Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of the Environment,
Transport, Energy and Communications DETEC

Federal Office of Civil Aviation FOCA
Safety Division - Flight Operations

FOCA GM/INFO

Guidance Material / Information

Certification Leaftlet NVIS

Helicopter Operations with Night Vision Imaging Systems

Scope	Helicopter CAT-Operators seeking SPA.NVIS Approval
Applies to	Helicopter AOC-Holders
Valid from	25 March 2024
Version	ISS 01 / REV 01

Business object	033.1-1/148
Document Owner	SBHE
Distribution	Internal / External

Log of Revision (LoR)

Date	Issue	Revision	Highlight of Revision	Prepared by	Released by
04.02.2014	1	0	First Issue	mor (SBHE)	SBHE
25.03.2024	1	1	Update • Divers regulation updates, specifically for: - 2019/1384 and ED Decision 2019/019/R (applicablity by 25 May 2024); - 2021/2237 and ED Decision 2022/012/R; - 2023/1020 and ED Decision 2023/007/R; • Required information in operator's documentation (adaptation to EASA CM-FT-001 Issue 03, helicopter NVIS) • Editorials • Transponition of CL into GM/INFO template as per SBFF	wet, alj (SBHE)	Policy Meet SBHE (25.03.2024)

List of Effective Chapters

CP	ISS 1 / REV 1 / 25.03.2024
LoA	ISS 1 / REV 1 / 25.03.2024
Def	ISS 1 / REV 1 / 25.03.2024
ToC	ISS 1 / REV 1 / 25.03.2024
Ch. 0	ISS 1 / REV 0 / 04.02.2014
Ch. 0.1	ISS 1 / REV 0 / 04.02.2014
Ch. 0.2	ISS 1 / REV 0 / 04.02.2014
Ch. 0.3	ISS 1 / REV 0 / 04.02.2014
Ch. 0.4	ISS 1 / REV 0 / 04.02.2014
Ch. 0.5	ISS 1 / REV 0 / 04.02.2014
Ch. 0.6	ISS 1 / REV 1 / 25.03.2024
Ch. 1	ISS 1 / REV 0 / 04.02.2014
Ch. 1.1	ISS 1 / REV 0 / 04.02.2014
Ch. 2	ISS 1 / REV 1 / 25.03.2024
Ch. 2.1	ISS 1 / REV 1 / 25.03.2024
Ch. 3	ISS 1 / REV 1 / 25.03.2024
Ch. 3.1	ISS 1 / REV 1 / 25.03.2024
Ch. 4	ISS 1 / REV 1 / 25.03.2024
Ch. 4.1	ISS 1 / REV 1 / 25.03.2024
Ch. 4.2	ISS 1 / REV 1 / 25.03.2024
Ch. 4.3	ISS 1 / REV 1 / 25.03.2024
Ch. 4.4	ISS 1 / REV 1 / 25.03.2024
Ch. 4.5	ISS 1 / REV 1 / 25.03.2024
Ch. 4.6	ISS 1 / REV 1 / 25.03.2024
Ch. 4.7	ISS 1 / REV 1 / 25.03.2024
Ch. 4.8	ISS 1 / REV 1 / 25.03.2024
Ch. 4.9	ISS 1 / REV 1 / 25.03.2024
Ch. 5	ISS 1 / REV 0 / 04.02.2014
Ch. 5.1	ISS 1 / REV 0 / 04.02.2014
Ch. 5.2	ISS 1 / REV 0 / 04.02.2014
Ch. 5.3	ISS 1 / REV 0 / 04.02.2014
Ch. 5.4	ISS 1 / REV 0 / 04.02.2014
Ch. 5.5	ISS 1 / REV 0 / 04.02.2014
Ch. 5.5	ISS 1 / REV 0 / 04.02.2014

List of Abbreviations

LoA ISS 1 / REV 1 / 25.03.2024

The following abbreviations are within this GM/INFO:

Abbreviation	Definition
AGL	Above ground level
ANVIS	Aviator’s night vision imaging system
ATC	Air traffic control
CG	Centre of gravity
CRM	Cockpit/crew ressource management
CONOPs	Concept of operations
DOD	Department of Defense
DOT	Department of Transportation
EFIS	Electronic flight information system
EMS	Emergency medical service
EASA	European Aviation Safety Agency
FOCA	Federal Office of Civil Aviation
FAA	FederalAviation Administration
FOR	Field of regard
FOV	Field of view
FLIR	Forward looking infrared radar
GEN	Generation
GM/INFO	Guidance Material / Information
HUD	Head-up display
IR	Infrared
IFR	Instrument flight rules
IMC	Instrument meteorological conditions
JAA	Joint Aviation Authorities
MOPS	Minimum Operational Performance Standard
NAS	National airspace system
NVD	Night vision device
NVED	Night vision enhancement device
NVG	Night vision goggles
NVIS	Night vision imaging system
NOTAMS	Noticies to Airmen
SC	Special committee
TFR	Temporary flight restrictions
VA	Visual acuity
VFR	visual flight rules
VMC	visual meteorological conditions

Definitions for terms used in this Guidance Material

Def ISS 1 / REV 1 / 25.03.2024

'Absorptance' means the ratio of the radiant energy absorbed by a body to that incident upon it.

'Aided night vision imaging system (NVIS) flight' means, in the case of NVIS operations, that portion of a visual fl light rules (VFR) fl light performed at night when a crew member is using night vision goggles (NVG).

'Albedo' means the ratio of the amount of light reflected from a surface to the amount of incident light.

'Alternative Means of Compliance' means those means that propzose an alternative to an existing acceptable means of compliance or those that propose new means to establish compliance with Regulation (EC) No 216/2008 and its Implementing Rules for which no associated AMC have been adopted by the Agency;

'Automatic Brightness Control (ABC)' means one of the automatic gain control circuits found in second and third generation NVG devices. It attempts to provide consistent image output brightness by automatic control of the micro channel plate voltage.

'Automatic gain control (AGC)' means comprised of the automatic brightness control and bright source protection circuits. Is designed to maintain image brightness and protect the user and the image tube from excessive light levels. This is accomplished by controlling the gain of the intensifier tube.

'Blackbody': an ideal body of surface that completely absorbs all radiant energy falling upon with no reflection.

'Blooming' means common term used to denote the "washing out" of all or part of the NVG image due to de-gaining of the image intensifier tube when a bright light source is in or near the NVG field of view.

Bright Source Protection (BSP)' means protective feature associated with second and third generation NVGs that protects the intensifier tube and the user by controlling the voltage at the photo cathode.

'Brownout' means condition created by blowing sand, dust, etc., which can cause the pilots to lose sight of the ground. This is most commonly associated with landings in the desert or in dusty LZs.

'Category A with respect to helicopters' means a multi-engined helicopter designed with engine and system isolation features specified in the applicable airworthiness codes and capable of operations using take-off and landing data scheduled under a critical engine failure concept that assures adequate designated surface area and adequate performance capability for continued safe flight or safe rejected take-off in the event of engine failure;

'Category B with respect to helicopters' means a single-engined or multi-engined helicopter that does not meet category A standards. Category B helicopters have no guaranteed capability to continue safe flight in the event of an engine failure, and unscheduled landing is assumed;

'Civil nautical twilight' means the time when the true altitude of the centre of the sun is six degrees below the horizon. Illuminance level is approximately 3.40 lux and is above the usable level for NVG operations.

'Congested area' means in relation to a city, town or settlement, any area which is substantially used for residential, commercial or recreational purposes;

'Crew member' means a person assigned by an operator to perform duties on board an aircraft;

'Diopter' means a measure of the refractive (light bending) power of a lens.

'Electro-optics (EO)' means the term used to describe the interaction between optics and electronics, leading to transformation of electrical energy into light or vice versa.

'Electroluminescent (EL)' means referring to light emission that occurs from application of an alternating current to a layer of phosphor.

'Final Approach and Take-Off area (FATO)' means a defined area for helicopter operations, over which the final phase of the approach manoeuvre to hover or land is completed, and from which the take-off manoeuvre is commenced. In the case of helicopters operating in performance class 1, the defined area includes the rejected take-off area available;

'Flight Simulation Training Device (FSTD)' means a training device which is:

(a) in the case of aeroplanes, a full flight simulator (FFS), a flight training device (FTD), a flight and navigation procedures trainer (FNPT), or a basic instrument training device (BITD);

(b) in the case of helicopters, a full flight simulator (FFS), a flight training device (FTD) or a flight and navigation procedures trainer (FNPT);

'Foot-candle' means a measure of illuminance; specifically, the illuminance of a surface upon which one lumen is falling per square foot.

'Foot-Lambert' means a measure of luminance; specifically the luminance of a surface that is receiving an illuminance of one foot-candle.

'Gain' means when referring to an image intensification tube, the ratio of the brightness of the output in units of foot-lambert, compared to the illumination of the input in foot-candles. A typical value for a GEN III tube is 25,000 to 30,000 Fl/fc. A "tube gain" of 30,000 Fl/fc provides an approximate "system gain" of 3,000. This means that the intensified NVG image is 3,000 times brighter to the aided eye than that of the unaided eye.

'Ground emergency service personnel' means any ground emergency service personnel (such as policemen, firemen, etc.) involved with helicopter emergency medical services (HEMSs) and whose tasks are to any extent pertinent to helicopter operations;

'Helicopter' means a heavier-than-air aircraft supported in flight chiefly by the reactions of the air on one or more power-driven rotors on substantially vertical axes;

'HEMS crew member' means a technical crew member who is assigned to a HEMS flight for the purpose of attending to any person in need of medical assistance carried in the helicopter and assisting the pilot during the mission;

'HEMS flight' means a flight by a helicopter operating under a HEMS approval, where immediate and rapid transportation is essential and the purpose of which is either of the following:

(a) to facilitate emergency medical assistance by carrying one or more of the following:

(i) medical personnel;
(ii) medical supplies (equipment, blood, organs, drugs);
(iii) ill or injured persons and other persons directly involved;

(b) to perform an operation where a person faces an imminent or anticipated health risk posed by the environment and either of the following conditions is met:

(i) that person needs to be rescued or provided with supplies;
(ii) persons, animals or equipment need to be transported to and from the HEMS operating site;

'HEMS HEC operation' means air and ground operations for the purpose of transporting one or more persons as human external cargo (HEC) within a HEMS flight;

'HEMS operating base' means an aerodrome at which the crew members and the HEMS helicopter may be on standby for HEMS operations;

'HEMS operating site' 'HEMS operating site' means a site that is selected by the commander during a HEMS flight for a HEMS HEC operation or a landing or a take-off;

'Hostile environment' means:

(a) an environment in which:

(i) a safe forced landing cannot be accomplished because the surface is inadequate;

(ii) the helicopter occupants cannot be adequately protected from the elements;

(iii) search and rescue response/capability is not provided consistent with anticipated exposure; or

(iv) there is an unacceptable risk of endangering persons or property on the ground;

(b) in any case, the following areas:

(i) for overwater operations, the open sea areas north of 45N and south of 45S designated by the authority of the State concerned;

(ii) those parts of a congested area without adequate safe forced landing areas;

'Illuminance' means also referred to as illumination. The amount, ratio or density of light that strikes a surface at any given point.

'Image intensifier' means an electro-optic device used to detect and intensify optical images in the visible and near infrared region of the electromagnetic spectrum for the purpose of providing visible images. The component that actually performs the intensification process in a NVG. This component is composed of the photo cathode, MCP, screen optic, and power supply. It does not include the objective and eyepiece lenses.

'Incandescent' means refers to a source that emits light based on thermal excitation, i.e., heating by an electrical current, resulting in a very broad spectrum of energy that is dependent primarily on the temperature of the filament.

'Infrared' means that portion of the electromagnetic spectrum in which wavelengths range from 0.7 microns to 1 mm. This segment is further divided into near infrared (0.7-3.0 microns), mid infrared (3.0-6.0 microns), far infrared (6.0-15 microns), and extreme infrared (15 microns-1 mm). A NVG is sensitive to near infrared wavelengths approaching 0.9 microns.

'Irradiance' means the radiant flux density incident on a surface. For the purpose of this document the terms irradiance and illuminance shall be interchangeable.

'Local helicopter operation' means a commercial air transport operation of helicopters with a maximum certified take-off mass (MCTOM) over 3 175 kg and a maximum operational passenger seating configuration (MOPSC) of nine or less, by day, over routes navigated by reference to visual landmarks, conducted within a local and defined geographical area specified in the operations manual;

'Lumen' means a measurement of luminous flux equal to the light emitted in a unit solid angle by a uniform point source of one candle intensity.

'Luminance' means the luminous intensity (reflected light) of a surface in a given direction per unit of projected area. This is the energy used by NVGs.

'Lux' means a unit measurement of illumination. The illuminance produced on a surface that is one-meter square, from a uniform point source of one candle intensity, or one lumen per square meter.

'Maximum operational passenger seating configuration (MOPSC)' means the maximum passenger seating capacity of an individual aircraft, excluding crew seats, established for operational purposes and specified in the operations manual. Taking as a baseline the maximum passenger seating configuration established during the certification process conducted for the type certificate (TC), supplemental type certificate (STC) or change to the TC or STC as relevant to the individual aircraft, the MOPSC may establish an equal or lower number of seats, depending on the operational constraints;

'Medical passenger' means a medical person carried in a helicopter during a HEMS flight, including but not limited to doctors, nurses and paramedics;

'Microchannel plate' means a wafer containing between 3 and 6 million specially treated microscopic glass tubes designed to multiply electrons passing from the photo cathode to the phosphor screen in second and third generation intensifier tubes.

