European Union Aviation Safety Agency

Explanatory Note to Decision 2021/016/R

Rotorcraft chip detection systems *and* Rotorcraft occupant safety in the event of a bird strike

CS-27 Amendment 9 *and* CS-29 Amendment 10

RELATED NPA/CRD: 2021-01 — RMT.0725 (SUBTASK 1)
RELATED NPA/CRD: 2021-02 — RMT.0726 (SUBTASK 1)

EXECUTIVE SUMMARY

The objectives of this Decision are to:

— improve rotorcraft safety by ensuring that the chip detection systems that are installed in rotorcraft rotor drive systems achieve an acceptable minimum level of effectiveness in detecting the incipient degradation or failure of components of the rotor drive system; and

— improve rotorcraft occupant safety in the event of a bird strike.

This Decision amends:

— the Certification Specifications, Acceptable Means of Compliance and Guidance Material for Small Rotorcraft (CS-27) and the Certification Specifications, Acceptable Means of Compliance and Guidance Material for Large Rotorcraft (CS-29) to introduce:
  — certification specifications (CSs) for the effectiveness demonstration of chip detection systems; and
  — related acceptable means of compliance (AMC) and guidance material (GM);

— CS-27 to introduce:
  — a design CS (CS 27.631 'Bird strike') to ensure safe landing after a bird strike on the windshield of rotorcraft with six or more passenger seats; and
  — the related AMC to support the application of that CS; and

— CS-29 to:
  — improve the wording of CS 29.631 'Bird strike'; and
  — introduce related AMC to support the application of that CS.

The amendments are expected to:

— increase the safety of rotorcraft rotor drive systems by improving their designs; and

— increase the safety of newly designed small-rotorcraft (CS-27) operations.

The amendments will have no significant economic impact, and no environmental or social impacts.

Domain:	Design and production		
Related rules:	CS-27 and CS-29		
Affected stakeholders:	Design organisation approval (DOA) holders and production organisation approval (POA) holders		
Driver:	Safety	**Rulemaking group:**	Yes (RMT.0725), No (RMT.0726 Subtask 1)
Impact assessment:	Yes	**Rulemaking Procedure:**	Standard

EASA rulemaking procedure milestones

	Start Terms of Reference	**Public Consultation** NPA 2021-01 and NPA 2021-02	**Proposal to the Commission** Opinion	**Adoption by the Commission** Implementing Rules	**Decision** Certification Specifications, Acceptable Means of Compliance, Guidance Material
RMT.0725 Subtask 1	7.4.2020	29.1.2021 (via CRT)	N/a	N/a	2021 Q/4
RMT.0726 Subtask 1	8.9.2020	25.2.2021 (via CRT)	N/a	N/a	2021 Q/4

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1. About this Decision

The European Union Aviation Safety Agency (EASA) developed Decision 2021/016/R in line with Regulation (EU) 2018/1139[1] (the 'Basic Regulation') and the Rulemaking Procedure[2].

Rulemaking Tasks RMT.0725 and RMT.0726 are included in the European Plan for Aviation Safety (EPAS) for 2021-2025. The scope and timescales of the tasks were defined in the related Terms of Reference (ToR) documents[3].

EASA developed the *draft* text of this Decision also based on the input of Rulemaking Group (RMG) RMT.0725. All the interested parties were consulted through Notice of Proposed Amendment (NPA) 2021-01 'Rotorcraft chip detection systems' and NPA 2021-02 'Rotorcraft occupant safety in the event of a bird strike'[4]. Comments were received from interested parties, including industry and national competent authorities (NCAs).

Table 1 provides an overview of the number of comments received during the public consultations of the related NPAs.

NPA	RMT	# of comments received	# of commenters	CRD
NPA 2021-01	RMT.0725	74	14	CRD 2021-01
NPA 2021-02	RMT.0726	83	18	CRD 2021-02

Table 1

EASA reviewed the comments received during the public consultations. The comments received and EASA's responses to them are presented in Comment-Response Document (CRD) 2021-01 and CRD 2021-02[5].

