

Certification Memorandum

Helicopter Night Vision Imaging Systems

EASA CM No.: CM-FT-001 Issue 02 issued 01 December 2017

Regulatory requirement(s): CS27 Book 2 AMC 27 General (MG16), CS29 Book 2 AMC 29 General (MG16)

In accordance with the EASA Certification Memorandum procedural guideline, the European Aviation Safety Agency proposes to issue an EASA Certification Memorandum (CM) on the subject identified below.

All interested persons may send their comments, referencing the EASA Proposed CM Number above, to the e-mail address specified in the “Remarks” section, prior to the indicated closing date for consultation.

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Log of issues

Issue	Issue date	Change description
01	02.12.2014	First issue.
02	01.12.2017	Second issue.

Table of Content

Log of issues.....	2
Table of Content	2
1. Introduction.....	4
1.1. Purpose and scope	4
1.2. References	4
1.3. Abbreviations.....	5
2. Background.....	5
3. EASA Certification Policy	6
3.1. Classification of Changes	6
3.1.1. Non NVIS approved helicopters	6
3.1.2. Helicopters with NVG friendly lighting	6
3.1.3. Modifications of already NVIS approved helicopters.....	6
3.2. Eligibility	7
3.2.1. APDOA and DOA NVIS scope of approval.....	7
3.2.2. Eligibility criteria for NVIS approvals and design changes.....	7
3.2.3. Applicant personnel qualifications	8
3.2.3.1. Compliance Verification Engineers and Engineering Personnel.....	8
3.2.3.2. Flight Test Personnel	8
3.3. Compliance showing.....	9
3.3.1. NVIS approval of helicopters with NVIS friendly lighting	9
3.3.2. Flight Testing.....	9
3.4. Configuration Control.....	9
3.4.1. Non NVIS approved helicopters	9
3.4.2. Modifications of already NVIS approved helicopters.....	10
3.5. Rotorcraft Flight Manual Supplement (RFMS)	10



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3.6.	Instructions for Continued Airworthiness (ICA)	10
3.7.	Operational Suitability Data	11
3.8.	Miscellanea	12
3.8.1.	Some clarifications on MG 16.....	12
3.8.2.	White Phosphor NVGs	12
3.9.	Who this Certification Memorandum affects.....	13
4.	Remarks	13
5.	Annexes	14



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1. Introduction

1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide specific clarification and additional guidance for certification of Night Vision Imaging System (NVIS) on helicopters.

1.2. References

The following reference material is 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
AC 29-2C MG 16	Certification Procedure for Rotorcraft Night Vision Imaging Systems (NVIS) Equipment	Advisory Circular, AC 29-2C, Certification of Transport Category Rotorcraft	Change 4 Change 7	01.05.2014 04.02.2016
AC 27-1B MG16	Certification Procedure for Rotorcraft Night Vision Imaging Systems (NVIS) Equipment	Advisory Circular, AC 27-1B, Certification of Normal Category Rotorcraft	Change 4 Change 7	01.05.2014 04.02.2016
Part-SPA.NVIS	Helicopter Operations with Night Vision Imaging Systems	Commission Regulation EU 965/2012 (and subsequent amendments)	---	05.10.2012
Part-FCL	Flight Crew Licensing	Commission Regulation EU 1178/2011 (and subsequent amendments)	---	03.11.2011



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1.3. Abbreviations

AC	A dvisory C ircular
AMC	A cceptable M eans of C ompliance
AFM	A ircraft F light M anual
APDOA	A lternative P rocedures to D esign O rganisation A pproval
CM	C ertification M emorandum
CRI	C ertification R evision I tem
CS	C ertification S pecification
DH	D ecision H eight
DOA	D esign O rganisation A pproval
EASA	E uropean A viation S afety A gency
EU	E uropean U nion
FAA	F ederal A viation A dministration
GM	G uidance M aterial
ICA	I nstructions for C ontinued A irworthiness
MMEL	M aster M inimum E quipment L ist
NAA	N ational A viation A uthority
NVG	N ight V ision G oggle(s)
NVIS	N ight V ision I maging S ystem
RFM	R otorcraft F light M anual
RFMS	R otorcraft F light M anual S upplement
STC	S upplemental T ype C ertificate
TC	T ype C ertificate
TCDS	T ype C ertificate D ata S heet

2. Background

The number of NVIS certification projects has been increasing in recent years. Existing material in AC 27 and AC 29 MG 16 gives essential advice to address means of demonstrating compliance and continued airworthiness. However, additional guidance is needed in order to comply with Part 21 requirements, to address advances in technology and the differences between EASA and FAA certification practices. Therefore, this Certification Memorandum provides additional information to AC MG 16.