'Micron' means a unit of measure commonly used to express wavelength in the infrared region; equal to one millionth of a meter.

'Nanometer (nm)' means a unit of measure commonly used to express wavelength in the visible and near infrared region; equal to one billionth of a meter.

'Night' means the period between the end of evening civil twilight and the beginning of morning civil twilight or such other period between sunset and sunrise as may be prescribed by the appropriate authority, as defined by the Member State.

'Night Vision Device (NVD)': an electro-optical device used to provide a visible image using the electromagnetic energy available at night.

'Night Vision Goggles (NVG)' means a head-mounted, binocular, light intensification appliance that enhances the ability to maintain visual surface references at night.

'Night Vision Imaging System (NVIS)' means the integration of all elements required to successfully and safely use NVGs while operating a helicopter. The system includes as a minimum: NVGs, NVIS lighting, helicopter components, training and continuing airworthiness.

'NVIS crew member' means a technical crew member assigned to an NVIS flight

'NVIS flight' means a flight under night visual meteorological conditions (VMC) with the flight crew using NVGs in a helicopter operating under an NVIS approval.

'Non-hostile environment' means an environment in which:

(a) a safe forced landing can be accomplished;

(b) the helicopter occupants can be protected from the elements; and

(c) search and rescue response/capability is provided consistent with the anticipated exposure.

In any case, those parts of a congested area with adequate safe forced landing areas shall be considered non-hostile;

'Operating site' means a site, other than an aerodrome, selected by the operator or pilot-in-command or commander for landing, take-off and/or external load operations;

'Operation in performance class 1' means an operation that, in the event of failure of the critical engine, the helicopter is able to land within the rejected take-off distance available or safely continue the flight to an appropriate landing area, depending on when the failure occurs;

'Operation in performance class 2' means an operation that, in the event of failure of the critical engine, performance is available to enable the helicopter to safely continue the flight, except when the failure occurs early during the take-off manoeuvre or late in the landing manoeuvre, in which cases a forced landing may be required;

'Operation in performance class 3' means an operation that, in the event of an engine failure at any time during the flight, a forced landing may be required in a multi-engined helicopter and will be required in a single-engined helicopter;

'Pilot-in-command' means the pilot designated as being in command and charged with the safe conduct of the flight. For the purpose of commercial air transport operations, the 'pilot-in-command' shall be termed the 'commander';

'Photon' means a quantum (basic unit) of radiant energy (light).

'Photopic vision' means vision produced as a result of the response of the cones in the retina as the eye achieves a light adapted state (commonly referred to as day vision).

'Public Interest Site (PIS)' means a site used exclusively for operations in the public interest;

'Radiance': means the flux density of radiant energy reflected from a surface. For the purposes of this manual the terms radiance and luminance shall be interchangeable.

'Reflectivity' means the fraction of energy reflected from a surface.

'Safe forced landing' means an unavoidable landing or ditching with a reasonable expectancy of no injuries to persons in the aircraft or on the surface;

'Scotopic vision' means that vision produced as a result of the response of the rods in the retina as the eye achieves a dark-adapted state (commonly referred to as night vision).

'Situational awareness (SA)' means degree of perceptual accuracy achieved in the comprehension of all factors affecting an aircraft and crew at a given time.

'Starlight' means the illuminance provided by the available (observable) stars in a subject hemisphere. The stars provide approximately 0.00022 lux ground illuminance on a clear night. This illuminance is equivalent to about one-quarter of the actual light from the night sky with no moon.

'Stereopsis' means visual system binocular cues that are used for distance estimation and depth perception. Three dimensional visual perception of objects. The use of NVGs seriously degrades this aspect of near-depth perception.

'Technical crew member' means a crew member in commercial air transport HEMS, HEMS HEC, HHO or NVIS operations other than a flight or cabin crew member, assigned by the operator to duties in the aircraft or on the ground for the purpose of assisting the pilot during HEMS, HHO or NVIS operations, which may require the operation of specialised on-board equipment

'Transmittance' means the fraction of radiant energy that is transmitted through a layer of absorbing material placed in its path.

'Ultraviolet' means that portion of the electromagnetic spectrum in which wavelengths range between 0.1 and 0.4 microns.

'Wavelength' means the distance in the line of advance of a wave from any one point to the next point of corresponding phase; is used to express electromagnetic energy including IR and visible light.

'Whiteout' means a condition similar to brownout but caused by blowing snow.

Table of Contents (ToC)

ToC ISS 1 / REV 1 / 25.03.2024

0 Introduction

Ch. 0 ISS 1 / REV 0 / 04.02.2014

All Guidance Material/Information (GM/INFO) are intended to assist the organisation/operator in administrative matters. The administrative requirements and processes will facilitate liaising with the Federal Office of Civil Aviation (FOCA). It is to be considered a tool for the organisation/operator in order to ease processes of obtaining required and defined approvals and authorisations issued by the FOCA. Using this GM/INFO will be conducive to establish compliance with the requirements of Annex V (Part-SPA) to Regulation (EU) No 965/2012, subpart H: SPA.NVIS and will lead through the respective certification.

0.1 Terms and Conditions

Ch. 0.1 ISS 1 / REV 0 / 04.02.2014

The use of the male **gender** should be understood to include all genders.

The most frequent **abbreviations** used by the **EASA** are listed here: easa.europa.eu/abbreviations.

When used throughout the GM/INFO the following terms shall have the meaning as defined below:

Term	Meaning	Reference
shall, must, will	These terms express an obligation, a positive command.	EC English Style Guide
may	This term expresses a positive permission.	EC English Style Guide
shall not, will not	These terms express an obligation, a negative command.	EC English Style Guide
may not, must not	These terms express a prohibition.	EC English Style Guide
need not	This term expresses a negative permission.	EC English Style Guide
should	This term expresses an obligation when an acceptable means of compliance should be applied.	EASA Acceptable Means of Compliance publications FOCA policies and requirements
could	This term expresses a possibility.	http://oxforddictionaries.com/ definition/english/could
ideally	This term expresses a best possible means of compliance and/or best experienced industry practice.	FOCA recommendation

0.2 Legal References

Ch. 0.2 ISS 1 / REV 0 / 04.02.2014

- Basic Regulation (EU) No 2018/1139:
- Commission Regulation (EU) No 965/2012 as amended
- Commision Regulation (EU) No 1178/2011 as amended
- Commision Regulation (EU) No 748/2012 as amended

0.3 Purpose of this GM/INFO

Ch. 0.3 ISS 1 / REV 0 / 04.02.2014

The purpose of this GM/INFO is to provide:

- an overview of the general requirements of an NVIS approval;
- guidance on the possibility of developing the necessary NVIS content of the operations manual;
- a self-assessment tool for organisations to verify compliance with the relevant legal requirements; and
- a certification tool for the competent authority to conduct document evaluation regarding compliance with the relevant legal requirements.

0.4 Scope

Ch. 0.4 ISS 1 / REV 0 / 04.02.2014

The material in this GM/INFO covers all aspects of requirements for NVIS approval. It will help the applicant to implement the necessary content in the company's operations manuals to comply with the requirements. The questions in this GM/INFO are derived from the relevant implementing rules (IR), applicable means of compliance (AMC) and related guidance material (GM).

The examples provided in this GM/INFO may be incomplete and solely represent one possible means of how to provide the required data. The operator must add further information or adapt the examples to its specific needs in accordance with the necessary requirements.

Definitions of terms used in this dokuement are listed on page “Definitions for terms used in this Guidance Material” above or are outlined and explained within the reference boxes.

0.5 Operator Responsibilities

Ch. 0.5 ISS 1 / REV 0 / 04.02.2014

Helicopters shall only be operated for the purpose of NVIS operations if the operator has been approved by the competent authority.
To obtain such approval by the competent authority, the operator shall:

- operate in CAT and hold a CAT AOC in accordance with Annex III (Part-ORO);
- demonstrate to the competent authority compliance with the requirements contained in Subpart SPA.NVIS (H).

In addition to the requirements for commercial air-transport operations (CAT), NVIS operations must be compliant with a set of additional and different elements. Some of these elements are subject to a separate approval (e.g. operations to/from public interest sites).

The operator is responsible for ensuring that NVIS operations remain in compliance with the requirements of the applicable IR’s and AMCs/GMs.

Note: Manuals must be structured in accordance with the relevant regulation: ORO.MLR.100 / AMC1 ORO.MLR.100 / AMC 3 ORO.MLR.100

0.6 Format of the Assessment Checklist Items

Ch. 0.6 ISS 1 / REV 1 / 25.03.2024

This GM/INFO contains a checklist in the format of a standardised modular reference box system. The following presentation provides details of the defined format:

❶ **3.2. Minimum Equipment List (MEL)**
TOPIC

❷ M/CC
EVALUATION METHOD

❸ RVSM
CL TOPIC
3-B9-075
CL Ch.-OM Ch.-Seq.-No.

❹ ORO.MLR.105 CAT.IDE.A.105
LEGAL REFERENCE

❺ OM B, Chapter 9, Minimum Equipment List (MEL)
MANUAL REFERENCE

❻ **APP:** The MEL and any amendment thereto requires prior approval
IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

❼ ☐ Is the MEL amended in order to cover all system components that are relevant for the RVSM capability of the aeroplane?
QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

❽ The MEL shall be amended in order to comply with the requirement for RVSM operations in respect to system capability and redundancy.

❶	Topic: subject description
❷	FOCA evaluation method
❸	FOCA / Topic Reference Number which may be used as identification in addition to interlink between this GM/INFO and the Document Evaluation Report (Finding Report). The Number consists of a combination of: - a subject code related to the specific topic/ theme; and - sequence number in the respective chapter of the GM/INFO. The above example 3-B9-075 indicates: RVSM = CL regarding RVSM Specific Approval, 3 = CL section; B9 = OM chapter under evaluation (here OM-B, Chapter 9.), followed by 075 = sequence number (if applicable).
❹	Associated legal reference and/ or reference to other relevant publications including information on formal Acceptance (ACC) or Approval (APP) where applicable.
❺	Proposed reference to the Part(s), Chapter(s) and/or Subchapters of the organisation’s document systems or manual system as required by the applicable Part.
❻	If the legal provision requires a formal approval, a short description of the content of this approval is provided.
❼	Questions for self-assessment and compliance verification.
❽	Provides instructions, provisions, regulatory requirements, guidelines, acceptable means of compliance and examples of current best practice.

1 Requirements Related to NVIS

Ch. 1 ISS 1 / REV 0 / 04.02.2014

1.1 Elements of the NVIS Requiring Approval

Ch. 1.1 ISS 1 / REV 0 / 04.02.2014

The following elements of the NVIS operation require prior approval by FOCA:

- Airworthiness approval of helicopter and all associated NVIS equipment
- Training and checking programmes.

2 Documentation and Information

Ch. 2 ISS 1 / REV 1 / 25.03.2024

The operator shall ensure that, as part of its risk analysis and management process, risks associated with the NVIS environment are minimised by specifying in the operations manual: selection, composition and training of crews; levels of equipment and dispatch criteria; and operating procedures and minima, such that normal and likely abnormal operations are described and adequately mitigated.

2.1 Content of the Operations Manual for NVIS

Ch. 2.1 ISS 1 / REV 1 / 25.03.2024

In addition to general content as per AMC3 ORO.MLR.100 the operations manual (OM) for NVIS should include:

- equipment to be carried and its limitations;
- the minimum equipment list (MEL) entry covering the equipment specified;
- risk analysis, mitigation and management;
- pre- and post-flight procedures and documentation;
- selection and composition of crew;
- crew coordination procedures, including:
  - flight briefing;
  - procedures when one crew member is wearing NVG and/or procedures when two or more crew members are wearing NVGs;
  - procedures for the transition to and from NVIS flight;
  - use of the radio altimeter on an NVIS flight; and
  - inadvertent instrument meteorological conditions (IMC) and helicopter recovery procedures, including unusual attitude recovery procedures;
- the NVIS training syllabus;
- in-flight procedures for assessing visibility, to ensure that operations are not conducted below the minima stipulated for non-assisted night VFR operations;
- weather minima, taking the underlying activity into account; and
- the minimum transition heights to/from an NVIS flight.

3 Specific Approval - General

Ch. 3 ISS 1 / REV 1 / 25.03.2024

3.1 General requirements

Ch. 3.1 ISS 1 / REV 1 / 25.03.2024

M/CC
EVALUATION METHOD

SPA.GEN CL TOPIC	SPA.GEN.100	SPA.GEN.105	SPA.GEN.110	SPA.GEN.115	SPA.GEN.120 LEGAL REFERENCE
3-OMA0-005 CL Ch.-OM Ch.-Seq.-No.	OM A, chapter 0.X “introduction“ OM A, chapter 0.X “system of amendment and revision” MANUAL REFERENCE				

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

General:

☐ Does the commercial air transport (CAT) operator have its principle place of business in Switzerland?

