed warning by manually disconnecting the autopilot (AP) and then by applying large pitch up inputs on the side stick. The speedbrakes were not used. The flight crew then selected a Mach number of 0.7, which actually corresponds to an airspeed below V_{LS} . The aircraft consequently started to climb at a pitch rate of up to 5700 ft/min. The speed was decreasing with the thrust at idle in accordance with the selected Mach.

Dual ADR switch OFF: Alternate law, loss of A/THR, protections and FD

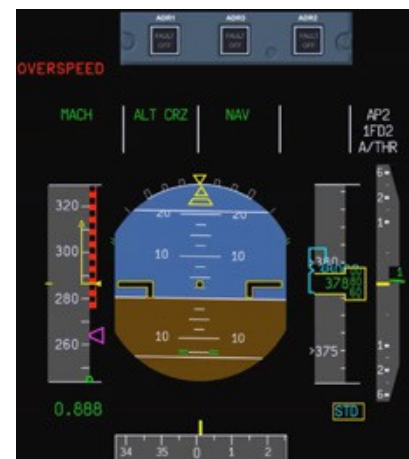
The flight crew erroneously applied the OEB49 procedure and switched off the ADR 2 and ADR 3 about 15 seconds after the autopilot disconnection. This caused the aircraft to revert to Alternate law, with the loss of the FD bars and disconnection of autothrust. As a consequence, the thrust remained at the current value which was still idle at that time (**fig. 2**). Indeed the THR LK function at autothrust disconnection maintains the thrust at its current value until the thrust levers are moved again. This is indicated by the associated “**ENG THRUST LOCKED**” ECAM alert that requests to move the thrust levers and the “**THR LOCK**” displayed on the FMA.

32 seconds of climb with idle thrust until reaching STALL warning

After the A/THR disconnection, the thrust levers were not moved for 32 s. During this time, the aircraft therefore continued its climb with the thrust at idle and decreasing speed. While reaching FL399, four successive stall warnings triggered. The crew reacted by applying stall recovery maneuvers and sent a MAYDAY call.

ADRs switched back to ON

The flight crew finally switched ADR2 and ADR3 back to ON. This enabled the flight crew to reengage both the AP and A/THR. The aircraft resumed normal flight and landed without further incident.



(fig.1)

View of the PFD at the time of the overspeed



(fig.2)

View of the PFD after switching off ADR2 and ADR3

“ Autopilot is robust to overspeed situations ”

Flight Data Analysis

Analysis of the flight data highlights two main aspects of this event: the handling of overspeed and the improper application of the OEB49.

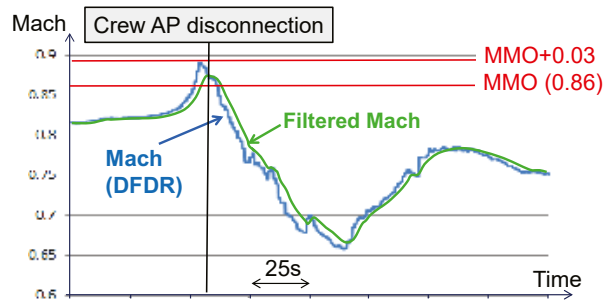
Overspeed handling

During this event, the flight crew disconnected the autopilot following the OVERSPEED warning. However, the autopilot is robust to overspeed situations. The autopilot automatically disconnects only when the filtered Mach becomes higher than $M_{MO} + \text{margin}$ ($M_{MO} + 0.03$ on A330/A340 aircraft). The filtered Mach is a smoothed and slightly delayed Mach which dampens any abrupt variation of the current Mach and makes the autopilot even more robust against automatic disconnection.

Simulations show that if the autopilot had been left engaged, it would have remained engaged during this event (fig.3). As a result, the aircraft would have stayed on its trajectory.

(fig.3)

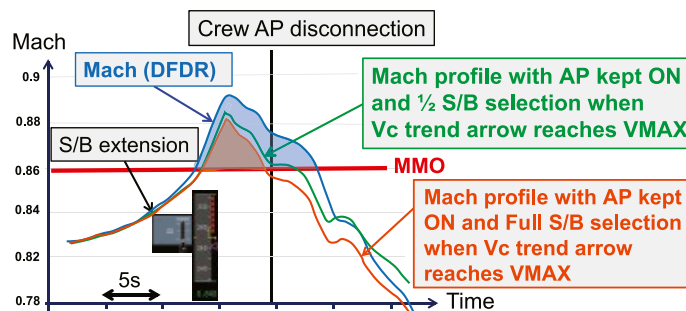
Evolution of the filtered Mach versus the current Mach and versus the autopilot automatic disconnection threshold value ($M_{MO}+0.03$)



In addition, the use of speedbrakes (S/B) is an efficient way to limit the V_{MO}/M_{MO} overshoot in cruise. This event has been simulated with autopilot kept ON and S/B selection at the time the V_{ctrend} arrow reaches V_{MAX} . The comparison of the event Mach with the Mach resulting from these simulations shows that the use of AP combined with a S/B extension would have minimized the altitude excursion as well as the V_{MAX} overshoot and overshoot duration (fig.4).

(fig.4)

Comparison of the recorded Mach evolution with the simulated Mach evolutions if AP was kept ON with the selection of half and full S/B when the V_c trend arrow reached V_{MAX}



For more information on the handling of an overspeed situation in cruise, refer to the Safety first article “Management of overspeed events in cruise”.

Improper application of OEB49

During this event, the flight crew interpreted a rising of the alpha protection strip on the PFD as an entry condition of the “Abnormal V Alpha prot” OEB49 and switched off ADR2 and 3. However, none of the OEB entry conditions were actually encountered. ■

AVOIDING IMPROPER APPLICATION OF OEB48/49

Only 2 cases of improper AOA protection activation occurred since the introduction of Airbus fly-by-wire aircraft 31 years ago.

The first time was in November 2012 on an A330 aircraft after the introduction of conic AOA cover plates. All the conic plates were immediately removed subsequent to this event and the original flat cover plate design type was refitted.

The second event occurred 2 years later on an A321 equipped with the initial AOA flat cover plate design. This is the only case of undue AOA protection activation with this configuration which has accumulated more than 300 Million flight hours.

OEB48 for A320 family and OEB49 for A330/A340 family were however issued at that time to cover the risk of undue activation of AOA protection in case of multiple AOA blockage at a consistent high value.

These OEB request the flight crew to keep only one ADR ON and switch off the other two ADR. This forces reversion to alternate law which will disable flight envelope protections and thus prevent inappropriate activation of the high angle of attack protection.

OEB48/49 entry conditions

OEB48 and OEB49 have two types of entry conditions: one reactive entry and some preventive entries.

These OEB must be applied only if one of the entry conditions has been confirmed, remembering that only the reactive entry condition requires immediate action.

Reactive entry condition for OEB48 and OEB49: Incorrect activation of the AoA Protection

The reactive entry condition is unique, simple and the same for the A320 family, A330 and A340 aircraft (**fig.5**). The OEB procedure must be immediately applied if the aircraft goes to a continuous nose down pitch rate that cannot be stopped with full backward sidestick inputs while flying at a speed above V_{LS} .

<p>● AT ANY TIME, with a speed above VLS, if the aircraft goes to a CONTINUOUS NOSE DOWN PITCH RATE that cannot be stopped with backward sidestick inputs, IMMEDIATELY APPLY:</p>	
ONE ADR.....	KEEP ON
TWO ADRs.....	OFF

Preventive entries based on PFD speedscale monitoring

These OEB also describe “preventive” entry conditions that enable to detect an abnormal overestimation of the **aProt** strip on the PFD, which could lead to an undue activation of the AoA protection later in the flight. The flight crew must confirm that all the parameters of the preventive entry condition are true before applying the OEB.

“ This is the only case of undue AOA protection activation with the flat cover plate configuration which has accumulated more than 300 Million flight hours ”

“ Only the reactive entry condition requires immediate action ”

“ The reactive entry condition is unique, simple and the same for the A320 family, A330 and A340 aircraft ”

(fig.5)
Immediate actions of the OEB48/49 procedure

OPERATIONS

Overspeed Event with Crew Take-over and OEB49 Application

“ The flight crew must confirm that all the parameters of the preventive entry condition are true before applying the OEB ”

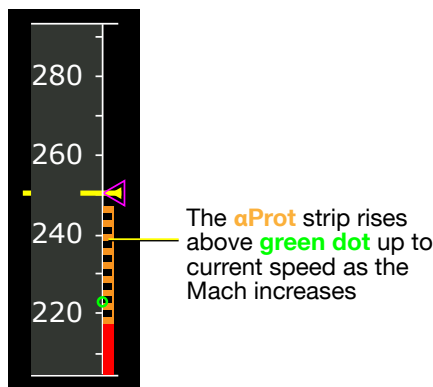
(fig.6)
Preventive entry conditions of the OEB49 for A330 and A340 aircraft

The effects on the PFD speedscale differ depending on the aircraft type:

- A330/A340 aircraft (OEB49)

On A330 or A340 aircraft, the preventive entry condition is when the **αProt** strip continuously increases and exceeds Green Dot (GD) speed as the Mach increases in a stabilized wings-level flight path (typically during the climb phase) **(fig.6)**.