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Issue 2 of this Certification Memorandum encompasses the latest amendments of the EU regulations and related means of compliance and guidance material. It also implements the lessons learnt during certification projects run since its first publication in 2014.

3. EASA Certification Policy

3.1. Classification of Changes

3.1.1. Non NVIS approved helicopters

According to Part 21.A.91, any modification that changes an aircraft from non-NVIS to NVIS-compliant is a major change because it has an appreciable effect on the operational characteristics of the aircraft. Additionally, design changes in the internal and external lighting needed to achieve NVIS certification are considered as a major change as they introduce functions whose failure could have a hazardous effect, due to the inherent characteristics of NVIS technology and the effect that the use of NVGs has on visual perception.

3.1.2. Helicopters with NVG friendly lighting

Some helicopters have lighting systems that are referred as '*NVG friendly*'. These helicopters do not hold any NVIS approval and appropriate certification activity has to be accomplished in order to have those helicopters approved for NVIS. NVIS approval of helicopters equipped with NVG friendly lighting should also be classified as a major design change due to the need for demonstration of compliance with the relevant helicopter Certification Specifications during NVIS operations. Moreover, applicant should exercise caution in ensuring that, in this case, the configuration of the helicopter proposed for certification has not been changed by means of subsequent modification or maintenance activities from the one that has been initially declared as NVG friendly. In case the configuration has been modified, a proper evaluation should be performed in order to identify the effects of the modifications on the NVIS operation capability. The extent of evaluation and re-design needed could lead to a case of non-NVIS helicopter as described in paragraph 3.1.1.

3.1.3. Modifications of already NVIS approved helicopters

Part 21.A.91 defines the criteria for changes classification (minor vs. major changes). For NVIS approved helicopters, experience has shown that some changes that are classified as minor according to Part 21.A.91 for unaided flight may have an appreciable effect on the cockpit/cabin lighting characteristics and thus on crew vision through the NVGs. For example, a radio installation could emit light that could shine directly in the NVG if the screen is not NVG compatible or a cable cutter could reflect external lighting and affect the crew NVG aided vision. Therefore, the classification of changes should take into account the effects on cockpit/cabin lighting characteristics and the NVIS. It is difficult to provide a list of minor vs. major lighting changes, primarily because each helicopter will exhibit different lighting characteristics due to the cockpit layout and the location and type of instruments fitted and this will have a bearing on crew NVG aided vision. Historically EASA has agreed that each TC/STC holder of an NVIS approval should propose their own criteria for classification of lighting changes that only have a limited impact on the NVIS approval and therefore can be considered minor. These criteria depends greatly on the:

- experience and knowledge of the specific organisation acquired in previous NVIS projects,
- type/model affected,



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- extent and effect of the modification
- kind of NVIS technology applied, and
- NVIS approval.

For those companies having a Design Organisation Approval (DOA) with NVIS capability in the Terms of Approval, the DO Handbook should contain these classification criteria.

It is important to note that any design changes to a NVIS approved helicopter, although not related to internal or external lighting, could invalidate its NVIS certification and thus requiring reinvestigation as per MG 16.

On the other hand, operators and their CAMOs that hold the complete information about each aircraft configuration carefully verify that the installation of any design change does not affect the NVIS approval. This is particularly important when installing a design change (Minor Change, Major Change, or STC) designed and produced by a company other than the original NVIS TC/STC holder. ICA and RFM(S) provided by the NVIS approval holder should provide clear indication of the items that need to be removed or added as part of the NVIS configuration when the helicopter is to be configured for NVIS operations.

3.2. Eligibility

3.2.1. APDOA and DOA NVIS scope of approval

NVIS modification design and implementation on an aircraft could involve many disciplines and specialised expertise. Companies need to have significant resources available (such as; a dark hangar, tri-bar charts and illuminators, qualified test pilot) and appropriate procedures to manage them. Initial assessment and continuous oversight and personnel competencies are required in order to give assurance that these resources and procedures are maintained at an acceptable level in compliance with Part 21.