☐ Has the operator applied for a specific approval and provided the required documentation and information:
- the name, address, mailing address of the applicant and
- a description of the intended operation?

☐ Has the operator provided the following evidence:
- compliance with the requirements of the applicable Subpart and
- the relevant elements defined in the data established in accordance with Regulation (EU) No 748/2012 have been taken into account.

☐ Does the operator retain records related to the required documentation for the approval at least for the duration of the SPA operation?

☐ Is the scope of activity that the operator (AOC holder) is approved to conduct documented and specified in the operations specifications to the AOC?

☐ Does the operator require himself to provide the FOCA with the relevant documentation when conditions of a specific approval are affected by changes?

☐ Does the operator specify that the SPA only remains valid if the operator remains in compliance with the requirements associated with the SPA and the relevant elements in accordance with Regulation (EU) No 748/2012?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

DOCUMENTATION (AMC1 SPA.GEN.105(a))

(a) Operating procedures should be documented in the operations manual.

(b) If an operations manual is not required, operating procedures may be described in a procedures manual (SOP).

4 Night vision imaging system (NVIS) operations

Ch. 4 ISS 1 / REV 1 / 25.03.2024

4.1 NVIS operations

Ch. 4.1 ISS 1 / REV 1 / 25.03.2024

M/CC
EVALUATION METHOD

NVIS CL TOPIC	SPA.NVIS.100 LEGAL REFERENCE
4-OMA-005 CL Ch.-OM Ch.-Seq.-No.	OM A, chapter ”explanations and definitions” MANUAL REFERENCE

APP: Helicopter operations under VFR at night with the aid of NVIS (-> ‘NVIS Approval’)

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

☐ Is the operation in CAT and does operator hold a CAT AOC in accordance with Annex III (Part-ORO)?

☐ Has the operator demonstrated compliance with the requirements in Subpart H of Part-SPA (Annex V) (NVIS)?

☐ Has the operator successfully integrated all elements of the NVIS?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

Definitions

‘Aided night vision imaging system (NVIS) flight’ means, in the case of NVIS operations, that portion of a visual flight rules (VFR) flight performed at night when a crew member is using night vision goggles (NVG).

‘NVIS flight’ means a flight under night visual meteorological conditions (VMC) with the flight crew using NVGs in a helicopter operating under an NVIS approval.

4.2 Equipment requirements for NVIS operations Ch. 4.2 ISS 1 / REV 1 / 25.03.2024		M/CC/IN EVALUATION METHOD
NVIS CL TOPIC 4-OMA/B-010 CL Ch.-OM Ch.-Seq.-No.	SPA.NVIS.110 (EU) No 748/2012 CM-FT-001 LEGAL REFERENCE	
	OM A, chapter 8.X ”installation and use” OM B, chapter 1.X ”certification” OM B, chapter 8.X ”configuration deviation list” OM B, chapter 9.X ”minimum equipment list” MANUAL REFERENCE	

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

General:

☐ Is the helicopter NVIS-ready as verified by FOCA STLB?

☐ Is the NVG/aircraft (STC) compatibility fully verifiable by means of a controlled document?

☐ Do the NVGs have a back-up/secondary power source (e.g. battery pack)?

☐ Do the crew helmets have appropriate NVG attachments?

☐ Do the procedures for continuing airworthiness contain the necessary information for carrying out ongoing maintenance and inspections on NVIS equipment, covering at least:

- helicopter windscreens and transparencies;
- NVG lighting;
- NVGs and
- any additional equipment that supports NVIS operations?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

Verification of NVG/Aircraft (STC) Compatibility

In order to ensure the NVG/aircraft (STC) compatibility, EASA memorandum CM-FT-001 (Issue 3, 2020) requires RFM-supplements to specify NVG make, model, part-number, type, generation and color. These more stringent requirements, in comparison to FAA AC 27-1B for example, can lead to informational gaps when FAA or other foreign STCs are cross-credited by EASA (based-on STC). This lack of information can hamper the verification of the NVG/aircraft (STC) compatibility and ultimately the operational NVIS approval.

Should the compatibility not be fully verifiyable by the respective STC, the operators shall record the following NVG specifics in their operations manual (OM):

1. Make (e.g. L3, Elbit)
2. Model (e.g. F4949, M949)
3. Part Number (e.g. 264332-29-P / not to be confused with the serial number!)
4. Filter Class (i.e. A, B)
5. Generation (i.e. Gen II, Gen III)
6. Phosphor screen color (i.e. white, green)

In addition, for operators managing multiple NVGs with varying specifications, the OM shall specify which NVGs are compatible with which helicopters and describe a process to prevent the use of NVGs in non-compatible aircraft.

For Multi-Crew NVIS operations using different models of NVGs, refer to chapter 4.3.

Modification or maintenance to the helicopter (GM1 SPA.NVIS.110(f))

It is important that the operator reviews and considers all modifications or maintenance to the helicopter with regard to the NVIS airworthiness approval. Special emphasis needs to be paid to modification and maintenance of equipment such as light emitting or reflecting devices, transparencies and avionics equipment, as the function of this equipment may interfere with the NVGs.

4.3	**Equipment requirements – considerations for multi-crew NVIS operations** Ch. 4.3 ISS 1 / REV 1 / 25.03.2024	M/CC/IN EVALUATION METHOD
NVIS CL TOPIC 4-OMA/B-15 Ch.-OM Ch.-Seq.-No.	SPA.NVIS.110 LEGAL REFERENCE	
	OM A, chapter 8.X ”operating procedures” OM B, chapter 8.X ”configuration deviation list” OM B, chapter 9.X ”minimum equipment list” CAME MANUAL REFERENCE	

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

☐ If different NVG makes and model are being used amongst crew members within the same mission, do they fulfill the visual acuity criteria and are they of the same filter class?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

Visual acuity:

The operator has to ensure that either:

1. The NVGs are of the same make and model; or
2. The NVGs meet the same set of specifications and the lowest figure of merit is not less than 85% of the higher figure of merit.
   Note: If the NVGs specifications indicate that they are of different generations, they must only be used together on a temporary basis, i.e. an upgrade must be done asap (must be specified in a risk assessment – see further down);

   If different models of NVGs are used, a demonstration and risk assessment is required.

   <u>Demonstration</u> for compatibility including the following:

   - Environmental conditions (within relevant, representative terrain and lights):
     - Full moon and moisture <70% relativ humidity;
     - At least one lighting condition that is in between;
     - No moon (e.g. 5mlux)
   - Operational conditions:
     - Demonstration may take place on non-commercial flights, or during commercial flights if:
       - The lighting conditions remain the same within the same mission; and
       - Different models of NVG are used on different flights within the same mission
     - Note: an FSTD is not to be used for operational demonstration
   - The operations manual should define the demonstration methodology and the crew members in charge of the demonstration should be provided with an ‘operational demonstration sheet’ wich includes all defined elements to be assessed undel all defined light conditions
   - Crew members in charge of the demonstration should have at least 100 NVIS flights or 30 hours flight time under NVIS as PIC/CMD

   <u>Risk assessment</u> that specifies the use of different NVGs on the same flight:

   - The operator concludes in this risk assessment:
     - the results of analysis of the different specifications of the NVGs; and
     - the results of the operational demonstration (see above)

     … resulting in either of the following restrictions:
     - the different NVGs may not be used together on the same flight;

- the different NVGs may be used on the same flight – no restrictions;
- the different NVGs may be used on the same flight with one more of the following restrictions
  - the pilot flying uses the best NVG avaiable;
  - for dark nights a briefing is made on the differences (‘dark night’ defined as < 1mLux or to be specified by the operator);
  - any additional restriction defined by the operator

- Further the risk assessment should specify the interchangeability of the NVGs available on board, including different makes and model as well as spare NVGs; and
- it may include an upgrading programme to better NVGs where:
  - the dureation / transition is taken into account;
  - possible differences on different operating bases including interchangeability of crews is considered;
  - reversal procedures (e.g. for reverting back to a previous model when a newer model is in maintenance) are taken into account (familiarisation and training).

SOPs are developped by the operator complying with any restrictions established in the risk assessment.

Filter class

If using different NVGs the operator has to demonstrate that they have the same filter class.

Note: Further details on the demonstration of equivalent visual acuity may be found in GM1 SPA.NVIS.110(e).

4.4 NVIS operating minima Ch. 4.4 ISS 1 / REV 1 / 25.03.2024	M/CC EVALUATION METHOD
NVIS CL TOPIC 4-OMA-020 CL Ch.-OM Ch.-Seq.-No.	SPA.NVIS.120 LEGAL REFERENCE OM A, chapter 8.X ”operating minima” OM A, chapter 8.X “operating procedures” OM A, chapter 12.X ”rules of the air” MANUAL REFERENCE

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

☐ Does the operations manual require the same weather minima for NVIS operation as for using unaided vision?

☐ Has the operator established the minimum transition height from where a change to/from aided flight may be continued?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

Operating Minima for NVIS operations under IFR

The limitations given by the rotorcraft flight manual must be complied with.

NVG may be in a flipped-down position in IFR when:

- in actual VMC;
- in actual IMC:
  - in preparation for the visual segment of an instrument approach or visual approach;
  - during the visual segment of an instrumet approach or -departure;
  - during a visual approach;
  - in preparation of a transition to VFR

Continuation on a visual segment should only be done, if the visual cues are enough to be seen by unaided vision, as it is for proceeding VFR, which must only be done if assessed by unaided vision.

4.5 Crew requirements - selection, experience, operational training Ch. 4.5 ISS 1 / REV 1 / 25.03.2024	M/CC/IN EVALUATION METHOD

NVIS CL TOPIC 4-OMA/D-025 CL Ch.-OM Ch.-Seq.-No.	SPA.NVIS.130 LEGAL REFERENCE
	OM A, chapter 1.X ”duties and responsibilities” OM A, chapter 2.X ”operational control and supervision” OM A, chapter 4.X ”crew composition” OM A, chapter 5.X ”qualification requirements” OM D, chapter 2.X ”training syllabi” MANUAL REFERENCE

APP: NVIS training and checking syllabi

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

General:

☐ Selection: Has the operator established selection criteria for crew member regarding the NVIS tasks?

☐ Trainee’s experience: Does the operator require at least 20 hours night VFR as PIC/CMD before commencing training?

☐ Instructors: Does the operator require following experience and qualification for NVIS instructors:

- flight instructor (FI(H)) or type rating instructor (TRI(H)) with the applicable type rating on which NVIS training will be given; and
- logged at least 100 NVIS flights or 30 hours’ flight time under NVIS as PIC/commander?

☐ Does the operator require that pilots flying with NVG, and technical crew members where applicable, have completed the operational training in accordance with the NVIS procedures contained in the OM?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

Definition

‘NVIS crew member’ means a technical crew member assigned to an NVIS flight.

Example - Selection criteria of flight crew member

- *New crew members undergo an assessment process. Based on flight hours, experience and qualification, candidates are assessed for suitability. After an interview led by the flight operations manager and/and crew training manager, the candidate performs a computer based test. Evaluation criteria during the interview are CRM skills, suitable attitude and maturity of the candidate.*

Formal criteria flight crew:

- *Age;*
- *CPL(H) or ATPL(H);*
- *Flight hours on turbine helicopters as PIC;*
- *Language (D, F or I).*

Formal criteria technical crew:

- *are at least 18 years of age;*
- *medical certificate class 2 (initial only);*
- *have been checked as proficient to perform all assigned duties in accordance with the procedures specified in the OM A XY, OM D XY.*

Qualification

Successful completion of training in accordance with the NVIS procedures contained in the operations manual and relevant experience in the role and environment under which NVIS operations are conducted.

Recency

All pilots and NVIS technical crew members conducting NVIS operations have to complete three NVIS flights in the last 90 days. Recency may be re-established on a training flight in the helicopter or an approved full flight simulator (FFS), which shall include the elements of training and checking syllabus in OM D XY.

Example - Experience before starting training

A trainee for NVIS operations must have at least 20 hours night VFR as PIC/commander before commencing NVIS training.

4.6 Crew requirements for NVIS operations - recency, minimum crew Ch. 4.6 ISS 1 / REV 1 / 25.03.2024	M/CC/IN EVALUATION METHOD
NVIS CL TOPIC 4-OMA-30 Ch.-OM Ch.-Seq.-No.	SPA.NVIS.130 LEGAL REFERENCE OM A 4.1.X “crew composition” OM A 5.X “qualification PIC/commander” OM A 5.5.X “qualification of NVIS technical crew member” MANUAL REFERENCE

APP: NVIS training and checking syllabi

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

- ☐ Recency: Does the operator require at least 3 NVIS flights in the last 90 days for all crew members according the training and checking syllabus (in FFS or helicopter)?
- ☐ Minimum crew: Does the operator require a minimum crew of a least one pilot and one NVIS technical crew member for operations to HEMS operating sites?
- ☐ If NVIS under IFR: Does the operator require a minimum crew of two pilots or one pilot & technical crew member?
- ☐ Single-pilot operation: Is the single-pilot NVIS operation limited to the en-route phase of a flight?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

Example - Recency

All pilots and NVIS technical crew members conducting NVIS operations have to complete three NVIS flights in the last 90 days. Recency may be re-established on a training flight in the helicopter or an approved full flight simulator (FFS), which shall include the elements of training and checking syllabus in OM D XY.

