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.
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.
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 $V_{MO}/M_{MO}$:

1. **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.

2. **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

1. Keep AP and A/THR ON
2. Select a lower Speed/Mach*
3. Monitor speed trend
4. Use speedbrakes as required

* The new selected Speed/Mach must remain above Green Dot speed
Overspeed Recovery 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.

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

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:

1. Smoothly adjust the pitch*
2. Keep the speed brakes

*Disregards FD orders

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

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

*If A/THR is OFF adjust thrust manually
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.
Safety first is published by the Product 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, comment and feedback are welcome. Enquiries
related to this publication should be addressed to:

Airbus
Product Safety department (GS)
1, rond point Maurice Bellonte
31707 Blagnac Cedex - France
Fax: +33(0)5 61 93 44 29
safetycommunication@airbus.com

© Airbus S.A.S. 2019 – 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, effecting the true public
representation. Airbus assumes no obligation
to update any information contained in this
document or with respect to the information
described herein.

Airbus 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 damages.