EASA developed the *final* text of this Decision with the certification specifications (CSs), acceptable means of compliance (AMC), and guidance material (GM) based on the input of the public consultation, and published the Decision on the Official Publication[6] of EASA.

The major milestones of the RMTs are presented on the cover page.

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1 Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 (OJ L 212, 22.8.2018, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1535612134845&uri=CELEX:32018R1139).

2 EASA is bound to follow a structured rulemaking process as required by Article 115(1) of Regulation (EU) 2018/1139. Such a process has been adopted by the EASA Management Board (MB) and is referred to as the 'Rulemaking Procedure'. See MB Decision No 18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by EASA for the issuing of opinions, certification specifications and guidance material (http://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-18-2015-rulemaking-procedure).

3 https://www.easa.europa.eu/document-library/terms-of-reference-and-group-compositions/tor-rmt0725 (RMT.0725)
https://www.easa.europa.eu/document-library/terms-of-reference-and-group-compositions/tor-rmt0726 (RMT.0726)

4 In accordance with Article 115 of Regulation (EU) 2018/1139 and Articles 6(3) and 7 of the Rulemaking Procedure.

5 https://www.easa.europa.eu/document-library/comment-response-documents

6 https://www.easa.europa.eu/official-publication

2. In summary — why and what

2.1. Why we need to introduce and amend the CSs, AMC, and GM — issue/rationale

2.1.1 RMT.0725 — Rotorcraft chip detection systems

The function of a rotorcraft rotor drive system is to transmit power from the engines to the rotors, while reducing the rotational speed and increasing torque. A typical main gearbox of a rotorcraft rotor drive system consists of many highly loaded dynamic components that are essential for continued safe flight and landing. Such components are enclosed in the housing, which makes them difficult to inspect. However, the designs of rotorcraft rotor drive systems usually have single-load-path architectures. In addition, the nature of degradation and failure mechanisms of such systems make it necessary to regularly inspect the integrity of the critical components. For this reason, such systems need to use alternative means of detecting degradation and potential impending failures.

One of these means is to use chip (metal particle) detectors that are located in key areas of the rotor drive system gearboxes to indicate to the crew and/or maintenance personnel the presence of ferromagnetic particles. Such particles are typically released by worn or damaged gearbox components, and are therefore considered a reliable means of detecting no longer serviceable elements of the system. However, detection of these particles is only considered reliable once performance and effectiveness of the system are proven. To establish the effectiveness of a chip detection system, a detailed evaluation through specific testing is necessary, to ensure reliable and repeatable results.

Related safety issues

CS 27/29.1337(e) requires equipping the rotor drive system transmissions and gearboxes of small and large rotorcraft with chip detectors of ferromagnetic particles. Such particles result from damage or excessive wear of elements of the rotor drive system, and signal caution or warning to the crew, as specified in CS 29.1305(a)(23) and in CS 27.1305(v). However, no provisions require demonstrating the effectiveness of the chip detection system.

Lacking such provisions, and based on findings from recent accident and incident investigations[7], chip detection systems may be uncapable of detecting the incipient degradation or failure of components of the rotor drive system. EASA's review revealed that many catastrophic accidents have occurred due to inefficient European chip detection systems. Those accidents could have been prevented if more effective chip detection systems had been installed on the affected gearboxes of the rotor drive systems.

2.1.2 RMT.0726 — Rotorcraft occupant safety in the event of a bird strike

The data for 2009-2018 from EASA's occurrence database shows an upward trend in the number of bird strikes to the windshield area of small rotorcraft. Such bird strikes had a force of impact that, in some cases, directly endangered the rotorcraft occupants. This trend elevates the probability of serious injuries to the occupants or of fatalities, increasing the risk to safe rotorcraft operations.

[7] Safety recommendation 'NORW-2018-004' states: 'The Accident Investigation Board Norway recommends that the European Aviation Safety Agency (EASA) revise the Certification Specifications for Large Rotorcraft (CS-29) to introduce requirements for MGB chip detection system performance.'