4.7	**Crew requirements for NVIS operations – training and checking VFR & IFR** Ch. 4.7 ISS 1 / REV 1 / 25.03.2024	M/CC/IN EVALUATION METHOD
NVIS CL TOPIC 4-OMA/D-35 Ch.-OM Ch.-Seq.-No.	SPA.NVIS.130 LEGAL REFERENCE OM A 5.X “qualification of NVIS technical crew member” OM D 2.X “training for flight crew” OM D 2.X “training for NVIS technical crew member” MANUAL REFERENCE	

APP: NVIS training and checking syllabi

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

- ☐ Does the operator’s NVIS ground training and flight training syllabi include all the subjects as required (e.g. example syllabi below) and are the syllabi part of the OM?
- ☐ Does the operator require the same ground training for flight crew and NVIS technical crew members?
- ☐ Has the operator defined which parts of the flight training are relevant for technical crew members (e.g. example syllabi below)?
- ☐ Crew coordination: Does the operator require that all crew members familiar and qualified with all aspects of NVIS flights (according their tasks and responsibility)?
- ☐ Do crew member have to demonstrate competency in those areas, both on the ground and in flight?
- ☐ Checking: Is the NVIS checking done in night proficiency checks and -line checks with a validity of 12 months?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

General

For the validtiy of the operator proficiency check and line check the usual 3 months “grace period” may be applied.

The checks may be combined with those checks required for the underlying activity (i.e. CAT; HEMS; HHO).

Training and checking syllabi content:
(Note: for NVIS under IFR see ‘Add-on for NVIS under IFR’ further down)

Flight crew - training

- *NVIS working principles, eye physiology, vision at night, limitations and techniques to overcome these limitations;*
- *preparation and testing of NVIS equipment;*
- *preparation of the helicopter for NVIS operations;*
- *normal and emergency procedures including all NVIS failure modes;*
- *maintenance of unaided night flying;*
- *crew coordination concept specific to NVIS operations;*
- *practice of the transition to and from NVG procedures;*
- *awareness of specific dangers relating to the operating environment; and*
- *risk analysis, mitigation and management.*

Flight crew - checking

- *night proficiency checks, including emergency procedures to be used on NVIS operations; and*
- *line checks with special emphasis on the following:*
  - *local area meteorology;*
  - *NVIS flight planning;*

  - *NVIS in-flight procedures;*
  - *transitions to and from night vision goggles (NVG);*
  - *normal NVIS procedures; and*
  - *crew coordination specific to NVIS operations?*

Technical crew - training and checking

- *NVIS working principles, eye physiology, vision at night, limitations, and techniques to overcome these limitations;*
- *duties in the NVIS role, with and without NVGs;*
- *the NVIS installation;*
- *operation and use of the NVIS equipment;*
- *preparing the helicopter and specialist equipment for NVIS operations;*
- *normal and emergency procedures;*
- *crew coordination concepts specific to NVIS operations;*
- *awareness of specific dangers relating to the operating environment; and*
- *risk analysis, mitigation and management.*

Add-on for NVIS under IFR

Flight crew - training and checking

- *training and experience:*
  - *efficient scanning of instruments with NVG flipped up / down as defined in the SOPs;*
  - *proficiency during transition phase and the visual segments of the flight during which they are expected to be used;*
  - *continuity of the crew concept.*

  Note: the person conducting the training should be a NVIS instructor and hold an instrument rating
- *initial and recurrent training using a suitable FSTD*
  - *transition from instrument to visual flight during the approach;*
  - *transition from visual to instrumet flight departure;*
  - *the 'suitable FSTD' may be a generic without motion (i.e. FNPT-II or higher);*
    - *it must be based on a helicopter type on which the crew member is current (unless the additional training for compensation is provided);*
    - *it must have an NVIS-compatible cockpit, have a night visual system that can represent different moon phases and allows external visual cues to be adjusted to the point where they are no longer visible without NVGs and remain visible with NVGs, when simulating night conditions; and*
    - *the night visual system must feature atmospheric conditions such as*
      - *more than one cloud layer or one cloud layer with a geographically variable cloud base;*
      - *variable visibility; and*
      - *snow, light rain and heavy rain with and without NVGs;*
- *the training has a validity of 12 months with the ususal 3 months "grace period".*
- *the operator proficiency check should include one transition from instrument to visual flight during the final approach, using NVIS. This manoeuvre may be combined with a 2D or 3D approach to minima.*
- *If on more than one type or variant with different levels of automation:*
  - *the crew member should be provided with differences training or familiarisation; and*
  - *the flight crew member should perform the manoeuvre defined in the bullet point above (transition) each time on a different type or variant.*

Technial crew - training and checking

- *General - initial and recurrent:*
  - *Duties in the technical crew member role;*
  - *Map reading*
    - *Ability to keep track with position and map, to detect conflicting terrain/obstacles on a given route and altitude;*
    - *Use of moving maps;*
  - *Basic understanding of the helicopter type and its systems, the location and design of normal and emergency systems and -equipment, including all lights and operation of doors, and knowledge appropriate to understand the terminology used in checklists;*
  - *Danger of rotor-turning helicopters;*
  - *Outside lookout during the flight;*
  - *Crew coordination with in-flight call-outs, with emphasis on crew coordination regarding his/her tasks, including checklist inititation, interruptin and termination;*
  - *Warnings, and use of normal, abnormal and emergency checklists assisting the pilot as required;*
  - *Use of the intercommunication system;*
  - *Basic helicotper performance principles including definition of Categroy A certification and perfromance class 1 and 2;*
  - *Operational control and supervision;*
  - *Meteorology;*
  - *Applicable SERA parts, including IFR, as relevant to his/her tasks;*
  - *Mission planning;*
  - *Early identification of pilot incapacitation;*
  - *Debriefing; and*
  - *PBN, as necessary.*
- *Navigation – initial and recurrent:*
  - *Aeronautical map reading (in addition to the above), navigation principles;*
  - *Navaid principles and use;*
  - *Crew coordination with in-flight call-outs, emphasis on navigation issues;*
  - *Applicable SERA parts; and*
  - *Airspace, restricted areas, and noise-abatement procedures.*
- *Monitoring – initial and recurrent:*
  - *Basic understanding of the helicopter type, including knowledge of the limitiations of the parameter the person is tasked to monitor, and knowledge of the basic principles of flight;*
  - *Instrument reading;*
  - *Inside monitoring of the flight*
    - *Aircraft state/cockpit corss-check;*
    - *Automation philosophy and autopilot status monitoring, as relevant;*
    - *FMS, as relevant;*
  - *Crew coordination with in-flight call-outs, emphasis on call-outs and actions resulting from monitoring process;*
  - *Flight path monitoring.*
- *Training on aircraft/FSTD - initial*
  - *Shall include leat 4 hours instruction dedicated to crew coorperation with the pilot. It shall be:*
    - *in a realistic crew composition;*
    - *supervised by a pilot with at least 500 hours in either multi-pilot OPS or single-pilot OPS with a technical crew member.*

    Note: The training may be skipped if the technical crew member has alsready done such training at another operator, or has performed 50 missions assisting the pilot from the front seat in the role as technical crew member.
- *LIFUS*
  - *Should take place during operator’s conversion course;*

    - *shall educate the technical crew member to the point where he/she can safely and independently conduct the assigned flight operational duties in accordance with the procedures contained in the OM;*
    - *should be conducted by a suitable qualified technical crew member or CMD nominated by the operator;*
    - *should include a minimum of five sectors under IFR.*
- *Training on aircraft/FSTD - recurrent*
    - *Shall be at leat 2 hours of flight, focussing on crew coorperation;*
    - *Should take place in the same conditons as the initial training (crew composition, supervision).*

Ground training

Example – Subjects to be instructed - ground training areas – flight crew and technical crew

Item	*Subject Area*	*Subject Details*	*Time*
1	*General anatomy and characteristics of the eye*	***Anatomy**:* *• Overall structure of the eye* *• Cones* *• Rods* ***Visual deficiencies:*** *• myopia* *• hyperopia* *• astigmatism* *• presbyopia* ***Effects of light on night vision & NV protection physiology:*** *• Light levels* *– illumination* *– luminance* *– reflectance* *– contrast* *• Types of vision:* *– photopic* *– mesopic* *– scotopic* *• Day versus night vision* *• Dark adaptation process:* *– dark adaptation* *– pre-adaptive state* *• Purkinje shift* *• Ocular chromatic aberration* *• Photochromatic interval*	*1 hour*
2	*Night vision human factors*	*Night blind spot (as compared to day blind spot)* *• Field of view and peripheral vision* *• Distance estimation and depth perception:* *– monocular cues* *– motion parallax* *– geometric perspective* *– size constancy* *– overlapping contours or interposition of objects* *• Aerial perspective:* *– variations in colour or shade* *– loss of detail or texture* *– position of light source* *– direction of shadows* *• Binocular cues* *• Night vision techniques:* *– off -centre vision* *– scanning* *– shapes and silhouettes* *• Vestibular illusions* *• Somatogyral illusions:* *– leans* *– graveyard spin* *– coriolis illusion* *• Somatogravic illusions:* *– oculographic illusions* *– elevator illusion* *– oculoagravic illusions* *• Proprioceptive illusions* *• Dealing with spatial disorientation* *• Visual illusions:* *– auto kinetic illusion* *– confusion with ground lights* *– relative motion* *– reversible perspective illusion* *– false vertical and horizontal cues*	*1hour*

		– altered planes of reference *– height /depth perception illusion* *– flicker vertigo* *– fascination (fixation)* *– structural illusions* *– size-distance illusion* *• Helicopter design limitations:* *– windscreen condition* *– helicopter instrument design* *– helicopter structural obstruction* *– interior lights* *– exterior lights* *• Self-imposed stresses:* *– drugs* *– exhaustion* *– alcohol* *– tobacco* *– hypoglycaemia* *– injuries* *– physical fitness* *• Stress & fatigue:* *– acute vs. chronic* *– prevention* *• Hypoxia issues and night vision* *• Weather/environmental conditions:* *– snow (white-out)* *– dust (brown-out)* *– haze* *– fog* *– rain* *– light level* *• Astronomical lights (moon, star, northern lights)* *• Effects of cloud cover*	
3	*NVIS general characteristics*	*• Definitions and types of NVIS:* *– light spectrum* *– types of NVIS* *• Thermal-imaging devices* *• Image-intensifier devices* *• Image-intensifier operational theory* *• Types of image intensifier systems:* *– generation 1* *– generation 2* *– generation 3* *– generation 4* *– type I / II* *– class A & B minus blue filter* *• NVIS equipment* *– shipping and storage case* *– carrying case* *– binocular assembly* *– lens caps* *– lens paper* *– operators manual* *– power pack (dual battery)* *– batteries* *• Characteristics of NVIS:* *– light amplification* *– light intensification* *– frequency sensitivity* *– visual range acuity* *– unaided peripheral vision* *– weight* *– flip-up device* *– break-away feature* *– neck cord* *– maintenance issues*	*1 hour*

		– *human factor issues* • *Description and functions of NVIS components:* – *helmet visor cover and extension strap* – *helmet NVIS mount and attachment points* – *different mount options for various helmets* – *lock release button* – *vertical adjustment knob* – *low battery indicator* – *binocular assembly* – *monocular tubes* – *fore and aft adjustment knob* – *eye span knob* – *tilt adjustment lever* – *objective focus rings* – *eyepiece focus rings* – *battery pack*	
4	*NVIS care & cleaning*	• *Handling procedures* • *NVIS operating instructions:* – *pre-mounting inspection* – *mounting procedures* – *focusing procedures* – *faults* • *Post-flight procedures;* • *Deficiencies: type and recognition of faults:* – *acceptable faults* *black spots* *chicken wire* *fixed pattern noise (honeycomb effect)* *output brightness variation* *bright spots* *image disparity* *image distortion* *emission points* – *unacceptable faults:* *shading* *edge glow* *fishing, flickering or intermittent operation* • *Cleaning procedures* • *Care of batteries* • *Hazardous material considerations;*	*1 hour*
5	*Pre- & post-flight procedures*	• *Inspect NVIS* • *Carrying case condition* • *Nitrogen purge due date* • *Collimation test due date* • *Screens diagram(s) of any faults* • *NVIS kit: complete* • *NVIS binocular assembly condition* • *Battery pack and quick disconnect condition* • *Batteries life expended so far* • *Mount battery pack onto helmet:* – *verify no LED showing (good battery)* – *fail battery by opening cap and LED illuminates* *(both compartments)* • *Mount NVIS onto helmet* • *Adjust and focus NVIS* • *Eye-span to known inter-papillary distance* • *Eye piece focus ring to zero* • *Adjustments:* – *vertical* – *fore and aft* – *tilt* – *eye-span (fine-tuning)* • *Focus (one eye at a time at 20 ft, then at 30 ft from an eye chart)* – *objective focus ring* – *eye piece focus ring* – *verify both images are harmonised*	*1 hour*

