European Union Aviation Safety Agency

Terms of Reference

for Rulemaking task RMT.0725

Rotorcraft chip detection system

ISSUE 1

Issue/rationale

Certification specifications (CS) 27.1337(e) and 29.1337(e) require the installation of chip detectors to detect particles of ferromagnetic material that are released by elements of rotor drive systems as a result of damage or wear.

Additionally, chip detectors are frequently identified, and accepted, as one of the compensating provisions for hazardous or catastrophic failures in the design assessment (refer to CS 29.917(b)). However, there is no explicit provision in the CSs, nor any detailed AMC, for consistently demonstrating that chip detectors perform their intended function.

In-service experience shows that there have been occurrences where the chip detection system was not capable of indicating the presence of wear or degradation of elements of rotorcraft gearboxes, even if resulting particles were present in the system for some time before a failure occurred. Therefore, the specific objective of this proposal is to ensure that an acceptable minimum level of effectiveness is achieved by the chip detection systems installed in rotorcraft drive systems.

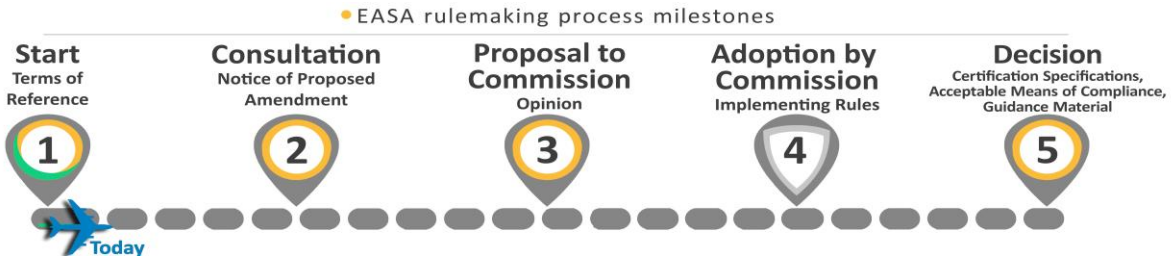
This objective will be achieved by:

— introducing a new objective-based certification requirement for the demonstration of the performance of a chip detection system (Subtask 1); and

— assessing whether it is necessary to implement a proportionate retroactive application of the certification requirements to the existing fleets and/or to the future production of type-certified rotorcraft (Subtask 2).

Action area:	Design and production; Rotorcraft		
Affected rules:	Regulation (EU) 2015/640 and its Annex I (Part 26), CS 27, CS 29, CS 26		
Affected stakeholders:	DOA and POA holders		
Driver:	Safety	**Rulemaking group:**	Yes
Impact assessment:	Full	**Rulemaking Procedure:**	Standard

Subtask 1			
07.04.2020	2021/Q1		2022/Q1



Subtask 2				
07.04.2020	TBC	TBC	TBC	TBC

1. Why we need to change the rules — issue/rationale

1.1. Background

The function of a rotorcraft drive system is to transmit power from the engines to the rotors, whilst at the same time reducing the rotational speed and increasing torque. A typical rotorcraft rotor drive system main gearbox consists of many highly loaded dynamic components that are essential for continued safe flight and landing. Rotorcraft drive systems usually have a single-load-path architecture, and it is difficult to directly access and regularly inspect the integrity of each critical component between scheduled overhauls, which for practical reasons cannot be too frequent. It is for this reason that the detection of ferromagnetic particles has always played an essential role in identifying any degradation of these systems that would otherwise prevent continued safe flight and landing.

Chip detectors performing this function are located in key areas of drive system gearboxes to provide an indication to the crew and/or maintenance personnel of the presence of ferromagnetic particles.

The actual capability of chip detectors to indicate the presence of ferromagnetic particles (referred to as 'chip detection effectiveness' from this point on) depends on:

— the possibility of ferromagnetic particles released by any critical component reaching the chip detector location;

— the capability of the chip detector to detect, or collect and detect, these particles; and

— the amount of accumulated particles that are needed to initiate a warning.

