

Certification Memorandum

Display of attitude at night for VFR approval in rotorcraft

EASA CM No.: CM-FT-003 Issue 01 issued 12 March 2021

Regulatory requirement(s): CS 27.1303, CS 27.1309, CS 29.1303 and CS 29.1309

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Log of issues

Issue	Issue date	Change description
01	12.03.2021	First issue

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1. Introduction

1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide clarification on the EASA certification policies for night VFR approval of CS-27 and CS-29 rotorcraft. In particular, the objective of this Certification Memorandum is to clarify how some of the most common failure conditions affecting attitude indications need to be classified for rotorcraft to be approved for night VFR operations.

1.2. References

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

Reference	Title	Code	Issue	Date
Part 21	Certification of aircraft and related products, parts and appliances, and of design and production organisation	Annex I to Commission Regulation EU No 748/2012 (and subsequent amendments)	---	03.08.2012
CS-27	Certification Specifications for small rotorcraft		Amendment 6	17.12.2018
CS-29	Certification Specifications for large rotorcraft		Amendment 7	15.07.2019
AC 29-2C	Advisory Circular, AC 29-2C, Certification of Transport Category Rotorcraft		Change 7	04.02.2016
AC 27-1B	Advisory Circular, AC 27-1B, Certification of Normal Category Rotorcraft		Change 7	04.02.2016
	The Air Operations Regulation	Commission Regulation (EU) No. 965/2012 on air operations & related EASA Decisions	Latest issue	-----

1.3. Abbreviations

AC	Advisory Circular
ADI	Attitude Direction Indicator
AMC	Acceptable Means of Compliance
APDOA	Alternative Procedures to Design Organisation Approval
CM	Certification Memorandum
CRI	Certification Review Item
CS	Certification Specification
DAL	Design Assurance Level
DOA	Design Organisation Approval
EASA	European Union Aviation Safety Agency
EU	European Union
FAA	Federal Aviation Administration
GM	Guidance Material
IFR	Instrument Flight Rules
MMEL	Master Minimum Equipment List
NVIS	Night Vision Imaging System
RFM	Rotorcraft Flight Manual
RFMS	Rotorcraft Flight Manual Supplement
STC	Supplemental Type Certificate
TC	Type Certificate
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

2. Background

An attitude indicator is required by the European operational rules for operations with all rotorcraft that are operated at night or under certain visibility conditions for both commercial and non-commercial use.

However, the same approach is not followed in the CSs for rotorcraft as detailed below:



- For a large CS-29 rotorcraft, an attitude indicator is required in order to be approved for flight in VFR by CS 29.1303 “Flight and Navigation Instruments”;
- For small CS-27 rotorcraft, CS 27.1303 does not require the installation of an attitude indicator in order to be approved for flight in VFR, including night VFR operations. For a small CS-27 rotorcraft, such an indicator is only required for IFR approval (see Appendix B to CS-27 that in turn requires compliance with CS 29.1303).

For NVIS approval, CS-27 and CS-29 Book 2 refer to FAA Advisory Circulars (ACs) 27-1B and 29-2C; Miscellaneous Guidance (MG)-16 recommends the installation of an attitude indicator but does not provide guidance on the safety objectives to be met by the installation.

The objective of this Certification Memorandum is to provide guidance on the installation of attitude indicators for rotorcraft:

- already approved for night VFR operations; or
- to be approved for night VFR operations.

Also guidance on the classification of the functional failures to be applied during the certification is provided.

However, with this Certification Memorandum, EASA does not intend to change the policy applied to attitude indicators installations that are based on mechanical technology and that have been already approved for night VFR operations or to their replacement. A more detailed list of the applicable cases and relevant policy that should be applied can be found in Appendix 1.

3. EASA Certification Policy

3.1. Criteria for the Avionics Functional Hazard Assessment (FHA)

When attitude indicators are installed on rotorcraft to be approved for **IFR**, the classification of attitude related functional failures is driven by the fact that a misleading attitude indication is widely recognized as being classified as a CATASTROPHIC failure. This classification drives the integrity requirements of the system that provides the attitude indication and consequently the number of sensors and indicators that are required to be installed.

When an attitude indicator is installed on a rotorcraft that is only approved for **VFR** operations, there are frequently in-depth discussions related to the most appropriate classification to be assigned to the following two functional failures:

- Loss of attitude indication (including erroneous attitude indication detected by the crew);
- Misleading attitude indication.