APDOA and DOAs that intend to perform NVIS changes need to apply for the introduction of the NVIS capability in the company's Terms of Approval, in order to identify the capability and level of competence in this area. Lack of this capability will lead to limitations in the ability to perform NVIS related design changes as specified in paragraph 3.2.2.

It should be noted that the APDOAs have the possibility to apply and conduct certification activities related to NVIS, but no associated privileges are granted or implied.

For DOA holders, this extension will also entitle the holder to directly classify and approve minor NVIS changes in accordance with Part 21.A.95 and Part 21.A.263(c)(1) and (c)(2).

3.2.2. Eligibility criteria for NVIS approvals and design changes

The need to hold a DOA for NVIS projects should be determined by taking into account the classification criteria explained in paragraph 3.1 and the level of complexity characterising the different kind of NVIS design changes. In advance of the expected amendments to GM to Part 21.A.112B, the Agency will apply the following eligibility criteria effective from the issuance date of this CM.

- 1) Only companies holding a DOA with NVIS capability are eligible to apply for a NVIS approval (major change or STC) of Non-NVIS helicopters. APDOA are not eligible for such changes. Therefore, APDOA that



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are already holders of this kind of NVIS STC are expected to apply for a full DOA before application of further NVIS STC of the same kind.

- 2) DOA or APDOA with NVIS capability are permitted to apply for:
 - a) The NVIS approval of a NVG friendly cockpit and exterior lighting (refer to paragraph 3.1.2 for specific conditions applicable to this case).
 - b) Major changes to previously approved NVIS helicopters that affects their NVIS approval, and for which NVIS approval is to be retained. Caution should be exercised in this case, since if the change is extensive, the design change could constitute a new NVIS approval itself, thus requiring a DOA.
- 3) Applicants not holding a DOA or APDOA (typically operators), as any legal person, can only apply for Minor Changes to previously approved NVIS helicopters.

In case 3), the applicant should always perform the NVIS assessment with the assistance of a DOA or a APDOA having NVIS capability and the subsequent change approval should indicate that a positive NVIS assessment has been performed. If this is not the case, then the new change approval certificate and RFM/ICA should stipulate that no NVIS compatibility assessment has been conducted, therefore invalidating the original NVIS approval. In this case, it will be the responsibility of the operator, when installing the change, to seek a re-validation of the NVIS approval, prior to release to service for NVIS operations, if needed.

3.2.3. Applicant personnel qualifications

3.2.3.1. Compliance Verification Engineers and Engineering Personnel

The showing and verification of NVIS compliance affects various certification requirements under the responsibility of different disciplines. There is no requirement to have a dedicated CVE NVIS within the design organisation or to spread the responsibility among all CVEs of the involved disciplines. Although the choice is left to the company and its specific organisation, it must be recognised that NVIS design and compliance showing may require specific skills to be developed and maintained over time. Therefore, EASA recommends that personnel appointed as CVE for NVIS projects are specifically trained and have extensive experience in NVIS design and certification.

Engineering personnel who support the NVIS design and certification activities, should receive appropriate training even though they are not flying personnel. Operational NVIS training of ground personnel can be found in the GM2 to Part-SPA.NVIS.130(f).

3.2.3.2. Flight Test Personnel

In accordance with the definitions given in Part 21 Appendix XII, flight tests for development and certification of helicopters with initial NVIS modification (including full NVIS approval of helicopters with NVIS friendly lighting) should be classified as Category 2, as the NVIS will require a re-assessment of the basic crew procedures. Similarly, NVIS flight tests for changes to previously NVIS approved helicopters that will have a major impact on NVIS capabilities should be classified as Category 2. Therefore, for these cases, flight test pilots and lead flight test engineers should have at least a competence level 2, as indicated in the same Appendix XII. Flight test for NVIS evaluation within a design change classified as having minor on NVIS aspects can be classified as Cat 4.

In addition to the above-mentioned requirements, the Company FTOM should establish the minimum NVIS operational and/or flight test experience in development and certification programmes. However, these



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minimum requirements should not be less than the crew requirements laid down in the SPA.NVIS.130 and related AMC and GM.