Moreover, in numerous cases, the pilot was partially or completely incapacitated by a direct bird strike, increasing the risk of rotorcraft loss of control and, therefore, of fatalities.

CS 29.631 'Bird strike' is applicable to newly designed large rotorcraft since the first issue of the Certification Specifications, Acceptable Means of Compliance and Guidance Material for Large Rotorcraft (CS-29). CS 29.631 'Bird strike' has proven its effectiveness as no fatalities or significant injuries have been recorded in the last 10 years on large rotorcraft that are compliant with this CS.

Unlike CS-29, the Certification Specifications, Acceptable Means of Compliance and Guidance Material for Small Rotorcraft (CS-27) did not contain a CS on bird strike protection. Therefore, this Decision introduced CS 27.631.

2.2. What we want to achieve — objectives

The overall objectives of the EASA system are defined in Article 1 of the Basic Regulation. This Decision will contribute to achieving the overall objectives by addressing the issues described in Section 2.1.

The specific objectives of this Decision are, therefore, to:

— improve rotorcraft safety by ensuring that the chip detection systems that are installed in rotorcraft rotor drive systems achieve an acceptable minimum level of effectiveness in detecting ferromagnetic particles that indicate the incipient degradation or failure of components of the rotor drive system; and

— improve the safety of occupants of newly designed CS-27 rotorcraft with six or more passenger seats in the event of a bird strike by providing a design that ensures a safe landing after a bird strike on the windshield.

2.3. How we want to achieve it — overview of the amendments

2.3.1 RMT.0725 —Rotorcraft chip detection systems

Amendments to CS-27

CS 27.1337 'Power plant instruments'

CS 27.1337(e) is amended to ensure that the chip detection systems that are installed in rotorcraft rotor drive systems are demonstrated to be effective in detecting ferromagnetic particles.

AMC1 27.1337(e) 'Power plant instruments' — Chip detection system

AMC1 27.1337(e) provides:

— acceptable means of compliance to demonstrate the effective performance of a chip detection system, including objectives for an acceptable level of performance; and

— acceptable methodologies for using test and analysis means to comply with the amended CS 27.1337(e).

To ensure a proportionate approach, AMC1 27.1337(e) allows a simplified demonstration of compliance for non-Category-A small rotorcraft.

GM1 27.1337(e) 'Power plant instruments' — Chip detection system

New guidance material (GM) is introduced to describe the chip detection system.

	Differences with NPA 2021-01
AMC1 27.1337(e) **GM1 27.1337(e)**	In response to the comments received: — the AMC 27.1337(e) structure was improved for clarity; — 60 mg is no longer the preferred amount of ferromagnetic particles to support compliance demonstration, but an alternative that may be used when an adequate amount is not justified; — 20 minutes is no longer the only valid period to be considered between the appearance and detection of ferromagnetic particles; — additional details on reliability and maintenance aspects of chip detection systems were provided; and — minor editorial and other corrections were made. In addition, the following changes were introduced: — AMC1 27.1337(e) and GM1 27.1337(e) were renumbered for consistency with the EASA Rulemaking Style Guide and linguistically improved; and — the text of GM 27.1337(e) that contained AMC was moved to point (d) of AMC1 27.1337(e); the remaining text is a description of the chip detection system.

Table 2

Amendments to CS-29

CS 29.1337 'Power plant instruments'

CS 29.1337(e) is amended to ensure that the chip detection systems that are installed in rotorcraft rotor drive systems achieve an acceptable minimum level of effectiveness.

AMC 29.917 'Rotor drive system design'

AMC 29.917 is restructured as AMC**1** 29.917 and AMC**2** 29.917, and a new AMC**3** 29.917 is introduced.

— **AMC1 29.917 'Rotor drive system design — Vibration health monitoring'**

This AMC contains the first paragraph of AMC 29.917. The technical content is not affected.

