



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} :

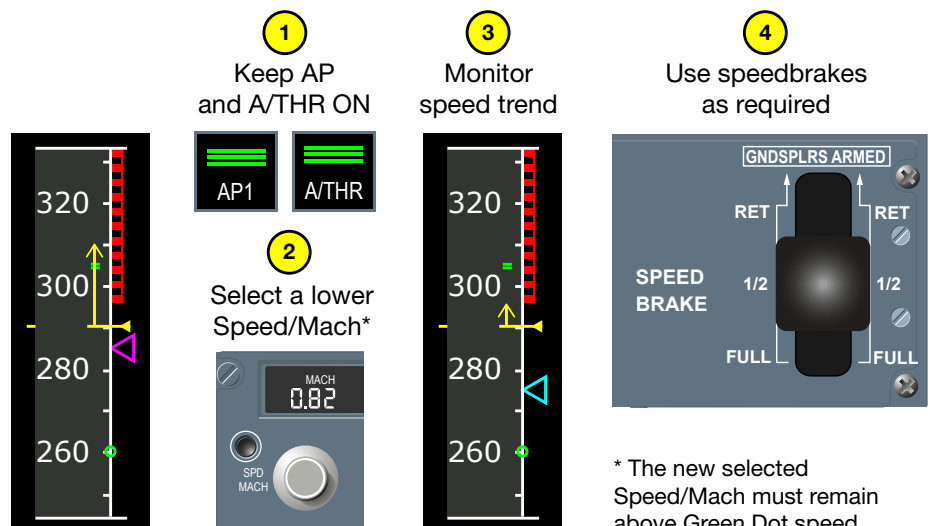
Keep autopilot and autothrust ON

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.

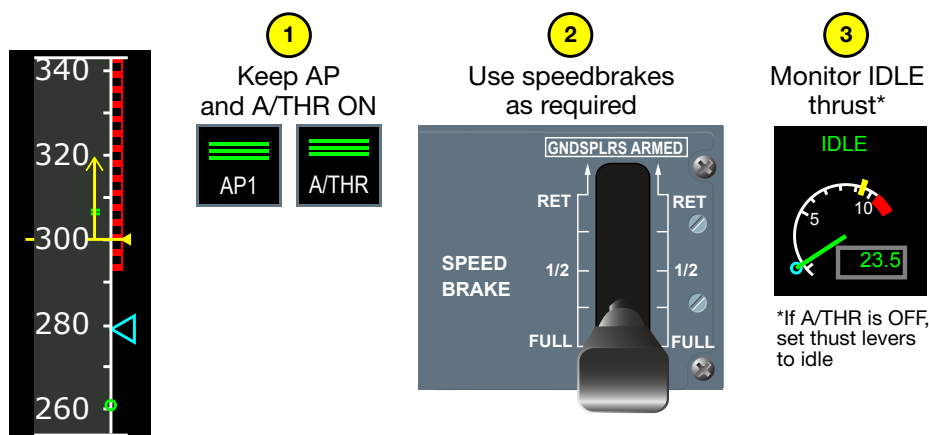
Use the speedbrakes

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.



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.

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“ 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

OPERATIONS

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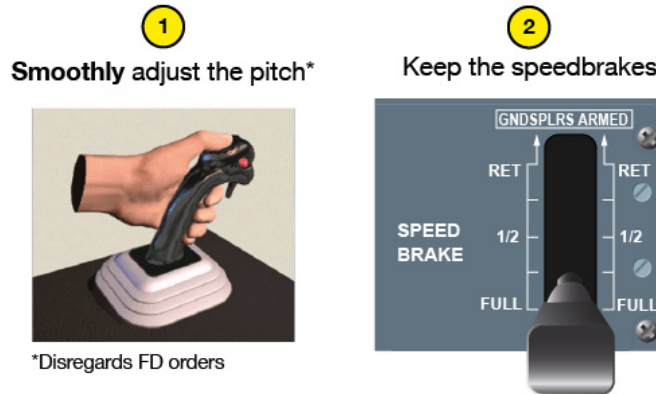
In case of automatic autopilot disconnection due to the HSP, the flight crew can smoothly adjust the pitch attitude but without overreacting, especially at high altitude and should keep speed brakes extended because they are compatible with HSP.

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

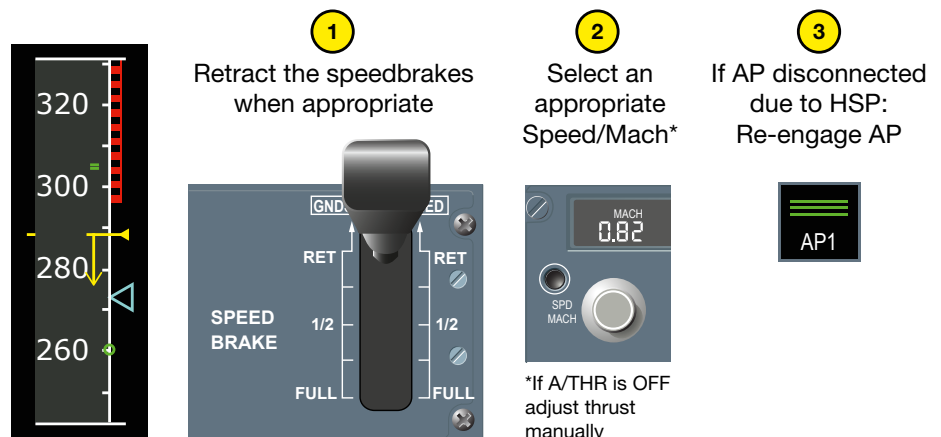
The flight crew should adjust the speed target to increase the margin to V_{MO}/M_{MO} if the risk of overspeed due to the external conditions remains, but ensure the speed target is set above Green Dot speed. If the autothrust is OFF, the flight crew should manually adjust thrust levers and engage autothrust.

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?



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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.

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