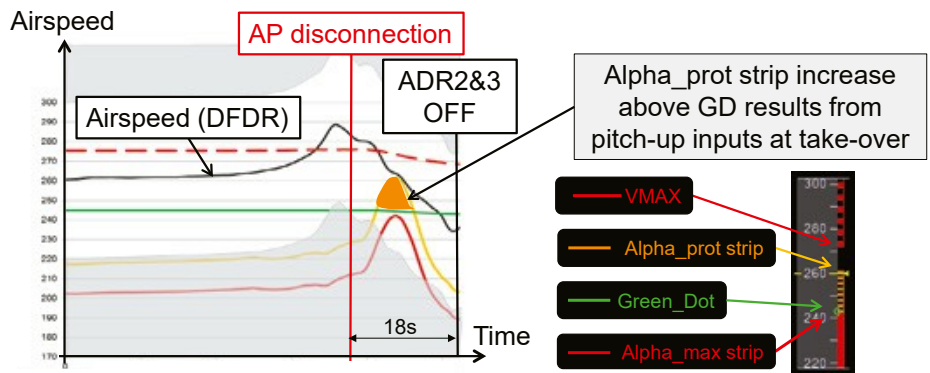
In stabilized wings-level flight



In the event described, the flight crew of the A340 improperly applied OEB49. The **αProt** strip increase above green dot speed did not occur with Mach increasing and in stabilized wings-level flight, but instead resulted from sidestick pitch up inputs **(fig.7)**.

The preventive entry condition of the OEB49 was therefore not fulfilled. The reactive entry was not fulfilled either as the aircraft was climbing when the OEB was applied.

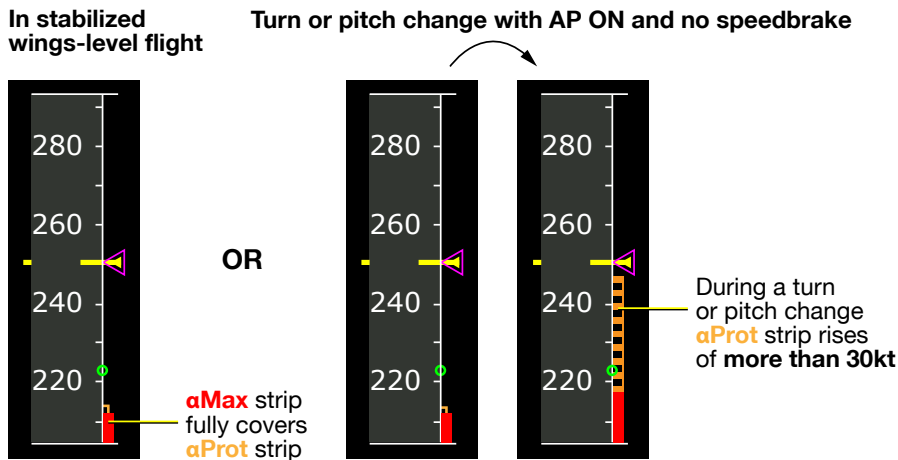
(fig.7)
Plot of the recorded airspeed, green dot speed, Valpha prot, Valpha max and Vmax during the event



- A320 family aircraft (OEB48)

On A320 family aircraft, by design, the **αProt** strip is limited by VLS out of g-load conditions, so that an abnormal **αProt** strip increase becomes visible only during manoeuvres (turn or pitch change)

- 1st preventive entry: The **αMax** strip completely hides the **αProt** strip in a stabilized wings-level flight path (without an increase in load factor)
- 2nd preventive entry: With the Auto Pilot (AP) engaged and the speed brakes in the retracted position, the **αProt** strip rapidly moves by more than 30 kt during flight maneuvers with an increase in load factor, for example turns or pitch variations.

**(fig.8)**

Preventive entry conditions of the OEB48 for A320 aircraft

No reported cases of proper application of OEB48 or OEB49

No cases of proper OEB48 or OEB49 application have been reported to Airbus since their publication in December 2014. However, there were six cases of improper application of these OEB procedures.

The OEB was applied in one event where the aircraft was already in alternate law when AOA protection is not available.

Two cases were reported on A320 family after a normal 20 kt αProt strip increase during a turn with autopilot engaged.

Three cases, including the A340 event described, occurred in similar conditions. The OEB was improperly applied in an overspeed context, after take-over with significant pitch-up inputs applied.

Avoid negative training

Improperly applying these OEB in overspeed situations could result from inappropriate training for the following reasons:

The current simulators cannot properly simulate the scenario requiring the application of these OEB. However some operators wrongly use some scenarios such as the dual “TOTAL PITOT BLOCKAGE” to train their pilots to switch off two ADRs following an undue activation of the High Speed Protection. This undoubtedly generates negative training and can impair the pilots’ understanding and trust of the flight envelope protection. The article “The Adverse Effects of Unrealistic Simulator Scenarios” explains why the use of the Dual “TOTAL PITOT BLOCKAGE” scenario in simulators is inappropriate and must not be used.

Ensuring that Flight crews understand the reasons for applying OEB48/49 and knowing their entry conditions is essential. Supporting training material, such as instructional videos, are available on the Airbus World portal. For more information on the material available, refer to Flight Operations Transmission (FOT) 999.0148/14 Rev 01 dated 23-DEC-2014 for A330/A340 aircraft and to FOT 999.0147/14 Rev 01 dated 23-DEC-2014 for A320 family aircraft.

“ The application of these OEB must not be trained in simulator. This is negative training and can impair the pilot’s trust of flight envelope protection ”

“ Supporting training material, such as instructional videos, are available on the Airbus World portal ”

Switching two ADR to OFF has a significant impact on the flight

Switching two ADR to OFF has a significant consequences for the flight, especially in dynamic conditions.

Reversion to ALTERNATE law means the loss of the flight envelope protections including High angle of attack, bank angle and pitch attitude protections. The loss of autopilot and Flight Directors increases the workload of the flight crew. Finally, when the A/THR disconnects the thrust remains at this value as long as the thrust levers are not moved.

The OEB48/49 cancellation fix is available: upgrade your fleet

Two modifications are now available that will cancel OEB48 & OEB49 when implemented on affected aircraft.

These modifications consists in installing at least two Thales AoA probes, which are more robust to potential blockage at high AoA value, and in a software update for the Flight Control Computers.

This software update introduces two additional monitoring functions:

- Reinforced AoA monitoring

Updated monitoring will detect AoA probe blockages including multiple and consistent blockages and will reject the data of the concerned probe(s).

- “AoA protection watchdog” monitoring

This function is an additional independent monitoring that is active at high speeds. It detects inconsistencies between the actual aircraft behavior and the AoA protection activation. In the case of inconsistency, it disables the AoA protection. This independent monitoring would detect undue activation of the AoA protection caused by any possible unforeseen conditions.

Note: These two monitoring functions are already implemented on all A350 and A380 aircraft.

The installation of the probes and of the software update is mandated by Airworthiness Directives on A320 family and A330/A340 aircraft and cancels the OEB48/49.

(fig.9)

Summary of the relevant EASA Airworthiness Directives with their respective compliance date

AIRCRAFT TYPE	SOFTWARE STANDARD	EASA AD	COMPLIANCE DATE (EASA)
A330	FCPC P15 or equivalent	2017-0246R1	25-Dec-18
A340-200/-300	FCPC L25 or L26	2019-0028	21-Nov-19
A340-500/-600	FCPC W14	2019-0028	21-Nov-19
A320	ELAC L97+	2018-0007R1	2-Jun-17
A318/A319/A321	ELAC L99	2018-0007R1	24-Jan-20

AIRCRAFT TYPE	RETROFIT OF AT LEAST 2 THALES AOA PROBES EASA AD	COMPLIANCE DATE (EASA)
A330/A340	2015-0134	31-Mar-17
A318/A319/A320/A321	2015-0135	31-Mar-17

OEB48 & OEB49 must not be applied after the fix

It is the operator's responsibility to remove the OEB from the FCOM and QRH as soon as the corrective modifications are installed on the aircraft and inform flight crews that the OEB is cancelled and its procedure must not be applied anymore. ■

“ Once the OEB is cancelled, it must not be applied anymore ”

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**With thanks to the A330/A340
Handling qualities and Flight
Control laws Engineering teams**

The «abnormal Valpha prot» OEB48 and OEB49 have been issued following only one event of undue activation of the angle of attack protection in over 300 million flight hours.

No case of proper application of OEB48 or OEB49 has been reported to Airbus since they were published. However, six cases of improper application were reported.

Application of the OEB48/49 must not be trained in simulator since it can't be adequately simulated. Instead, flight crews must understand the full context of these OEB and be able to identify their entry conditions for proper application if required. Supporting training materials on these OEB have been made available to the flight operations division of all Airbus operators. They can still be downloaded from the Airbus World portal.

An improper application of OEB48 and OEB49 may have significant consequences, especially in dynamic flight conditions due to the loss of autopilot, Flight Directors, autothrust and reversion to alternate law with loss of flight envelope protections.