In the past, functional failures leading to a misleading attitude indication were classified as MAJOR for both day and night VFR. The assumption that night VFR operations were always conducted by maintaining reference to the surface (and horizon) was used as a rationale to support the MAJOR classification for functional failures leading to a misleading indication of attitude. It was further assumed that the flight crew would detect the misleading attitude indication by comparison with external references and/or other instruments available in the cockpit. This comparison may result in a significant increase in flight crew workload before the failure is detected and therefore a Major classification was deemed appropriate. A dedicated entry in the RFM Limitations Section was sometimes included to complement this approach stating that night operations were only allowed with visual reference to the ground and under conditions of celestial illumination.

In view of the currently available equipment technology and observed operational practice, EASA believes that the above assumptions should no longer be made when classifying the functional failure of a misleading attitude indication in night VFR operations for the following reasons:



- Rotorcraft may be operated in VFR with reduced visibility minima. In uncontrolled airspace they can fly anywhere, at any time, as long as the crew deems it safe and the rotorcraft remains clear of clouds;
- Even when the rotorcraft is operated in compliance with the minimum visibility and distance from clouds in accordance with VMC minima, the capability of the flight crew to maintain the necessary visual reference with ground objects that are illuminated by ground lights or by adequate celestial illumination has been found to be compromised if conditions are not ideal;
- It has been observed that rotorcraft frequently operate in a fairly hostile environment, low to the ground, near obstacles and at speeds that leave very little time for the flight crews to detect and assess malfunctions that are not annunciated to them;
- Flight crews are trained to trust their instrumentation. Therefore, with a poorly defined horizon and a misleading attitude information on a compelling display, the flight crews are likely to trust the Attitude Direction Indicator (ADI) rather than the poor visual references;
- The view of the surface does not always correlate to the view of the horizon. This assumption that the view of the surface provides sufficient references was the driving factor for the MAJOR failure classification given in the past.

In summary, EASA's opinion is that the attitude indication is a safety critical indication to the flight crew for operations carried out in ambient conditions where the horizon is not always visible. Therefore EASA's policy is that functional failures leading to the misleading attitude indication for night VFR operations cannot be assumed to be recognised by the flight crew in every case before a hazard is created and therefore they should be classified as "HAZARDOUS".

Under the same assumptions, functional failures leading to the total loss of attitude indication should be classified as "MAJOR".

3.2. Classification of changes introducing attitude indicators in rotorcraft to be approved for night VFR operations

Based on the rationale provided in paragraph 3.1, the installation of attitude indicators on rotorcraft to seek night VFR initial approval should be classified by the DOAHs as a Major Change.

The same change classification applies when the installation of the attitude indicator is carried out during the NVIS approval for a CS-27 rotorcraft.

3.3. Compliance showing: Safety Assessment

3.3.1. Single - Engine CS-27 rotorcraft to be approved for night VFR operations

CS 27.1309 (c) applies to single-engine CS-27 rotorcraft to be approved for Night VFR operations. For this class of rotorcraft, CS 27.1309 requires that "the equipment, systems, and installations must be designed to **minimize** hazards in the event of a probable malfunction or failure".

Details on how to demonstrate compliance with the hazardous classification and the applicable DALs are provided in the AMC¹ to CS 27.1309 that is applicable to the project and they are not the intent of this CM.

However for this class of rotorcraft a quantitative assessment is not systematically required and therefore, on a case by case basis, EASA may accept different mitigating factors such as, for instance:

- The installation of additional instruments (that are not required by the certification specifications) that may help the crew to detect the failure earlier than if only a single attitude indicator installed;

¹ The AMC to CS 27.1309 is contained in FAA Advisory Circular (AC) 27-1B, as referenced by CS-27 Book2



- The specific avionic system architecture and the level of protection that is implemented against this type of failure.

In such a case, a Certification Review Item may be required in order to properly track the technical discussion and document how the hazard related to this functional failure is minimized by the design.

3.3.2. Multi - Engine CS-27 rotorcraft to be approved for night VFR operations

CS 27.1309 (b) applies to multi-engine CS-27 helicopters to be approved for night VFR operations. For this class of rotorcraft, CS 27.1309 requires that “the equipment, systems, and installations must be designed to **prevent** hazards in the event of a probable malfunction or failure”.

Therefore for this class of rotorcraft, a quantitative assessment is required to show compliance with CS 27.1309. Details on how to demonstrate compliance with the hazardous classification and the applicable DALs are provided in the AMC² to CS 27.1309 that is applicable to the project and they are not the intent of this CM .

3.3.3. CS-29 Category B rotorcraft to be approved for night VFR operations

CS 29.1309 (b) (1) applies to CS-29 Category B rotorcraft to be approved for night VFR operations. For this class of rotorcraft, systems and components need to be considered individually and in combination with the other installed systems. In addition, as per CS 29.1309, “the equipment, systems, and installations must be designed to **prevent** hazards if they malfunction or fail”.

