CERTIFICATION SPECIFICATIONS
ACCEPTABLE MEANS OF COMPLIANCE
AND
GUIDANCE MATERIAL
FOR
SMALL ROTORCRAFT

CS-27 AMENDMENT 9 — CHANGE INFORMATION

The European Union Aviation Safety Agency (EASA) issues amendments to certification specifications (CSs) as consolidated documents. These documents are used for establishing the certification basis for applications submitted after the date of entry into force of the applicable amendment.

Consequently, except for a note '[Amdt No: 27/9]' under the amended rule, the consolidated CS-27 Amendment 9 (Annex 1 to ED Decision 2021/016/R) does not highlight the changes introduced. To show the changes, this change information document was created, using the following format:

— deleted text is ~~struck through~~;

— new or amended text is highlighted in blue;

— an ellipsis '[…]' indicates that the rest of the text is unchanged.

Note to the reader

In amended, and in particular in existing (that is, unchanged) text, 'Agency' *is used interchangeably with* 'EASA'. *The interchangeable use of these two terms is more apparent in the consolidated versions. Therefore, please note that both terms refer to the* 'European Union Aviation Safety Agency (EASA)'.

PREAMBLE

CS-27 Amendment 9

Effective: ***See Decision 2021/016/R***

The following is a list of paragraphs affected by this amendment.

Subpart A	
Appendix C	Amended (NPA 2021-01)
Subpart D	
CS 27.631	Created (NPA 2021-02)
AMC1 27.631	Created (NPA 2021-02)
Subpart F	
CS 27.1305	Amended (NPA 2021-01)
CS 27.1337	Amended (NPA 2021-01)
AMC1 27.1337(e)	Created (NPA 2021-01)
GM1 27.1337(e)	Created (NPA 2021-01)

SUBPART A — GENERAL

Appendix C — Criteria for Category A

[…]

29.1331(b) – Instruments using a power supply.

29.1337(e) – Chip detection system.

29.1351(d)(2) – Additional requirements for Category A rotorcraft (Operation with the normal electrical power generating system inoperative).

[…]

[Amdt No: 27/2]

[Amdt No: 27/4]

[Amdt No: 27/5]

[Amdt No: 27/6]

[Amdt No: 27/9]

SUBPART D — DESIGN AND CONSTRUCTION

GENERAL

[…]

CS 27.631 Bird strike

(See AMC1 27.631)

Rotorcraft with six or more passenger seats must be designed to ensure a safe landing after a strike upon the windshield by a 1.0-kg (2.2-lb) bird when the velocity of the rotorcraft relative to the bird along the flight path of the rotorcraft is equal to V_{NE} or V_H 'True Airspeed' (TAS), whichever is less, at altitudes up to 2 438 m (8 000 ft). The applicant must demonstrate compliance through tests, or analysis based on tests that are carried out on sufficiently representative structures of similar design.

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AMC1 27.631 Bird strike

(a) To demonstrate the remaining capability of the rotorcraft after a single bird strike, the applicant should evaluate the parts of the rotorcraft as follows:

(1) the windshield directly in front of the occupants and its supporting frame should be capable of withstanding a bird strike without penetration; and

(2) any systems and equipment (including their controls) that are essential to ensure a safe landing and are installed near the windshield and its supporting frame should remain operative in case of shock loads resulting from a bird strike.

Note: the capability to withstand multiple bird strikes is only evaluated for engines as specified under CS-E 800 'Bird Strike and Ingestion'.

(b) For the demonstration under point (a), the altitude range within which the velocity V_H is evaluated should be defined and should not exceed 2 438 m (8 000 ft).

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SUBPART F — EQUIPMENT

GENERAL

[…]

CS 27.1305 Powerplant instruments

The following are the required powerplant instruments:

[…]

(v) Warning or caution devices to signal to the flight crew when ferromagnetic particles are detected by the chip ~~detector~~detection system required by CS 27.1337(e).

