

Bird or Hail Strikes on the Radome



Abnormal events such as bird strikes and hail strikes can occur at any time. When the aircraft is struck by birds or Foreign Object Debris (FOD), the correct inspection process must be followed, before the next flight, to determine if the aircraft is safe to fly.

This article focuses on the effect that a bird or hail strike can have on the radome of the aircraft. It recalls the recommendations to flight and maintenance crews to ensure correct detection, reporting, and management of a bird or hail strike. It also explains why it is important to always check both the outer and inner sides of a radome after any bird or hail strike event.

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



CASE STUDY

Event Description

An A350 aircraft was climbing towards its cruise altitude when the **SURV WXR 1 FAULT** ECAM alert triggered just before reaching 12 000 ft. The flight crew pressed the WXR SYS 2 pushbutton of the SURV panel to switch to weather radar system 2. The **SURV WXR 2 FAULT** ECAM alert triggered shortly after. The flight crew then performed several weather radar system switchovers with the same result during the climb. The aircraft eventually reached its cruising altitude of 35 000 ft. The **SURV WXR 1+2 FAULT** ECAM alert triggered. The flight crew contacted their Operations Control Center and decided to perform an in-flight turnback. They initiated the turnback and started to descend. The flight crew then heard a loud noise, followed by strong aerodynamic noise, and observed indicated speed discrepancies. The following ECAM cautions subsequently triggered: **NAV ISIS SPD UNRELIABLE**, **NAV AIR DATA REDUNDANCY LOST**, and **NAV RNP AR CAPABILITY DOWNGRADED**. Three minutes after the collapse, the flight control system temporarily reverted to alternate law for 17 minutes. Normal law was then recovered and was maintained for the remainder of the descent. There was another reversion to alternate law that occurred at the beginning of the approach lasting almost two minutes, after which normal law was recovered and maintained until landing.

When the aircraft reached the gate, the ground crew observed that the nose radome had collapsed onto the radar (**fig.1**).

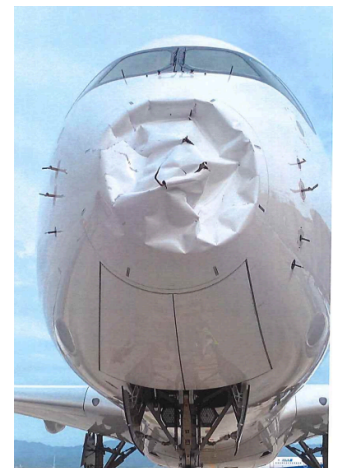
Event Analysis

Previous report of bird strike

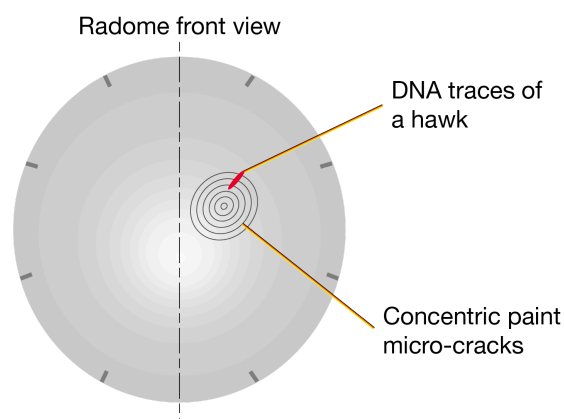
The aircraft technical logbook revealed that the aircraft had a bird strike on the left side of the radome one month prior to the event. The technical logbook stated that an inspection was performed in accordance with the MP A350-A-05-51-14-00001-282A-A - Inspection of the Aircraft after a Bird Strike and that traces of bird strike were found on the outer surface left side of the radome, but there was no damage detected. The logbook did not specifically mention if the inner surface of the radome was also inspected. Therefore, it is not possible to confirm if a complete inspection of the radome was performed.

Confirmation of the bird strike

A detailed examination of the collapsed radome by Airbus confirmed that there was a bird strike to the left side of the radome prior to the event where the radome collapsed. DNA of a hawk was found as well as some paint micro-cracking around the likely impact area (**fig.2**).



