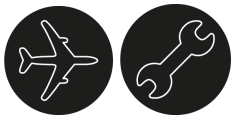
Safety first
The Airbus Safety magazine

Unreliable Airspeed at Takeoff



Since the beginning of 2020, Airbus has received an increasing number of reports of unreliable airspeed events at takeoff due to Pitot probe obstruction. Despite the existing prevention means and the preflight exterior walkaround, takeoffs with obstructed air data probes may happen. This article highlights why it is so important for pilots to actively monitor the airspeed during the entire takeoff roll, to detect an airspeed discrepancy as early as possible, and safely reject the takeoff, if required to do so.

This article is also available on safetyfirst.airbus.com and on the Safety first app for iOS and Android devices.

MULTIPLE UNRELIABLE AIRSPEED EVENTS AT TAKEOFF

Preparing for a Safe Return to the Skies is a Safety first article published in June 2020 that already highlighted the increased risk of unreliable airspeed events after aircraft parking or storage. The number of reported occurrences since this article was published is still a reason for concern.

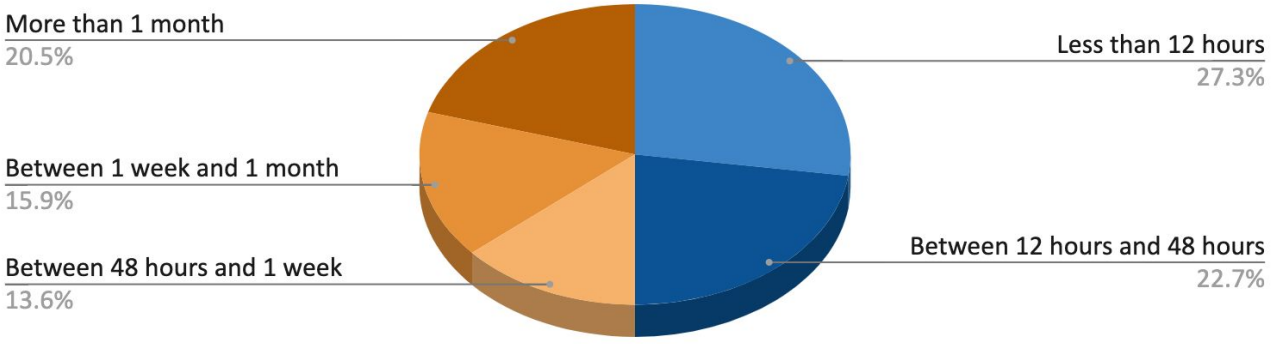
Between January 2020 and March 2021, 55 events of unreliable airspeed indication during takeoff were reported to Airbus.

Majority of events linked to Pitot obstruction

44 of the 55 reported cases of unreliable airspeed at takeoff were due to obstruction of the Pitot tube. Obstructions can be caused by the presence of insects, sand, dirt, dust or any other foreign materials that could enter the Pitot when protective covers are not fitted to the aircraft when on the ground. In one reported case, the obstruction was because the protective covers were not removed before the flight.

Pitot contamination occurring during various types of parking conditions

The chart below **(fig.1)** shows the duration of time an aircraft spent on the ground before the flight when the unreliable airspeed event occurred.



(fig.1) Duration of time an aircraft spent on ground before reported unreliable airspeed event

Also beware during shorter ground stays

Contamination of Pitot probes by insects does not happen only during long periods of parking or storage. Half of all reported Pitot contamination related events occurs when the aircraft is parked for a time period of less than 48 hours. A significant number of reported occurrences of obstructed Pitots were on aircraft in transit and on the ground for less than two hours. Pitot probes are not always protected by covers during short duration transits.

Why Pitots are even more exposed to the risk of contamination during the pandemic

The COVID-19 pandemic had the effect of a significantly reduced number of flights, which means aircraft spent more time on the ground between flights. In cases where the air data probe protective covers are not fitted, the exposure to the risk of Pitot contamination is greatly increased.