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INSTRUMENTS: INSTALLATION

[…]

CS 27.1337 Powerplant instruments

[…]

(e) *Chip detection system*. Rotor drive system transmissions and gearboxes utilising ferromagnetic materials must be equipped with chip ~~detectors~~detection systems designed and demonstrated to effectively indicate the presence of ferromagnetic particles resulting from damage or excessive wear within the transmission or gearbox. Each ~~C~~chip ~~detectors~~detection system must:

(1) be designed to provide a signal to the ~~indicator required by~~warning or caution devices in accordance with CS 27.1305(v); and

(2) be provided with a means to allow crew members to check or to be informed of, in flight, whether the electrical circuits of the chip detection system function correctly.~~the function of each detector electrical circuit and signal.~~

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AMC1 27.1337(e) Powerplant instruments

CHIP DETECTION SYSTEM

This AMC provides further guidance and acceptable means of compliance to supplement Federal Aviation Administration (FAA) Advisory Circular (AC) 27-1B, § AC 27.1337. As such, it should be used in conjunction with the FAA AC.

The applicant should consider the following aspects of chip detection systems:

(a) Chip detection effectiveness

The effectiveness of the chip detection system should be understood as its capability to indicate the presence of ferromagnetic particles within a transmission or a gearbox. As a chip detection system requires these ferromagnetic particles to be near its sensing element(s) (chip detector(s)), its effectiveness depends on the following:

— the design of the rotor drive system's transmission or gearbox, which may help or prevent released ferromagnetic particles to move to the chip detector location(s);

— the location of the chip detector; and

— the design of the chip detector.

(b) Demonstration of effectiveness

As specified in CS 27.1337(e), the applicant should demonstrate that a chip detection system that is installed in a rotor drive system's transmission or gearbox effectively indicates the presence of ferromagnetic particles resulting from damage or excessive wear within the transmission or gearbox. For this purpose, the applicant should consider the approach that is described in this section.

As mentioned above, the design of the transmission or gearbox, and the location of the chip detectors within them also affect the effectiveness of a chip detection system. As a result, when assessing the effectiveness of a chip detection system, the applicant should consider the characteristics of the complete transmission or gearbox. Hence, as part of the demonstration of the effectiveness of a chip detection system, the applicant should demonstrate that the system can consistently generate a caution/warning signal, within an acceptable period of time, of a limited amount of representative ferromagnetic particles being released. In doing so, the applicant should also consider the characteristics of the corresponding transmission or gearbox, such as oil ways and flow paths towards the chip detectors.

To demonstrate the effectiveness of a chip detection system, the applicant should carry out a detailed design assessment, using representative test data that support the performance of the relevant chip detectors in their local environments.

The applicant should use this assessment to demonstrate that the design provisions are adequate to ensure that the ferromagnetic particles that are released due to damage or excessive wear in the relevant locations will reach at least one chip detector. Sufficient test data to support the performance of the relevant chip detectors in representative environments should be available to demonstrate that the caution/warning signal that is specified in CS 27.1305(v) is generated. When assessing the available test data, the applicant should consider that based on the area of the transmission or gearbox where the particles originate,

additional test points may be needed, depending on the design of the chip detectors and of the areas around them. If the design of the transmission or gearbox has questionable features that may trap particles or impede their progress, representative test data or in-service experience that demonstrate the impact of these features on the effectiveness of the chip detection system should be available to support the assessment.

The applicant may obtain supporting test data from representative full-scale tests, previous similar designs and/or components, or sub-assembly tests, as appropriate.

To demonstrate the effectiveness of the chip detection system, as described in this section, the applicant should also ensure that the chip detection system performs its intended function under any expected operating conditions. Therefore, the applicant should consider, through design analysis and/or dedicated testing, any aspects of the chip detection system and of the elements in which it is installed (i.e. gearboxes and transmissions) that could affect the effectiveness of the system. These aspects should include the following:

— attitude of the rotorcraft;

— temperature and viscosity of the oil; and

— exact location from which the ferromagnetic particles originate, and the vicinity of potential retention features.

(c) Acceptable level of effectiveness

This section provides an acceptable measure for demonstrating the effectiveness of the chip detection system that is described in point (b).