The OEB48 and OEB49 cancellation fix is mandated by Airworthiness Directive and available for both A320 and A330/A340 aircraft families. It is highly recommended to upgrade aircraft as soon as possible with these modifications. Remove the OEB from the documentation as soon as the fix is installed and ensure that flight crews will no longer apply them.



Management of Overspeed Events in Cruise

Modern aircraft operate at high altitude and close to their high speed limits. As a consequence, temporary overspeed events can occur in cruise in changing wind conditions.

The analysis of in-service data shows the need to remind the appropriate techniques to manage such temporary overspeed and avoid potential significant trajectory deviation.

This article therefore recalls the aircraft capabilities to cope with overspeed and the recommended techniques to safely prevent and manage overspeed conditions in cruise.

FLIGHT DATA ANALYSIS

Airbus studied the data provided by Operators for over a million of flights to gain an insight into overspeed management in actual operational conditions.

This study indicates that there is about one V_{MAX} exceedance every 1 400 flights, which demonstrates that overspeed events occur frequently. Temporary overspeed scenarios are more often occurring in the cruise phase where the aircraft can be subject to changing wind conditions.

Managing overspeed: the importance of applying recommended techniques

Analysis showed that the handling of overspeed is not always done in accordance with the recommended techniques provided by the Flight Crew Techniques Manual (FCTM). Focusing on the flights with V_{MAX} exceedance, the following can be highlighted:

Numerous manual autopilot disconnections

In 25% of these flights, flight crew disconnects the autopilot and takes over control of the aircraft.

Several cases of abrupt and large control inputs during manual takeover leading to a significant altitude deviation were reported to Airbus.

No reduction of speed target

In 30% of these flights, speed target is not reduced to increase margins when approaching V_{MAX} .

No use of speedbrakes

In 60% of these flights speedbrakes are not used to prevent or manage the overspeed. ■

AIRCRAFT CAPABILITIES

In cruise, V_{MO}/M_{MO} provides a significant margin to design limits

All Airbus aircraft are designed and tested to be safe to fly up to design limit speed, which is a value with margin well above V_{MO}/M_{MO} at cruising altitude. (Refer to the Safety First article « Control Your Speed in Cruise », published in 2016). There is therefore no need to rush in taking over manually when the aircraft reaches V_{MO}/M_{MO} .

Autopilot is robust to overspeed

The AP will remain engaged throughout most of the overspeed events encountered in cruise.

The AP will only automatically disconnect if there is a large or prolonged V_{MO}/M_{MO} exceedance.

“ Temporary overspeed excursions often happen in cruise phase where the aircraft can be subject to changing wind conditions ”

“ The AP will remain engaged throughout most of the overspeed events encountered in cruise ”

“ Keeping the AP and A/THR ON in the case of an overspeed event minimizes altitude excursion and reduces the crew workload ”

On fly-by-wire aircraft, when the aircraft is in overspeed situation, as long as the autopilot is engaged, the High Speed Protection (HSP) is not active and the AP flight objectives remain unchanged. The autopilot will automatically disconnect if the HSP activates. The HSP will command the appropriate pitch up input.

Inspection following an overspeed event

Aircraft inspection is only required when the speed exceeds V_{MO} by 20 kt (or $M_{MO}+0.02$ for A330/A340 aircraft and $M_{MO}+0.04$ for A320 family). There have been no findings reported following inspections performed after overspeed events on Airbus fly-by-wire aircraft. ■

RECOMMENDED TECHNIQUES

The Flight Crew Techniques Manual (FCTM) provides efficient techniques to prevent and recover from an overspeed situation.

Overspeed Prevention Technique

The following overspeed prevention techniques must be applied in the case of significant speed variations close to V_{MO}/M_{MO} :

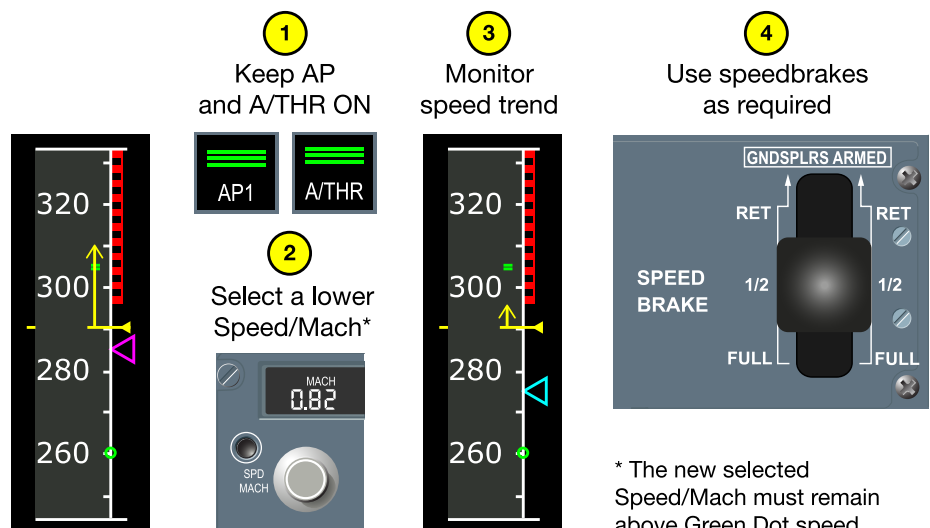
Keep autopilot and autothrust ON

The autopilot maintains the aircraft on the intended flight path and the autothrust will automatically command idle thrust.

That is why keeping the autopilot and autothrust ON during an overspeed event minimizes altitude excursion and reduces crew workload.

Select a lower speed target

Selection of a lower speed target increases the margin to V_{MO}/M_{MO} . The selected speed must remain above Green Dot speed to avoid any speed decay.



(fig.1) Overspeed prevention technique

Monitor the speed trend arrow and use speedbrakes if necessary

At any time, when the speed trend arrow approaches or exceeds V_{MO}/M_{MO} , the flight crew should use the speedbrakes to decelerate the aircraft.

The use of speedbrakes is the most efficient way to decelerate the aircraft without destabilizing its trajectory.

On A380, when autopilot and autothrust are engaged, the speedbrakes automatically extend in cruise above $V_{MO}-5$ kt. Refer to FCOM and FCTM for more information.

Overspeed Recovery Technique

The flight crew must apply the Overspeed Recovery Technique if the speed exceeds V_{MO}/M_{MO} .

Keep autopilot and autothrust ON

The autopilot being robust to overspeed situation, the flight crew must not disconnect manually the autopilot and autothrust in the case of an overspeed situation. Manual takeover should be limited to the cases where the HSP activates and automatically disconnects the autopilot.

Use the speedbrakes

The use of speedbrakes will reduce the V_{MAX} exceedance and duration. Using speedbrakes can help to prevent reaching the speed threshold that causes HSP to activate and the autopilot to disconnect.

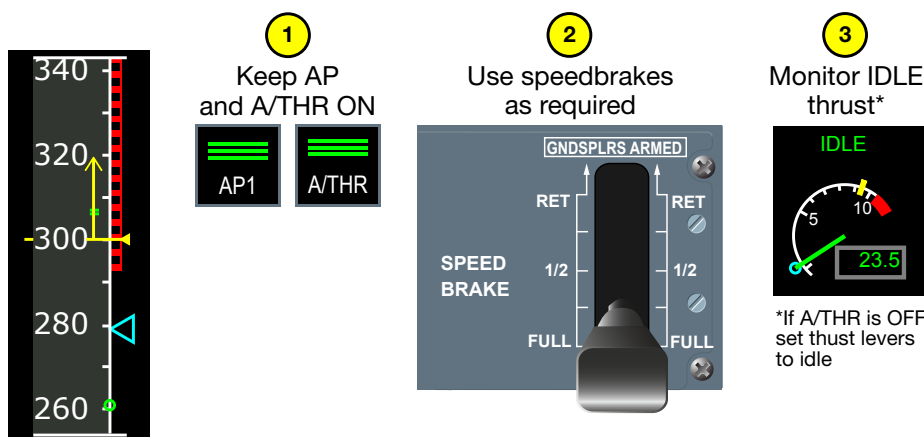
For A350, the speed brakes fully extend at $V_{MO}+5$ kt automatically, regardless of the position of the SPEED BRAKES lever. Refer to the FCOM/FCTM for more information.

Monitor IDLE thrust on the Engine/Warning Display (E/WD)

The flight crew should monitor that the autothrust commands idle thrust on the E/WD or set the thrust levers to idle if the autothrust is disconnected.

“ The use of speedbrakes is the most efficient way to decelerate the aircraft without destabilizing the aircraft trajectory ”

“ The autopilot being robust to overspeed situation, the flight crew must not disconnect manually the autopilot and autothrust in the case of an overspeed situation ”



(fig-2)
Overspeed Recovery technique

What to do if the HSP activates and disconnects the autopilot?

On fly-by-wire aircraft, the autopilot may automatically disconnect due to the activation of the HSP. In this case, the aircraft reverts in manual flight with the HSP active. The HSP is designed to target V_{MO} or M_{MO} stick free and to limit the excursion beyond V_{MO}/M_{MO} when a full forward stick input is applied. When the Mach or speed decreases close to V_{MO}/M_{MO} , the HSP protection deactivates, the aircraft remaining in manual flight mode.