INFORMATION

Prevention of air data probe obstruction

Airbus published several documents to provide recommendations for the prevention and detection of obstructed air data probes on ground:

- **ISI(*) 34.11.00026**: A320FAM and A330/A340 Pitot probes - Description, evolutions and maintenance recommendations
- **OIT(*) 999.0019/20** (May 2020) - ATA 10 – Parking and Storage: Exceptional Procedures and Recommendations Related to COVID-19 Massive Grounding Situation
- **OIT(*) 999.0048/20** (July 2020) - Increasing number of events related to adverse effects on air data probes following a parking/storage period
- **Parking and Storage / Return to Service Summary Letter**
- **Safety first articles**:
  - Pitot Probe Performance Covered On the Ground (July 2016)
  - Aircraft Parking and Storage (April 2020)
  - Preparing for a Safe Return to the Skies (June 2020)
  - News: Parking and Storage / Return to Service Summary Letter (December 2020)
- **WIN video:** What about the exterior walkaround? (September 2020)

(*) ISI articles, OITs, and the Parking and Storage / Return to Service Summary Letter are available on the AirbusWorld portal

---

Several cases of late detection

In 36 of the 55 reported cases, the flight crew detected the speed discrepancy and rejected the takeoff. For many of the reported rejected takeoffs, the speed discrepancy could have been detected earlier during the takeoff roll, which would have incited the flight crew to reject the takeoff at a lower speed. The following case studies of three events of unreliable airspeed at takeoff highlight the importance of speed monitoring during the takeoff roll.

CASE STUDY 1

Event description

Flagged speed indications detected during the takeoff roll

An A330 aircraft was lined up for takeoff in night conditions. The first officer was the Pilot Flying (PF). The weather was clear with no wind. The recomputed takeoff decision speed was 150 kt and the rotation speed was 159 kt.

During aircraft acceleration, the speed indications were flagged on both PFDs.

A 100 kt callout and a rotation based on ground speed indication

The Pilot Monitoring (PM) made the 100 kt callout when the ground speed reached 100 kt. The PF then initiated the rotation at 159 kt of ground speed.

Unreliable airspeed indication procedure application

The flight crew applied the FCOM unreliable airspeed procedure when airborne and switched all three ADRs to OFF when the aircraft reached FL 110, activating the BackUp Speed Scale (BUSS) indication (as requested by the procedure when all ADRs are affected below FL 250).

In-flight turnback and overweight landing

The flight crew decided to return to the departure airport and performed an overweight landing.

When the aircraft finally returned to the gate, it was noticed that the protective covers were not removed before the flight and they were still fitted on all three Pitot probes.

Event Analysis

Analysis of the recorder data confirmed that the Pitot covers, which were not removed before the flight, were the cause of the unreliable airspeed indication.

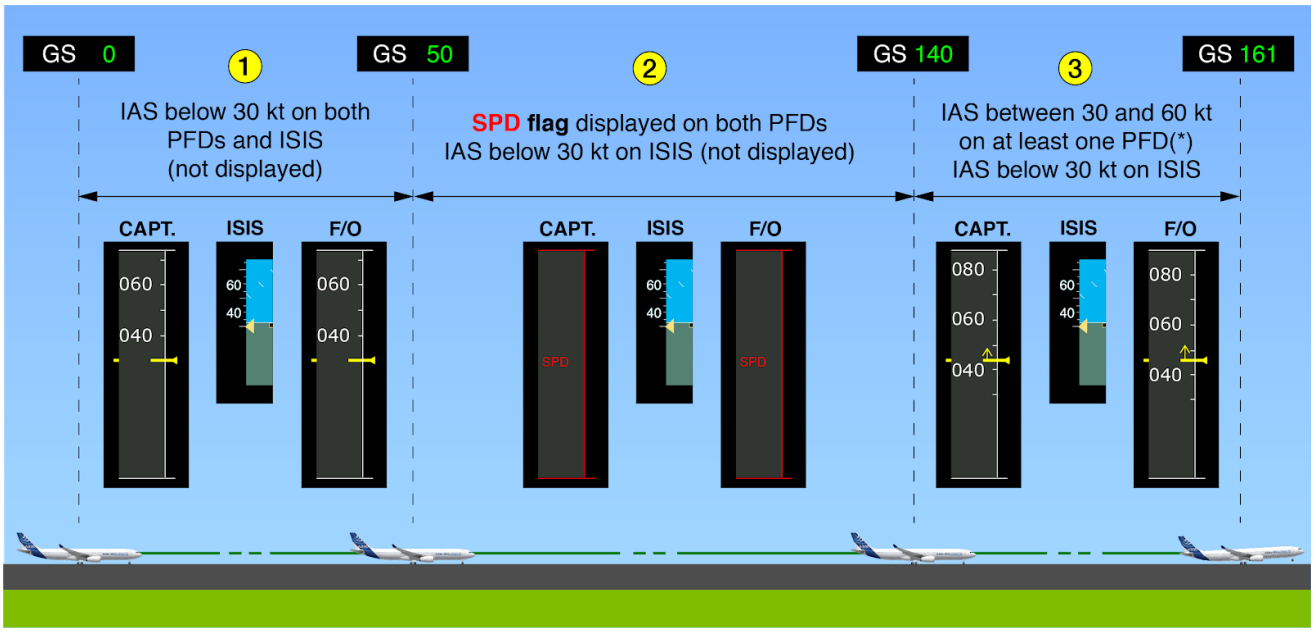
Three missed opportunities of detecting the covers