		– read eye-chart 20/40 line from 20 ft *• NVIS mission planning* *• NVIS light level planning* *• NVIS risk assessment*	
6	*NVIS terrain interpretation and environmental factors*	*• Night terrain interpretation* *• Light sources:* *– natural* *– lunar* *– solar* *– starlight* *– northern lights* *– artificial* *– cultural* *– infra-red* *• Meteorological conditions:* *– clouds/fog* *– indications of restriction to visibility:* *– loss of celestial lights* *– loss of ground lights* *– reduced ambient light levels* *– reduced visual acuity* *– increase in video noise* *– increase in halo effect* *• Cues for visual recognition:* *– object size* *– object shape* *– contrast* *– ambient light* *– color* *– texture* *– background* *– reflectivity* *• Factors affecting terrain interpretation:* *– ambient light* *– flight altitudes* *– terrain type* *• Seasons* *• Night navigation cues:* *– terrain relief* *– vegetation* *– hydrographical features* *– cultural features*	*1 hour*
7	*NVIS training & equipment requirements*	*Cover the relevant regulations and guidelines that pertain to night and NVIS flight to include as a minimum:* *• Crew experience requirements;* *• Crew training requirements;* *• Airspace requirements;* *• Night / NVIS MEL;* *• NVIS / night weather limits;* *• NVIS equipment minimum standard requirements.*	*1 hour*
8	*NVIS emergency procedures*	*Cover relevant emergency procedures:* *• Inadvertent IMC procedures* *• NVIS goggle failure* *• Helicopter emergencies:* *– with goggles* *– transition from goggles*	*1 hour*
9	*NVIS flight techniques*	*Respective flight techniques for each phase of flight for the type and class of helicopter used for NVIS training*	*1 hour*
10	*Basic instrument techniques*	*Present and confirm understanding of basic instrument flight techniques:* *• Instrument scan* *• Role of instruments in NVIS flight* *• Unusual attitude recovery procedures*	*1 hour*
11	*Blind cockpit drills*	*Perform blind cockpit drills:* *• Switches* *• Circuit breakers*	*1 hour*

		• *Exit mechanisms* • *External / internal lighting* • *Avionics*	

Source: GM2 SPA.NVIS.130(f)

Flight training

Example – Subjects to be instructed – flight training – flight crew and techncial crew (as required)

1	*Ground operations*	• *NVIS equipment assembly* • *Pre-flight inspection of NVISs* • *Helicopter pre-flight* • *NVIS flight planning:* - *light level planning* - *meteorology* - *obstacles and known hazards* - *risk analysis matrix* - *CRM concerns* - *NVIS emergency procedures review* • *Start-up/shut down* • *Goggling and degoggling*	*1 hour*
2	*General handling*	• *Level turns, climbs, and descents* • *For helicopters, confined areas and sloped landings* • *Operation specific flight tasks* • *Transition from aided to unaided flight* • *Demonstration of NVIS related ambient and cultural effects*	*1 hour*
3	*Take-offs & landings*	• *At both improved illuminated areas such as airports/airfields and unimproved unlit areas such as open fields* • *Traffic pattern* • *Low speed manoeuvres for helicopters*	*1 hour*
4	*Navigation*	• *Navigation over variety of terrain and under different cultural lighting conditions*	*1 hour*
5	*Emergency proce-dures*	• *Goggle failure* • *Helicopter emergencies* • *Inadvertent IMC* • *Unusual attitude recovery*	*1 hour*

Source: GM3 SPA.NVIS.130(f)

Note: Further training**:** guidelines and considerations are described in GM1 SPA.NVIS.130(f)

4.8	**Crew requirements for NVIS operations – training other personnel / briefings** Ch. 4.8 ISS 1 / REV 1 / 25.03.2024	M/CC/IN EVALUATION METHOD
NVIS CL TOPIC 4-OMA/B/D-40 Ch.-OM Ch.-Seq.-No.	SPA.NVIS.130 LEGAL REFERENCE OM A, chapter 5.X “qualification of other operations personnel” OM B, chapter 2.X “checklist” OM B, chapter 9.X „minimum equipment list” MANUAL REFERENCE	

APP: NVIS training and checking syllabi

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

- ☐ Has the other personnel (e.g. medical passenger, ground personnel) who are involved or support NVIS operations also to receive an adequate training in their areas of expertise (e.g. light discipline within the helicopter and on ground)?
- ☐ Are the NVIS equipment minimum requirements (for training) defined?
- ☐ Is a NVIS pre-flight briefing/checklist available (content as within the example below)?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

Training and checking of other than flight crew
Crew members other than flight crew (including technical crew member) need to be trained on NVIS matters. They should complete all phases of ground training given to flight crew as well.
They should demonstrate competency in all areas where they have any task specific to their position in the helicopter.

Ground personnel training
Non-flying personnel supporting NVIS operations need to be trained in their area of expertise, e.g. in light discipline within the helicopter and on ground.

Example - NVIS equipment minimum requirements (for training) (GM1 SPA.NVIS.130(f))

Minimum equipment lists and standard NVIS equipment requirements are stipulated in the MEL of the helicopter. Beside the MEL the following procedures and minimum equipment requirements have to be considered:
The following is recommended for minimum NVIS equipment and procedural requirements:

- *back-up power supply;*
- *NVIS adjustment kit or eye lane;*
- *use of helmet with the appropriate NVG attachment; and*
- *both the instructor and student should wear the same NVG type, generation and model.*

Example - NVIS pre-flight briefing/checklist

Item	***Subject***
1	*Weather:* • *METAR/TAF* • *Cloud cover/dew point spread/precipitation*
2	*OPS:* • *NOTAMs* • *DABS* • *Swiss Met Net* • *Publications (IFR/VFR backup/maps);* • *Goggles adjusted (acc. defined procedures/test set)*
3	*Ambient light:* • *Moon rise/set/phase/position/elevation* • *Light-level, % illumination and millilux (MLX) for duration of flight* • *Recommended minimum MLX: 1.5*

4	*Mission:* • *Mission outline* • *Terrain appreciation* • *Surface (sand, fresh snow, risk of “white/brown-out”)* • *Detailed manoeuvres* • *Decisions (criteria for continuation/aborting the mission)* • *Flight timings* • *Start/airborne/debrief* • *Airspace coordination for NVIS* • *Obstacles/minimum safe altitude* • *NVIS goggle up/degoggle location/procedure* • *Instrument IFR checks*
5	*Crew:* • *Crew day/experience* • *Crew position* • *Equipment: NVIS, case, video, fl ashlights* • *Lookout duties: left hand seat (LHS) – from 90° left to 45° right, RHS – from 90° right to 45°left;* • *Calling of hazards/movements landing light* • *Transfer of control terminology* • *Below 100 ft AGL – pilot monitoring (PM) ready to assume control*
6	*Helicopter:* • *Configuration* • *Fuel* • *CG* • *performance*
7	*Emergencies:* • *NVIS failure: cruise and low level flight* • *Tasks of PIC/commander, instructor, technical crew member* • *Inadvertent IMC/IFR recovery* • *Helicopter emergency: critical & non-critical* • *Radio call*

Source: GM4 SPA.NVIS.130(f)

4.9 Information and documentation Ch. 4.9 ISS 1 / REV 1 / 25.03.2024	M/CC/IN EVALUATION METHOD
NVIS CL TOPIC 4-OMA/D/OMM-045 CL Ch.-OM Ch.-Seq.-No.	SPA.NVIS.140 LEGAL REFERENCE OM A, chapter 0.X ”general” OM A, chapter 1.X ”organization and responsibilities” OM A, chapter 2.X ”operational control and supervision” OM A, chapter 4.X ”crew composition” OM A, chapter 5.X ”qualification requirements” OM A, chapter 6.X ”crew health precautions” OM A, chapter 7.X ”flight time limitations” OM D, chapter 2.X ”training syllabi and checking programmes” OMM, chapter 3.X ”duties, responsibilities and accountabilities” OMM, chapter 4.X ”hazard identification and risk management” MANUAL REFERENCE

IF APPLICABLE, BRIEF DESCRIPTION OF ELEMENT REQUIRING PRIOR APPROVAL

General:

☐ Does the operator ensure that, as part of its risk analysis and management process, risks associated with the NVIS environment are minimised by specifying in the operations manual:

- selection; composition and training of crews;
- levels of equipment and dispatch criteria; and
- operating procedures and minima, such that normal and likely abnormal operations are described and adequately mitigated?

☐ Does the operations manual include crew coordination procedures, including:

- flight briefing;
- procedures when one crew member is wearing NVG and/or procedures when two or more crew members are wearing NVGs;
- procedures for the transition to and from NVIS flight;
- use of the radio altimeter on an NVIS flight; and
- inadvertent instrument meteorological conditions (IMC) and helicopter recovery procedures, including unusual attitude recovery procedures;
- the NVIS training syllabus?

☐ Does the operations manual include:

- in-flight procedures for assessing visibility, to ensure that operations are not conducted below the defined minima
- non-assisted night VFR operations;
- weather minima, taking the underlying activity into account; and
- the minimum transition heights to/from an NVIS flight?

QUESTION FOR COMPLIANCE VERIFICATION AND SELF ASSESSMENT

5 Attachment GM1 SPA.NVIS.140 - Guidance / Reference guide on NVIS

Ch. 5 ISS 1 / REV 0 / 04.02.2014

EASA has published explaining NVIS (e.g. historical background, concept of operations under IFR, terminologies, system description, operating considerations, training, continuing airworthiness) based on divers official publications.

This document is considered a sound information library on NVIS. It could be used as a source for the establishment of the operation manuals' content (including the training) and as a reference guide.

5.1 CONCEPT OF OPERATIONS

Ch. 5.1 ISS 1 / REV 0 / 04.02.2014

5.1.1 Foreword

This document, initially incorporated in JAA TGL-34, prepared by a Sub-Group of EUROCAE Working Group 57 "Night Vision Imaging System (NVIS) Standardisation" is an abbreviated and modified version of the RTCA Report DO-268 "Concept Of Operations – Night Vision Imaging Systems For Civil Operators" which was prepared in the USA by RTCA Special Committee 196 (SC-196) and approved by the RTCA Technical Management Committee in March 2001.

The EUROCAE Working Group 57 (WG-57) Terms of Reference included a task to prepare a Concept of Operations (CONOPS) document describing the use of NVIS in Europe. To complete this task, a Sub- Group of WG-57 reviewed the RTCA SC-196 CONOPS (DO-268) to assess its applicability for use in Europe. Whilst the RTCA document was considered generally applicable, some of its content, such as crew eligibility and qualifications and the detail of the training requirements, was considered to be material more appropriately addressed in Europe by at that time other Joint Aviation Requirements (JAR) documents such as JAR-OPS and JAR-FCL. Consequently, WG-57 condensed the RTCA CONOPS document by removing this material which is either already addressed by other JAR documents or will be covered by the Agency's documents in the future. In addition, many of the technical standards already covered in the Minimum Operational Performance Standards (MOPS) for Integrated Night Vision Imaging System Equipment (DO-275) have been deleted in this European CONOPS.

5.1.2 Executive summary

The hours of darkness add to a pilot's workload by decreasing those visual cues commonly used during daylight operations. The decreased ability of a pilot to see and avoid obstructions at night has been a subject of discussion since aviators first attempted to operate at night. Technology advancements in the late 1960s and early 1970s provided military aviators some limited ability to see at night and therein changed the scope of military night operations. Continuing technological improvements have advanced the capability and reliability of night vision imaging systems to the point that they are receiving increasing scrutiny are generally accepted by the public and are viewed by many as a tool for night flight.

Simply stated, night vision imaging systems are an aid to night VFR flight. Currently, such systems consist of a set of night vision goggles and normally a complementary array of cockpit lighting modifications. The specifications of these two sub-system elements are interdependent and, as technology advances, the characteristics associated with each element are expected to evolve. The complete description and performance standards of the night vision goggles and cockpit lighting modifications appropriate to civil aviation are contained in the Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment.

An increasing interest on the part of civil operators to conduct night operations has brought a corresponding increased level of interest in employing night vision imaging systems. However, the night vision imaging systems do have performance limitations. Therefore, it is incumbent on the operator to employ proper training methods and operating procedures to minimise these limitations to ensure safe operations. In turn, operators employing night vision imaging systems must have the guidance and support of their regulatory agency in order to safely train and operate with these systems.

The role of the regulatory agencies in this matter is to develop the technical standard orders for the hardware as well as the advisory material and inspector handbook materials for the operations and training aspect. In addition, those agencies charged with providing flight weather information should modify their products to include the night vision imaging systems flight data elements not currently provided.

An FAA study (DOT/FAA/RD-94/21, 1994) best summarised the need for night vision imaging systems by stating, 'When properly used, NVGs can increase safety, enhance situational awareness, and reduce pilot workload and stress that are typically associated with night operations.'

5.1.3 Concept of operations — NVIS operations under IFR

The NVIS can be useful to assess the environment when not in a cloud layer if procedures are established for its use. It may also be useful for decision-making before cancelling IFR and during the transition from instrument flight to visual flight under IFR.

During departure, the NVIS provides extra safety if used correctly. This is especially true for a departure where the instruction is to proceed VFR from the FATO to the initial departure fix (IDF) because VFR departures provide no obstacle protection. It could also be useful for other instrument departures.

During the transition to visual flight, the NVIS provides additional safety because the visibility may be very different with or without the NVIS, and it may help to assess the situation.

The scanning of instruments and of external cues will be modified. Multi-crew operations with SOPs and the relevant training should be in place.