OPERATIONS

Management of Overspeed Events in Cruise

In case of automatic autopilot disconnection due to the HSP, the flight crew can smoothly adjust the pitch attitude but without overreacting, especially at high altitude and should keep speed brakes extended because they are compatible with HSP.

If AP disconnection due to HSP activation:

“ Always apply smooth control inputs ”

(fig.3)
Actions to be taken after an AP disconnection due to HSP activation



What to do after an overspeed recovery?

Once the aircraft's speed decreases below V_{MO}/M_{MO} , the flight crew should apply the following steps:

Retract the speed brakes when appropriate

Retracting the Speedbrakes too early could lead to re-occurrence of the V_{MO}/M_{MO} exceedance, but retracting too late may cause speed decay.

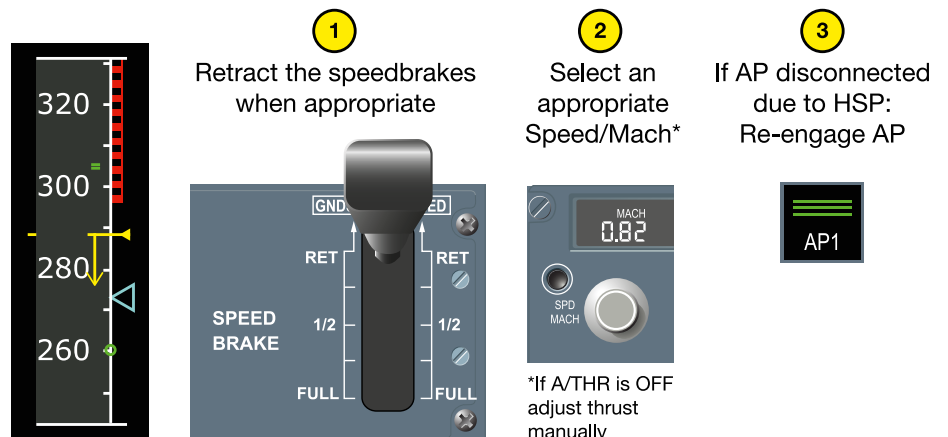
Adjust the speed target as necessary

The flight crew should adjust the speed target to increase the margin to V_{MO}/M_{MO} if the risk of overspeed due to the external conditions remains, but ensure the speed target is set above Green Dot speed. If the autothrust is OFF, the flight crew should manually adjust thrust levers and engage autothrust.

Re-engage autopilot if it was disconnected

If AP was previously disconnected due to HSP, the flight crew should recover the flight path smoothly and re-engage the AP. ■

(fig.4)
What to do after an overspeed recovery?



*If A/THR is OFF adjust thrust manually

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Overspeed scenarios often occur in cruise due to changing wind conditions. Applying the recommended overspeed prevention and recovery techniques from the FCTM reduces the risk of aircraft's altitude variation and minimizes the flight crew's workload when managing overspeed events.

On Airbus aircraft the autopilot is designed to cope with temporary overspeed situations. The High Speed Protection will disconnect the autopilot and provide optimum pitch up command to slow the aircraft only in the case of a large and prolonged overspeed. Flight Crews should not manually disconnect the autopilot in anticipation of High Speed Protection activation.

In the case of AP disconnection following HSP activation, the flight crew must apply smooth pitch inputs to avoid sudden inappropriate and excessive control inputs with their inherent consequences on the aircraft trajectory.

Keeping the autopilot and autothrust ON, combined with an optimal use of speedbrakes, enables a smooth and safe recovery of an overspeed event in cruise.

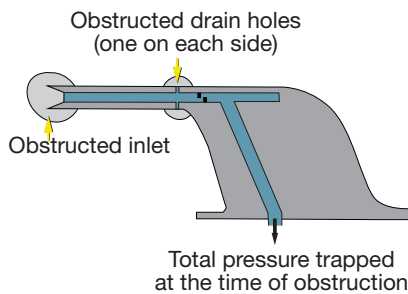


The Adverse Effects of Unrealistic Simulator Scenarios

The use of unrealistic failure scenarios during simulator training can lead to negative training. This article describes the «TOTAL PITOT BLOCKED» failure that is available in simulators. It explains why simultaneous and permanent dual «TOTAL PITOT BLOCKED» in climb or descent phase leads to negative training.

THE “TOTAL PITOT BLOCKED” FAILURE

The “TOTAL PITOT BLOCKED” failure is available on simulators. This failure simulates a simultaneous obstruction of both the inlet and drain holes of a Pitot probe. As a consequence, the measured total pressure remains at a constant value corresponding to the total pressure measured at the time of the total obstruction.



(fig.1)
Illustration of the “TOTAL PITOT BLOCKAGE” simulated failure

Effect of the “Total Pitot Blocked” failure on the airspeed computation

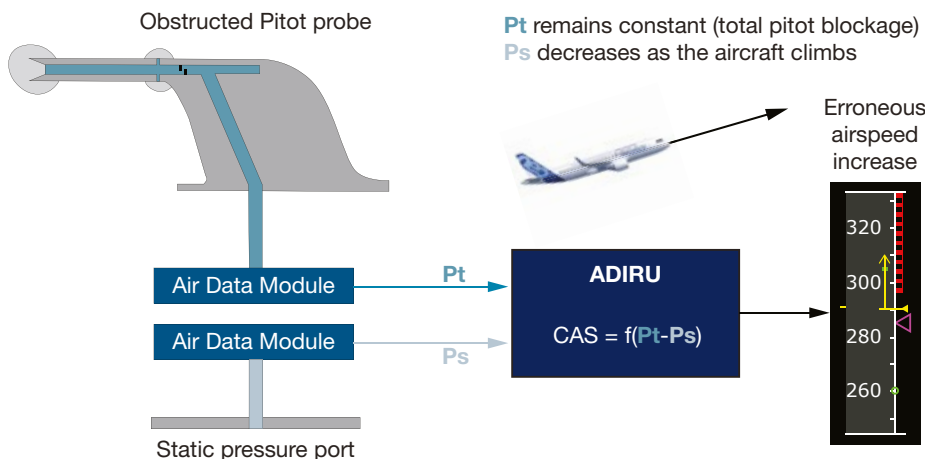
The ADR (Air Data Reference) computes the airspeed from the difference between the Total Pressure (Pt measured by the Pitot tube) and the static pressure (Ps measured by the static pressure ports).

$$CAS = f (Pt-Ps)$$

3 ADR are installed on Airbus aircraft, each of them using its own Pitot tube and static pressure ports.

A computed airspeed that varies with altitude

In the case of full Pitot blockage, at low altitude, when the aircraft climbs, the airspeed is computed wrongly based on the difference between the constant total pressure trapped inside the Pitot tube at the time of the obstruction and the current static pressure which is decreasing with increasing altitude. Therefore, when the aircraft climbs, the measured airspeed is permanently wrong and more and more overestimated. ■



(fig.2)
Example of the effect of the “TOTAL PITOT BLOCKAGE” simulated failure on the airspeed computation when in climb

“ The normal flight control law remains unduly active and uses erroneous but consistent airspeed information ”

USE OF A DUAL “TOTAL PITOT BLOCKED” FAILURE SCENARIO: A NEGATIVE TRAINING

The simultaneous dual TOTAL PITOT BLOCKED failure consists in introducing, in a short term, the TOTAL PITOT BLOCKED failure on 2 Pitot probes (For example CAPT Pitot AND F/O Pitot).

This failure scenario provides a negative training and must not be used as explained here after.

Effects of a dual “TOTAL PITOT BLOCKED” failure

The Electrical Flight Control System (EFCS) permanently monitors the 3 Airspeeds information delivered by the 3 ADRs. When the Airspeed information delivered by one of the 3 ADRs is detected different from the 2 others, the EFCS rejects the corresponding ADR that will no longer be used by the EFCS system.

In the case of a simultaneous dual TOTAL PITOT BLOCKED simulated failure, the 2 corresponding ADR deliver wrong but consistent airspeed information while the third ADR delivers correct but single airspeed information. The EFCS cross comparison monitoring will therefore reject the correct airspeed information and keeps the two wrong but consistent airspeeds.

Therefore, during this whole unreliable airspeed event, the normal flight control law remains unduly active and computed from erroneous airspeed information.

An erroneous computed airspeed increase and an undue activation of the High Speed protection until the High Angle of Attack protection activates

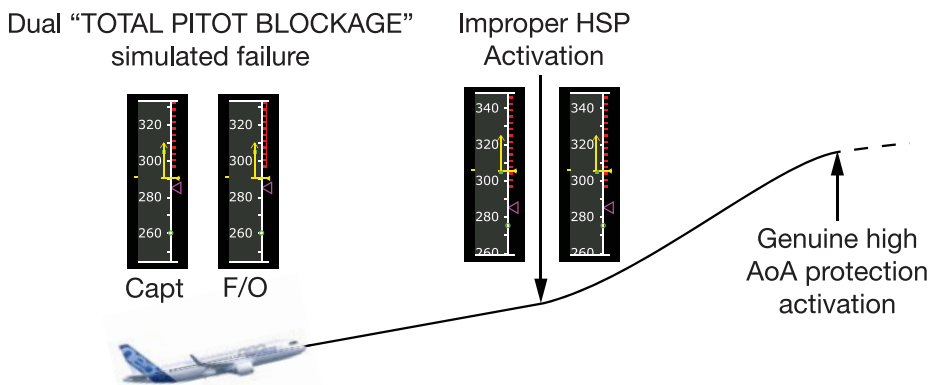
If the dual TOTAL PITOT BLOCKED failure is set on Captain and F/O sides at low altitude after takeoff, when the aircraft climbs, this leads to a consistent and increasing overestimation of the airspeed delivered on CAPT and F/O sides and used by the EFCS system.