— **AMC2 29.917 'Rotor drive system design — Lubrication systems'**

This AMC consists of the lubrication systems section of AMC 29.917. The language is improved without affecting the technical content.

— **AMC3 29.917 'Rotor drive system design — Chip detection system'**

This AMC provides additional considerations for chip detection systems that are used as compensating provisions.

— **AMC 29.927 'Additional tests'**

The title of this AMC is changed to AMC**1** 29.927**(c)**, and the cross reference to AMC 29.917 is updated to read AMC**2** 29.917.

— **AMC1 29.1337(e) 'Power plant instruments' — Chip detection system**

AMC1 29.1337(e) provides:

— acceptable means of compliance to demonstrate the effective performance of a chip detection system, including objectives for an acceptable level of performance, and

— acceptable methodologies for using test and analysis means to comply with the amended CS 29.1337(e).

Therefore, this new AMC complements the related AMC of CS-27.

— **GM1 29.1337(e) 'Power plant instruments' — Chip detection system**

New GM is introduced to describe the chip detection system.

	Differences with NPA 2021-01
AMC1 29.917 **AMC2 29.917** **AMC3 29.917**	In response to the comments received: — AMC 29.917 was restructured into three different AMC (AMC 1-3) that treat different topics; — the new AMC were renumbered for consistency with the EASA Rulemaking Style Guide; and — minor editorial changes were introduced for clarity.
AMC1 29.1337(e) **GM1 29.1337(e)**	In response to the comments received: — the AMC1 29.1337(e) structure was improved for clarity; — 60 mg is no longer the preferred amount of ferromagnetic particles to support compliance demonstration, but at alternative that may be used when an adequate amount is not justified; — 20 minutes is no longer the only valid period to be considered between the appearance and detection of ferromagnetic particles; — additional details on reliability and maintenance aspects of chip detection systems were provided; and — minor editorial and other corrections were made. In addition, the following changes were introduced: — AMC1 29.1337(e) and GM1 29.1337(e) were renumbered for consistency with the EASA Rulemaking Style Guide and linguistically improved; and — the text of GM1 29.1337(e) that contained AMC was moved to point (d) of AMC1 29.1337(e); the remaining text is a description of the chip detector system.
AMC1 29.927(c)	The cross references to AMC 29.917 was updated to read AMC2 29.917.

Table 3

2.3.2 RMT.0726 — Rotorcraft occupant safety in the event of a bird strike

Amendments to CS-27

A new design CS (CS 27.631 'Bird strike') is introduced to ensure safe landing after a bird strike on the windshield of rotorcraft with six or more passenger seats.

CS 27.631 'Bird strike' is derived from CS 29.631 'Bird strike', the wording of which was improved. CS 27.631:

— specifies that rotorcraft must be designed to ensure safe landing after a bird strike on the windshield;

— only covers strikes on the windshield, where bird strike damage mostly occurs; and

— only applies to rotorcraft with six or more passenger seats as the impact assessment (IA) showed that such a CS is not economically viable for small rotorcraft with less than six passenger seats.

AMC1 27.631 'Bird strike':

— provides acceptable means of compliance with CS 27.631 'Bird strike'; and

— describes the rotorcraft parts that should be evaluated in the event of a single bird strike.

	Differences with NPA 2021-02
CS 27.631	The applicability of CS 27.631 was changed from 'a maximum of six to nine passenger seats' to 'six or more passenger seats'. The reference to 'True Airspeed (TAS)' was introduced after the velocities: 'V_{NE} or V_H **(TAS)**'.
AMC1 27.631	The structure of AMC 27.631 was improved: — the reference to CS-E 800 was changed to a note; and — V_H evaluation was introduced.

Table 4

Amendments to CS-29

CS 29.631 'Bird strike' is amended to reflect the wording improvements of CS 27.631 'Bird strike'. The technical content remains unchanged as the CS has shown its effectiveness to date.