3.3. Compliance showing

3.3.1. NVIS approval of helicopters with NVIS friendly lighting

Manufacturers/TC holders may produce and deliver Helicopters with NVIS friendly lighting without full NVIS approval. Cockpit and/or exterior lighting of such helicopters may be similar (if not the same) to the ones delivered with NVIS approval, since they use equipment with the same P/N. When third parties pursue full NVIS approval of such helicopters, they should be reminded that, while modification design could be significantly lower than a full NVIS approval, certification activities should not be less than a full NVIS certification of non-NVIS helicopters. Therefore, unless proof of demonstration of compliance is provided by means of a proper arrangement established with the TC holder in accordance with Part 21.A.113(b), a full investigation of the NVIS lighting design is expected by the Applicant.

3.3.2. Flight Testing

In accordance with the provisions given in the latest amendment of Part 21 and related guidance material regarding the Level of Involvement, EASA Flight Test Team may deem it necessary for a ground and/or flight evaluation for a NVIS project. This activity often requires significant logistic coordination, as it should be performed with appropriate weather (clear sky, no moon) and environmental (area with little or no cultural lighting) conditions. Therefore, although this should already be in any Certification Programme/Plan, it is essential that the Applicant provides a thorough detailed planning of the ground and flight test activities, so that the EASA Flight Test Team can easily identify and properly de-conflict their availability.

Ground and Flight Test Programme/Plan should to be agreed and accepted by EASA before company flight test takes place; Flight Test Report or preliminary company flight test results should be provided to the EASA Flight Test Team prior to their evaluation visit.

3.4. Configuration Control

3.4.1. Non NVIS approved helicopters

Applicants seeking a NVIS approval of a helicopter that has already been Night VFR approved should establish a procedure that allows clear identification and assessment of each cockpit-cabin lighting configuration. A configuration file should be prepared and made available to the operator and to the maintenance facility, to be used to check the conformity of each helicopter configuration to the NVIS approved configuration. The configuration file can be provided as an Appendix of the ICA or of the master Drawing List (MDL), detailing the applicable serial number(s) having the same configuration. Refer to paragraph 3.6 and to Annex 1 for an example of configuration file. The approval holder should also put in place adequate measures to inform operators of the need for caution when incorporating future modifications that could invalidate the original NVIS approval. Refer to MG16 of AC 27/29 for dedicated statements to be inserted in the RFM and ICA. The same guidance material also highlights additional considerations regarding the compatibility with other helicopter kits. To the same objective, the following statement, similar to the one reported in the MG16 at paragraph h.(2)(iii), will be provided in all the NVIS approval certificates (Major Change or STC):



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“Rotorcraft modified by this design change employs Night Vision Imaging System lighting, commonly named NVIS lighting, which has been certified to ensure the aircraft is compatible with Night Vision Goggles (NVG). For this reason, any deviation from the cockpit or cabin configuration specified in this design change may affect the compatibility of the NVIS lighting and may require a re-evaluation for NVG compatibility, substantiated by further approval. Once the aircraft is modified with this design change, any future modification that adds or changes systems that emit or reflect light have the potential to alter or change the NVIS lighting vs NVG compatibility, and therefore may require further approval.”

3.4.2. Modifications of already NVIS approved helicopters

Applicants seeking to introduce changes to already approved NVIS kits for which they do not hold the original TC/STC should carefully examine what is already existing as NVIS configuration file, RFM and ICA.

Any supplementary information should be presented in the same format as the existing data in order to facilitate the work of the operator and CAMO/maintenance facility in reviewing the initial NVIS configuration and successive NVIS approved minor or major changes.

3.5. Rotorcraft Flight Manual Supplement (RFMS)

For NVIS approvals not limited to specific helicopter serial numbers, it is probable that there will be a variety of different pre-existing cockpits on which the same STC will be applied. This may require different limitations or crew procedures to be applied. For these reasons, the applicant of a NVIS STC/major change should provide a dedicated RFM supplement for each serial number(s) set having the same lighting configuration. As an alternative, the RFMS can be structured in two parts. The first covering the basic helicopter configuration, having the general normal procedures and limitations. The second part should be an Appendix, specific to applicable helicopter serial number(s), containing any modified or additional limitations or procedures relative to any specific configurations or optional equipment installed and possibly including reference to the specific helicopter serial number(s) configuration file. An example RFM Appendix is provided in Annex 2. An example RFM supplement is provided in MG16 of AC27/29.