As a consequence, the aircraft remains in normal law and the high speed protection will unduly activate when these 2 wrong but consistent airspeeds exceed V_{MO}/M_{MO} .

The high speed protection therefore activates wrongly and commands permanently an increasing pitch-up movement that the flight crew cannot counteract even with a full forward side-stick input.

This leads to a genuine increasing Angle of Attack (AoA) that will eventually result in the activation of the high Angle-of-Attack protection (as the high AoA protection has priority on High Speed protection). The high AoA protection will command a pitch down movement of the aircraft as long as the AoA remains above the AoA protection activation threshold.

Then either the aircraft exceeds the threshold that activates the abnormal attitude flight control law, or the high speed protection and the AoA protection alternatively activates. This results in large pitch oscillations with high speed protection becoming active again when the AoA becomes back below the high AoA protection activation threshold.

**(fig.3)**

effects of a DUAL "TOTAL PITOT BLOCKAGE" simulated failure in climb

An unrealistic scenario that creates negative training

A dual TOTAL PITOT BLOCKED is not realistic

Such simultaneous dual failure mode with permanent and consistent dual airspeed increase (decrease) when the aircraft climbs (descends) with a resulting undue activation of the flight envelope protections has never been reported in service.

Multiple Pitot obstructions can never occur exactly at the same time and can never have permanently the same obstruction characteristics along the time. This is fundamental because multiple Pitot obstructions will undoubtedly lead to airspeed discrepancy detected by the flight control system which, in this case, will reject the erroneous airspeed information and associated ADR and revert to alternate law.

In addition, a permanent dual "TOTAL PITOT BLOCKED" failure all along the climb will undoubtedly generate confusion to the trainees. It will together jeopardize their understanding of aircraft systems, of the behavior of flight control laws and flight envelope protections and of the operational consequences of air data failures:

- It leads to keep the normal laws and associated protections active while they are computed with erroneous airspeed.
- It leads to an undue activation of the High Speed protection. The subsequent uncontrollable and dynamic aircraft pitch-up is a very negative physical experience.
- It leads to an unrealistic alternative activation of the High Speed protection and the AoA protection which does not allow understanding of the behavior of the protections and even create some confusion in the way the protections work.



Identically, if the permanent dual “TOTAL PITOT BLOCKED” is introduced at high altitude when the aircraft descends, it remains unduly in normal law based on the two more and more underestimated but consistent airspeeds. Despite the very low speeds displayed to the flight crew, the High AoA protection will never activate as the AoA remains (correctly) below the activation threshold of the protection.

An example of negative simulator training scenario

The aircraft is in climb. A dual total pitot blockage failure is set on captain and first officer sides.

While the aircraft is climbing, the erroneous captain’s and first officer’s speeds increase and reach V_{MO}/M_{MO} with the triggering of the Overspeed warning. Then the AP disconnects and the High Speed Protection unduly activates, the aircraft pitch-up, the flight crew tries to counteract with full forward sidestick input, without success. To recover, the flight crew is trained to switch off two ADRs to revert to alternate law and then to manage the aircraft trajectory.

Such scenario leads to the following questions:

How many pilots were trained that way?

It is likely that many pilots have potentially been trained that way if we refer to the questions we received from operators and to an article published in an online aviation magazine: «*Recently, we have been able to train for uncontrollable nose up pitch, with the same actions –the ones of OEB48&49- required for the recovery, which at least gets us to think (rapidly) about disabling the protections in order to regain control*».

What should be the reaction of the flight crew in this situation?

The combination of the speed discrepancy (between ADR1, 2, 3 and standby indications) and of the abnormal correlation between the basic flight parameters (as for example the IAS increases whereas there is an important nose-up pitch), is a condition for the application of the UNRELIABLE AIRSPEED INDICATIONS procedure of the QRH. The “UNRELIABLE AIRSPEED INDICATIONS” FCTM

chapter provides a description of the potential symptoms that the flight crew must have in mind to be able to detect this situation early and apply the procedure.

In this example of training scenario, the flight crew remains passive while facing an unreliable airspeed situation. This is negative training. Indeed, the pilots should be trained to take action if things do not go as expected and apply the adequate procedure.

What is the pilot's experience during this scenario?

This scenario can create confusion in the mind of the trainee considering that it includes a number of potentially conflicting cockpit effects: unreliable speed indication situation, overspeed, activation of the HSP, application of OEB48/49 Abnormal V Alpha Prot immediate actions...

The fear of a potential non-controllable aircraft pitch-up could remain engraved in the trainee's memory. As a consequence, it will create a complete loss of trust in High Speed and High AoA protections.

How to avoid negative training?

A dual "TOTAL PITOT BLOCKED" failure must not be used for your training scenario.

Do not create confusion between UNRELIABLE AIRSPEED INDICATIONS procedure / Overspeed / OEB48/49 immediate actions.

Unrealistic and striking scenarios create fear and loss of trust for long time. ■

UPDATE OF THE SIMULATOR PACKAGE

Removal of the possibility to use a dual TOTAL PITOT BLOCKED failure

For the reasons explained here above, Airbus decided to remove, the possibility to simulate a dual total Pitot blockage from the simulators. Operators will then have to modify their simulators in accordance.

The single FULL PITOT blocked failure will remain available. It can be used in combination with another type of Pitot failure in order to simulate a multiple airspeed failure. It can be combined with an AIRSPEED CHANNEL FAULT or an INLET PITOT BLOCKAGE (or a PARTIAL PITOT BLOCKAGE). However, the use of a dual "INLET PITOT BLOCKAGE" should be preferred.

The INLET PITOT BLOCKAGE: A more realistic simulated failure

Most of the Pitot probes issues encountered in-service are obstruction of the Pitot probe inlet only. This is typically what happens in the case of a Pitot obstruction due to ice crystals.

Therefore, if the INLET PITOT BLOCKAGE (or a PARTIAL PITOT BLOCKAGE) is available on your simulator, it is advised to use it.

TRAINING

The Adverse Effects of Unrealistic Simulator Scenarios



INLET PITOT BLOCKAGE failure

In case of inlet Pitot obstruction, the pressure delivered by the Pitot will be the local static pressure measured through the drain holes instead of the Total pressure. In this case the airspeed will be computed from the difference between the pressure measured through the drain holes of the Pitot probe and the pressure measured through the static pressure ports. Therefore at the time of the inlet obstruction, the measured airspeed will drop abruptly and will remain at low value as long as the inlet obstruction exists.

A dual INLET PITOT BLOCKAGE can be used as a more realistic scenario of multiple airspeeds failure.

How to create positive training?

Airbus recommends to use positive training in the spirit of Evidence Based Training and to demonstrate the effectiveness of the protections to reinforce the flight crew's confidence in them.

Training is powerful when it is appropriate. That is why it is crucial to develop realistic scenarios with the support of the updated Operations Training Transmissions (OTT) and/or its associated Flight Crew Training Standard (FCTS).

The competencies are based on knowledge, skill and attitude, but crew confidence in aircraft systems is also essential. This confidence can be built-up only with an adequate training which properly replicate the actual aircraft behavior. ■

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A "TOTAL PITOT BLOCKED" failure simulates a simultaneous obstruction of both the inlet and drain holes of a Pitot probe. The use of a dual and permanent "TOTAL PITOT BLOCKED" is an unrealistic scenario that has never been encountered in service. It leads to keep inappropriately the normal laws and associated protections available whereas they are computed with wrong and consistent speeds. This clearly jeopardizes the understanding of aircraft systems, flight control laws and may alter the trust in flight envelope protections that are acting wrongly in such context.

If the dual and permanent failure is simulated during the climb phase, it will generate an undue activation of the high speed protection and subsequent uncontrollable and dynamic aircraft pitch-up.

Training consisting in requesting flight crew to switch off two ADRs to revert to alternate law in such scenario is clearly negative training.

Therefore the dual "TOTAL PITOT BLOCKED" failure must not be used and Airbus has decided to remove from simulators the possibility to simulate it.



Preventing Fan Cowl Door Loss

Fan cowl door loss events are still reported to Airbus. In all cases, the fan cowl doors were not latched closed and secured following a maintenance task.

This article provides an update on the design and procedure improvements introduced on the Airbus fleet to prevent fan cowl door loss events.

This article is an update of the Safety First #14 article, published in 2012.

It provides information to the Operators of the improvements and additional recommendations put in place since 2012.

FAN COWL DOOR LOSS EVENTS STILL OCCUR

Since the previous article published in July 2012, 14 events of loss of fan cowl doors during flight were reported to Airbus (12 events on A320, one on A330 and another on A300 aircraft).