Operator SOPs may define that when one of the crew members uses the NVGs in a flipped-down position, the other should have the NVGs flipped up and should monitor the flight instruments and navigation instruments used for the flight. In this case, the continuity of the crew concept will rely on efficient crew communication.

In other situations and operations, the operator SOPs may also define that both crew members have NVGs in the flipped-down position, using the capability to look below the NVGs to monitor both the instruments and the VMC situation.

5.2 TERMINOLOGY

Ch. 5.2 ISS 1 / REV 0 / 04.02.2014

5.2.1 Night vision goggles

An NVG is a binocular appliance that amplifies ambient light and is worn by a pilot. The NVG enhances the wearer's ability to maintain visual surface reference at night.

5.2.1.1 Type

Type refers to the design of the NVG with regards to the manner in which the image is relayed to the pilot. A Type 1 NVG is one in which the image is viewed directly in-line with the image intensification process. A Type 1 NVG is also referred to as "direct view" goggle. A Type 2 NVG is one in which the image intensifier is not in-line with the image viewed by the pilot. In this design, the image may be reflected several times before being projected onto a combiner in front of the pilot's eyes. A Type 2 NVG is also referred to as an "indirect view" goggle.

5.2.1.2 Class

Class is a terminology used to describe the filter present on the NVG objective lens. The filter restricts the transmission of light below a determined frequency. This allows the cockpit lighting

1. Class A

Class A or "minus blue" NVGs incorporate a filter, which generally imposes a 625 nanometercutoff. Thus, the use of colours in the cockpit (e.g. colour displays, colour warning lights, etc.) may be limited. The blue green region of the light spectrum is allowed through the filter.

2. Class B

Class B NVGs incorporate a filter that generally imposes a 665 nanometercutoff. Thus, the cockpit lighting design may incorporate more colours since the filter eliminates some yellows and oranges from entering the intensification process.

3. Modified class B

Modified Class B NVGs incorporate a variation of a Class B filter but also incorporates a notch filter in the green spectrum that allows a small percentage of light into the image intensification process. Therefore, a Modified Class B NVG allows pilots to view fixed head-up display (HUD) symbology through the NVG without the HUD energy adversely affecting NVG performance.

5.2.1.3 Generation

Generation refers to the technological design of an image intensifier. Systems incorporating these light-amplifying image intensifiers were first used during WWII and were operationally fielded by the US military during the Vietnam era. These systems were large, heavy and poorly performing devices that were unsuitable for aviation use, and were termed Generation I (Gen I).

Gen II devices represented a significant technological advancement and provided a system that could be head-mounted for use in ground vehicles.

Gen III devices represented another significant technological advancement in image intensification, and provided a system that was designed for aviation use. Although not yet fielded, there are prototype NVGs that include technological advances that may necessitate a Gen IV designation if placed into production. Because of the variations in interpretations as to generation, NVGs will not be referred to by the generation designation.

5.2.1.4 Omnibus

The term OMNIBUS refers to a US Army contract vehicle that has been used over the years to procure NVGs. Each successive OMNIBUS contract included NVGs that demonstrated improved performance. There have been five contracts since the mid 1980s, the most current being OMNIBUS V. There may be several variations of NVGs within a single OMNIBUS purchase, and some NVGs from previous OMNIBUS contracts have been upgraded in performance to match the performance of goggles from later contracts. Because of these variations, NVGs will not be referred to by the OMNIBUS designation.

5.2.1.5 Resolution and visual acuity

Resolution refers to the capability of the NVG to present an image that makes clear and distinguishable the separate components of a scene or object.

Visual acuity is the relative ability of the human eye to resolve detail and interpret an image.

5.2.2 Aviation night vision imaging system (NVIS)

The Night Vision Imaging System is the integration of all elements required to successfully and safely operate an aircraft with night vision goggles. The system includes at a minimum NVGs, NVIS lighting, other aircraft components, training, and continuing airworthiness.

5.2.2.1 Look under (under view)

Look under is the ability of pilots to look under or around the NVG to view inside and outside the aircraft.

5.2.3 NVIS lighting

An aircraft lighting system that has been modified or designed for use with NVGs and which does not degrade the performance of the NVG beyond acceptable standards, is designated as NVIS lighting. This can apply to both interior and exterior lighting.

5.2.3.1 Design considerations

As the choice of NVG filter drives the cockpit lighting design, it is important to know which goggle will be used in which cockpit. Since the filter in a Class A NVG allows wavelengths above 625 nanometers into the intensification process, it should not be used in a cockpit designed for Class B or Modified Class B NVGs. However, since the filter in a Class B and Modified Class B NVGs is more restrictive than that in a Class ANVG, the Class B or Modified Class B NVG can be used with either Class A or Class B cockpit lighting designs.

5.2.3.2 Compatible

Compatibility, with respect to an NVIS system, includes a number of different factors:

compatibility of internal and external lighting with the NVG, compatibility of the NVG with the crew station design (e.g. proximity of the canopy or windows, proximity of overhead panels, operability of controls, etc.), compatibility of crew equipment with the NVG and compatibility with respect to colour discrimination and identification (e.g. caution and warning lights still maintain amber and red colours). The purpose of this paragraph is to discuss compatibility with respect to aircraft lighting. An NVIS lighting system, internal and external, is considered compatible if it adheres to the following requirements:

1. the internal and external lighting does not adversely affect the operation of the NVG during any phase of the NVIS operation;
2. the internal lighting provides adequate illumination of aircraft cockpit instruments, displays and controls for unaided operations and for “look-under” viewing during aided operations; and
3. The external lighting aids in the detection and separation by other aircraft.

NVIS lighting compatibility can be achieved in a variety of ways that can include, but is not limited to, modification of light sources, light filters or by virtue of location. Once aircraft lighting is modified for using NVGs, it is important to keep in mind that changes in the crew station (e.g., addition of new display) must be assessed relative to the effect on NVIS compatibility.

5.2.4 NVIS operation

A night flight wherein the pilot maintains visual surface reference using NVGs in an aircraft that is NVIS approved.

5.2.4.1 Aided

Aided flight is flight with NVGs in an operational position.

5.2.4.2 Unaided

Unaided flight is a flight without NVGs or a flight with NVGs in a non-operational position.

5.3 SYSTEM DESCRIPTION

Ch. 5.3 ISS 1 / REV 0 / 04.02.2014

5.3.1 NVIS capabilities

NVIS generally provides the pilot an image of the outside scene that is enhanced compared to that provided by the unaided, dark-adapted eye. However, NVIS may not provide the user an image equal to that observed during daylight. Since the user has an enhanced visual capability, situational awareness is generally improved.

5.3.1.1 Critical elements

The following critical elements are the underlying assumptions in the system description for NVIS:

1. aircraft internal lighting has been modified or initially designed to be compatible;
2. environmental conditions are adequate for the use of NVIS (e.g. enough illumination is present, weather conditions are favourable, etc.);
3. the NVIS has been properly maintained in accordance with the minimum operational performance standards;
4. a proper pre-flight has been performed on the NVIS confirming operation in accordance with the continued airworthiness standards and training guidelines; and
5. the pilot(s) has been properly trained and meets recency of experience requirements.

Even when insuring that these conditions are met, there still are many variables that can adversely affect the safe and effective use of NVIS (e.g. flying towards a low angle moon, flying in a shadowed area, flying near extensive cultural lighting, flying over low contrast terrain, etc.). It is important to understand these assumptions and limitations when discussing the capabilities provided by the use of NVIS.

5.3.1.2 Situation awareness

Situation awareness, being defined as the degree of perceptual accuracy achieved in the comprehension of all factors affecting an aircraft and crew at a given time, is improved at night when using NVG during NVIS operations. This is achieved by providing the pilot with more visual cues than is normally available under most conditions when operating an aircraft unaided at night. However, it is but one source of the factors necessary for maintaining an acceptable level of situational awareness.

5.3.1.2.1 Environment detection and identification

An advantage of using NVIS is the enhanced ability to detect, identify, and avoid terrain and/or obstacles that present a hazard to night operations. Correspondingly, NVIS aid in night navigation by allowing the aircrew to view waypoints and features.

Being able to visually locate and then (in some cases) identify objects or areas critical to operational success will also enhance operational effectiveness. Finally, use of NVIS may allow pilots to detect other aircraft more easily.

5.3.1.3 Emergency situations

NVIS generally improve situational awareness, facilitating the pilot’s workload during emergencies. Should an emergency arise that requires an immediate landing, NVIS may provide the pilot with a means of locating a suitable landing area and conducting a landing. The pilot must determine if the use of NVIS during emergencies is appropriate. In certain instances, it may be more advantageous for the pilot to remove the NVG during the performance of an emergency procedure.

5.3.2 NVG design characteristics

5.3.2.1 There are limitations inherent in the current NVG design.

Visual acuity

The pilot's visual acuity with NVGs is less than normal daytime visual acuity.

Field of view

Unaided field of view (FOV) covers an elliptical area that is approximately 120° lateral by 80° vertical, whereas the field of view of current Type I NVG systems is nominally 40° and is circular. Both the reduced field of view of the image and the resultant decrease in peripheral vision can increase the pilot's susceptibility to misperceptions and illusions. Proper scanning techniques must be employed to reduce the susceptibility to misperception and illusions.

Field of regard

The NVG has a limited FOV but, because it is head-mounted, that FOV can be scanned when viewing the outside scene. The total area that the FOV can be scanned is called the field of regard (FOR). The FOR will vary depending on several factors: physiological limit of head movement, NVG design (e.g., protrusion of the binocular assembly, etc.) and cockpit design issues (e.g., proximity of canopy or window, seat location, canopy bow, etc.).

NVG weight & centre of gravity

The increased weight and forward CG projection of head supported devices may have detrimental effects on pilot performance due to neck muscle strain and fatigue. There also maybe an increased risk of neck injury in crashes.

Monochromatic image

The NVG image currently appears in shades of green. Since there is only one colour, the image is said to be "monochromatic". This colour was chosen mostly because the human eye can see more detail at lower brightness levels when viewing shades of green. Colour differences between components in a scene helps one discriminate between objects and aids in object recognition, depth perception and distance estimation. The lack of colour variation in the NVG image will degrade these capabilities to varying degrees.

Ambient or artificial light

The NVG requires some degree of light (energy) in order to function. Low light levels, noncompatible aircraft lighting and poor windshield/window light transmissibility, diminish the performance capability of the NVG. It is the pilot's responsibility to determine when to transition from aided to unaided due to unacceptable NVG performance.

LED lights

Some red obstacle lights and other artificial lights that are clearly visible to the naked eye are not visible to NVGs. These obstacle lights may employ LED instead of traditional incandescent sources. The use of LED lights is becoming more common for almost all lighting applications because of their extensive lifetime and low energy consumption.

Aviation red light ranges from about 610 to 700 nanometres (nm), and NVGs approved for civil aviation (having a Class B Minus Blue Filter) are only sensitive to energy ranging from 665 to about 930 nm. LED and other artificial lights may have a relatively narrow emission band (around 630 nm ± 20 nm) and that band is below the range in which NVGs are sensitive and LEDs do not emit infrared energy like incandescent lights for obstacle red lights.

In general terms, NVG users should be aware that obstacle lighting systems and other artificial lights that fall outside the combined visible and near-infrared spectrum of NVGs (approximately 665 to 930 nm) will not be visible to their goggles. Other obstacle lights may use a wavelength very close to the approximate cut-off wavelength of 665 nm and will remain visible to the goggles, but they will be dimmed and will be better seen with the naked eye.

Full awareness of obstacle lights can only be achieved with an unaided scan.

5.3.2.2 Physiological and other conditions

Cockpit resource management

Due to the inherent limitations of NVIS operations, there is a requirement to place emphasis on NVIS related cockpit resource management (CRM). This applies to both single and multi-pilot cockpit environments. Consequently, NVIS flight requires effective CRM between the pilot(s), controlling agencies and other supporting personnel. An appropriate venue for addressing this issue is the pre-flight NVIS mission brief.

Fatigue

Physiological limitations that are prevalent during the hours of darkness along with the limitations associated with NVGs, may have a significant impact on NVIS operations. Some of these limitations are the effects of fatigue (both acute and chronic), stress, eyestrain, working outside the pilot's normal circadian rhythm envelope, increased helmet weight, aggressive scanning techniques associated with NVIS, and various human factors engineering concerns that may have a direct influence on how the pilot works in the aircraft while wearing NVGs. These limitations may be mitigated through proper training and recognition, experience, adaptation, rest, risk management, and proper crew rest/duty cycles.

Over-confidence

Compared to other types of flight operations, there may be an increased tendency by the pilot to over-estimate the capabilities of the NVIS.