An acceptable level of effectiveness is demonstrated when the chip detection system generates a caution/warning signal following the release of an amount of ferromagnetic particles. The applicant should justify that this amount results from the damage or excessive wear caused by the failure modes of the specific area of the transmission or gearbox under assessment. Alternatively, the applicant may choose to use 60 mg of ferromagnetic particles.

In addition, no more than 20 minutes should elapse between the introduction of the first ferromagnetic particles and the generation of the caution/warning signal by the chip detection system. However, if the applicant demonstrates that a specific design feature of the chip detection systems consistently leads to effective detection in a period greater than 20 min, the adequacy of that system may be considered on a case-by-case basis.

When demonstrating the effectiveness of the chip detection system, the applicant should consider particles with characteristics (shapes, sizes, densities, and magnetic properties) representative of the damage or excessive wear associated with the areas being tested.

(d) Other considerations

(1) Reliability considerations

CS 27.1337(e) focuses on the overall effectiveness of the chip detection system. The assumption is made that the electrical elements of the system, the chip detector(s), and the instruments function reliably due to good design practices and compliance with the applicable requirements for electrical systems.

(2) Design considerations

(i) Flat oil sumps can significantly limit the capability of ferromagnetic particles, coming from different locations in the transmission or gearbox, that need to move across the sump to reach a chip detector. Therefore, the applicant should normally use substantiating test data to support the certification of this type of design feature.

Note: if the applicant has successfully performed tests in accordance with point (b), no further test data are necessary.

(ii) When designing rotor drive system transmissions and gearboxes, the applicant should ensure that the flow path of the lubricating oil that is intended to carry ferromagnetic particles is directed to the locations of the chip detectors. The location, orientation, and flow of oil jets may affect the movement of the ferromagnetic particles subject to their influence.

(iii) The applicant should avoid, wherever possible, specific features, such as cavities or pockets that could act as retention features for ferromagnetic particles.

(iv) In pressure-lubricated gearboxes, ferromagnetic particles may be drawn into the lubrication circuit at the pump intake. This can be advantageous for locating chip detectors. However, the applicant should carefully consider that the chip detection system may require particles to be acquired and retained, allowing them to be recovered and analysed. Thus, areas of strong oil flow should be carefully considered, ensuring that the final location is defined and implemented in the design for particle recovery.

For non-pressure-lubricated gearboxes, the applicant should place the chip detector at the lowest point of the system.

(3) Maintenance and ICA considerations

The applicant should consider that CS 27.1337(e) focuses on the fitment of a chip detection system. That system should be an effective means to indicate the presence of ferromagnetic particles in rotor drive system transmissions and gearboxes, which may be caused by damage or excessive wear. It should also be capable to indicate the presence of such particles and to be checked in flight. However, following the detection of such particles by the rotorcraft chip detection system, additional actions are typically needed to ensure the airworthiness of the rotorcraft. The applicant should define the following actions in the instructions for continuing airworthiness (ICA):

— instructions to assess findings from any indication from the chip detection system, which may involve:

— analysis of the quantity and characteristics of the ferromagnetic particles that are detected and retrieved, and/or

— maintenance checks to retrieve additional ferromagnetic particles from other areas of the rotor drive system, such as the oil filter of the lubrication system;

— specific criteria to establish whether any findings may indicate that parts of the affected transmission or gearbox are subject to damage or wear and require to be restored to a serviceable condition; and

— additional inspections in support of continued operation when the aforementioned criteria are not reached.

In addition, the applicant may consider complementing the caution/warning signal of the chip detection system by regular inspection of the chip detector(s) and/or other elements of the transmission or gearbox where ferromagnetic particles may be located.

Finally, the applicant should ensure that the reliability of the system is maintained in service by conducting the necessary in-flight and maintenance checks to verify that the elements of the chip detection system function correctly.

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GM1 27.1337(e) Powerplant instruments

CHIP DETECTION SYSTEM

The chip detection system typically includes one or more sensing elements (i.e. 'chip detectors') per transmission or gearbox. Those chip detectors have the function of detecting the presence of ferromagnetic particles and generating a caution/warning signal. The chip detection system also includes the connectors' wiring, as well as the hardware unit for processing the caution/warning signal, if needed, transferring it, and generating the warning or caution required by CS 27.1305(v).

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