3.6. Instructions for Continued Airworthiness (ICA)

Routine continued airworthiness tasks such as scheduled maintenance or non-routine tasks such as repairs that affect NVIS cockpit compatibility could compromise the initial approval. The Applicant of a NVIS STC/major change should update maintenance manual(s) to include a dedicated NVIS paragraph and instructions in order to cover, at least, the following occurrences:

- Scheduled and unscheduled maintenance instructions including cockpit disassembly.
- Repairs on NVIS components.
- An inspection to check if the cockpit and external lights conform to the approved NVIS configuration, to be conducted following the change/repair of any NVIS equipment, or regularly. Any discrepancies must be communicated to the NVIS STC/TC holder.
- The maintenance instructions should also include a NVIS light leak check to be conducted as part of the NVIS inspection. The NVIS light leak check should verify that the NVIS lighting has not degraded since its approval. The ICA should indicate that this check is to be conducted by appropriate personnel capable of assessing the existing cockpit compared to the one initial NVIS certified



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configuration. The assessment should be conducted from all crew stations that are intended to be used (including cabin, if applicable) during NVG operations.

- Light leakage checks should also be conducted after a hard landing or after any lightning strike.
- The following are maintenance items typical to NVIS that should be considered in the scheduled maintenance:
 - Change the windshield/transparencies if crazed or cracked in a manner to impair vision when using NVGs.
 - If the NVIS configuration includes removable filters, they should be checked for condition, cleanliness, security, crazing and moisture between the filter and instrument glass. No cracks, crazing or moisture should be allowed. A day light inspection of the filtered avionics should be conducted to ensure that the filter has not degraded in a way to impair readability or colour identification in daylight conditions.
 - All NVIS bezel lights / map lights/ post lights/ should be checked for condition and security.

Annex 3 contains an example of daylight and night light leakage checks that could be incorporated into the ICA.

Annex 1 contains an example of configuration file and cover page as ICA appendix, including applicability to specific configurations or helicopter serial numbers.

The ICA should also highlight that, in case the part 145 (or the maintenance facility) has no previous or recent maintenance experience with NVIS modified rotorcraft, for the first NVIS installation and/or the first NVIS maintenance activity of a NVIS approved design change, the followings should be carried out with the collaboration of the NVIS TC/STC holder:

- light leak check,
- compatibility inspections,
- functional system checks, and
- conformity inspections of the configuration

3.7. Operational Suitability Data

Commission Regulation (EU) 69/2014 has introduced the Operational Suitability Data in Part 21. Based on this regulation, as of 19 December 2016, all applications for Minor or Major change to Type Certificate or Supplemental Type Certificate shall also assess the impact on the approved Operational Suitability Data and develop supplements to the affected OSD constituents, as necessary.

As NVIS installation constitutes an optional specific equipment to be used for specialised operations, applicants for NVIS approvals and NVIS related design changes are required to assess if their design change has an effect on the approved Operational Suitability Data, with particular regard to Flight Crew Data (FCD) and Master Minimum Equipment List (MMEL). In such a case, in order to satisfy the applicable EU operational requirements as contained in Commission Regulation (EU) 965/2012, applicants should also apply for related OSD Change Approval at the same time of the Minor/Major Change or STC application. Book 2 of CS-FCD and CS-MMEL also contain specific guidance and consideration for NVIS related matters.



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3.8. Miscellanea

3.8.1. Some clarifications on MG 16

At the time in which this Certification Memorandum is issued, the AMC for NVIS certification is constituted by MG 16, which is included in FAA AC 27-1B and AC29-2C change 4, as referenced in Book 2 of respectively CS-27 and CS-29. However, FAA has recently published change 7 of both AC 27-1B and AC29-2C, which contains a thorough revision of MG 16. This latest FAA amendment of MG 16, represents the most advanced guidance for certification of helicopters for NVIS operations, and applicants are encouraged to use FAA AC MG 16 Change 7 as an alternative AMC for their certification projects in advance of its endorsement in future amendment of CS-27 and CS-29.

