

# Birdstrike

## CS 27/29.631

**Presentation by:**

Emily LEWIS

Senior Expert – Structures, GA/VTOL



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**Rotorcraft Structures Workshop**  
18-19 February 2025

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# CS-27 and CS-29 Requirements



**CS-27 < 6 PAX**

✗ No requirement

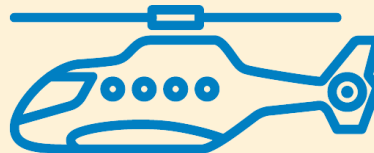


**CS-27 ≥ 6 PAX**

→ Windshield

✓ Safe landing

CS 27 Amdt 9, 17 Dec 2021



**CS-29**

→ Rotorcraft

✓ Continued safe flight and landing (Cat A)

✓ Safe landing (Cat B)

Part 29 29-40, 8 Aug 1996

Updated CS 29 Amdt 10, 17 Dec 2021



1.0 kg bird

- VNE or VH 'True Airspeed' (TAS), which ever is less
- Altitudes up to 2 438m (8 000 ft)
- Test or validated analysis based on test of similar design

# Rulemaking: RBSWG ARAC Report

**Bird strike is a primary safety threat on Rotorcraft**

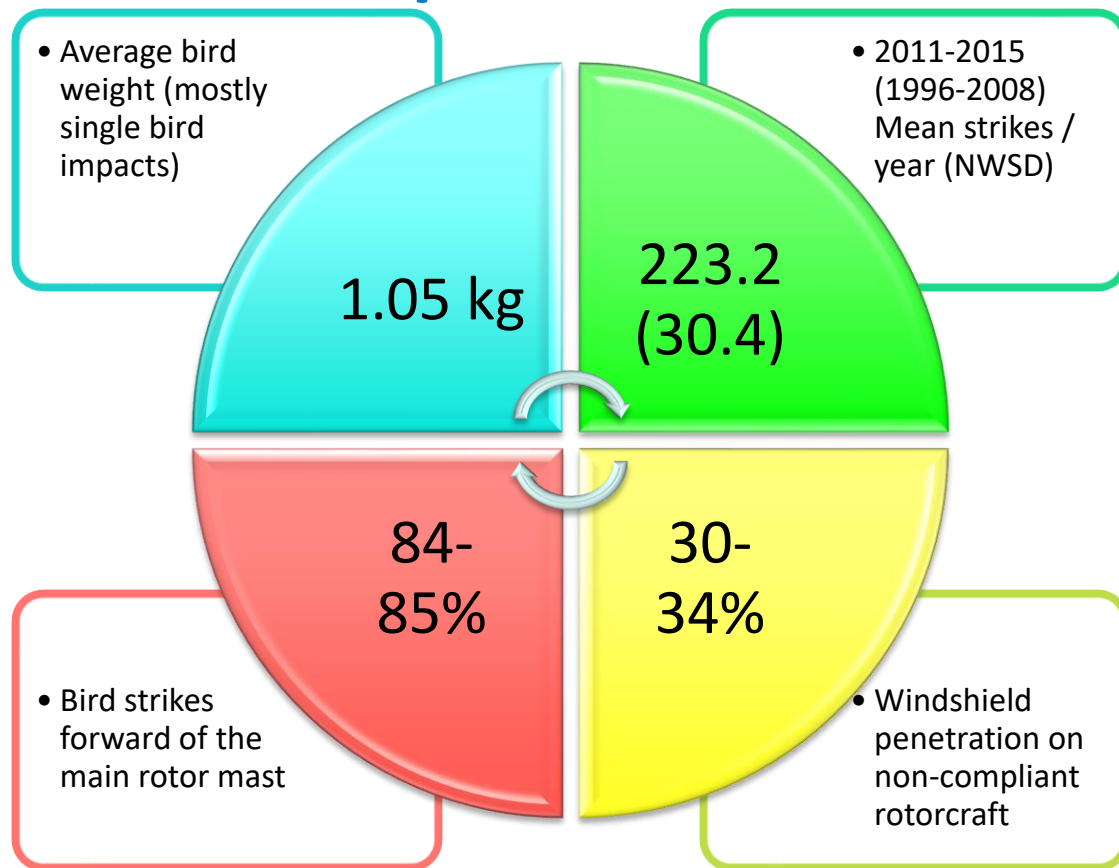


Rotorcraft Bird Strike Working Group: Recommendation to the ARAC → 10 Nov 2017

# Rulemaking: RBSWG ARAC Report

## Recommendations:

- 27.631 requirement for windshield protection
- 29.631: no update
- For newly manufactured:
  - ≥15 PAX: 29.631
  - 10-14 PAX: protection for windshield and critical equipment/components fwd of MR
- Guidance for operators