1.2. Description of the safety issue

CS 27.1337(e) and 29.1337(e) require rotor drive system transmissions and gearboxes of small and large rotorcraft to be equipped with chip detectors to indicate the presence of ferromagnetic particles resulting from damage or excessive wear of elements of the systems, and provide a warning signal to the crew.

However, currently, there are no provisions in the certification specifications or their associated acceptable means of compliance that require the demonstration of an adequate level of chip detection effectiveness. In addition, it is recognised that the establishment of the chip detection effectiveness of a system is not a simple task and typically requires a detailed evaluation through specific testing to ensure reliable and repeatable results.

Based on the above considerations, there is a potential for current and future rotorcraft types to feature systems that have low chip detection effectiveness, and that would not be capable of detecting the incipient degradation of rotor drive system components as intended.

A review conducted by the European Union Aviation Safety Agency (EASA) revealed that a number of catastrophic accidents have occurred which could have been prevented by having a more effective chip detection system installed on the affected rotorcraft drive system gearboxes. Additionally, this review identified that there have been other incidents where a more effective chip detection system could have mitigated a safety issue.

Based upon the outcome of this analysis, it is considered that there may be a gap between the assumed safety benefit that is provided by the installation of chip detectors in rotorcraft drive systems and the actual effectiveness of the chip detection that is provided by the current systems.

An impact assessment has been performed as part of the Best Intervention Strategy (BIS). The assessment will be reviewed during the work of the rulemaking group and updated, if necessary. This will then be consulted at the NPA stage.

1.3. Related Safety recommendation to EASA

The following safety recommendation (SR), addressed to EASA, from aircraft accident investigation reports and published by the designated safety investigation authority[1] will be considered for this rulemaking task (RMT). New SRs related to this task may be considered after the publication of this ToR, where appropriate.

AIB Norway safety recommendation NORW-2018-004:

> '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.'

This SR is related to one accident that occurred on 29 April 2016 during an offshore mission at the North Sea, Norway, involving a EUROCOPTER — EC225 rotorcraft registered LN-OJF.

There are no:

— exemptions that are pertinent to the scope of this RMT;

— direct references to ICAO Standards and Recommended Practices; or

— references to EU regulatory material that is relevant for this RMT.

1.4. Actions already launched by EASA

Considering the safety issue described above, EASA has, on recent projects, prepared interpretative material in the form of possible means of compliance with the CS to address the issue. Furthermore, EASA is continuously investigating whether an unsafe condition may exist in the rest of the in-service large rotorcraft fleet, and has therefore actioned TC holders of CS-29 products to review design data and service experience to assess:

— the potential for critical cracks to initiate and grow in a gearbox planet gear with an integrated bearing race, prior to the detection of debris, and

— the capability of the chip detection/oil debris monitoring system to protect against the failure modes identified in the rotor drive system design assessment.

[1] Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (OJ L 295, 12.11.2010, p. 35) (http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1479716039678&uri=CELEX:32010R0996).

2. What we want to achieve — objective

The overall objectives of the EASA system are defined in Article 1 of Regulation (EU) 2018/1139. This project will contribute to the achievement of the overall objectives by addressing the issues outlined in Chapter 1.

The specific objective of this proposal is to ensure that the chip detection systems installed in rotorcraft drive systems achieve an acceptable minimum level of effectiveness.

3. How we want to achieve it

To ensure the achievement of the objectives identified in Chapter 2, the following activities will be conducted:

— Based on a detailed review of the existing interpretative material that has been applied to recent rotorcraft certification projects, EASA will consider the best approach to the certification of the performance aspects of chip detector systems, taking into account the need for proportionality between CS-27 and CS-29. To that end, EASA will consider the introduction of a new objective-based certification requirement for the demonstration of the performance of chip detection systems; and

— EASA will also assess whether it is necessary to implement a proportionate retroactive application of certification requirements to the existing fleets and /or to the future production of type-certified rotorcraft.