(fig.1) View of the collapsed radome (source: operator)



(fig.2) Location of the bird strike based on the observed paint micro-cracks

Damage at the impact area

The inner skin disbonded from the composite structure of the radome, and there was damage to the honeycomb structure near the location of the bird strike. This damage compromised the structural resilience of the radome, which resulted in the radome collapsing.

WXR antenna drive failure messages on previous flights

The Post Flight Reports (PFR) of the aircraft showed intermittent and repetitive **SURV WXR 1 FAULT**, **SURV WXR 2 FAULT**, and **SURV WXR 1+2 FAULT** ECAM alerts triggered during the three previous flights with the associated “**Drive Unit - WXR antenna**” failure message. This failure message is triggered if the antenna fails to move to its commanded position during an antenna scan cycle. It may be the result of a failure of the drive unit of the antenna or of a mechanical blockage of the antenna. System tests were performed on the ground at the end of each of the three flights with no fault found. The condition of the inner skin that had disbonded from the radome structure was not detected during these ground checks.

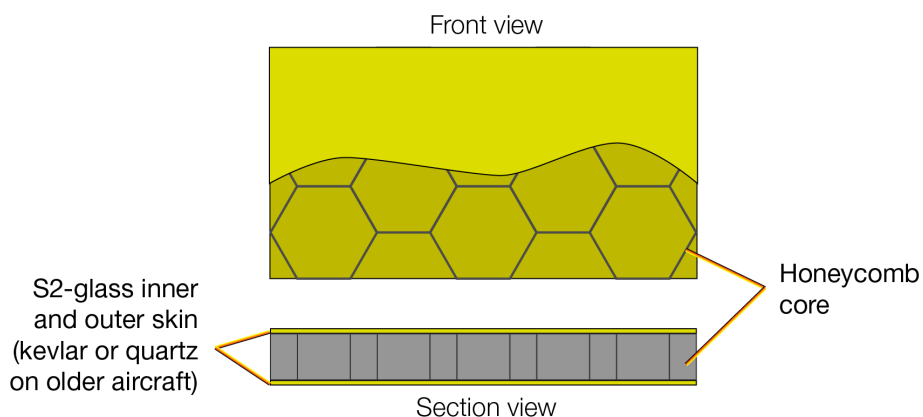


EFFECTS OF A BIRD OR HAIL STRIKE ON A RADOME

The radome is an aerodynamic weatherproof fairing that protects the radar antenna. It is manufactured with materials that allow transmission and reception of the radar radio waves with minimal interference.

Radome Structure

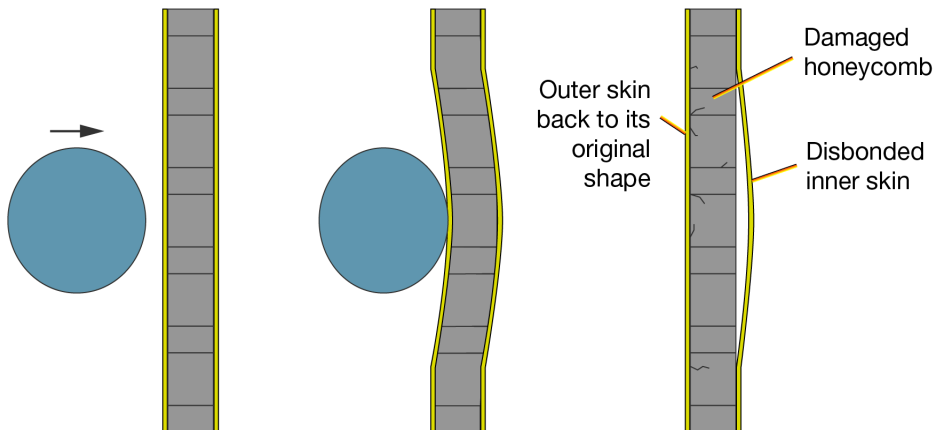
All radomes on Airbus commercial aircraft since the A300 are composed of a composite sandwich structure constructed of a honeycomb core located between internal and external skins (except A380 which has a double sandwich honeycomb core). These skins were previously manufactured from Glass, Kevlar & quartz. The latest radomes are manufactured from S2-glass® materials.