# Rulemaking: RMT.0726



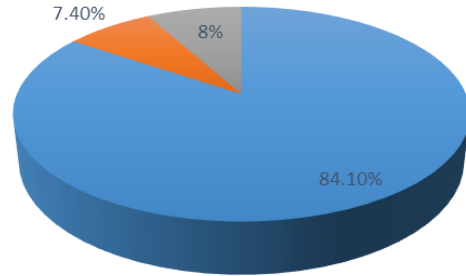
## Rotorcraft occupant safety in the event of a bird strike (ToR Sept 2020)

SUBTASK 1: to prevent windshield penetration on smaller rotorcraft with higher PAX capacities

SUBTASK 2: Assessment of retroactive application of bird strike certification to existing fleets and/or new production

NPA: 2021-02, 25 Feb 2021 (SUBTASK 1):

### EU rotorcraft fleet (2019)



■ CS-27 ■ CS-29 not compliant with CS 29.631 ■ CS-29 compliant with CS 29.631

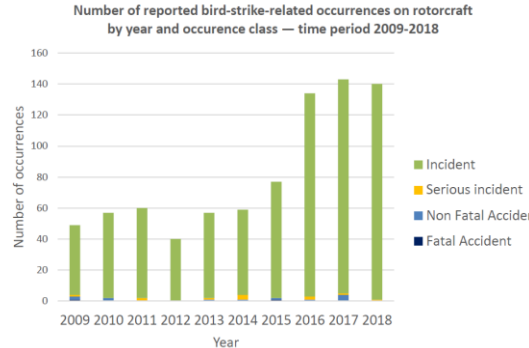


Figure 1 — Rotorcraft bird strike occurrences in EASA's occurrence database

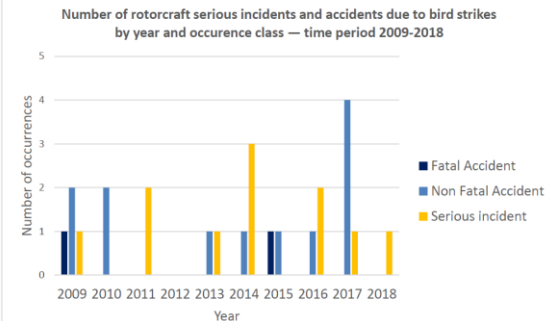


Figure 2 — Rotorcraft serious incidents and accidents due to bird strikes in EASA's occurrence database

# Rulemaking: RMT.0726 conclusion

## SUBPART 1



**CS-27 Amdt 9**    **CS-29 Amdt 10**  
**17 Dec 2021**    **17 Dec 2021**

- ✓ CS-27 new rule and AMC
- ✓ CS-29 update and AMC

## SUBPART 2

- Significant Economic Impact for the industry for the retroactive application
- Unpracticable technical solutions for retrofit on some rotorcraft
- SIB on Birdstrike Risk Mitigation in Rotorcraft Operations published

✓ **RMT.0726 CLOSED**



# Windshield Requirement and Substantiation

## PASS/FAIL Criteria:

- ✓ Impact: **No penetration** of windshield and supporting frame
- ✓ Residual Strength: **safe landing** (CS-27, CS-29 Cat B) or **continued safe flight and landing** (CS-29 Cat A)
- ✓ Essential systems and equipment remain operative in case of shock loading



Test should be performed to an approved test proposal:




ASTM F330-89  
Standard Test Method for Bird  
Impact Testing of Aerospace  
Transparent Enclosures





# Windshield Requirement and Substantiation

Windshield material is sensitive to temperature:

- 
- Substantiation should cover all expected temperatures
  - **Min temperature**: brittle → failure
  - **Max temperature**: maximum deflection → contact

Typically multiple strikes are performed

Critical locations should be selected:

- 
- 
- Dependent on the critical temperature(s)
  - Selection supported by simulation/experience
  - Simulation validated by the test



Birdstrike Test Set-up Example

# Windshield Requirement and Substantiation

## Windshield:

- Typically any cracks on windshield will result in failure of residual strength criteria

## Residual Strength



## Supporting Structure:

- All damages following the impact must be identified and reported
- If the strength capability could be affected, the following demonstration is required:
  - Limit loads (with flight limitations, if applicable)
  - Worst environmental conditions (temperature, humidity)
  - Typical (mean) material values for test / B design values for analysis
  - As manufactured quality