The aircraft had undergone overnight maintenance and, in most of the cases, the fan cowl doors were opened to check the Integrated Drive Generator (IDG) oil level. The morning of the incident, the walkaround inspection did not reveal the opened fan cowls.

Airbus developed several additional devices to prevent fan cowl door loss events by enhancing the prevention means and reducing the number of fan cowl doors openings required by scheduled maintenance. ■

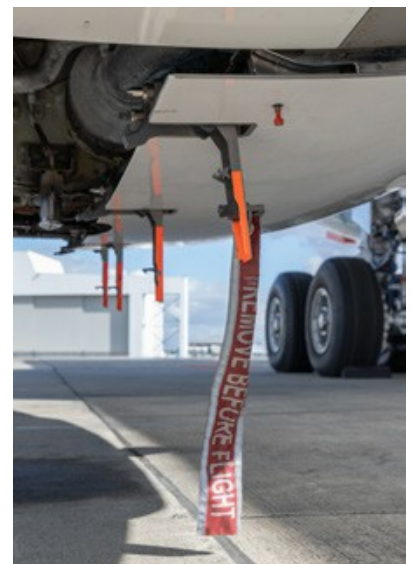
ENHANCED PREVENTION MEANS

Latch Key (A320 CFM56, A320 IAE V2500 and A330neo)

An improved latch with a key and a **REMOVE BEFORE FLIGHT** flag attached to the key (**fig.1**) has been introduced in December 2015 on the A320ceo aircraft. The key is needed to open the latch. When the fan cowl door is opened, the key remains on the latch. It can only be removed if the latch is fully closed. When not used, the latch key has to be stored in the cockpit with the landing gear pin.

The following Airworthiness Directives (ADs) mandate the retrofit of this new lockable latch on A320ceo aircraft equipped with IAE and CFM56 engines:

Engine	SB	AD	AD Compliance date
CFM56-5A/5B	71-1068	EASA 2016-0257	24-MAR-2019
		FAA 2018-05-04	11-MAR-2021
IAE V2500	71-1069	EASA 2016-0053	24-MAR-2019
		FAA 2017-13-10	03-AUG-2020



(fig-1)
Latch with key and "Remove before flight" red flag on A330neo aircraft



INFORMATION

A Monitored Retrofit Campaign was launched by Airbus in August 2018, refer to the RIL SA71M15018054 R02 for more information.

Latch key maintenance tips are available in the ISI 71.00.00062.

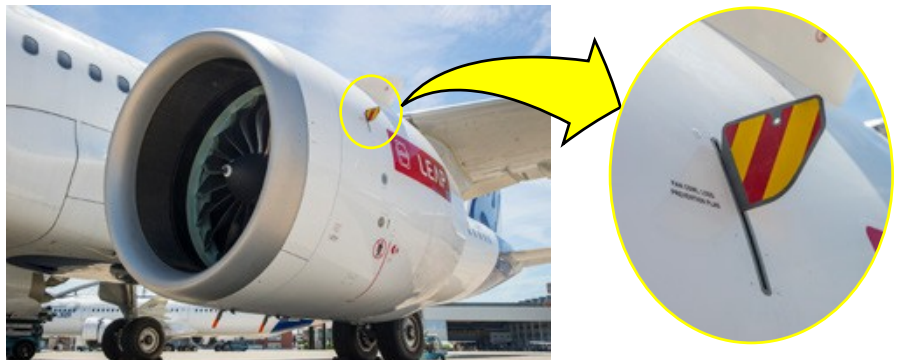
A330neo aircraft equipped with RR Trent 7000 engines are also fitted with this latch key device from production line.

Latch Closure Monitoring (A320neo)

Proximity sensors located at each latch monitor the fan cowls position on A320neo aircraft equipped with PW1100 and LEAP-1A engines. The ECAM displays the **ENG1(2) FAN COWL NOT CLSD** caution if the fan cowls are not properly closed.

Mechanical Prevention Flag (A320neo LEAP)

In addition to the cowl position monitoring, a prevention flag extends mechanically from the surface of the left hand fan cowl when the forward latch is opened to warn the ground personnel and the flight crew that the latch is not closed **(fig.2)** on A320neo equipped with CFM LEAP-1A engines.

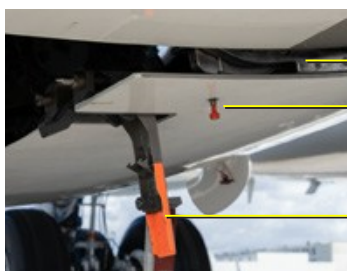


(fig.2)

Mechanical prevention flag on an A320neo equipped with LEAP engines

Devices to hold open the fan cowl doors when they are lowered (A320 IAE, A320neo PW, A340-500/600 and A330neo)

A U-arrestor device holds the fan cowls in a partially open position when the cowls are lowered on A340 equipped with TRENT 500 engines and on A330neo with TRENT 7000 engines. It is obvious to the operator that the cowls are not fully closed when looking from below or from the side of the cowl. The U-arrestor pin must be pressed to close the fan cowl door **(fig.3)**.



(fig.3)

A330neo U-arrestor

U-arrestor device

U-arrestor pin

FCD Latch 1

The equivalent function is insured by the “Hold Open Device”, mandated by the AD 2001-381(B), requiring embodiment of the SB A320 71-1028 on A320ceo equipped with V2500 engines.

It is insured by a similar “Push Open Device” on A320neo equipped with PW1100G.

Optional **LATCH COWL BEFORE FLIGHT** flag (A300-600, A310, A330ceo and A340)

Airbus recommends the use of a **LATCH COWL BEFORE FLIGHT** red flag when the fan cowl doors are unlatched on A300-600, A310, A330ceo, A340, A340-500/600 aircraft. This flag can be obtained with the following SBs:

- SB A300-600 71-6030
- SB A310 71-2039
- SB A330 71-3034
- SB A340 71-4009
- SB A340-500/600 71-5005

Latch Access Panel (A350 and A380)

If the fan cowl door latches are left open on the A350 or A380 aircraft, the latch access panel cannot be closed. This will be visible to ground operator or flight crew during an exterior walkaround check **(fig.4)**.



(fig.4)

Engine of an A350 with fan cowl door latch access panel open

CAUTION markings

Additional markings with arrows pointing toward the latches **(fig.5)** are there to remind the ground staff to check the latches are engaged and correctly secured on A320ceo aircraft. They can be installed through:

- VSB RA32071-161 on CFM56-5A/5B
- VSB NAC-71-0330 on IAE V2500

These are optional SBs and therefore they are not installed on production aircraft.

OPERATIONS

Preventing Fan Cowl Door Loss

Decals with cautions located at eye level ensure that fan cowl doors are closed and correctly latched before flight **(fig.6)** on A320 aircraft. They are installed on recent A320ceo production aircraft and on A320neo. They can also be installed by retrofit with the following VSBs:

- VSB RA32071-117 on CFM56-5A/5B
- VSB NAC-71-0235 on IAE V2500 ■



(fig.5)

Arrows pointing toward the latches



(fig.6)

Eye level decal with cautions



(fig.7)

Latches voluntarily left in an obvious unlatched position



BEST PRACTICE

The latches should be left in a position so that it is obvious that they are not engaged if the fan cowl is lowered. This helps to identify any cowls that are not latched and secured.

As a good practice, the fan cowl doors should be latched as soon as they are lowered.

MAINTENANCE EVOLUTION

Update of AMM: Introduction of a Logbook Entry (all aircraft)

Airbus revised the AMM TASK “Opening/Closing of the Fan Cowls” on all Airbus aircraft to introduce a logbook entry that informs the flight crew that the fan cowl doors have been previously opened. This will alert the flight crew that they should confirm that the fan cowl doors are correctly closed during their exterior walkaround.

IDG access door

Additional technical solutions were also developed to reduce the number of fan cowl doors openings.

An optional IDG access door is available on A320ceo aircraft equipped with CFM56-5A/5B engines. IDG oil level can be checked via this access door without opening the fan cowl doors. A320neo LEAP, A330ceo RR Trent 700 and A340-500/600 RR Trent 500 are already equipped with this IDG access door **(fig.8)**.



(fig.8)

IDG oil access door on A320neo LEAP

Increased interval for IDG oil level check

To reduce the frequency of fan cowl door opening for aircraft not equipped with the IDG access door, Airbus demonstrated that the IDG oil level check interval could be extended from 150 FH to 300 FH (or 2 months) on CFM56-5A/5B and IAE V2500 engines.

IDG Remote Oil Level Sensor (ROLS)

A Remote Oil Level Sensor (ROLS) monitors the IDG oil level and an IDG LOW OIL LEVEL ECAM alert will appear when servicing is required. With this monitoring, the inspection interval is longer **(fig.9)**.