In the event that an applicant proposes to use MG 16 Change 7 of AC 27-1B and AC29-2C, the following specific parts need to be further clarified when applying this document to certification projects in EU.

Reference in FAA MG16 Change 7	EASA clarification
Paragraph d.(2)	Referenced TSOs should be read as their equivalent ETSOs
Paragraph e.(7)	NVG class A filters are deemed not acceptable for certification by EASA
Paragraph e.(9)	Specific guidance applicable for EASA certification is given in paragraph 3.1.3 of this Certification Memorandum.
Paragraph f.(6)(i)(D)	<p>CS-27 and CS-29 do not require a radar altimeter for night VFR type of operation, on which NVIS is based. The MG16 considers the radar altimeter with suitable low height and failure indication as an essential equipment for NVIS. Therefore, a radar altimeter with an analogue representation is not required in the framework of the NVIS airworthiness approval.</p> <p>However, in case the operator is seeking approval for NVIS operations in EU, he should be advised that Air Operations Regulation (EU) 965/2012 at Part-SPA.NVIS.110(b), associated AMC and related GM to the AMC, requires a radar altimeter with analogue representation.</p> <p>In any case, whatever is the type of radar altimeter installed, EASA recommends that a careful evaluation is carried out of the radar altimeter human machine design (including the height presentation and the possibility of selecting the DH) to ascertain that it is able to provide the crew with the necessary information.</p>

3.8.2. White Phosphor NVGs

White phosphor NVGs are the latest development in goggle technology. Whilst traditional goggles use P-43 (green) phosphor screen, by means of which the night-time image is depicted in green and black colour, the



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so called “white phosphor NVGs” use a P-45 (white) phosphor screen, allowing the scene to appear in black and white. Based on an assessment of the current market, it appears that certain NVG manufacturers have designed and produced the same NVG model, with both the white or green phosphor screen, without making any differentiation in the model name or number for both types.

Studies have demonstrated that, in general black and white vision is more natural for the human eye and therefore enhances the overall scene recognition, while providing equal or better performance in terms of; contrast, reduction in night blindness, and eye strain. However, some early operators have reported that the image is less bright as well as there being the potential for image persistence phenomena.

Until solid experience is gained in the certification field regarding this new technology, it is believed that the first introduction of white phosphor NVGs in an already NVIS certified helicopter should always be classified as a major change, regardless if the same model is already certified on the aircraft with a green phosphor screen. The new NVGs should be evaluated for compatibility with cockpit and external lighting under any foreseeable operating condition, in order to ascertain that pilot visibility and workload are not impaired, and that NVG susceptibility to halos, reflections and glare remains acceptable. Both ground and inflight aided evaluation should be conducted in support of this assessment.

For the reason stated above, it is highly recommended that RFM, when mentioning the NVG approved models, make clear reference to the kind of tubes (green or white) that they use, unless the model name/number univocally identifies this NVG characteristic.

In accordance with the Part-SPA.NVIS.110(e), all crew members should use NVGs of the same model, type and generation. This should be considered valid also for the image intensifier type, given the different image quality and perception among the two types of intensifiers. Therefore, the RFM limitation section should give instructions so that all crewmembers use the same model with the same NVG image intensifier type (white or green phosphor).

3.9. Who this Certification Memorandum affects

Applicants for and approval holders of minor changes, STCs and major changes concerning NVIS certification approval and more specifically:

- TC holders, DOA and APDOA with the appropriate NVIS capability, explicitly mentioned in their Terms of Approval;
- Applicants for NVIS minor 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 Safety Information Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu or fax +49 (0)221 89990 4459.
2. For any question concerning the technical content of this EASA Proposed Certification Memorandum, please contact:

Name, First Name: **Raffaele DI CAPRIO**

Function: **Rotorcraft Project Certification Manager & Flight Test Engineer**



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Phone: **+49 (0)221 89990 4389**

E-mail: **raffaele.dicaprio@easa.europa.eu**

5. Annexes

Annex 01. Example of ICA NVIS configuration appendix

Annex 02. Example of NVIS RFM appendix

Annex 03. Example of Maintenance NVIS Inspection Checklist



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