(fig.3) Typical structure of a radome (the shape of the honeycomb may vary depending on the aircraft)

Effect of an impact on the radome

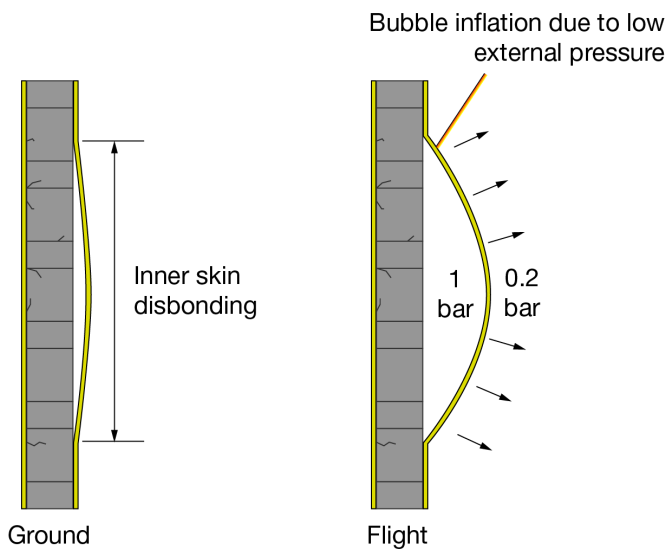
When impacted by hail, a bird strike, or other foreign objects, a sandwich composite structure deforms and then may return to its original shape with little to no damage visible on its external surface, but with potentially significant damage to its internal structure. **(fig.4)**. In-service experience shows that there is often very little trace of the impact on the outer surface of the radome whereas the honeycomb core can be damaged and the radome inner skin can be disbonded around the impact zone.



(fig.4) Example of damage due to an impact on a composite panel

Inflation of the disbonding during flight

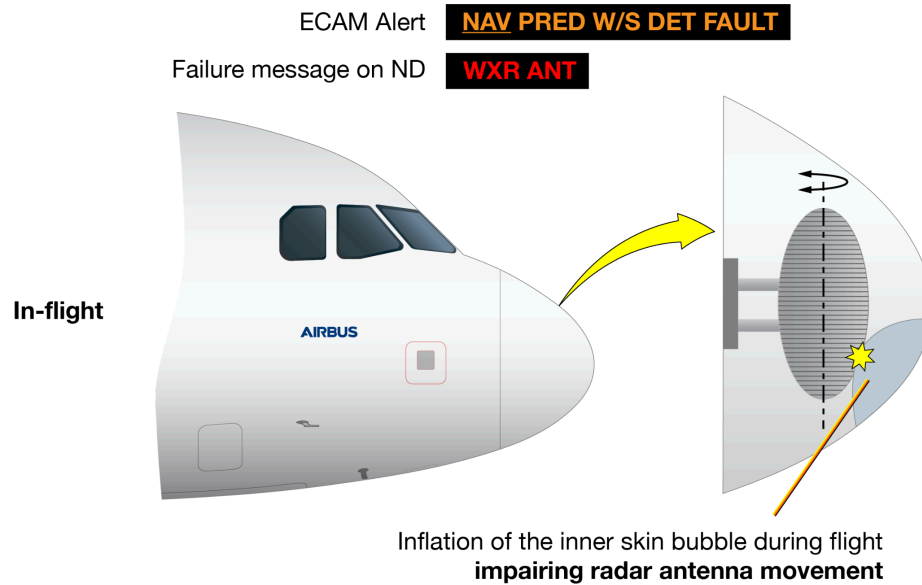
If the damage due to bird or hail strikes is not detected on the ground, the damaged area will be subject to several flight cycles. The air trapped between the honeycomb and disbonded skin (around 1 bar on the ground) will tend to inflate during each flight and create a bubble where the skin is disbonded due to the lower ambient air pressure at altitude (around 0.2 bar at cruise altitude) **(fig.5)**.