Therefore, for this class of rotorcraft a quantitative assessment is required to show compliance with CS 29.1309. Details on how to demonstrate compliance with the hazardous classification and the applicable DALs are provided in AMC³ to CS 29.1309 that is applicable to the project and they are not the intent of this CM .

3.3.4. CS-29 Category A rotorcraft to be approved for night VFR operations

CS 29.1309 (b) (2) applies to CS-29 Category A rotorcraft to be approved for night VFR, and also provides the probabilities to be applied for failure conditions that would prevent the continued safe flight and landing capability and reduce the capability of the rotorcraft or the ability of the flight crew to cope with adverse operating conditions.

For this class of rotorcraft a quantitative assessment is required to show compliance with CS 29.1309. Details on how to demonstrate compliance with the hazardous classification and the applicable DALs are provided in AMC⁴ to CS 29.1309 that is applicable to the project and they are not the intent of this CM .

3.3.5. Rotorcraft already approved for night VFR operations

For rotorcraft already approved for night VFR, the assumptions made during the certification of the original design and the conclusions on the failure classification could be still applicable depending on the type of change that is introduced. For additional guidance see Appendix 1.

3.4. Compliance showing: Flight Testing

For all the cases considered under paragraph 3.3, the suitability of the attitude indicator for night VFR operations needs to be evaluated in-flight to verify compliance with the requirements included in the

² The AMC to CS 27.1309 is contained in FAA Advisory Circular (AC) 27-1B, as referenced by CS-27 Book2

³ The AMC to CS 29.1309 is contained in FAA Advisory Circular (AC) 29-2C, as referenced by CS-29 Book2

⁴ The AMC to CS 29.1309 is contained in FAA Advisory Circular (AC) 29-2C, as referenced by CS-29 Book2



certification basis of the change. The following table includes, as a reference, the list of the provisions of CS-27 and CS-29 that should be considered during the evaluation:

CS-27	CS-29
CS 27.771	CS 29.771
CS 27.773	CS 29.773
CS 27.1301	CS 29.1301
CS 27.1309 (a) and (c)	CS 29.1309 (a) and (c)
CS 27.1321 (a), (c), (d)	CS 29.1321 (a), (b), (f) and (g)
CS 27.1523	CS 29.1333 (b) and (c)
CS 27.1525	CS 29.1523
	CS 29.1525

NOTE: if an earlier certification basis applies (FAR, JAR,...), the corresponding or equivalent provisions would also apply.

If the installation is part of a NVIS upgrade of the cockpit, it is recommended that the evaluation process⁵ for NVIS approval is followed.

3.5. MMEL

The effect of the loss of the attitude indicator needs to be taken into account in the MMEL.

3.6. Who this Certification Memorandum affects

Applicants who seek EASA approval of attitude indicator installations for night VFR and more specifically:

- TC holders, DOA and APDOA;
- Applicants for NVIS changes (with or without APDOA; DOA without NVIS capability).

4. Remarks

1. Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Planning Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu.
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⁵ Refer to CM-FT-001 for NVIS



5. Appendix 1 – Considerations on Misleading Attitude Information for different Type Design changes

Type Design	Change Description	Explanatory Notes
Already night VFR approved	<ul style="list-style-type: none"> - Introduction of a mechanical primary or stand-by ADI - Replacement of a mechanical ADI (primary or stand-by) with a digital ADI. - Replacement of a mechanical ADI (primary or stand-by) with a digital ADI that <u>embodies</u> additional instruments that are already installed in the cockpit. - Replacement of a digital ADI with another digital ADI. 	<p>Assumptions of the original design remain applicable.</p> <p>No further hazard assessment is required for the misleading attitude indication.</p>
Already night VFR approved	<ul style="list-style-type: none"> - Complete change of the cockpit from a mechanical to a digital technology - Replacement of mechanical ADI with a federated digital instrument that also <u>replaces</u> other required instruments (iaw CS-27 or CS-29). - Major significant changes 	<ul style="list-style-type: none"> - The human machine interface and the cockpit concept is completely changed. - The assumptions based on which the instrument is used by the crew are changed. - Self-explanatory <p>Misleading Attitude to be classified as Hazardous</p>
To be approved for night VFR	<ul style="list-style-type: none"> - All cases 	<p>Misleading Attitude to be classified as Hazardous.</p>

This Appendix does not contain all possible design cases.

For advice on other design cases than those included in this Appendix, the Agency should be contacted.