Post event analysis shows that the Pitot protective covers were not seen by the maintenance engineer during the external aircraft inspection, and neither by the captain during the preflight exterior walkaround nor by ground personnel during pushback, as recorded on the airport surveillance videos.

Speed display during takeoff roll

Recorder data also showed that the display of the **SPD** red flag on both PFDs from 50 kt of ground speed should have made the flight crew aware of the airspeed issue which would have enabled them to reject the takeoff**.**

- ① **From 0 kt to 50 kt of ground speed**: The Indicated Air Speed (IAS) was at the bottom of the speed scale on both PFDs and on the speed scale of the Integrated Standby Instrument System (ISIS). This was because the measured airspeed from all 3 ADRs was below 30 kt.
- ② **From 50 kt to approximately 140 kt of ground speed**: The **SPD** red flag was displayed on the speed scale of both PFDs and the IAS on the ISIS was still at the bottom of the speed scale.
- ③ **From 140 kt of ground speed until rotation and liftoff:** The IAS was between 30 kt and 50 kt on at least one of the PFDs. The IAS of the ISIS remained at the bottom of the speed scale.



(*) This type of flight data recorder records only the airspeed value of the captain's side, provided it is valid information. Otherwise, it will record the first officer's IAS. The IAS may have been displayed on both PFDs at this stage. If it was only displayed on one PFD, the other PFD would still have displayed the SPD red flag.

(fig.2) PFD airspeed indication during the takeoff roll of the event

This sequence is in accordance with the display logic of the IAS on the PFD:

- If the measured airspeed is below 30 kt and ground speed is below 50 kt, then the IAS remains at the bottom of the speed scale
- If the measured airspeed is below 30 kt and the ground speed is above 50 kt, the **SPD** red flag is displayed on the speed scale
- When the measured airspeed is above 30 kt, it will be displayed on the PFD.

CASE STUDY 2

Event Description

A speed discrepancy at the 100 kt callout

An A330 aircraft was ready for takeoff. The captain, who was the PF, applied takeoff power and the aircraft started to accelerate. The flight crew noticed a discrepancy between the PFD airspeeds at the 100 kt crosscheck. The flight crew continued the takeoff and performed the rotation at 133 kt.

ECAM cautions and level off for troubleshooting

The **NAV IAS DISCREPANCY** ECAM caution triggered shortly after liftoff, followed by the **NAV ADR1 FAULT**. The flight crew levelled off the aircraft at 3000 ft to perform ECAM actions and troubleshooting. The flight crew set the AIR DATA rotary selector to "CAPT ON 3" and resumed the climb to cruise FL 340.

Overspeed warning while approaching cruise FL

An overspeed warning triggered while the aircraft was passing FL 334. The autopilot remained engaged and the aircraft leveled off at FL 340. The overspeed warning stopped a few seconds later.