(fig.5) Inflation effect at altitude where the skin has disbonded from the structure

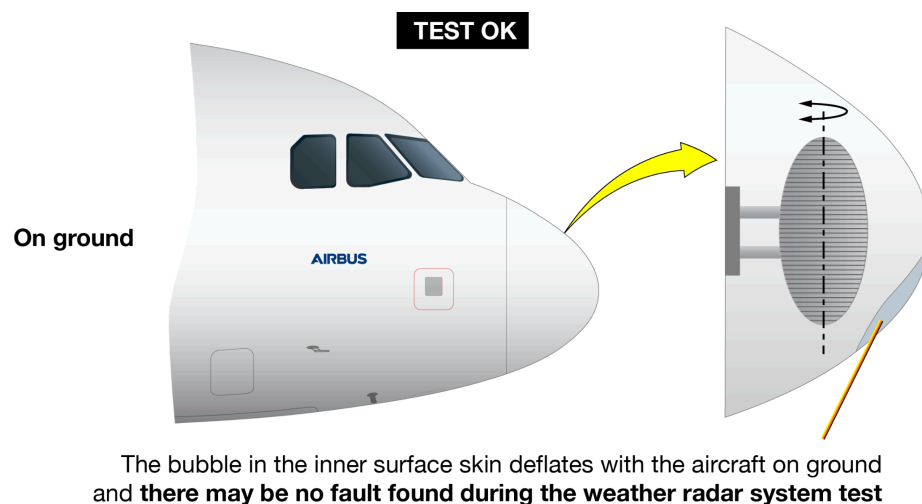
Weather radar faults as a secondary effect

If a damage is not detected, depending on its size and location, it may impair the movement of the weather radar antenna and trigger the weather radar alerts (**fig.6**).



(**fig.6**) Example of secondary effects of radome damage on A320 aircraft

When the aircraft is back on the ground and the radome inner skin bubble deflates, it may no longer impair the movement of the antenna (**fig.7**). This can explain why there was no fault found during the troubleshooting test of the weather radar system on ground. ■



(**fig.7**) Radar system troubleshooting tests performed on ground may not identify the fault despite the radome damage still being present

OPERATIONAL CONSIDERATIONS

Flight crews have an important role to play in reporting and detecting damage due to bird or hail strikes.

Report any bird or hail strikes to maintenance personnel

In the case of an actual or suspected bird or hail strike during flight, and regardless of the location on the aircraft, the flight crew must make a **logbook entry** to report the event to maintenance personnel, so that they can perform the appropriate aircraft inspection.

The flight crew report should provide detailed information to aid in isolating any issues such as:

At the time of the bird or hail strike event:

- Aircraft configuration (position of the landing gears and flight controls)
- Flight phase

At the time of **and after** the bird or hail strike event:

- Any erroneous engine, radio, or navigation system behaviors
- Any smells noticed in the air conditioning system (burning smells or other odors)
- List of ECAM (EICAS for A220) alerts that triggered
- Description of any other system malfunctions during or after the event

Check for bird or hail strike during exterior walkaround

Conducting a thorough exterior walkaround inspection of the aircraft is also an opportunity to detect any potential bird/hail or FOD related damage. Should traces of bird or hail strike or FOD be found on any aircraft part, the flight crew must inform maintenance personnel and make a logbook entry. 

MAINTENANCE CONSIDERATIONS

Aircraft Inspection after a Bird or Hail Strike

Careful inspection of the aircraft as per the AMM/MP/AMP after a reported bird or hail strike is essential, to check if the aircraft is safe to perform the next flight or if component repair or replacement is required.

Perform bird or hail strike inspections as soon as possible

In-service experience shows that it may be difficult to identify the signs of a bird or hail strike due to the fact that composite parts may return back to their original profiles after impact and this may mask or hide damage to the internal structure. The inspection must, therefore, be performed right after the bird or hail strike event to maximize the chance of findings.

Use lights for accurate detection

High quality additional lighting should be used to perform the inspection if in low light conditions. The use of a grazing light (applying directional light near the surface and lighting it at a narrow angle) to accentuate the shadows of uneven areas can help to detect defects.