AMC1 29.631 'Bird strike' is introduced to support the application of CS 29.631 'Bird strike'. AMC1 29.631:

— is based on lessons learned from recent certification processes;

— describes the rotorcraft parts that should be evaluated in the event of a single bird strike; and

— gives recommendations on the use of a comprehensive hazard analysis for selecting the rotorcraft parts that should be evaluated.

This new AMC supersedes AC 29.631 of Federal Aviation Administration (FAA) Advisory Circular (AC) 29-2C, which contains similar provisions.

	Differences with NPA 2021-02
CS 29.631	The reference to 'True Airspeed (TAS)' was introduced after the velocities: 'V_{NE} or V_H **(TAS)**'.
AMC1 29.631	The structure of AMC 29.631 was improved: — the reference to CS-E 800 was changed to a note; — V_H evaluation was introduced; and

	— 'exposed' was inserted before 'structures, systems, and equipment' in point (a)(2).

Table 5

2.4. What are the stakeholders' views — outcome of the consultation

2.4.1 RMT.0725 — Rotorcraft chip detection systems

During the public consultation, EASA received 79 comments from 14 commenters. 6 commenters represented the national competent authorities (NCAs) and 8 commenters represented industry.

Two-fifths of the comments came from industry and three fifths from NCAs. Apart from the general comments, most comments were on the AMC and GM.

A quarter of the comments submitted were not accepted, forty percent were noted, and the remaining ones were accepted.

Generally, the commenters supported the proposal, and the comments received helped to improve the CSs, AMC, and GM.

Amount of particles and time needed for detection (4 commenters)

Several commenters considered the amount of particles and the time needed to detect them as adequate design provisions to ensure that any released particles are driven to the chip detector. EASA reviewed those comments and updated the structure of the text accordingly. In addition, 60 mg is now only an alternative amount of particles that may be used as a minimum AMC without the need to thoroughly investigate failure modes at every critical location. The 20-minute time is now the preferred duration, but a longer period may be considered, if appropriately justified.

Costs (2 commenters)

Two comments from industry indicated that additional tests could increase the certification costs. A commenter provided a cost estimation, which was harmonised with the estimation provided in the economic IA. However, the commenter did not agree with the resulting economic impact. EASA indicated that only the most severe modes and locations must be tested. EASA also explained that the cost estimates in the IA were provided by industry.

Terminology (2 commenters)

The commenters proposed to update or modify specific terms. EASA reviewed the proposals and justified the terms used based on the need for consistency.

Additional proposed means of compliance (3 commenters)

Industry and NCAs made further proposals for addressing performance and reliability of the chip detection system. EASA reviewed the proposals and updated the text accordingly.

Scope of Subtasks 1 and 2 (3 commenters)

The commenters asked for clarification of the scope of Subtasks 1 and 2. EASA clarified the scope of Subtask 1 and indicated the objectives of Subtask 2. EASA considered specific guidance on advanced means for particle detection and on degradation monitoring to be out of the scope of this RMT.

EASA took into account most of the comments on inconsistent numbering or typos.

For further information, please refer to CRD 2021-01[8] which contains individual responses to the stakeholder comments.

2.4.2 RMT.0726 — Rotorcraft occupant safety in the event of a bird strike

EASA received 83 comments from 18 commenters. 10 commenters represented Industry, 7 commenters represented NCAs, and 1 commenter was an individual.

Two-thirds of the comments came from industry and one-third from NCAs. Apart from the general comments, most industry comments were on the regulatory text and the IA, while NCA comments were mainly on the IA.

EASA accepted 25 %, noted 25 %, and did not accept 50 % of the comments.

Generally, the commenters supported the proposals, and some of them even proposed to broaden the scope of the CSs. Some comments helped to clarify the objective of NPA 2021-02, correct editorial mistakes, and improve the regulatory text.

CS 27.631, CS 29.631, AMC 27.631, and AMC 29.631

EASA received 30 comments on the proposed regulatory text, mainly from industry (23 comments). EASA agreed on 8 comments mainly on improving and clarifying AMC 27.631 and AMC 29.631.