In-flight turn back

The flight crew performed an in-flight turnback and landed safely. Maintenance personnel inspected the Pitot on the captain's side and found that it was obstructed by dust.

Event Analysis

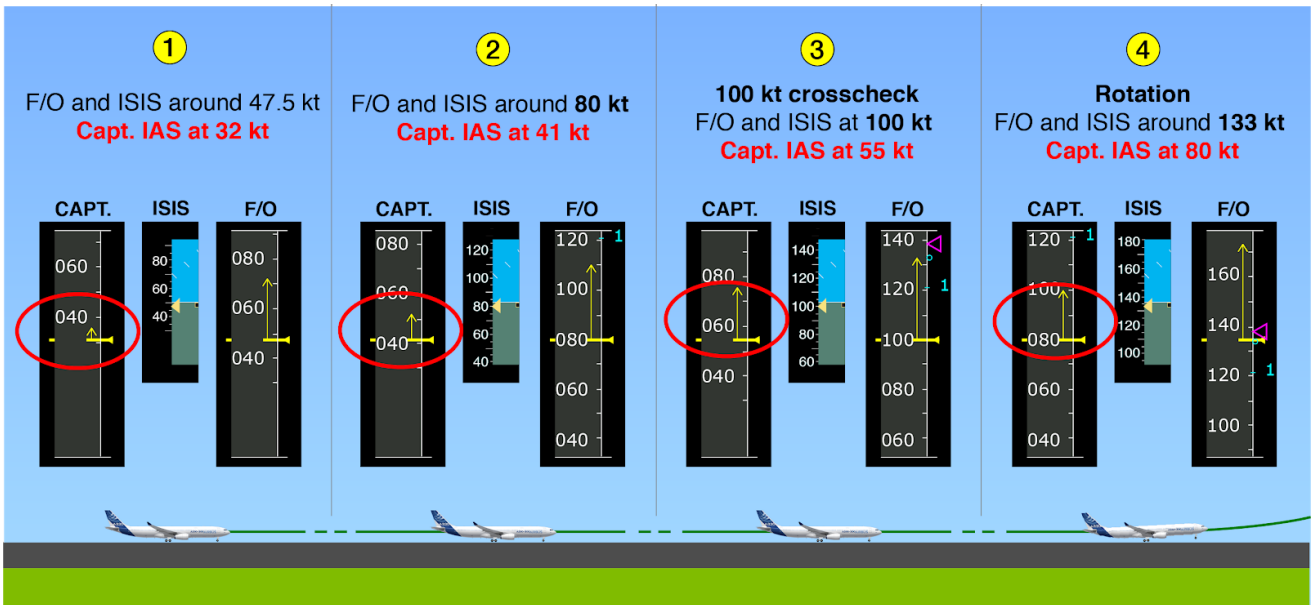
Flight data recorder analysis confirmed the effects caused by the obstruction of the captain's Pitot probe.

A missed opportunity to reject the takeoff

If the airspeed was monitored even more closely by the flight crew during the takeoff roll, they may have identified the speed discrepancy sooner, allowing them to reject the takeoff and bring the aircraft safely to a stop.

Airspeed display during the takeoff roll

- ① The IAS remained at the bottom of the PFD speed scale on both PFDs, and on the ISIS, at the start of the takeoff roll until the measured speed reached 30 kt (which is its normal behavior). The captain's IAS went above 30 kt when the first officer and ISIS IAS both indicated approximately 47 kt.
- ② When the first officer and ISIS IAS indicated approximately 80 kt, the captain's IAS was only displaying 41 kt.
- ③ When the first officer and ISIS IAS indicated 100 kt, the captain's IAS was only displaying approximately 55 kt.
- ④ The captain rotated the aircraft when 133 kt was indicated on the first officer's PFD and ISIS, but the captain's IAS was only displaying 80 kt.



(fig.3) PFD airspeed indication during the takeoff roll of the event

CASE STUDY 3

Event Description

Rolling takeoff

An A320 was cleared for takeoff and the PF, who was the captain, performed a rolling takeoff. The captain performed the 1.05 EPR stabilization step and then applied takeoff thrust.

