

## **Notification of a Proposal to issue a Certification Memorandum**

### **Display of attitude at night for VFR approval in rotorcraft**

**EASA CM No.: Proposed CM-FT-003 Issue 01 issued 29 June 2020**

**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	29.06.2020	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 Specification for small rotorcraft		Amendment 6	17.12.2018
CS-29	Certification Specification 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
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 certification specifications for the installation of an attitude indicator are not harmonised between CS-27 and CS-29.

For a large rotorcraft, an attitude indicator is required in order to be approved for VFR by CS 29.1303 “Flight and Navigation Instruments”.

However for small rotorcraft, CS 27.1303 does not require the installation of an attitude indicator in order to be approved for VFR, including night VFR operations. For a small 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 or
- to be approved for night VFR

and on the classification of the functional failures to be applied during the certification.

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 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 are driven by the fact that misleading attitude indication is widely recognized as being a CATASTROPHIC failure. This classification drives the integrity of the system providing the attitude indication and consequently the number of sensors and indicators that are 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:

- A) Loss of attitude indication (including erroneous attitude indication detected by the crew)
- B) Misleading attitude indication

In earlier times, the misleading attitude indication functional failure was 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 the misleading indication of attitude. It was further assumed that the 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 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 visibility and distance from clouds in accordance with VMC minima, the capability of the crew to maintain the visual reference with ground objects illuminated by ground lights or by adequate celestial illumination has been found to be compromised if conditions are not ideal.
- It is observed that rotorcraft operate frequently in a fairly hostile environment, low to the ground, near obstacles and at speeds that leave very little time for the crews to detect and assess malfunctions that are not annunciated.
- Crews are trained to trust their instrumentation. Therefore, with a poorly defined horizon and a misleading attitude information on a compelling display, the crews likely trust the Attitude Direction Indicator (ADI).
- The view of the surface does not always imply view of the horizon, which 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 crew for operations carried out in ambient conditions where the horizon is not always visible. Therefore EASA's policy is that the misleading attitude indication for night VFR cannot be assumed to be recognised by the crew in every case before a hazard is created and therefore it should be classified as "HAZARDOUS".

Under the same assumptions, 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. CS-27 Single- Engine rotorcraft to be approved for night VFR operations

CS 27.1309 (c) applies to CS-27 single engine 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".

FAA AC 27-1B that provides guidance for showing compliance with this provision defines as an acceptable means to show compliance that a probability in the order of  $1 \times 10^{-7}$  to  $1 \times 10^{-9}$  should be demonstrated for a failure condition that is classified as HAZARDOUS. Applicants are encouraged to follow this approach.

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:

- Installation of additional instruments that are not required by the certification specifications but that may help the crew to detect the failure earlier than with only a single attitude indicator installed.
- 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.

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

CS 27.1309 (b) applies to CS-27 multi-engine helicopters to be approved for night VFR operations. For this class of helicopters 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 helicopters a quantitative assessment is required to show compliance with CS 27.1309. FAA AC 27-1B that provides guidance for showing compliance with this provision defines that a probability in the order of  $1 \times 10^{-7}$  to  $1 \times 10^{-9}$  should be demonstrated for a failure condition that is classified as HAZARDOUS.

### 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 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 29.1309. FAA AC 29-2C that provides guidance for showing compliance with this provision defines that a probability of in the order of  $1 \times 10^{-7}$  to  $1 \times 10^{-9}$  should be demonstrated for a failure condition that is classified as HAZARDOUS.

### 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 helicopters to be approved for night VFR, and also provides 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 crew to cope with adverse operating conditions.

For this class of rotorcraft a quantitative assessment is required to show compliance with CS 29.1309. FAA AC 29-2C that provides guidance for showing compliance with this provision defines that a probability of in the order of  $1 \times 10^{-7}$  to  $1 \times 10^{-9}$  should be demonstrated for a failure condition that is classified as HAZARDOUS.

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

CS 27	CS 29
27.771	29.771
27.773	29.773
27.1301	29.1301

27.1309	29.1309
27.1321	29.1321
27.1523	29.1333
27.1525	29.1523
	29.1525

NOTE: if an earlier certification basis applies (FAR, JAR,...), the corresponding paragraphs or equivalent should be included.

If the installation is part of a NVIS upgrade of the cockpit, it is recommended that the evaluation process 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. This EASA Proposed Certification Memorandum will be closed for public consultation on the **3<sup>rd</sup> of August 2020**. Comments received after the indicated closing date for consultation might not be taken into account.
2. 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](mailto:CM@easa.europa.eu).
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## 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"> <li>- Introduction of a mechanical primary or stand-by ADI</li> <li>- Replacement of a mechanical ADI (primary or stand-by) with a digital ADI.</li> <li>- 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.</li> <li>- Replacement of a digital ADI with another digital ADI.</li> </ul>	<p>Assumptions of the original design architecture remain applicable.</p> <p><b>No further hazard assessment is required for the misleading attitude indication.</b></p>
Already night VFR approved	<ul style="list-style-type: none"> <li>- Complete change of the cockpit from a mechanical to a digital technology</li> <li>- Replacement of mechanical ADI with a federated digital instrument that also <u>replaces</u> other required instruments (iaw CS 27 or CS 29).</li> <li>- Major significant changes</li> </ul>	<ul style="list-style-type: none"> <li>- The human machine interface and the cockpit concept is completely changed.</li> <li>- The assumptions based on which the instrument is used by the crew are changed.</li> <li>- Self-explanatory</li> </ul> <p><b>Misleading Attitude to be classified as Hazardous</b></p>
To be approved for night VFR	<ul style="list-style-type: none"> <li>- All cases</li> </ul>	<p><b>Misleading Attitude to be classified as Hazardous.</b></p>