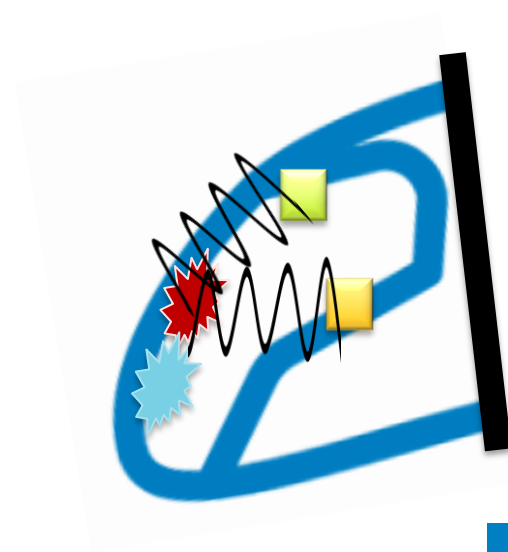
Specific instructions may be necessary in ICA following a birdstrike

# Windshield Requirement and Substantiation

## Critical Equipment:

Any critical systems or equipment (including their controls) that are essential to ensure safe landing / continued safe flight and landing must be identified.

- Measurement of local acceleration due to shock wave (dummy equipment or local structure measurements)
- Alternatively, equipment may be installed during test



# Compliance to CS 29.631

In addition to the windshield requirement:

1. Identify exposed structures, systems and equipment, and flight control systems  
**! Main rotor shielding should not be considered !**
2. Final selection of areas to be evaluated based on the criticalities the exposed items, taking into consideration:

## Direct Effects:

- Integrity of the structure
- Functionality of the systems or equipment (also shock loads)

## Induced Effects:

- Consequence of pieces that are ejected from the bird strike impacting other structures, systems and equipment

3. Compliance demonstration through tests, or analysis based on tests that are carried out on sufficiently representative structures of similar design

# Compliance to CS 29.631

All damages following the impact (primary or induced) must be identified and reported:

→ If the strength capability could be affected, the following demonstration is required:

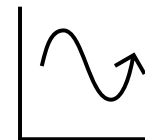
- Limit loads (with flight limitations, if applicable)
- Worst environmental conditions (temperature, humidity)
- Typical (mean) material values for test / B design values for analysis
- As manufactured quality



Residual Strength

→ For high cycle loaded components, if there are damages:

- Fatigue demonstration to demonstrate period until detection and repair, i.e.
  - Full mission for unknown impacts and obvious damage
  - Half mission for known impacts and obvious damage  
(Cat-B: Sufficient for safe landing for known impacts)
  - Interval inspection demonstration for smaller damages



Fatigue Loading

**Specific instructions may be necessary in ICA following a birdstrike event**

# Lol and change classifications

## Level of Involvement:



Novelty

- May be novel, depending on the Applicant experience.



Complexity

- Complex, if dynamic analysis is used.



Criticality

- Critical, as the concerned parts ensure continued safe flight and landing (CS-29 Category A) or safe landing (CS-27 and CS-29 Category B)

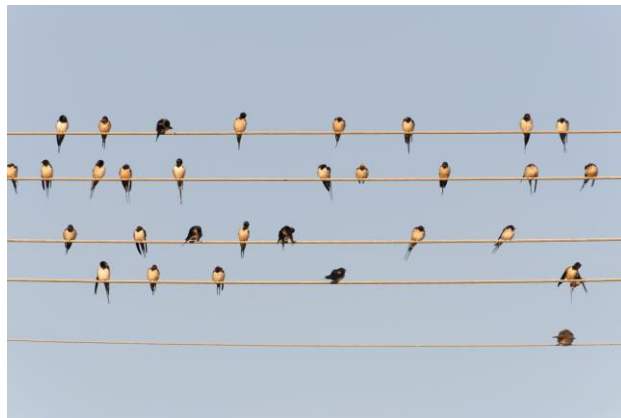
## Change classification:

MAJOR MINOR

**Major:** 27/29.631 Birdstrike Requirement is to ensure continued safe flight and landing (CS-29 Category A) or safe landing (CS-27 and CS-29 Category B) following a birdstrike

# Conclusion

- Applicability of requirement:
  - CS-27  $\geq 6$  PAX: windshield, CS-29: rotorcraft
- RMT.0726 and RBSWG ARAC report:
  - CS 27.631 requirement introduced
  - RMT.0726 is closed → no retroactive application
- Windshield:
  - No penetration
  - Temperature assessment is important
  - Residual strength demonstration (if damages) and check of critical systems or equipment
- In addition for CS 29.631:
  - Direct effects and induced effects on exposed structures, systems and equipment, and flight control systems
  - Test or analysis based on validated analysis of a similar design
  - Residual strength demonstration and fatigue (high cycle) (if damages)
- Specific instructions may be necessary in ICA following a birdstrike event







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