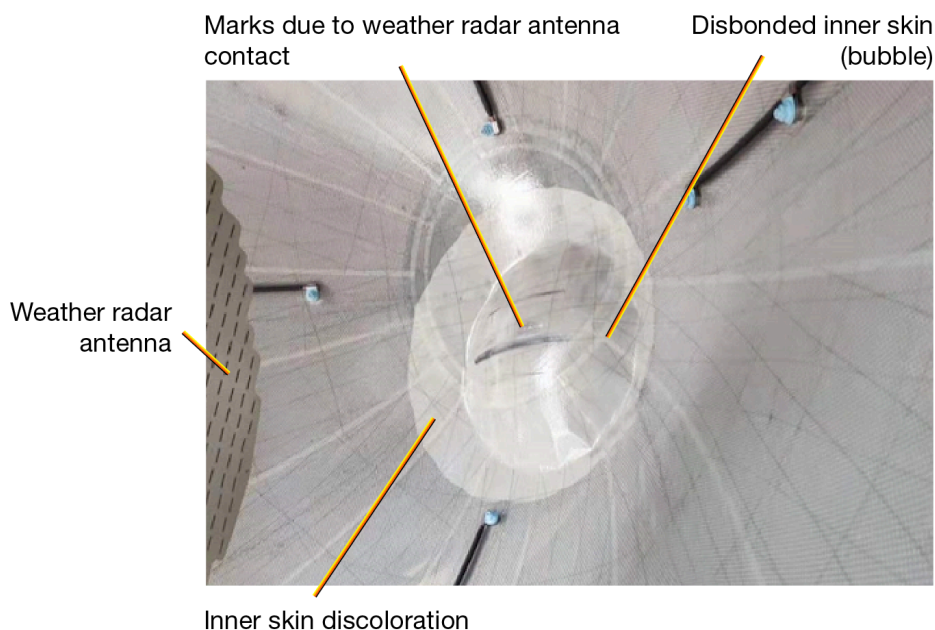
Perform a radome inspection for any reported bird or hail strikes

In the case of a bird or hail strike, the damage may not be limited to a single zone. Therefore, regardless of the location of the reported bird or hail strike (e.g. engine, fuselage, wing leading edges, etc.) the radome must always be inspected since it may also be affected by the strike.

Inspect the Radome external AND internal structure

In all cases after bird or hail strikes, in addition to the external inspection, it is mandatory to open and inspect the internal structure and surface of the radome for signs of delamination and disbonding, even if there is no trace on the external side of the radome. Typical signs of disbonding of the inner skin can be uneven surfaces or skin discoloration (**fig.8**). If any damage is detected, it must be checked that it is within the allowable damage limit provided in the SRM/ASR/ASRP to continue in service. If the damage is outside the allowable damage limits, then the radome must be repaired or replaced.

The documentation for A380 aircraft (with double sandwich honeycomb core structure), and for A220 aircraft (single sandwich honeycomb core structure but with a different manufacturing process), does not currently require a systematic inspection of the internal surface of the radome in the case of every reported bird or hail strike. An update is under evaluation of the need to harmonize the procedure with the other Airbus aircraft types.



(fig.8) Example of out-of-limits damage on the inner surface of the radome (source: Operator)

Weather Radar Antenna Drive Troubleshooting

At the time of the event described above, the A350 fault isolation task to be applied in the case of a fault message concerning the weather antenna drive requested the confirmation of the fault by performing a radar system test:

- If the system test failed, the task requested an inspection of the inner structure and surface of the radome.
- If the system test revealed no fault, no further action was requested. However, as per Aircraft Fault Isolation philosophy, after three or more occurrences of a fault, the full fault identification procedure must be done. This includes inspecting the inner structure and surface of the radome when there are three or more occurrences of a weather radar antenna fault message.

Troubleshooting and fault isolation task improvements

An update of the troubleshooting/aircraft fault isolation task linked to the weather antenna drive failure was launched for A320/A330/A340 and A350 aircraft. This is to take into account the conditions described in the above event causing the possible inflation at altitude, and deflation on the ground of the disbonded inner skin bubble of the radome. The procedure now requires a **systematic inspection of the inner structure or surface of the radome** to check for damage whenever there is a failure message related to the weather antenna or antenna drive. ■



INFORMATION

Further information can be found in the AMM/MP/AMP, SRM/ASR/ASRP documents available on the AirbusWorld portal and in the following published documents:

- ISI 53.15.00024: A320Fam - Radome Information - standards /interchangeability & events procedures
- ISI 53.51.00001: A300, A330 & A340Fam - Radomes information - standard and interchangeability possibilities.
- ISI 53.15.00026: A350 - Radome Information - standards/interchangeability & event procedures

Contributors:

Jean Charles ANTUNES

Abnormal Events &
Multi-ATA Engineer
Customer Support

Andrei BULANCEA

Radome Expert
Design office

Hélène CARROLS

Accident/Incident
Investigator
Aviation Safety

Adam FLETCHER

Structure Support
Engineer
Customer Services

Jacques FOURNIE

Radome Specialist
Design Office

Maxime LANSONNEUR

Director Safety - Training
and Flight Operations
Customer Support

Any bird strike, hail strike, or foreign object debris striking any part of the aircraft must be reported to maintenance personnel, and the flight crew must make an entry in the logbook. It is important to provide as much detailed information as possible to aid in isolating any issues. The inspection should be carried out as soon as possible, because damage to composite parts may not be easily detected if the external surface is left to return to its original profile over time, masking or hiding the damage to the internal structure.

Whenever a bird or hail strike occurs anywhere on the aircraft, the radome must always be inspected using good quality lighting to check both the external and internal surfaces and structures. A fault message concerning the weather radar antenna may also be indicative of damage to the radome. When there is a weather radar antenna fault message, the updated troubleshooting procedures request a thorough inspection of the internal surfaces and structures of the radome to check for damage that could impair the movement of the radar in flight.

It is also important to recall the fault isolation philosophy that requires the full fault identification procedure to be carried out for the system when there are three or more occurrences of the same fault.

Safety first, 2024. Safety first is published by Airbus S.A.S. 1, rond point Maurice Bellonte - 31707 Blagnac Cedex/France.

Editor: Yannick Malinge, SVP Aviation Safety.

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

Photos by Airbus.

© Airbus S.A.S. 2024 – All rights reserved. Proprietary documents.

By taking delivery of this Brochure (hereafter "Brochure"), you accept on behalf of your company to comply with the following guidelines:

- No other intellectual property rights are granted by the delivery of this Brochure than the right to read it, for the sole purpose of information.
- This Brochure and its content shall not be modified and its illustrations and photos shall not be reproduced without prior written consent of Airbus.
- This Brochure and the materials it contains shall not, in whole or in part, be sold, rented, or licensed to any third party subject to payment.

This Brochure contains sensitive information that is correct at the time of going to press.

This information involves a number of factors that could change over time, affecting the true public representation. Airbus assumes no obligation to update any information contained in this document or with respect to the information described herein.

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

Safety first

The Airbus Safety magazine

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

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

Material for publication is obtained from multiple sources and includes selected information from the Airbus Flight Safety Confidential Reporting System, incident and accident investigation reports, system tests and flight tests. Material is also obtained from sources within the airline industry, studies and reports from government agencies and other aviation sources.

All articles in Safety first are presented for information only and are not intended to replace ICAO guidelines, standards or recommended practices, operator-mandated requirements or technical orders. The contents do not supersede any requirements mandated by the State of Registry of the Operator's aircraft or supersede or amend any Airbus type-specific AFM, AMM, FCOM, MMEL documentation or any other approved documentation.

Articles may be reprinted without permission, except where copyright source is indicated, but with acknowledgement to Airbus. Where Airbus is not the author, the contents of the article do not necessarily reflect the views of Airbus, nor do they indicate Company policy.

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

Airbus - Aviation Safety department (W)

1, rond point Maurice Bellonte
31707 Blagnac Cedex - France
safetycommunication@airbus.com

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