CS 27.631 and CS 29.631

Some commenters (from industry and NCAs) proposed to extend the applicability of CS 27.631 to Tier II rotorcraft[9], even to all CS-27 rotorcraft, and to apply a continuum approach from CS-29 to CS-27 rotorcraft. They also asked to consider the number of occupants instead of the number of passenger seats to reflect specific operational configurations. EASA did not accept those proposals as the IA supports the option of regulating only Tier III (Option 3), and the passenger seat criterion is the same as the applicability criterion in CS 27.1. Instead of defining new tiers, EASA decided to use those defined by the FAA Aviation Rulemaking Advisory Committee Rotorcraft Bird Strike Working Group (ARAC RBSWG), which had carried out an extensive study. In response to the comments on specific operations, EASA referred to the Safety Information Bulletin (SIB) on 'Bird Strike Risk Mitigation in Rotorcraft Operations', which was published in April 2021.

A commenter indicated that the range of passenger seats in CS 27.631 ('a maximum of six to nine passenger seats') was misleading as it could apply to all CS-27 rotorcraft. EASA redrafted CS 27.631 to prevent such potential confusion.

Few commenters proposed to consider a higher bird mass. EASA did not accept it as the NPA 2021-02-proposed mass adequately reflects the mean mass of birds that are involved in strikes with CS-29 rotorcraft.

In response to two comments, EASA specified that drone strikes are not regulated by the bird strike CSs but are considered under a dedicated research project.

8 https://www.easa.europa.eu/document-library/comment-response-documents

9 Tier I: 0-2 passenger seats; Tier II: 3-5 passenger seats; Tier III: 6-9 passenger seats.

EASA clarified the choice between the two velocities V_H and V_{NE}, and agreed to refer to 'True Airspeed (TAS)' to determine the velocities in CS 27.631 and CS 29.631. EASA did not find necessary to clarify that the velocities are considered for forward flight.

AMC1 27.631 and AMC1 29.631

Industry had more comments on the AMC than on the CSs, mainly on windshield and equipment. EASA clarified the issues raised and accepted only few of the proposals.

Commenters expressed diverging concerns about the non-penetration criterion of the windshield (not a sufficient AMC or too difficult to demonstrate). EASA did not accept to remove the non-penetration criterion from the evaluation of the windshield because it has shown its effectiveness in demonstrating compliance with CS 29.631. However, EASA confirmed that this is only one proposed AMC (e.g. some other systems and equipment need to be evaluated as well).

EASA did not accept to define neither 'windshield' nor 'supporting frame' as they are design dependant.

Some commenters asked to clarify the need for referring to equipment qualification as an AMC to the bird strike CSs and to the potential impact of the AMC on additional equipment qualification. The new AMCs refer to the evaluation of shock loads on essential equipment to ensure safe landing. This effect depends on the design, and the applicant for a rotorcraft certification is responsible for demonstrating compliance with the design provided for in the CS. AMC 29.631 was redrafted to clarify that 'exposed' structures, systems, and equipment should be evaluated. The new AMC do not introduce changes to equipment qualification methods, and EASA did not include a reference to RTCA DO-160.

EASA did not accept comments that requested to provide more specific AMC (e.g. test temperature range, rotorcraft attitude, use of finite analysis, etc.) because the applicant for certification is responsible for defining the conditions of the evaluation and for selecting the appropriate analysis of the product.

EASA did not accept a comment on a potential inconsistency between the reference to FAA AC 27.1B in AMC 27 'General' (i.e. to the AC 27-1B.573 part that deals with 'discrete source damage' and refers to bird strike) and the new AMC 27.631. However, EASA will consider this under RMT.0128 'Regular update of CS-27 and CS-29'.

EASA agreed to restructure the AMC to correctly present the means of compliance and the notes to them.

IA

EASA received 24 comments on the NPA 2021-02 IA (evenly shared between industry and NCAs) and accepted or partially accepted 4 comments on correcting a calculation and improving the text. Half of the comments were not accepted and one third were noted.