Rejected takeoff following an airspeed discrepancy at the 100 kt crosscheck

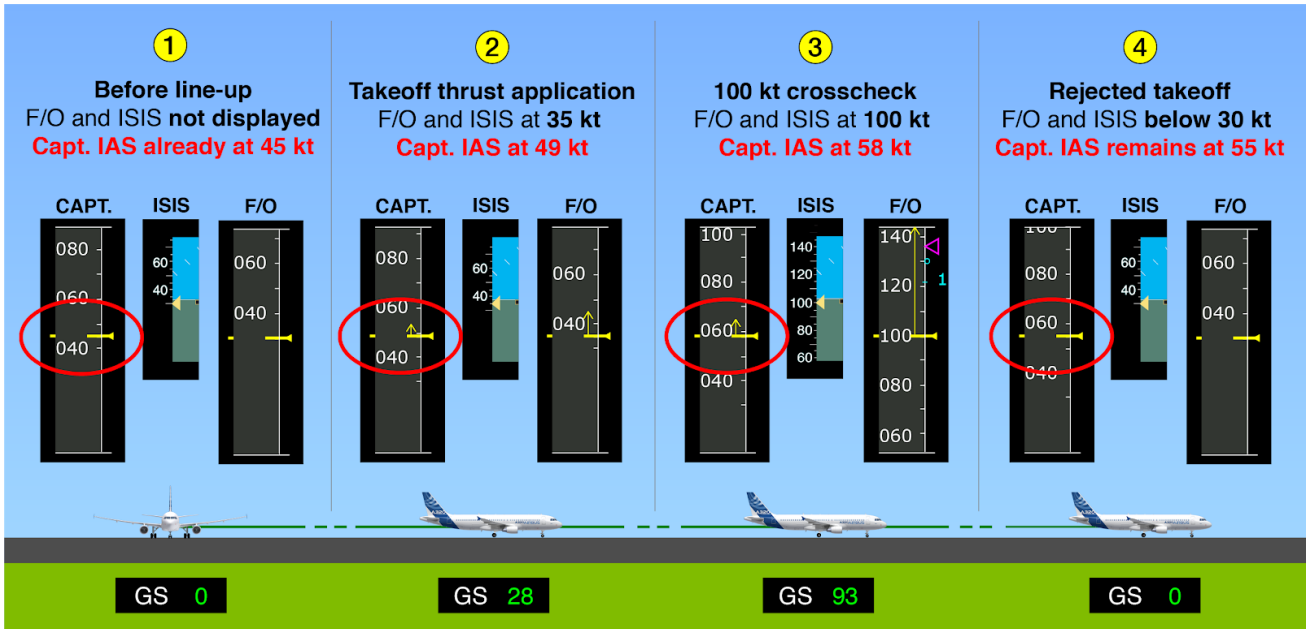
The aircraft accelerated nominally, but the captain identified a speed discrepancy when the PM did the 100 kt callout, and immediately rejected the takeoff.

Maintenance personnel performed troubleshooting when the aircraft returned to the gate and they found small pieces of leaves in the captain's Pitot probe and its pressure line.

Event Analysis

An early speed discrepancy on the captain's side

- ① Recorder data showed that obstruction of the captain's Pitot probe was providing an initial IAS of approximately 45 kt while the aircraft Ground Speed (GS) was 0 kt prior to the aircraft lining up on the runway.
- ② At the application of takeoff thrust, the first officer and ISIS IAS indicated 35 kt with nominal acceleration shown by the speed trend arrow on the first officer's PFD. However, the IAS on the captain's PFD was 49 kt with a very small speed trend arrow.
- ③ When 100 kt was reached on the first officer's PFD and ISIS, the captain's IAS was only 58 kt.
- ④ When the aircraft safely came to a complete stop after the RTO, the captain's IAS was still at 55 kt.



(fig.4) PFD airspeed indication during the takeoff roll of the event

A useful 100 kt crosscheck!

During the entire takeoff roll, the captain's IAS increased slightly but remained below 64 kt. The 100 kt crosscheck enabled the captain to identify the discrepancy and immediately reject the takeoff.