Spatial orientation

There are two types of vision used in maintaining spatial orientation: central (focal) vision and peripheral (ambient) vision. Focal vision requires conscious processing and is slow, whereas peripheral information is processed subconsciously at a very fast rate. During daytime, spatial orientation is maintained by inputs from both focal vision and peripheral vision, with peripheral vision providing the great majority of the information. When using NVGs, peripheral vision can be significantly degraded if not completely absent. In this case, the pilot must rely on focal vision to interpret the NVG image as well as the information from flight instruments in order to maintain spatial orientation and situation awareness. Even though maintaining spatial orientation requires more effort when using NVGs than during daytime, it is much improved over night unaided operations where the only information is obtained through flight instruments. However, anything that degrades the NVG image to a point where the horizon is not visualised and/or ground reference is lost or significantly degraded will necessitate a reversion to flight on instruments until adequate external visual references can be established. Making this transition quickly and effectively is vital in order to avoid spatial disorientation. Additionally, added focal task loading during the operation (e.g. communications, looking at displays, processing navigational information, etc.) will compete with the focal requirement for interpreting the NVG image and flight instruments. Spatial disorientation can result when the task loading increases to a point where the outside scene and/or the flight instruments are not properly scanned. This potential can be mitigated to some extent through effective training and experience.

Depth perception & distance estimation

When flying, it is important for pilots to be able to accurately employ depth perception and distance estimation techniques. To accomplish this, pilots use both binocular and monocular vision. Binocular vision requires the use of both eyes working together, and, practically speaking, is useful only out to approximately 100 ft. Binocular vision is particularly useful when flying close to the ground and/or near objects (e.g. landing a helicopter in a small landing zone). Monocular vision can be accomplished with either eye alone, and is the type of vision used for depth perception and distance estimation when viewing beyond approximately 100 ft. Monocular vision is the predominant type of vision used when flying fixed wing aircraft, and also when flying helicopters and using cues beyond 100 ft. When viewing an NVG image, the two eyes can no longer provide accurate binocular information, even though the NVG used when flying is a binocular system. This has to do with the way the eyes function physiologically (e.g. accommodation, stereopsis, etc.) and the design of the NVG (i.e. a binocular system with a fixed channel for each eye). Therefore, binocular depth perception and distance estimation tasking when viewing terrain or objects with an NVG within 100 ft is significantly degraded. Since monocular vision does not require both eyes working together, the adverse impact on depth perception and distance estimation is much less, and is mostly dependent on the quality of the NVG image. If the image is very good and there are objects in the scene to use for monocular cueing (especially objects with which the pilot is familiar), then distance estimation and depth perception tasking will remain accurate. However, if the image is degraded (e.g., low illumination, airborne obscurants, etc.) and/or there are few or unfamiliar objects in the scene, depth perception and distance estimation will be degraded to some extent. In summary, pilots using NVG will maintain the ability to accurately perceive depth and estimate distances, but it will depend on the distances used and the quality of the NVG image. Pilots maintain some ability to perceive depth and distance when using NVGs by employing monocular cues. However, these capabilities may be degraded to varying degrees.

Instrument lighting brightness considerations

When viewing the NVG image, the brightness of the image will affect the amount of time it takes to adapt to the brightness level of the instrument lighting, thereby affecting the time it takes to interpret information provided by the instruments. The higher the quality (figure of merit (FOM), resolution, filters, contrast, etc.) of the 'tubes', the less critical this effect becomes.

For example, if the instrument lighting is fairly bright, the time it takes to interpret information provided by the instruments may be instantaneous. However, if the brightness of the lighting is set to a very low level, it may take several seconds to interpret the information, thus increasing the heads-down time and increasing the risk of spatial disorientation. It is important to ensure that instrument lighting is kept at a brightness level that makes it easy to rapidly interpret the information. This will likely be brighter than the one that is used during unaided operations. If the NVGs are used in the transition phase from IFR to VFR, the brightness level of the instrument lighting should be set in advance.

Dark adaptation time from NVG to unaided operations

When viewing an NVG image, both rods and cones are being stimulated (i.e. mesopic vision), but the brightness of the image is reducing the effectiveness of rod cells. If the outside scene is bright enough (e.g. urban area, bright landing pad, etc.), both rods and cones will continue to be stimulated. In this case there will be no improvement in acuity over time and the best acuity is essentially instantaneous. In some cases (e.g. rural area with scattered cultural lights), the outside scene will not be bright enough to stimulate the cones and some amount of time will be required for the rods to fully adapt. In this case it may take the rods one to two minutes to fully adapt for the best acuity to be realised. If the outside scene is very dark (e.g. no cultural lights and no moon), it may take up to five minutes to fully adapt to the outside scene after removing the NVGs. The preceding are general guidelines and the time required to fully adapt to the outside scene once removing the NVG depends on many variables: the length of time the NVG has been used, whether or not the pilot was dark adapted prior to flight, the brightness of the outside scene, the brightness of cockpit lighting, and variability in visual function among the population. It is important to understand the concept and to note the time requirements for the given operation.

Complacency

Pilots must understand the importance of avoiding complacency during NVG flights. Similar to other specialised flight operations, complacency may lead to an acceptance of situations that would normally not be permitted. Attention span and vigilance are reduced, important elements in a task series are overlooked, and scanning patterns, which are essential for situational awareness, break down (usually due to fixation on a single instrument, object or task). Critical but routine tasks are often skipped.

Experience

High levels of NVIS proficiency, along with a well-balanced NVIS experience base, will help to offset many of the visual performance degradations associated with night operations. NVIS experience is a result of proper training coupled with numerous NVIS operations. An experienced NVIS pilot is acutely aware of the NVIS operational envelope and its correlation to various operational effects, visual illusions and performance limitations. This experience base is gained (and maintained) over time through a continual, holistic NVIS training programme that exposes the pilot to NVIS operations conducted under various moon angles, percentage of available illumination, contrast levels, visibility levels, and varying degrees of cloud coverage. A pilot should be exposed to as many of these variations as practicable during the initial NVIS qualification programme. Continued exposure during the NVIS recurrent training will help strengthen and solidify this experience base.

5.4 OPERATIONS

Ch. 5.4 ISS 1 / REV 0 / 04.02.2014

Operations procedures should accommodate the capabilities and limitations of the systems described in Section 5.3 of this GM as well as the restraints of the operational environment.

All NVG operations should fulfil all applicable requirements in accordance with Regulation (EC) No 216/2008.

5.4.1 Pilot eligibility

About 54% of the civil pilot population wears some sort of ophthalmic device to correct vision necessary to safely operate an aircraft. The use of inappropriate ophthalmic devices with NVGs may result in vision performance decrement, fatigue, and other human factor problems, which could result in increased risk for aviation accidents and incidents.

5.4.2 Operating environment considerations

5.4.2.1 Weather and atmospheric obscurants

Any atmospheric condition, which absorbs, scatters, or refracts illumination, either before or after it strikes terrain, may reduce the usable energy available to the NVG.

Weather

During NVIS operations, pilots can see areas of moisture that are dense (e.g. clouds, thick fog, etc.) but may not see areas that are less dense (e.g. thin fog, light rain showers, etc.). The inability to see some areas of moisture may lead to hazardous flight conditions during NVIS operations and will be discussed separately in the next section.

The different types of moisture will have varying effects and it is important to understand these effects and how they apply to NVIS operations. For example:

1. It is important to know when and where fog may form in the flying area. Typically, coastal, low-lying river, and mountainous areas are most susceptible.
2. Light rain or mist may not be observed with NVIS but will affect contrast, distance estimation, and depth perception. Heavy rain is more easily perceived due to large droplet size and energy attenuation.
3. Snow occurs in a wide range of particle sizes, shapes, and densities. As with clouds, rain, and fog, the denser the airborne snow, the greater the effect on NVG performance. On the ground, snow has mixed effect depending on terrain type and the illumination level. In mountainous terrain, snow may add contrast, especially if trees and rocks protrude through the snow. In flatter terrain, snow may cover high contrast areas, reducing them to areas of low contrast. On low illumination nights, snow may reflect the available energy better than the terrain it covers and thus increase the level of illumination.

All atmospheric conditions reduce the illumination level to some degree and recognition of this reduction with NVGs can be difficult. Thus, a good weather briefing, familiarity with the local weather patterns and understanding the effects on NVG performance are important for a successful NVIS flight.

Deteriorating weather

It is important to remain cognizant of changes in the weather when using NVGs. It is possible to “see through” areas of light moisture when using NVGs, thus increasing the risk of inadvertently entering IMC. Some ways to help reduce this possibility include the following:

4. Be attentive to changes in the NVG image. Halos may become larger and more diffuse due to diffraction of light in moisture. Scintillation in the image may increase due to a lowering of the illumination level caused by the increased atmospheric moisture. Loss of scene detail may be secondary to the lowering illumination caused by the changing moisture conditions.
5. Obtain a thorough weather brief with emphasis on NVG effects prior to flight.
6. Be familiar with weather patterns in the flying area.
7. Occasionally scan the outside scene. The unaided eye may detect weather conditions that are not detectable to the NVG.

Despite the many methods of inadvertent instrument meteorological conditions (IMC) prevention, one should have established IMC recovery procedures and be familiar with them.

Airborne obscurants

In addition to weather, there may be other obscurants in the atmosphere that could block energy from reaching the NVG, such as haze, dust, sand, or smoke. As with moisture, the size and concentration of the particles will determine the degree of impact. Examples of these effects include the following:

1. high winds during the day can place a lot of dust in the air that will still be present at night when the wind may have reduced in intensity;

2. forest fires produce heavy volumes of smoke that may cover areas well away from the fire itself;

3. the effects of rotor wash may be more pronounced when using NVGs depending on the material 4. (e.g. sand, snow, dust, etc.); and

4. pollution in and around major cultural areas may have an adverse effect on NVG performance.

Winter operations

Using NVGs during winter conditions provide unique issues and challenges to pilots.

Snow

Due to the reflective nature of snow, it presents pilots with significant visual challenges both en-route and in the terminal area. During the en-route phase of a flight the snow may cause distractions to the flying pilot if any aircraft external lights (e.g. anti-collision beacons/strobes, position lights, landing lights, etc.) are not compatible with NVGs. In the terminal area, whiteout landings can create the greatest hazard to unaided night operations. With NVGs the hazard is not lessened, and can be more disorienting due to lights reflecting from the snow that is swirling around the aircraft during the landing phase. Any emergency vehicle lighting or other airport lighting in the terminal area may exaggerate the effects.

Ice fog

Ice fog presents the pilot with hazards normally associated with IMC in addition to problems associated with snow operations. The highly reflective nature of ice fog will further aggravate any lighting problems. Ice fog conditions can be generated by aircraft operations under extremely cold temperatures and the right environmental conditions.

Icing

Airframe ice is difficult to detect while looking through NVGs. The pilot will need to develop a proper crosscheck to ensure airframe icing does not exceed operating limits for that aircraft. Pilots should already be aware of icing indicator points on their aircraft. These areas require consistent oversight to properly determine environmental conditions.

Low ambient temperatures

Depending on the cockpit heating system, fogging of the NVGs can be a problem and this will significantly reduce the goggle effectiveness. Another issue with cockpit temperatures is the reduced battery duration. Operations in a cold environment may require additional battery resources.

5.4.2.2 Illumination

NVGs require illumination, either natural or artificial, to produce an image. Although current NVG technology has significantly improved low light level performance, some illumination, whether natural or artificial, is still required to provide the best possible image.

Natural illumination

The main sources of natural illumination include the moon and stars. Other sources can include sky glow, the aurora borealis, and ionisation processes that take place in the upper atmosphere.

Moon phase

The moon provides the greatest source of natural illumination during night time. Moon phase and elevation determines how much moonlight will be available, while moonrise and moonset times determine when it will be available. Lunar illumination is reported in terms of percent illumination, 100% illumination being full moon. It should be noted that this is different from the moon phase (e.g. 25% illumination does not mean the same thing as a quarter moon). Currently, percent lunar illumination can only be obtained from sources on the Internet, military weather facilities and some publications (e.g. Farmers Almanac).

Lunar azimuth and elevation

The moon can have a detrimental effect on night operations depending on its relationship to the flight path. When the moon is on the same azimuth as the flight path, and low enough to be within or near the NVG field of view, the effect on NVG performance will be similar to that caused by the sun on the unaided eye during daytime. The brightness of the moon drives the NVG gain down, thus reducing image detail. This can also occur with the moon at relatively high elevations. For example, it is possible to bring the moon near the NVG field of view when climbing to cross a ridgeline or other obstacle, even when the moon is at a relatively high elevation. It is important to consider lunar azimuth and elevation during pre-flight planning. Shadowing, another effect of lunar azimuth and elevation, will be discussed separately.

Shadowing

Moonlight creates shadows during night time just as sunlight creates shadows during daytime. However, night time shadows contain very little energy for the NVG to use in forming an image. Consequently, image quality within a shadow will be degraded relative to that obtained outside the shadowed area. Shadows can be beneficial or can be a disadvantage to operations depending on the situation.

Benefits of shadows

Shadows alert aircrew to subtle terrain features that may not otherwise be noted due to the reduced resolution in the NVG image. This may be particularly important in areas where there is little contrast differentiation; such as flat featureless deserts, where large dry washes and high sand dunes may go unnoticed if there is no contrast to note their presence. The contrast provided by shadows helps make the NVG scene appear more natural.

Disadvantages due to shadows

When within a shadow, terrain detail can be significantly degraded, and objects can be regarding flight in or around shadowed areas is the pilot's response to loss of terrain detail. During flight under good illumination conditions, a pilot expects to see a certain level of detail. If flight into a shadow occurs while the pilot is preoccupied with other matters (e.g. communication, radar, etc.), it is possible that the loss in terrain detail may not have been immediately noted. Once looking outside again, the pilot may think the reduced detail is due to an increase in flight altitude and thus begin a descent - even though already at a low altitude. Consideration should be given during mission planning to such factors as lunar azimuth and elevation, terrain type (e.g. mountainous, flat, etc.), and the location of items significant to operation success (e.g., ridgelines, pylons, targets, waypoints, etc.). Consideration of these factors will help predict the location of shadows and the potential adverse effects.

Sky glow

Sky glow is an effect caused by solar light and continues until the sun is approximately 18 degrees below the horizon. When viewing in the direction of sky glow there may be enough energy present to adversely affect the NVG image (i.e. reduce image quality). For the middle latitudes the effect on NVG performance may last up to an hour after official sunset. For more northern and southern latitudes the effect may last for extended periods of times (e.g. days to weeks) during seasons when the sun does not travel far below the horizon. This is an important point to remember if planning NVG operations in those areas. Unlike skyglow after sunset, the sky glow associated with sunrise does not have an obvious effect on NVG performance until fairly close to official sunrise. The difference has to do with the length of time the atmosphere is exposed to the sun's irradiation, which causes ionisation processes that release near-IR energy. It is important to know the difference in these effects for planning purposes.

Artificial illumination

Since NVGs are sensitive to any source of energy in the visible and near-infrared spectrums, there are also many types of artificial illumination sources (e.g. flares, IR searchlights, cultural lighting, etc.). As with any illumination source, these can have both positive and detrimental effects on NVG utilisation. For example, viewing a scene indirectly illuminated by a searchlight can enable the pilot to more clearly view the scene; conversely, viewing the same scene with the searchlight near or within the NVG field of view will reduce the available visual cues. It is important to be familiar with the effects of cultural lighting in the flying area in order to be able to avoid the associated problems and to be able to use the advantages provided. Also, it is important to know how to properly use artificial light sources (e.g. aircraft IR spotlight). It should be noted that artificial light sources may not always be available or dependable, and this should be taken into consideration during flight planning.

When using NVGs in an area with high-intensity cultural lighting, the lights beyond this area may not be visible. The visibility assessed with the NVGs might be judged to be worse than the unaided visibility.

5.4.2.3 Terrain contrast

Contrast is one of the more important influences on the ability to correctly interpret the NVG image, particularly in areas where there are few cultural features. Any terrain that contains varying albedos (e.g. forests, cultivated fields, etc.) will likely increase the level of contrast in a NVG image, thus enhancing detail. The more detail in the image, the more visual information aircrews have for manoeuvring and navigating. Low contrast terrain (e.g. flat featureless desert, snow-covered fields, water, etc.) contains few albedo variations, thus the NVG image will contain fewer levels of contrast and less detail.

5.4.3 Aircraft considerations

5.4.3.1 Lighting

Factors such as aircraft internal and external lighting have the potential to adversely impact NVG gain and thus image quality. How well the windshield, canopy, or window panels transmit near infrared energy can also affect the image. Cleanliness of the windshield directly impacts this issue.

5.4.3.2 Cockpit ergonomics

While wearing NVGs, the pilot may have limited range of head movement in the aircraft. For example, switches on the overhead console may be difficult to read while wearing NVGs. Instruments, controls, and switches that are ordinarily accessible, may now be more difficult to access due to the extended mass (fore/aft) associated with NVGs.

In addition, scanning may require a more concentrated effort due to limited field of view. Lateral viewing motion can be hindered by cockpit obstructions (i.e. door post or seat back design).

5.4.3.3 Windshield reflectivity

Consideration within the cockpit and cabin should be given to the reflectivity of materials and equipment upon the windshield. Light that is reflected may interfere with a clear and unobstructed view. Items such as flight suits, helmets, and charts, if of a light colour such as white, yellow, and orange, can produce significant reflections. Colours that impart the least reflection are black, purple, and blue. This phenomenon is not limited to windshields but may include side windows, chin bubbles, canopies, etc.

5.4.4 Generic operating considerations

This section lists operating topics and procedures, which should be considered when employing NVIS.

The list and associated comments are not to be considered all inclusive. NVIS operations vary in scope widely and this section is not intended to instruct a prospective operator on how to implement an NVIS programme.

5.4.4.1 Normal procedures

Scanning

When using NVGs there are three different scan patterns to consider and each is used for different reasons: instrument scan, aided scan outside, and unaided scan outside. Normally, all three are integrated and there is a continuous transition from one to the other depending on the mission, environmental conditions, immediate tasking, flight altitude and many other variables. For example, scanning with the NVG will allow early detection of external lights. However, the bloom caused by the lights will mask the aircraft until fairly close or until the lighting scheme is changed. Once close to the aircraft (e.g. approximately one-half mile for smaller aircraft), visual acquisition can possibly be made unaided or with the NVG. Whether to use the NVG or unaided vision depends on many variables (e.g. external lighting configuration, distance to aircraft, size of aircraft, environmental conditions, etc.). The points to be made are that a proper scan depends on the situation and variables present, and that scanning outside is critical when close to another aircraft. Additionally, for a multi-crew environment, coordination of scan responsibilities is vital.

Instrument crosscheck scan

In order to effect a proper and effective instrument scan, it is important to predict when it will be important. A start can be made during pre-flight planning when critical phases of flight can be identified and prepared for. For example, it may be possible when flying over water or featureless terrain to employ a good instrument crosscheck. However, the most important task is to make the appropriate decision during flight as conditions and events change. In this case, experience, training and constant attention to the situation are vital contributors to the pilot's assessment of the situation.

NVG scan

To counteract the limited field of view, pilots should continually scan throughout the field of regard. This allows aircrew to build a mental image of the surrounding environment. How quickly the outside scene is scanned to update the mental image is determined by many variables. For example, when flying over flat terrain where the highest obstacle is below the flight path, the scan may be fairly slow. However, if flying low altitude in mountainous terrain, the scan will be more aggressive and rapid due to the presence of more information and the increased risk. How much of the field of regard to scan is also determined by many variables. For example, if a pilot is anticipating a turn, more attention may be placed in the area around the turn point, or in the direction of the new heading. In this situation, the scan will be limited briefly to only a portion of the field of regard. As with the instrument scan, it is very important to plan ahead. It may, for example, be possible to determine when the scan may be interrupted due to other tasks, when it may be possible to become fixated on a specific task, or when it is important to maximise the outside scan. An important lesson to learn regarding the NVG scan is when not to rely on visual information. It is easy to overestimate how well one can see with NVGs, especially on high illumination nights, and it is vital to maintain a constant awareness regarding their limitations. This should be

pointed out often during training and, as a reminder, should be included as a briefing item for NVG flights.

Unaided scan

Under certain conditions, this scan can be as important as the others can. For example, it may be possible to detect distance and/or closure to another aircraft more easily using unaided vision, especially if the halo caused by the external lights masks aircraft details on the NVG image. Additionally, there are other times when unaided information can be used in lieu of or can augment NVG and instrument information.

When using the NVGs in the transition from IFR to VFR, the unaided scan is essential to assess the unaided visibility conditions. Focusing on the first light seen when looking out is an automatic response, but it is vital to continue the scan in order to assess the surrounding weather conditions. Some examples where unaided scan can enhance safety is where LED-lit obstacles can be encountered (e.g. during low-altitude flying and when performing a reconnaissance of landing areas) or when unmanned aircraft systems (UASs) fly at night with LED navigation lights.

Air operators should incorporate procedures into their manuals and/or SOPs that require periodic unaided scanning when operating at low altitudes, when looking for potential landing areas, and when performing a reconnaissance of a landing area. This may be accomplished by looking under the NVGs, or by briefly placing the NVGs in the stowed (flipped-up) position. Manuals/SOPs should include procedures and call-outs for LED-lit obstacles.

Air operators and pilots are encouraged to report encounters with obstacles equipped with LED lighting systems not visible by NVGs, with pertinent information, to their competent authority.

Scan patterns

Environmental factors will influence scan by limiting what may be seen in specific directions or by degrading the overall image. If the image is degraded, aircrew may scan more aggressively in a subconscious attempt to obtain more information, or to avoid the chance of missing information that suddenly appears and/or disappears. The operation itself may influence the scan pattern. For example, looking for another aircraft, landing zone, or airport may require focusing the scan in a particular direction. In some cases, the operation may require aircrew in a multi place aircraft to assign particular pilots responsibility for scanning specific sectors.

The restrictions to scan and the variables affecting the scan pattern are not specific to night operations or the use of NVGs, but, due to the NVG's limited field of view, the degree of impact is magnified.

Pre-flight planning

Illumination criteria

The pilot should provide a means for forecasting the illumination levels in the operational area. The pilot should make the effort to request at least the following information in addition to that normally requested for night VFR: cloud cover and visibility during all phases of flight, sunset, civil and nautical twilight, moon phase, moonrise and moonset, and moon and/or lux illumination levels, and unlit tower NOTAMS.

NVIS operations

An inspection of the power pack, visor, mount, power cable and the binocular assembly should be performed in accordance with the operations manual.

To ensure maximum performance of the NVGs, proper alignment and focus must be accomplished following the equipment inspection. Improper alignment and focus may degrade NVIS performance.

Aircraft pre-flight

A normal pre-flight inspection should be conducted prior to an NVIS flight with emphasis on proper operation of the NVIS lighting. The aircraft windshield must also be clean and free of major defects, which might degrade NVIS performance.

Equipment

The basic equipment required for NVIS operations should be those instruments and equipment specified within the current applicable regulations for VFR night operations. Additional equipment required for NVIS operations, e.g. NVIS lighting system and a radio altimeter must be installed and operational. All NVIS equipment, including any subsequent modifications, shall be approved.

Risk assessment

A risk assessment is suggested prior to any NVIS operation. The risk assessment should include as a minimum:

1. illumination level
2. weather
3. pilot recency of experience
4. pilot experience with NVG operations
5. pilot vision
6. pilot rest condition and health
7. windshield/window condition
8. NVG tube performance
9. NVG battery condition
10. types of operations allowed
11. external lighting environment.

Flight operations

Elevated terrain

Safety may be enhanced by NVGs during operations near elevated terrain at night. The obscuration of elevated terrain is more easily detected with NVGs thereby allowing the pilot to make alternate flight path decisions. NVIS operations

Over-water

Flying over large bodies of water with NVGs is difficult because of the lack of contrast in terrain features. Reflections of the moon or starlight may cause disorientation with the natural horizon. The radio altimeter must be used as a reference to maintain altitude.

Remote area considerations

A remote area is a site that does not qualify as an aerodrome as defined by the applicable regulations. Remote area landing sites do not have the same features as an aerodrome, so extra care must be given to locating any obstacles that may be in the approach/departure path.

A reconnaissance must be made prior to descending at an unlighted remote site. Some features or objects may be easy to detect and interpret with the unaided eye. Other objects will be invisible to the unaided eye, yet easily detected and evaluated with NVGs.

Reconnaissance

The reconnaissance phase should involve the coordinated use of NVGs and white lights. The aircraft's external white lights such as landing lights, searchlights, and floodlights, should be used during this phase of flight. The pilot should select and evaluate approach and departure paths to the site considering wind speed and direction, and obstacles or signs of obstacles.

Sources of high illumination

Sources of direct high illumination may have the potential to reduce the effectiveness of the NVGs. In addition, certain colour lights, such as red, will appear brighter, closer and may display large halos.

5.4.4.2 Emergency procedures

No modification for NVG operations is necessary to the aircraft emergency procedures as approved in the operations manual or approved checklist. Special training may be required to accomplish the appropriate procedures.

5.4.4.3 Inadvertent IMC

Some ways to help reduce the potential for inadvertent flight into IMC conditions are:

1. obtaining a thorough weather brief (including pilot reports);
2. being familiar with weather patterns in the local flying area; and
3. by looking beneath the NVG at the outside scene.

However, even with thorough planning a risk still exists. To help mitigate this risk it is important to know how to recognise subtle changes to the NVG image that occur during entry into IMC conditions. Some of these include the onset of scintillation, loss of scene detail, and changes in the appearance of halos.

5.5 TRAINING

Ch. 5.5 ISS 1 / REV 0 / 04.02.2014

To provide an appropriate level of safety, training procedures must accommodate the capabilities and limitations of the systems described in Section 5.3 of this GM as well as the restraints of the operational environment.

To be effective, the NVIS training philosophy would be based on a two-tiered approach: basic and advanced NVIS training. The basic NVIS training would serve as the baseline standard for all individuals seeking an NVIS endorsement. The content of this initial training would not be dependent on any operational requirements. The advanced training would build on the basic training by focusing on developing specialised skills required to operate an aircraft during NVIS operations in a particular operational environment. Furthermore, while there is a need to stipulate minimum flight hour requirements for an NVIS endorsement, the training must also be event based. This necessitates that pilots be exposed to all of the relevant aspects, or events, of NVIS flight in addition to acquiring a minimum number of flight hours.

5.6 CONTINUING AIRWORTHINESS

Ch. 5.6 ISS 1 / REV 0 / 04.02.2014

The reliability of the NVIS and safety of operations are dependent on the pilots adhering to the instructions for continuing airworthiness. Personnel who conduct the maintenance and inspection on the NVIS must be qualified and possess the appropriate tools and facilities to perform the maintenance.