Some commenters from industry and NCAs proposed to regulate Tier II rotorcraft based on a cost-benefit analysis (CBA) and an additional sensitivity analysis. One NCA considered that the non-recurring costs are negligible for Tier I and Tier II rotorcraft, such that all CS-27 rotorcraft should be regulated for bird strike protection. EASA did not accept this proposal as:

— it was not supported by new data; and

— the required sensitivity analysis to include Tier II rotorcraft would imply a non-realistic increase in the accident rate.

Generally, EASA did not accept non-data-supported comments asking for reassessment of the IA conclusion.

Industry questioned the 30-year time span for the analysis, which might lead to extrapolation errors. EASA indicated that such a long period is necessary, to account for the years between the launches of new types of rotorcraft and the slow penetration of those new types into the total fleet.

To clarify the relationship between the accident rate and the estimated benefit, EASA provided additional information on the evolution of the small-rotorcraft (CS-27) fleet in EASA Member States (MSs) and on their flight hours for the 2020-2050 period.

In response to comments requesting to consider in the CBA recurring costs for operators, EASA indicated that the costs associated with a potential increase in weight (due to increased fuel consumption or decreased payload) are negligible for Tier III rotorcraft. In addition, non-negligible recurring costs for Tier I and Tier II rotorcraft would not affect the result of the CBA as the costs are already higher than the benefits in that case.

To avoid confusion, EASA explained that Subtask 1 of RMT.0726 applies only to new type designs. Therefore, EASA did not consider the costs and benefits associated with a potential retrofit.

One industry commenter indicated a calculation error under 'Total non-recurring costs in the 2020-2050 period' in Table 7 of NPA 2021-02. However, this miscalculation does not change the conclusion of the CBA, and reinforces the selection of Option 3. Table 6 shows that the correct net present value is EUR 4 601 947 compared to EUR 4 104 512 as in Table 8 of NPA 2021-02.

Description	Option 1 Tier I	Option 2 Tier II	Option 3 Tier III
Value of benefit	EUR 102 414	EUR 2 357 938	EUR 8 716 027
Cost	EUR 1 580 380	EUR 2 510 579	EUR 4 611 515
Net present value (= value of benefit-cost)	-EUR 1 477 966	-EUR 152 641	EUR 4 601 947

Table 6

In response to comments questioning that the frequency of bird strikes will increase, EASA clarified that the risk of bird strikes is considered higher due to the increasing number of occurrences and the unpredictable effects of such strikes.

For further information, please refer to CRD 2021-02[10], which contains individual responses to the comments.

[10] https://www.easa.europa.eu/document-library/comment-response-documents

2.5. What are the benefits and drawbacks of the amendments

2.5.1 RMT.0725 — Rotorcraft chip detection systems

Safety impact

EASA analysed rotorcraft incidents and accidents that were caused by ineffective chip detection systems. EASA's review revealed that many catastrophic accidents could have been prevented if more effective chip detection systems had been installed on the affected gearboxes of rotor drive systems.

Therefore, the related CSs must require demonstrating the effectiveness of a chip detection system.

Environmental impact

EASA did not identify any environmental impact.

Social impact

EASA did not identify any social impact.

Economic impact

EASA assessed the economic impact as being very low.

Conclusion

The amendments are expected to have a considerable safety benefit, no social or environmental impacts, no major impact on certification costs, as well as to streamline the certification process.

For the detailed IA, see NPA 2021-01.

2.5.2 RMT.0726 — Rotorcraft occupant safety in the event of a bird strike

CS 27.631

IA

EASA performed a full CBA in the NPA 2021-02 IA, dividing small rotorcraft into three tiers (Tier I: 0-2 passenger seats; Tier II: 3-5 passenger seats; Tier III: 6-9 passenger seats), and assessing the option to apply the bird strike CS to each tier (Options 1, 2, and 3, respectively). The division into tiers allowed EASA to assess the differences in costs and benefits, which result from the size of the rotorcraft.