(fig.9)

Summary of maintenance solutions

AIRCRAFT	ENGINE MODEL	ROLS	IDG/VFG OIL LEVEL INSPECTION INTERVAL (FH)	IDG VIEWING DOOR/ACCESS PANEL
A320CEO	CFM56-5A	-	Increase from 150 to 300	VSB RA32071-100 (Option)
	CFM56-5B			VSB RA32071-158 (Option)
	V2500	-	Increase from 150 to 300	-
A320NEO	CFM LEAP-1A	-	300	Standard
	PW1100G	Y	800	-
A330CEO	RR Trent 700	Y	800	Standard
	GE CF6-80E1	Y	800	-
	PW4000	Y	800	-
A330NEO	RR Trent 7000	Y	800	-
A340-200/300	CFM56-5C	Y	800	-
A340-500/600	RR Trent 500	Y	800	Standard
A380	RR Trent 900	Y	2 500	-
A380	EA GP 7200	Y	2 500	-
A350	RR Trent XWB	Y	2 500	-
A300	CF6-50	-	100	Standard
A310	CF6-80A	-	100	
A310 and A300-600	CF6-80C2	-	100	On Thrust Reverser
	JT9D-7R4	-	100	
	PW4000	-	100	

Inspection of latch paint condition (A320ceo)

To improve the latch visibility, they are covered with fluorescent paint. The condition of the paint on the latches needs to be checked every 7 500 FH (or every 24 months) on A320ceo aircraft in accordance with the Maintenance Planning Document. ■

Engine	MPD TASK	AMM TASK	VSB
CFM56- 5A/5B	711000-C6-1	71-13-13-220-802	RA32071-11
V2500	711000-I6-1	71-13-00-210-802	NAC-71-0227



(fig.10)

Fan cowl door latch with damaged paint

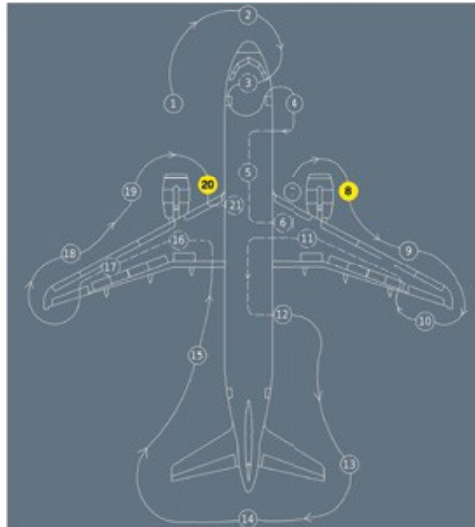
EXTERIOR WALKAROUND

Updated FCOM Procedures

Airbus updated the exterior walkaround section of the FCOM Standard Operating Procedures for all aircraft by introducing additional steps in the walkaround (**fig.11**). This change requests that the correct latching of the fan cowls is now checked from both sides of each engine.

(fig.11)

Additional steps at stations 20 and 8 in the exterior walkaround of the A320 FCOM



“ The exterior walkaround is one of the last opportunities to detect incorrectly latched fan cowl doors before flight ”

A last detection opportunity before the flight

The exterior walkaround is one of the last opportunities to detect incorrectly latched fan cowl doors before flight. The flight crew must pay particular attention to check the fan cowl doors are correctly latched.

The most effective way to confirm that all latch handles are correctly engaged and flush with the fan cowls is to crouch down to get a good line of sight with the latches. The flight crew needs to check on both sides of the engine to confirm there is no gap around the cowl and all latches are secured (**fig.12 and fig.13**). Use a torch light if the lighting conditions are poor or if the inspection is done by night. ■



(fig.12)

The flight crew should crouch down to correctly check the fan cowl door latching



(fig.13)

Incorrect latching: The latches are not flush with the nacelle and there is a small gap around the cowl

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Nacelle Engineering Support
Customer Engineering Support

With thanks to Eric DELMAS

The incorrect latching of the fan cowl doors following maintenance, added by a failure to detect this condition on the pre-flight exterior walkaround are the common causes in all fan cowl door loss events reported to Airbus.

Several prevention means have been implemented in addition to the solutions described in the Safety first article published in July 2012. These include:

- Latch with key and “Remove before flight” red flag (all except A320neo) - NEW
- Cockpit information (ECAM alert) on A320neo - NEW
- Prevention flag on A320neo LEAP-1A - NEW
- U-arrestor on A330neo (NEW) and A340-500/600
- Latch Access Panel on A380 and A350
- Remote Oil Level Sensor on IDG

Operational improvements have also been introduced:

- Increase of the IDG oil level check inspection interval on A320ceo - NEW
- Creation of a Log book entry after a fan cowl door opening/closing procedure – NEW
- Additional step in the exterior walkaround to duplicate the check of fan cowl latches – NEW
- New entry in the Preventing Identified Risks (PIR) section of the FCTM

As of today, aircraft equipped with these modifications have not experienced a fan cowl door loss event.

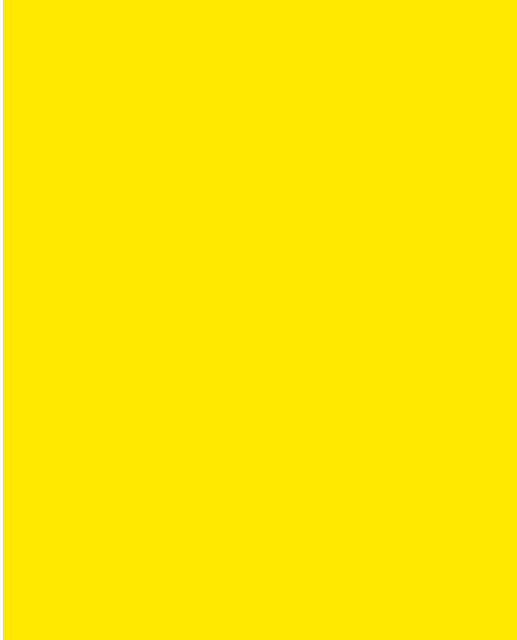
Incorporating these preventive devices, with the operational improvements, supported by the increased awareness of flight crews and maintenance personnel, are thus key elements to preventing such events.



Correct Escape Slides Maintenance for Successful Slides Deployment

It is of the outmost importance to make sure that escape slides' maintenance is properly done so that they can deploy correctly when they are the most needed.

This article recalls the importance of reporting scheduled and unscheduled slide deployment results to Airbus. It highlights the most common causes of unsuccessful slide deployments and provide recommendations to prevent them.



In the early nineties, an A300-600 aircraft overran the runway threshold and came to rest leaning to its left side. This meant that evacuation from the right hand side of the aircraft was impossible. The cabin crew also observed fire on the aft fuselage of the aircraft and decided to evacuate the passengers using only one escape slide from the forward left side door. The escape slide deployed correctly to allow all 160 passengers and crew to escape the wreckage and move to a safe distance away from the aircraft before it burst into flames.

This event highlights the importance of reliable escape slide deployment and how following correct maintenance procedures, and reporting slide deployment test results to Airbus, is essential for ensuring that escape slides will properly deploy when they are most needed.

REPORTING SLIDE DEPLOYMENTS TO AIRBUS

Reporting all slide deployments enables continuous improvement of slide reliability

Operators have to perform a certain number of slide deployment tests on a regular basis. Comprehensively reporting any slide deployment gives an overview of the slide's reliability, and this can help to identify areas of improvement. The AMM/MP provides the slide deployment report form template **(fig. 1)**. The operator should use this form to describe the result of each slide deployment and then send it to Airbus. This form is for reporting both successful and unsuccessful slide deployments for analysis.

A detailed report facilitates failure identification

The AMM/MP procedure for operational check of slide deployment also requests the operator to record the test with video cameras from different angles. Should the deployment be unsuccessful, this video recording enables detailed analysis of the deployment sequence and providing the videos and any photos to Airbus, in addition to the deployment report, will assist in the investigation to find the root cause of the failed deployment. ■

“Comprehensively reporting any slide deployment gives an overview of the slide's reliability, and this can help to identify areas of improvement.”

OPERATIONS

Correct Escape Slides Maintenance for Successful Slides Deployment

DEPLOYMENT OF ESCAPE SLIDE/SIDE RAFT REPORT

OPERATOR: A/C TYPE: MSN: DATE:

Tick the box corresponding to deployed slide/side raft position (LH/RH)

A316/A319/A320

A330/A340/A350/A300-600

A321

A343-600

A310

A380

Was the deployment: Scheduled: Inadvertent: Emergency:

When did the deployment happen? DAY: NIGHT:

In case of an inadvertent deployment, please precise the origin:

Maintenance:
 Cabin/Cockpit Crew:
 Ground Staff:
 Passenger:
 Other:

Precise:

Door ⁽¹⁾	Slide P/N (off)	Slide S/N (off)	Slide P/N (on)	Slide S/N (on)	Deployment Successful (YES/NO)
Date of last installation:					Overhaul performed by:
Date of last overhaul:					Overhaul performed by:
Please precise hereafter the Door Damper Pressure value and the temperature condition – If not checked, please precise "Not done"					Not for A380
<i>Criteria</i>					YES NO N/A
Pax Door Extended Test OK					A380 only
Slide/Side Raft pressure gage in green zone					Not for A380
Automatic Door opening					
If door is blocked before full opening, check door damper pressure for leakage before any other action					Not for A380
Door in fully open and locked position					
Automatic Slide/Side Raft deployment/inflation					
Slide/Side Raft deployment with manual back-up handle					Not for A380
Slide/Side Raft deployment with Manual Inflation Push-Button					A380 only
Slide/Side Raft fully extended and in usable condition					
Completion of Slide/Side Raft inflation within timeframe defined in AMM					
Slide/Side Raft Emergency Lights on					

Note (1): In case of multiple deployments on one MSN, fill the above details report for each door, and precise the door numbering for each table.