To ensure an effective process, the activities related to RMT.0725 will be carried out in two phases as follows:

— **Subtask 1:** Introduction of a new objective-based certification requirement for the performance of chip detection systems, and the associated acceptable means of compliance.

— **Subtask 2:** Assessment of whether it is necessary to implement a proportionate retroactive application of certification requirements to the existing fleets and to the future production of type-certified rotorcraft

4. What are the deliverables

The expected deliverables of this RMT for Subtask 1 are:

— a notice of proposed amendment (NPA) that proposes amendments to CS-27 and CS-29 as found necessary, including the associated AMC; and

— an ED Decision that amends CS-27 and CS-29, including the associated AMC, based on the proposal consulted in the NPA and the comments received thereto.

The expected deliverables of this RMT for Subtask 2 are:

— A detailed assessment, including the outcome of the action to TC holders to review design data and service experience, of whether the current continued airworthiness process is successful in comprehensively identifying and addressing any potential existing deficiencies in chip detection systems. If not, a full regulatory impact assessment (RIA), considering the safety benefits of mandating a retrospective measure for the future production of already type-certified products and/or a retrofit of the existing fleet in relation to the economics, environmental and social impacts of such a measure.

— If the above-mentioned RIA concludes that the safety benefit of a retrospective measure outweighs the potential negative economic, environmental, and social impacts:
  — an NPA that proposes changes to Regulation (EU) 2015/640 and its Annex I (Part-26), and to CS-26, including the associated guidance material (GM), as found necessary;
  — an Opinion with draft implementing acts to propose to the European Commission an amendment of Regulation (EU) 2015/640 and its Annex I (Part-26), based on the proposal consulted in the NPA and the comments received thereto; and
  — an ED Decision that amends CS-26, including the associated GM, as necessary, based on the proposal consulted in the NPA and the comments received on it.

5. How we consult

A public consultation through an NPA will take place for both phases of this RMT, in accordance with Article 7 of the Rulemaking Procedure[2].

6. Profile and contribution of the rulemaking group

A rulemaking group will be established with the following objectives:

a) Support EASA by providing data, as necessary to conduct this RMT, and, in particular, support the impact assessment of a retrospective measure for existing designs and the in-service fleet (Subtask 2).

b) Provide advice to EASA.

c) Provide comments on the draft proposals prepared by EASA before launching the public consultation through NPAs.

d) Support EASA as necessary in reviewing the comments received during the public consultation of the NPAs.

The profile of the rulemaking group and its members is as follows:

— Expertise required:
  — Experience in the design and development of rotorcraft drive transmission systems;
  — Experience in the planning and preparation of drive system certification tests, and, ideally, also of development tests for the evaluation of the performance of chip detection systems;
  — Certification experience related to rotorcraft drive systems;
  — Experience in the assessment of the cost and benefits of technical solutions or capability to liaise with companies/organisations' economic experts to provide such information as appropriate; and
  — Extensive awareness of the design of the gearboxes of rotorcraft drive systems and their associated lubrication systems.

[2] EASA Management Board Decision N°18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications, acceptable means of compliance and guidance material ('Rulemaking Procedure').

— The rulemaking group shall be composed of:

  — Authority representatives from EASA and Civil Aviation Authorities (CAAs); and

  — Rotorcraft manufacturers.

7. References

7.1. Affected regulations

— Commission Regulation (EU) 2015/640 of 23 April 2015 on additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012 (OJ L 106, 24.4.2015, p. 18)

7.2. Affected decisions

— ED Decision 2015/013/R of 8 May 2015 adopting Certification Specifications for additional airworthiness specifications for operations ('CS-26')

— 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 14 November 2003 on Certification Specifications and Acceptable Means of Compliance for Large Rotorcraft ('CS-29')