EASA considered the recommendations from the FAA ARAC RBSWG[11] report, to which EASA contributed. However, EASA adapted the costs and safety benefits to the characteristics of the EASA MSs' fleet.

None of the options is expected to have neither a social nor an environmental impact. The safety benefits exceed the development costs only under Option 3, which is in line with the FAA ARAC RBSWG recommendations.

EASA selected Option 3, limiting the applicability of CS 27.631 to newly designed small rotorcraft with six or more passenger seats.

[11] FAA ARAC RBSWG report, Revision B, 8 May 2019.

In response to comments, EASA clarified some aspects of the NPA 2021-02 IA in CRD 2021-02[12]. Also, based on a comment, Table 8 of NPA 2021-02 was updated as in Table 6, which reinforces the selection of Option 3.

Conclusion

The new bird strike CS for small rotorcraft with six or more passenger seats (CS 27.631) is expected to have a real safety benefit, no social or environmental impacts, and no major impact on certification costs.

For the detailed IA, see NPA 2021-02.

AMC1 27.631 and AMC1 29.631

AMC1 27.631 and AMC1 29.631 will support the application of the new CS 27.631 and the amended CS 29.631, and provide a level playing field among the applicants for certification.

12 https://www.easa.europa.eu/document-library/comment-response-documents

3. How we monitor and evaluate the amended CSs, AMC and GM

3.1. RMT.0725 — Rotorcraft chip detection systems

EASA will evaluate the effectiveness of the CS-27 and CS-29 amendments as part of the standard monitoring process of occurrences that are reported to EASA in accordance with Regulation (EU) No 376/2014 (the 'Occurrence Reporting' Regulation)[13]. EASA expects that the chip detection systems of rotorcraft certified in accordance with the new requirements will effectively detect the ferromagnetic particles indicating an incipient failure or degradation of internal gearbox components. Therefore, EASA expects that the number of undetected failures of internal gearbox components will decrease.

3.2. RMT.0726 — Rotorcraft occupant safety in the event of a bird strike

EASA will evaluate the effectiveness of the new CS 27.631 as part of the standard monitoring process of occurrences that are reported to EASA in accordance with the Occurrence Reporting Regulation. EASA expects that newly designed small rotorcraft that are certified in accordance with the new CS 27.631 will ensure effective protection in case of a bird strike. Therefore, EASA expects that the number of windshield failures due to bird strikes, leading to occupant injuries or unsafe emergency landings, will be negligible.

[13] Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation, amending Regulation (EU) 996/2010 of the European Parliament and of the Council and repealing Directive 2003/42/EC of the European Parliament and of the Council and Commission Regulations (EC) No 1321/2007 and (EC) No 1330/2007 (OJ L 122, 24.4.2014, p. 18) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R0376&qid=1610974200014).

4. References

4.1. Related EU regulations

N/a.

4.2. Related EASA decisions

— Decision No. 2003/15/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications for small rotorcraft ('CS-27')

— Decision No. 2003/16/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications for large rotorcraft ('CS-29')

4.3. Other reference documents

— FAA ROTORCRAFT BIRD STRIKE WORKING GROUP RECOMMENDATIONS TO THE AVIATION RULEMAKING ADVISORY COMMITTEE (ARAC), Revision B, 8 May 2019

— EASA/Atkins *Bird Strike Damage & Windshield Bird Strike*, Final Report, 5078609-rep-03, Version 1.1, December 2009

— ICAO ELECTRONIC BULLETIN, *2008-2015 WILDLIFE STRIKE ANALYSES (IBIS)*, EB 2017/25, 12 May 2017

— *Wildlife Strikes to Civil Aircraft in the United States 1990-2005*, Cleary, Dolbeer, & Wright, June 2006

— EASA Safety Information Bulletin on 'Bird Strike Risk Mitigation in Rotorcraft Operations', SIB No 2021-07, 19 April 2021

5. Related documents

— CRD 2021-01 ‘Rotorcraft chip detection systems’

— CRD 2021-02 ‘Rotorcraft occupant safety in the event of a bird strike’