In any case, please supply detailed explanation, especially in the case of non-successful and/or inadvertent deployment

(fig.1)
Escape slide deployment report template in the AMM/MP.

SAFETY PRECAUTIONS IN THE CASE OF AN UNSUCCESSFUL DEPLOYMENT DURING A TEST

If the slide does not deploy during a test, the deployment area must remain clear of any personnel as there is the risk that the slide can suddenly inflate until the slide is correctly secured. Sudden slide raft inflation may cause injuries or damage to equipment.

It is recommended to carefully take photos from the inside and from the outside of the aircraft in addition to recording details of the position of the slide during a failed test. When it is confirmed that the slide is not obstructed by the doorframe or its compartment the operator can then pull the manual inflation handle. This will ensure that the slide inflation gas cylinder is empty and that the slide is in a safe condition to handle.

COMMON CAUSES OF INCORRECT SLIDE DEPLOYMENTS

Reported slide deployments enabled Airbus to identify several common causes of unsuccessful deployments. A majority of these can be avoided by following these recommendations.

Checking for correct electrical harness routing during door slide installation

The slide's electrical harness routing is different depending if it is installed on the left or right side of the aircraft. Several reported cases showed that the slide harness routing was not correct for the side where the slide was installed. A door slide with an incorrect routing of the electrical harness can impede the evacuation of the passengers **(fig.2)**, or block door opening sequence and prevent the slide deployment.

Operators must carefully follow AMM instructions for slide installation and ensure that the electrical harness routing is correct for the position of the slide installed on the left, or on the right of the aircraft.

TIP: As a general rule, the electrical harness route should exit the slide assembly on the forward side of the door.

Incorrect packing during slide overhaul

Many incorrect slide deployments are due to incorrect packing of the slide during shop maintenance.

Slide overhaul should only be performed by certified maintenance organizations. The maintenance organizations in charge of the slide overhaul must refer to latest revision of the Component Maintenance Manual (CMM) or the folding procedure for packing slides.

“ A door slide with an incorrect routing of the electrical harness can impede the evacuation of the passengers, or block door opening sequence and prevent the slide deployment. ”



(fig.2)

Example of a deployed slide with an electrical harness incorrectly routed. In this case, the harness could impede the evacuation.

SYSTEM IMPROVEMENT: THE A320 SLIDE WRAPPER

A modification of the A320 slides called the “Slide Wrapper” provides more reliable deployment. The modification is a device that is installed to hold both the inflatable part of the slide and its reservoir together, which prevents early activation of the reservoir when a slide has not cleared the door **(fig.3)**.

This modification is known as the slide wrapper and it is installed via the following Service Bulletins (SB): SB A320-25-1B81, SB A320-25-1B82, SB A320-25-1B83, or SB A320-25-1B84. Embodiment of this modification is mandated by the EASA AD 16-0043 (March 2019 compliance)



(fig.3)

Showing an incorrect slide deployment where the reservoir was activated and began to inflate the slide before it had cleared the door. The slide wrapper modification is designed to prevent this kind of occurrence.

OPERATIONS

Correct Escape Slides Maintenance for Successful Slides Deployment

“ It is important to check the external dimensions of the slide after packing ”

“Fat packing”

The outer dimensions of a packed slide can exceed the normal envelope if the slide is not packed as per the vendor's folding instructions. This can effect the dropping kinematics of the slide and prevent the slide from being inflated automatically.

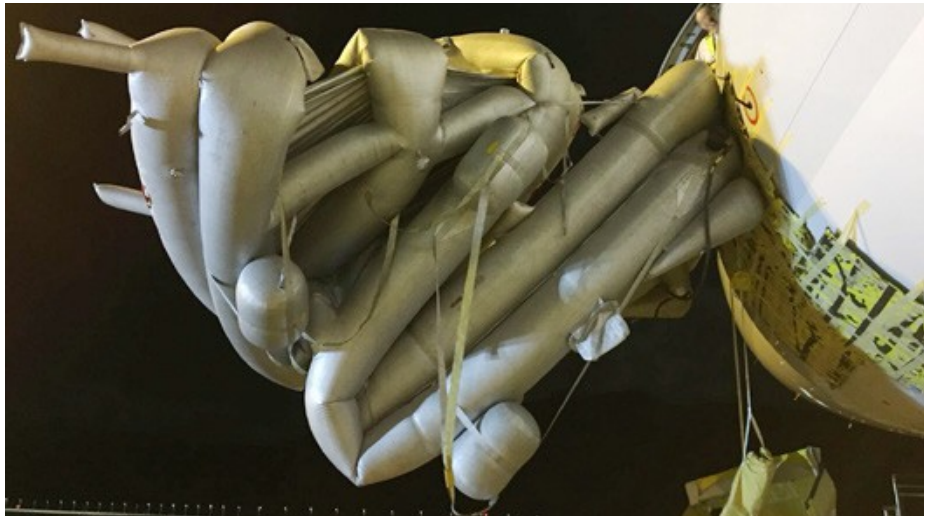
It is mandatory to carefully follow the packing process, including the oven cycle to set the material folds, to achieve the correct packing density inside the vendor defined outer dimensions envelope.

Check the external dimensions of the slide after packing using the three dimensional check tool described in the packing documentation, and by confirming the packed slide can be inserted with sufficient clearance into its cover.

Use of incorrect restraints during packing

Calibrated restraints are used to control the slide deployment sequence in various environmental conditions. They are designed to break with a pre-determined load when pulled during the slide inflation sequence. If an incorrect restraint is used, it may not release the slide during inflation and prevent the slide extending **(fig.4)**.

To avoid this kind of event, a color code on restraints is a visual indicator of the the correct restraints load calibration and the slide folding instructions must be carefully followed.



(fig.4)

Consequence of the use of an incorrect restraint during packing. The slide extension is blocked.

Inoperative door emergency actuator

The door emergency actuator provides a dynamic momentum to rapidly open the door and enable the release of the slide from its stowage to launch its deployment sequence. In some reported cases, the emergency actuator failed to open the door and it prevented the slide from deploying correctly. The actuator did not operate because of incorrect rigging of the door actuator percussion mechanism or the actuator was deactivated for maintenance but not reactivated at the end of the procedure.

Carefully following the AMM/MP during emergency actuator maintenance will ensure that the actuator percussion mechanism is correctly rigged and that a deactivated actuator is reactivated following the maintenance task.

Foreign object ingested by the inflation aspirator

A foreign object can either obstruct the aspirator inlet or block the flapper valve of the aspirator in the open position and cause incorrect slide deployment.

The obstruction of the inlet blocks the air intake to the aspirator, and prevents slide inflation or it may cause an incomplete slide deployment. The blockage of the flapper valve in the open position **(fig.5)** can cause an inflated slide to deflate.

Some operational deployment tests were reported as unsuccessful due to ingestion of the fuselage protection material **(fig.6)**. Fuselage protection must be done according to AMM/MP procedure to avoid ingestion of any protection materials into the aspirator during any operational test of a slide. Operators must not use protection materials other than those recommended by the AMM/MP.



(fig.5)
Aspirator flapper valve blocked in the open position due to a foreign object ingestion.



(fig.6)
Incomplete inflation due to obstructed aspirator inlet caused by non-standard fuselage protection during a slide deployment test.

Non-operational conditions during an operational deployment test

During a slide deployment test, the aircraft must be in a condition that is representative of real operations. The emergency actuator must be activated so that the test is performed in real conditions.

Analysis of previous unsuccessful deployments showed that to avoid maintenance on the emergency cylinder further to a slide deployment test, some operators de-activated it before the deployment test. As explained earlier, the emergency actuator actuation is part of the slide deployment kinematics, therefore, a de-activated emergency actuator during a test may lead to an unsuccessful deployment.

To be representative of the operational conditions, a deployment test should be done with the slide decorative cover installed **(fig.7)**. ■

“ During a slide deployment test, the aircraft must be in a condition that is representative of real operations. ”



(fig.7)
Removal of the decorative cover of a slide for a deployment test does not provide a realistic operational configuration.

OPERATIONS

Correct Escape Slides Maintenance for Successful Slides Deployment

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Escape slides can save lives in emergency situations.

Slide overhaul should only be done by certified maintenance organizations. Particular care should be taken to pack the slide using the latest folding instructions provided in the CMM or in the folding document. AMM procedures and recommendations must be carefully followed during installation and servicing of the slides to ensure the correct deployment of the slide.

Periodical slide deployment tests should be done on aircraft in an operational configuration and with approved fuselage protection in accordance with the AMM/MP recommendations. This will mean that the test is representative of the slide deployment in operational conditions.

A thorough reporting of both unsuccessful and successful slide deployments during scheduled tests, an inadvertent deployment or in any emergency situation is essential for Airbus and its suppliers to assess slide reliability. In case of an unsuccessful slide deployment, providing videos and photos of the event in addition to a detailed report facilitates identification of root causes and enables the continuous improvement of slide deployment reliability.



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