A possible earlier RTO

The Standard Operating Procedure requests monitoring of the PFD speed scale during the entire takeoff roll. Following this recommendation may have made the flight crew aware of the airspeed discrepancy earlier than the 100 kt callout and enabled them to reject the takeoff at lower speed. The first opportunity to detect the speed discrepancy was before lining up for takeoff, when the captain's airspeed indicated 45 kt while the aircraft was stationary with ground speed at 0 kt. The second opportunity was at the application of takeoff thrust when the IAS on the captain's PFD was almost steady speed with a very small speed trend arrow.

MONITORING OF THE AIRSPEED DURING THE TAKEOFF ROLL

The three events described above illustrate the importance of closely monitoring the airspeed throughout the takeoff roll. Both the Pilot Flying (PF) and the Pilot Monitoring (PM) have a role to play.

While the PF maintains the aircraft on the centerline using external references, the PM must actively monitor the airspeeds from the start of the takeoff roll. This will allow for the PM to detect any inconsistent airspeed indications between instruments, an abnormal airspeed trend or absence of airspeed indications as early as possible.

The "*Role of the Pilot Monitoring during Takeoff*" video on the Airbus Worldwide Instructors News (WIN) website illustrates each of the various steps for the PM to perform during the takeoff.

The 100 kt crosscheck: the last line of defense

Case study 3 shows us the importance of the 100 kt crosscheck, which is requested in the Standard Operating Procedure. It is the last line of defense in preventing a takeoff with an unreliable airspeed indication. The flight crew should be prepared to reject the takeoff at the time of the 100 kt crosscheck if an airspeed discrepancy is observed.

Monitoring that must be done for every takeoff

Takeoff with obstructed Pitot probes can happen for any flight as highlighted by the reported events described in this article. It is evidence of why it is essential to carefully monitor airspeed during every takeoff.

Contributors:

Panxika CHARALAMBIDES

Incident/Accident Investigator
Product Safety

Benoît DUQUESNE

Air Data System Support Engineer
Customer Support

Capt. Gilbert SAVARY

Head of Operational & Training Policy
Flight Operations & Training Support

Domenico SPATARO

Product Safety Enhancement
Product Safety

With thanks to Etienne BETTINGER and Michel SIBADE from the Handling Qualities Department and to Frédéric JUPIN from the Accident/Incident Analysis Department.

Obstructed Pitots are the main cause of the reported unreliable airspeed events at takeoff. Contamination of aircraft Pitot probes can happen in less than two hours on the ground in certain cases. The risk of Pitot contamination has increased since the beginning of the COVID-19 pandemic because there are fewer flights and aircraft spend more time on the ground between flights.

Airbus has published several documents to provide recommendations for the prevention of obstructed air data probes on the ground.

During transits or upon the return to service of a parked aircraft, it is important to pay particular attention to the Pitot probes during the maintenance external aircraft inspection and the pilot's preflight exterior walkaround. This will confirm that all protective covers are removed before flight.

Early detection of an unreliable airspeed event will enable the flight crew to reject the takeoff at a lower speed. From the start of the takeoff roll, the pilot monitoring must check for inconsistent airspeed indications, abnormal airspeed trends, or the absence of airspeed indications, and alert the pilot flying as early as possible if an issue is detected.

The 100 kt crosscheck is the last line of defense to prevent taking off with an unreliable airspeed indication. The flight crew should be prepared to reject the takeoff at the time of the 100 kt crosscheck if an airspeed discrepancy is observed.

It is essential that flight crews carefully monitor the airspeed indications during every takeoff. Obstruction or contamination of the Pitot can occur before any flight.

Safety first, 2021. Safety first is published by Airbus S.A.S. 1, rond point Maurice Bellonte - 31707 Blagnac Cedex/France.

Editor: Yannick Malinge, Chief Product Safety Officer.

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

20192534. Reference: X00D16031905.

Photos by Airbus.

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 Product Safety department. It is a source of specialist safety information for the use of airlines who y 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 fight 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 - Product 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: