Australian Government
Civil Aviation Safety Authority

Civil Aviation Advisory Publication
October 2007

Night Vision Goggles - Helicopters

This publication is only advisory but it is a CASA preferred method for complying with the Civil Aviation Regulations (CAR) 1988.

It is not the only method, but experience has shown that if you follow this method you will comply with the Civil Aviation Regulations.

Always read this advice in conjunction with the appropriate regulations.

Contents

See Page 2.

References

Regulation 174B (1) of the *Civil Aviation Regulations (CAR) 1988*.

Who this CAAP is intended to assist

- Pilots, other crew members such as aircrew members and medical personnel, and operators of helicopters using Night Vision Imaging Systems (NVIS) – Night Vision Goggles (NVG) in certain aerial work operations.
- Individuals and organisations conducting NVIS/NVG crew member training.
- Individuals and organisations carrying out modifications and other engineering work on helicopters which are to be used for NVIS/NVG operations.
- Organisations considering carrying out certain aerial work operations using NVIS/NVG in helicopters.
- CASA personnel involved in the assessment process of any industry organisation wishing to become involved with NVIS/NVG operations in any way.

Why this CAAP was written

- The purpose of this publication is to provide guidance on the conduct of certain aerial work operations using NVIS/NVG in helicopters.
- This publication also supports and expands upon the content of Civil Aviation Order (CAO) 82.6 under which approval must be obtained to use NVG.

Note: CAO 82.6 has been issued for a 12 month monitored trial period. This CAAP provides guidance and advice on CAO 82.6 and the trial.

Status of this CAAP

This is the first CAAP to be written on this subject.

For further information

Telephone the CASA office closest to you on 131757.

Contents

1. Abbreviations

ADF	Australian Defence Force
AGL	Above Ground Level
AIP	Aeronautical Information Publication
ALARP	As Low as Reasonably Practical
ANVIS	Aviator Night Vision Imaging Systems
AO	Air Operator
AOC	Air Operator’s Certificate
AOCM	Air Operator Certification Manual
AS	Australian Standard
ATO	Authorised Testing Officer
ATS	Air Traffic Services
CAA	Civil Aviation Authority (of the UK)
CAAP	Civil Aviation Advisory Publication
CAO	Civil Aviation Order
CAP	Civil Aviation Advisory Publication (UK)
CAR	Civil Aviation Regulations 1988
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations 1998
CG	Centre of Gravity
CP	Chief Pilot
CRM	Crew Resource Management

EMS	Emergency Medical Services
FAA	Federal Aviation Administration (of the USA)
FLIR	Forward Looking Infra Red
FOI	Flying Operations Inspector
FOR	Field of Regard
FOV	Field of View
FRMS	Fatigue Risk Management Systems
ft	foot/feet
G	Gravity
HF	High Frequency
HF	Human Factors
HLS	Helicopter Landing Site
HUD	Heads Up Display
ICAO	International Civil Aviation Organization
ICUS	In Command Under Supervision
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions (other than VMC)
IR	Ice on Runway
IRM	Immediately Reportable Matters
JAA	Joint Aviation Authorities (of the UK)
JAR-OPS	Joint Aviation Requirements Operations (of the UK)
LSALT	Lowest Safe Altitude
METAR	Aviation Routine Weather Report (in Aeronautical Meteorological Code)
MIL-STD	Military Standard
MOPS	Minimum Operational Performance Standard
nm	Nautical Miles
NOTAM	Notice to Airmen
NVD	Night Vision Device
NVED	Night Vision Enhancement Devices
NVG CCF	NVG Capability Check Flight
NVFR	Night Visual Flight Rules
NVG	Night Vision Goggles
NVIS	Night Vision Imaging Systems
NZS	New Zealand Standard
OEM	Original Equipment Manufacturer
PIC	Pilot-in-command
RIFTO	Restricted Instrument Flight Take-off
RRM	Routine Reportable Matters
RTB	Return to Base
RTCA	Radio Technical Commission for Aeronautics
SAR	Search and Rescue

TAF	Aerodrome Forecast
TCO	Training and Checking Organisation
TEM	Threat and Error Management
TSO	Technical Standard Order
UK	United Kingdom
USA	United States of America
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

2. Definitions

In this Civil Aviation Safety Publication (CAAP):

adverse event means any event or incident in which life, health or property is:

- lost or damaged in, on, or by a helicopter in which night vision goggles are used; or
- at significant risk of loss or damage in, on or by a helicopter.

Note: The following are some examples of significant risks: a near miss; NVG equipment failure, malfunction or abnormal operation; the failure, malfunction or abnormal operation of NVG-related or affected equipment; unintentional IMC penetration; inadvertent loss of visibility; abnormal degree or accelerated onset of fatigue.

aerial fire fighting means an operation in an operational area for a fire to fight the fire from the air using only the following:

(a) a helicopter equipped with a belly tank that:

(i) is capable of being filled and refilled while the helicopter is on the ground; and

(ii) during the operation, is only filled or refilled while the helicopter is on the ground;

(b) a flight crew of at least one pilot and one aircrew member.

aerial fire fighting support means an operation for:

(a) the tactical insertion or extraction of fire fighting crews in an operational area for a fire; or

(b) the carriage of persons to map, locate or observe fires, or to control or direct fire fighting operations.

Note: In CAO 82.6 aerial fire fighting support does not include aerial fire fighting in the form of, for example, water bombing.

aided flight means a flight in which NVG are used in an operational position by trained personnel to enhance night vision.

Note: Aided flight is associated with the procedure of goggle-up where the crewmember places NVG in the operational position.

aircrew member means a crew member of a helicopter (other than a supernumerary crew member) assigned by the operator:

- to assist the pilot in the operation of the helicopter;
- to operate the winch on the helicopter; or
- to supervise rappelling or sling-load operations; or
- to supervise or assist a medical, paramedical or rescue crewmember in the performance of his or her duties on the helicopter; or
- to use the auto-hover system to position/reposition the helicopter via inputs through an auto-hover trim control (crew hover).

approved NVG flight simulator means a flight simulator approved by CASA for NVG initial qualification training by a trainee who holds an endorsement for the aircraft which is simulated.

approved operator means an operator who has the approval mentioned in subparagraph 1 (c) (iii) of Appendix 1 of CAO 82.6 to use NVG for the trial.

CAR 1988 means the Civil Aviation Regulations 1988.

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 to be designed and installed in a manner that does not adversely affect NVG performance.

Class A or 'minus blue' NVG incorporate a filter, which generally imposes a 625 nanometre cut-off. 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.

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

de-goggle means the action of transferring from NVG flight to non-NVG (unaided) flight by removing the NVG from a usable position.

Note: The expression is also used as a command and is opposite to goggle-up.

devoid of surrounding cultural lighting means that at 500 ft above the terrain, and any object on it, in an area there is insufficient ground lighting to maintain an unaided visible horizon.

emergency medical services means an operation where transportation is required to facilitate emergency or medical assistance by an aircraft carrying one or more of the following:

- medical personnel;
- medical supplies (including equipment, blood, organs or drugs); and
- ill or injured persons, and other persons directly involved in, or associated with, their retrieval or care.

fatigue is the dynamic balance between competing forces; forces producing fatigue and forces reversing the effects of fatigue (recovery). There are a number of different definitions of fatigue, including:

- 'Weariness from bodily or mental exertion' (Macquarie Essential Dictionary; 1999:282);
- 'The consequences of inadequate restorative sleep' (Centre for Sleep Research); and
- 'The increasing difficulty to perform physical or mental activities' (Baker, Fletcher and Dawson; 1999:8).

Generation refers to the technological design of an image intensifier. Systems incorporating these light-amplifying image intensifiers were first used during World War II 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). Generation II devices represented a significant technological advancement and provided a system that could be head-mounted for use in ground vehicles.

Generation 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 NVG that include technological advances that may necessitate a Generation IV designation if placed into production. Because of the variations in interpretations as to generation, NVG will not be referred to by the generation designation.

goggle-up means the action of transferring to NVG flight by placing the NVG in a position where it may be used by the crew.

Note: The expression is also used as a command and is opposite to de-goggle.

HLS-NVG basic means a HLS that:

- does not conform to the guidelines contained in CAAP 92-2 (1) for standard HLS night operations; and
- is unlit or unprepared.

HLS-NVG standard means a HLS that:

- conforms to the guidelines contained in CAAP 92-2 (1) for NVG standard HLS night operations;
- is unlit; and
- does not require a windsock.

HLS operations for a helicopter means:

- take-off or landing at a HLS; or
- operations at a HLS that do not involve a landing on skids or wheels; or
- HLS similar operations:
    - that are approach to the hover, winching, sling load operations, rappelling, hovering, deplaning, emplaning or similar types of operations; and
    - for the conduct of which each relevant crewmember is qualified.

human factors Human Factors aims to optimise the relationships within systems between people, activities and equipment.

law enforcement, for an operation, means an operation for the enforcement of the laws applying in Australian territory, including, customs, waterways or border protection laws.

look under (under view) is the ability of operators to look under or around the NVG to view inside and outside the aircraft.

LSALT, or ***lowest safe altitude***, means not less than 1000 ft above the highest obstacle located within 10 nm of the helicopter in-flight, except when take-off or landing is necessary.

marine pilot transfer means an operation, in accordance with Civil Aviation Order 95.7.3, to transfer a marine pilot from:

- land to ship;
- ship to land; or
- ship to ship.

minimum NVG crew means the minimum number of NVG aided and NVG qualified crew members required for a particular flight or operation.

Note: CASA approval is not required for a person to use NVG for observation or surveillance only - the primary means of terrain avoidance for safe air navigation using visual surface reference external to the aircraft. However, a person engaged in such unapproved use is not part of the minimum NVG crew.

Modified Class B NVG incorporates a variation of a Class B filter and 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 operators to view a fixed heads up display (HUD) symbology through the NVG without the HUD energy adversely affecting NVG performance.

NVD, or ***night vision device***, means night vision enhancement equipment fitted to, or mounted in or on, an aircraft, or worn by a person in the aircraft, and that can:

- detect and amplify light in both the visual and near infra-red bands of the electromagnetic spectrum; or
- provide an artificial image representing topographical displays.

NVG, or ***night vision goggles***, means a self-contained binocular night vision enhancement device, usually helmet mounted or otherwise worn by a person that can detect and amplify light in both the visual and near infra-red bands of the electromagnetic spectrum.

NVG aircrew member means a person who:

- has successfully completed NVG aircrew member training and is qualified in accordance with CAO 82.6; or
- is an NVG aircrew member instructor; or

- is an NVG pilot, an NVG flight instructor, an NVG FOI or an NVG testing officer who has complied with the aircrew member training and competency requirements of Appendix 3 of CAO 82.6.

NVG aircrew member instructor means a person qualified in accordance with CAO 82.6 to instruct air crewmembers.

NVG CCF, or ***NVG capability check flight***, means:

- if carried out by a training or checking organisation (TCO) - an NVG proficiency check flight to test aeronautical skills and knowledge for use of NVG, carried out in accordance with:

  (i) the requirements of CAO 82.6 for an NVG capability check flight (CCF);

  (ii) the operator training and checking manual;

- otherwise — an NVG base check flight to test aeronautical skills and knowledge for use of NVG, carried out in accordance with: and

  (i) the requirements of CAO 82.6 for an NVG CCF; and

  (ii) Part C of the operator operations manual.

NVG compatible lighting means aircraft interior or exterior lighting with spectral wavelength, colour, luminance level and uniformity, that has been modified, or designed for use with NVG, and does not degrade or interfere with the image intensification capability performance of the NVG beyond acceptable standards.

NVG flight instructor means an NVG pilot who is a flight instructor qualified in accordance with this order and approved in writing by CASA to conduct NVG training.

NVG flight time means the flight time gained by an NVG aircrew member or pilot, or a person receiving NVG flight training, or during an NVG operation.

Note: NVG flight time must be logged in the specialist column of the aircrew flying logbook.

NVG FOI means a CASA flying operations inspector appointed to carry out some, or all, of the duties of an NVG FOI or an NVG testing officer.

NVG initial training means training to qualify a person for an NVG pilot or NVG aircrew member qualification.

NVG operation means a permitted NVG operation under subclause 5.1 of Appendix 1 of CAO 82.6.

NVG operator means an operator approved by CASA under clause 2 of Appendix 1 of CAO 82.6 to conduct NVG operations.

NVG pilot means a person who:

(a) has successfully met the requirements of CAO 82.6 for the issue of an initial NVG endorsement and had his or her logbook endorsed accordingly; or

(b) is an NVG flight instructor, an NVG training and checking pilot, an NVG FOI or an NVG testing officer.

NVG testing officer means a person appointed in writing by CASA to be an authorised testing officer to:

- conduct NVG flight tests; and
- issue endorsements for NVG qualifications based on those flight tests.

NVG training means training undertaken by a pilot, or aircrew member, for NVG flight in accordance with the relevant training requirements and competency standards mentioned in CAO 82.6.

NVG training and checking pilot means an NVG pilot who is training and checking pilot for a TCO, qualified in accordance with CAO 82.6 and approved in writing by CASA to conduct training and checking.

NVG training provider means:

(a) a training organisation in Australia approved by CASA to provide NVG initial training for CAO 82.6; or

(b) a training organisation outside Australia approved by the relevant national aviation authority, recognised by CASA, to provide NVG initial training.

Note: The National Aviation Authorities, recognised by CASA, are listed on page 21 of this CAAP.

NVG trial means the controlled trial of NVG in accordance with this order by NVG operators approved by CASA to participate in the trial.

NVIS, or ***night vision imaging system,*** means the system in which all of the elements required to operate an aircraft effectively and safely using NVG are integrated, including NVG and associated equipment, NVG compatible lighting, other associated aircraft components and equipment, associated training and recency requirements and continuing airworthiness.

Note: NVIS is synonymous with aviator night vision imaging systems, sometimes called ANVIS.

OMNIBUS refers to a US Army contract vehicle that has been used over the years to procure NVG. Each successive OMNIBUS contract included NVG that demonstrated improved performance. There have been five contracts since the mid 1980s, the most current being OMNIBUS VII. There may be several variations of NVG within a single OMNIBUS purchase, and some NVG from previous OMNIBUS contracts have been upgraded in performance to match the performance of goggles from later contracts.

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

RTCA/DO-275 means the document titled *Minimum Operational Performance Standards for Integrated Night Vision Imaging System Equipment*, referenced RTCA/DO-275, dated 12 October 2001, of RTCA Inc., Washington, USA.

search and rescue (SAR) means an operation by an aircraft to search, locate, rescue, or provide immediate assistance to a person threatened by a grave and immediate danger or a hostile environment.

TCO or ***training and checking organisation***, means a training and checking organisation approved by CASA under subregulation 217 (1) of CAR 1988 for this order.

type refers to the design of the NVG with regards to the manner in which the image is relayed to the operator. A Type 1 NVG is one in which the image is viewed directly inline 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 operator.

In this design, the image may be reflected several times before being projected onto a combiner in front of the crewmembers eyes. A Type 2 NVG is also referred to as an 'indirect view' goggle.

unaided flight means the NVG is in a non-operational position when night vision is not being enhanced by any other means.

Note: Unaided flight is associated with the de-goggle procedure where the crewmember places the NVG in the non-operational position.

use, in relation to NVG, means use as the primary means of terrain avoidance for safe air navigation by means of visual surface reference external to the aircraft.

3. How to Apply

3.1 Application Process

3.1.1 To apply for Civil Aviation Safety Authority (CASA) approval to conduct operations using night vision goggles (NVG) the operator should first obtain from CASA a copy of Civil Aviation Order (CAO) 82.6. The applicant should then formally apply for an Instrument of Approval for the use of NVG in helicopter operations. Applications should be made using CASA form 538 and submitted to the CASA Service Centre. The application must include:

- a complete and signed application form 538, and
- a copy of the operator's operations manual and training and checking manual (if applicable) satisfying the requirements laid out in CAO 82.6;

4. Assessment Process

4.1 Assessment & Approval

4.1.1 Once the application has been received, it will be forwarded to the night vision imaging system (NVIS) Flying Operations and Airworthiness representative group for assessment. The relevant CASA field office will also be notified.

4.1.2 The NVG assessment team will assess the application in accordance with the requirements of CAO 82.6 ensuring that all requirements are covered in the applicant's operations manual and check and training manuals. Inspections and tests may also be required.

4.1.3 If recommended, the NVG assessment team will draft the necessary Instrument/s of Approval and AOC amendment (if required) for the Group General Manager, General Aviation Operations Group (GAOG) signature.

5. Background

5.1 Overview - History of NVG application

5.1.1 Night vision imaging systems (NVIS) technology and particularly NVG technology has evolved from rather primitive (Generations 1 and 2) of the 1970s to later generations with more sophisticated devices (Generation 3 with updates) which have been exploited by the more advanced military forces, including the Australian Defence Force (ADF), for many years.

In recent years, with many military trained NVG pilots and other crewmembers entering the civil aviation environment, some operators have expressed an increasing interest in exploiting this technology, particularly in some specialised helicopter operations.

5.1.2 Interest in NVG operations has been most pronounced in the United States of America (USA). In 1990 the Federal Aviation Administration (FAA) stated that Night Vision Enhancement Devices (NVED) are considered an appliance, and that if an applicant wanted approval for operation with an NVED a minimum operational performance standard (MOPS) would need to be developed and accepted by the FAA.

5.1.3 This interest culminated in a 1994 study, where the FAA released a study, 'Night Vision Goggles in Emergency Medical Service (EMS) Helicopters'. The report stated that NVGs are a viable tool during the en-route and terminal operations during certain EMS scenarios. When properly used, NVG can increase safety, enhance situational awareness, and reduce pilot workload and stress that are typically associated with night operations.

6. CASA Philosophy on the Use of NVG

6.1 Philosophy

6.1.1 The CASA philosophy on the civil use of NVG is similar to that of the conclusions of the FAA study. The philosophy is:

- Provided that NVG operations are properly prepared, equipped and trained for, there is considerable potential for enhancing the overall safety of night helicopter operations; and
- The proper use of NVG has the potential to enhance the safety of visual flight at night by assisting the crew's ability to see the horizon and terrain, observe much of the in-flight meteorological conditions, and to identify objects that may cause a hazard to flight.

6.2 NVG Use

6.2.1 CASA has determined that over a 12 month trial period the use of NVG is to be regulated in accordance with CAO 82.6 which places conditions for the use of NVG by an air operators certificate (AOC) holder, including directions placed on an operator, which are contained in the CAO. Initially, the NVG operations permitted under CAO 82.6 require specific CASA approval and are:

- Search and Rescue (SAR);
- Law enforcement;
- Aerial fire fighting;
- Aerial fire fighting support;
- Emergency Medical Services (EMS);

- Marine Pilot Transfer; and
- NVG training, checking and testing.

Note: The above list of operations is to be the subject of a future joint review by CASA and the aviation industry.

6.2.2 The use of NVIS using NVG in private operations is prohibited under CASA Instrument 30/07.

6.2.3 CAO 82.6 and this Civil Aviation Advisory Publication (CAAP) are primarily directed at operators intending to undertake NVG operations, and crew members who are qualified or undergoing training in the operation of a helicopter using NVG, who are to manipulate the flight controls, or providing information for the purposes of safe air navigation, in maintaining terrain avoidance. This CAAP is not directed at the use of NVG by other operating crewmembers, where NVG may be used solely for the purposes of observation or surveillance where those crewmembers are not directly involved in air navigation or terrain avoidance functions.

However, much of the information in the CAO and this CAAP will be of some assistance in considering such operations.

7. CASA Policy on the Concept of Operations

7.1 CASA Policy & Concept

7.1.1 This document expands, where necessary, on the content of CAO 82.6 and provides advice on the CASA concept of operations of NVG use in civil aviation operations. This includes the terminology, capabilities, limitations, operations, training and other supporting agencies. The focus is on the safe and effective implementation of NVIS using NVG during various phases of flight, with the emphasis on improving the situational awareness of crews during night visual flight rules (NVFR) operations or the visual phases of instrument flight rules (IFR) flight where NVG may be used. The overall premise is that use of NVG is an adjunct to visual flight at night.

8. Trial Period

8.1 Overview of Trial

8.1.1 This CAAP and the CAO 82.6 will be reviewed in the first 12 months of circulation to determine appropriateness of established standards with a view to permitting NVG operations to be conducted by other categories of operations if it is safe to do so.

During this review, a joint CASA/aviation industry working group will be established and chaired by CASA.

8.1.2 The NVG working group will review NVG operations under the trial and make recommendations to CASA on the following:

- results from the trial and how these might affect the standards and requirements in the CAO 82.6;
- overseas considerations and developments;
- review of any NVG/NVIS 'adverse events' based on data from monthly reports submitted by participants - the data will be de-identified and used only with the participants consent; and
- human factors/fatigue review.

8.1.3 Towards the end of the 12 month trial, based on its results and taking into account the recommendations of the participants, CASA will review NVG operations and decide whether the NVG standards and requirements are sufficiently well developed and tested to be incorporated in a new Civil Aviation Safety Regulation (CASR) Part 133, - Helicopter Operations, or whether the trial should continue on the same or an adjusted basis for a further period.

9. Suggested Additional Reference Material

9.1 Additional Information

9.1.1 The following documents provide additional information and reference material that may be of assistance to operators and other personnel or organisations considering NVIS operations using NVG and associated training, engineering and maintenance aspects. Further, there is a considerable amount of other material that can be accessed from various sources on the internet that may also be of assistance.

Australian Transport Safety Bureau – Aviation Research Paper B2004/0152

United States Army – TC1-204 Night Flight Techniques and Procedures Appendix E (Aviation NVG Desert Training and Operations Planning Guide)

United States Army Technical Report 92-1 – Human Factors of Night Vision Device Use in South East Asia

United States Army 902-011-0020-T, Exportable training Package for NVG Operations

United States Coast Guard – Student Guide

United States Coast Guard – NVG Training Programme Instructor Guide

10. Acknowledgements

10.1 Radio Technical Commission for Aeronautics (RTCA)

10.1.1 Part 2 of Appendix C, NVG Equipment, Operations, Qualifications and Training of this CAAP contains extracts from certain copyright documents of RTCA, Inc. Use of these extracts is made with the written permission of RTCA, Inc.

10.1.2 The complete RTCA, Inc. documents may be purchased from RTCA, Inc. using the following contact information:

RTCA Inc.
1828 L Street, NW
Suite 805
Washington D.C. 20036
Ph. 202-833-9339
Fax 202-833-9434
www.rtca.org

10.1.3 The paragraph references and the extract descriptions are as follows:

- **Design Considerations** - RTCA DO268 - 'Concept of Operations - Night Vision Imaging System for Civil Operators' - 2.3.1 - Design Considerations, Page 4.
- **Compatible** - RTCA DO295 - 'Civil Operators Training Guidelines for Integrated Night Vision Imaging System Equipment' - 2.3.1 - Compatible, Page 6.
- **Instrument Lighting Brightness Considerations** - RTCA DO268 'Concept of Operations - Night Vision Imaging System for Civil Operators' 3.3.2.6, Page 11.

Note: The Part and Appendix headings refer to CAO 82.6.

Attachment 1 to CAAP 174-1(0)

Further Advice to CAO 82.6

Attachment 1 contains further advice to CAO 82.6. The numbering of the schedules, appendices and clauses in this attachment align with the numbering in the CAO and should be read as such.

Further Advice to CAO 82.6 - Night vision goggles - helicopters

PART 1 – Preliminary matters

1. Definitions

1.1 In accordance with the requirements promulgated in CAO 82.6 and set out at the beginning of this CAAP.

PART 2 – Directions and exemptions

2. Direction – instruments and equipment

2.1 In accordance with the requirements promulgated in CAO 82.6.

3. Direction – operations manual

3.1 In accordance with the requirements promulgated in CAO 82.6, Appendix 2.

3.2 CAO 82.6 provides the directions to operators of the matters that are to be included in the operations manual, including equipment standards, ongoing maintenance requirements, operating procedures and flight crew capability. Operators are at liberty to include additional items or more detail, in regard to their specific specialised NVG operations or training.

3.3 Operators who are exempt from CAO 48 via a Fatigue Risk Management System (FRMS) should amend this system to include aspects relevant to NVG operations.

3.4 'Further advice to Appendix 2 of CAO 82.6' of this attachment of this CAAP contains a list of suggested items, which build upon the requirements of CAO 82.6 that an operator should address.

4. Specified operators– provision of a training and checking organisation (TCO)

4.1 In accordance with the requirements promulgated in CAO 82.6. Initial NVG training may be conducted by a TCO or by an approved NVG training provider.

5. Direction – operations manual

5.1 In accordance with the requirements promulgated in CAO 82.6.

6. Exemption – minimum height for VFR flights at night

6.1 In accordance with the requirements promulgated in CAO 82.6.

6.2 CAO 82.6 makes provision for flight below the minimum altitudes detailed in CAR 174B, but only if operationally necessary.

6.3 The operations manual should establish the conditions, situations and associated procedures for when NVG operations below the lowest safe altitude (LSALT) may be carried out. Such low flight should be kept to the minimum and limited to manoeuvring that is operationally necessary in the vicinity of the intended landing or area for the operation.

7. Exemption – navigation lights

7.1 In accordance with the requirements promulgated in CAO 82.6.

PART 3 – Conditions on AOCs

8. AOC Condition

8.1 In accordance with the requirements promulgated in CAO 82.6.

9. Conditions for use of NVG by an AOC holder

9.1 In accordance with the requirements promulgated in CAO 82.6.

9.2 The AOC is automatically made subject to the condition that NVG operations must be in accordance with CAO 82.6. A TCO, or an approved training provider within Australia, providing initial flying training must have an AOC that authorises flying training.

9.3 A copy of the CASA Instrument of Approval to conduct NVG operations must be in the Operations Manual as one of the conditions of the approval.

Further Advice to Appendix 1 of CAO 82.6 – Use of Night Vision Goggles

1. Restricted use of Night Vision Goggles (NVG)

1.1 In accordance with the requirements promulgated in CAO 82.6.

1.2 The requirement to comply with the Civil Aviation Order (CAO) 82.6 does not apply where NVG are used by an appropriately trained person for observation or surveillance which is NOT the primary means of terrain avoidance for safe air navigation using visual surface reference external to the aircraft.

2. Approval to use NVG for the trial

2.1 In accordance with the requirements promulgated in CAO 82.6, a key requirement is to obtain a Civil Aviation Safety Authority (CASA) Instrument of Approval to use NVG.

3. Suspension or revocation of approval

3.1 In accordance with the requirements promulgated in CAO 82.6.

4. Reporting for NVG trial

4.1 After each flight in which an adverse event took place, the pilot-in-command is required to complete the web-based reporting form as detailed in CAO 82.6. All details will be kept confidential and, if further investigation is required, only the members of the human factors team will contact the reporters.

On-site investigation may be required, depending on the circumstances surrounding the event. Crews submit this reporting form online via the password protected reporting system. In addition to the pilot's reports, the company must also submit their report on the event once it has been internally investigated (also via the web-based reporting system).

Note: This does not absolve the pilot-in-command (PIC) or operator from the Aeronautical Information Publication (AIP) requirements in relation to Immediately Reportable Matters (IRM) and Routine Reportable Matters (RRM).

5. Permitted NVG operations

5.1 In accordance with the requirements promulgated in CAO 82.6.

5.2 For Marine Pilot Transfer/Ship/Moving Platform operations CASA advises that in consultation with Industry, operating standards for NVG operations whilst conducting Marine Pilot Transfer are currently being developed. Until appropriate standards are developed, there will be no authorisations for Marine Pilot Transfer will be given by CASA.

Note: Ship/Moving Platform operations may include for example: Law Enforcement, EMS, SAR

6. NVG qualifications

6.1 In accordance with the requirements promulgated in CAO 82.6: in Appendix 1 of CAO 82.6 which lists the various qualifications available; and Part 4 of Appendix 3 of CAO 82.6 'Recognised NVG qualification for NVG operations'.

6.2 Operators who are commencing initial NVG operations with key personnel who have limited NVG experience (i.e. no experience as they are a first time NVG operator, or who have a chief pilot (CP) with a newly gained NVG endorsement), may not appropriately satisfy the requirements of subparagraph 28 (1)(b)(iv) of the Civil Aviation Act (CAA) 1988.

CASA and industry acknowledge there is a training and experience gap between the basic NVG endorsement and an operator's line qualified NVG pilot. CASA believes the risk is further heightened in circumstances where, in addition to the operator's pilots, the operator themselves and/or the chief pilot of such an operation has limited NVG experience.

6.3 CASA will identify those operators to whom the above circumstances apply. The identified operators will have three options to satisfactorily mitigate the risk relating to general NVG inexperience. They are:

a. The operator employs or contracts an experienced NVG senior pilot, who is assessed by CASA as suitable to carry out NVG supervision and training duties and reports to the chief pilot on operational safety matters in relation to the operator's NVG operations. (The intention of the CAO provision is to provide the operator with a reasonable degree of flexibility in the appointment of the NVG senior pilot. However, the NVG senior pilot should have considerable NVG experience).

Note: If this person is a contract employee the operator will be required to demonstrate to CASA that they will be available to their operation via a service level agreement that outlines this availability.

b. The chief pilot is to receive additional training (by an approved and suitably experienced NVG training organisation) in line with that required in the operator's operations manual to ensure the chief pilot is at a minimum standard for NVG line flying and checking, in all of the NVG related authorisations provided for in the operator's AOC.

c. The operator is to submit an alternate course of action acceptable to CASA that provides an equivalent level of safety and risk mitigation to those detailed above in paragraphs 1 and 2. However CASA will only accept such an alternative if it meets the criteria specified in section 28(1)(b) of the CAA 1988.

6.4 It is envisaged any one of the above courses of action should effectively ensure an operator's CP is able to carry out his or her responsibilities in regard to the conduct of the operator's NVG operations; and may legitimately oversight or conduct the required training/checking to bring the remainder of the NVG pilots to a competent line flying standard. Such a course of action is also consistent with the revised CASA/industry approach towards bridging the experience and training gap between a basic NVG endorsement and being checked to line for NVG operations."

Note: The NVG Senior Pilot will be assessed to a CP level in relation to the NVG element of the operation.

7. Pre-requisites for training

7.1 In accordance with the requirements promulgated in CAO 82.6.

8. Training requirements

8.1 In accordance with the requirements promulgated in CAO 82.6.

9. NVG endorsements

9.1 In accordance with the requirements promulgated in CAO 82.6.

9.2 Log book entries for aircrew members must specify NVG aircrew member or NVG aircrew member instructor as relevant.

10. Endorsements based on recognition of training and experience

10.1 In accordance with the requirements promulgated in CAO 82.6.

Note: While CASA may recognise the qualification, training and experience, based on the requirements of CAO 82.6, an individual will also need to consider any additional requirements contained in the operators Operation Manual.

10.2 For the period of the trial, CASA intends and will require that all flight tests outlined in clause in CAO 82.6, Appendix 1, 10.1 (c) be conducted in Australia by a NVG FOI or an NVG testing officer. Based on the outcomes of the trial CASA, in consultation with the industry, will consider the potential for flight testing conducted by the military or a recognised overseas NVG Training Provider and assessor to be suitable for the purposes of sub-clause 10.1, 10.2 and 10.3.

10.2.1 Applicants wishing to apply for military or overseas testing recognition (after the completion of the trial period) should apply to the CASA NVG Project Team in writing and provide the following:

a. Flight Training Providers Details;
b. Flight Training Providers training approval certificates (issued by the National Aviation Authorities (NAA);
c. Flight Testing officers credentials (issued by the NAA or military as appropriate);
d. a copy of the training syllabus and testing syllabus;
e. proposals for differences training (if any);
f. a copy of the training and testing records;
g. Applicants logbook; and
h. If applicable, a signed statement by a person approved by the relevant NAA for NVG testing, recording for each of the competencies that has been demonstrated.

10.2.2 Based on successful assessment of the above criteria, it is CASA's intent to recognise Qualification Certificates issued by the military or NAAs, of the following states, subject to the completion of any identified differences training and additional assessment requirements:

i. Canada
j. Hong Kong (Special Administrative Region of China)
k. New Zealand
l. United States of America
m. The following European Aviation Safety Agency (EASA) member states:
    i. Belgium
    ii. Denmark
    iii. Finland
    iv. France
    v. Germany
    vi. Ireland
    vii. Italy
    viii. Netherlands
    ix. Norway
    x. Portugal
    xi. Spain
    xii. Sweden
    xiii. Switzerland
    xiv. United Kingdom

CASA may also recognise flight tests conducted by NVG flight testers who have been approved for this purpose by the relevant recognised NAA.

11. Endorsement and experience requirements for operations

11.1 High levels of night vision imaging systems (NVIS)/NVG proficiency, along with a well balanced NVG experience base, will assist in off-setting many of the visual performance degradations associated with night operations. NVG experience is a result of proper training coupled with numerous NVG operations. An experienced NVG crewmember is acutely aware of the NVG operational envelope and its correlation to various operational effects, visual illusions and performance limitations.

11.2 This experience base is gained and maintained over time through a continual, holistic NVG training programme which exposes the crews to NVG operations conducted under various moon angles, percentage of available illumination, contrast levels, visibility levels, and varying degrees of cloud coverage. A crewmember should be exposed to as many of these variations as practical during the initial NVG qualification programme. Continued exposure during the NVG recurrent training enhances the experience base.

11.3 Post Endorsement Experience for Pilots and Aircrew members

11.3.1 The operator is responsible for the promulgation of a suitable and appropriate NVG post endorsement/induction training programme. The operator is to ensure that there is specific training for operational roles, reduced illumination periods, marginal weather, dust, snow, rain etc.

11.3.2 There is a recognised experience/training gap that exists between a newly endorsed NVG pilot and a line qualified NVG pilot with an operator. The purpose of this training is to provide the newly qualified NVG pilot with NVG decision making skills suitable for safe pilot in command operations.

11.3.3 There also is a recognised experience/training gap that exists between a newly qualified NVG aircrew member and a line qualified NVG aircrew member with an operator. The purpose of this training is to provide the newly qualified NVG aircrew member with the NVG skills applicable for the operators aircrew member requirements.

11.3.4 CASA will consider an operator's proposed training package in this regard.

Note: For operators intending to use in command under supervision (ICUS), NVG ICUS can only be logged when a person is flying on NVG as ICUS. The pilot supervising the ICUS operation is also required to be on NVG during NVG flight time. All ICUS operations must be in accordance with CAR 5.40.

11.4 Post-endorsement Requirement for First Time Use of NVG

11.4.1 An NVG pilot using NVG for the first time in a helicopter for which he or she holds a type endorsement is to complete an NVG capability check flight, in the helicopter before commencing operational use of it.

11.4.2 For the purposes of the trial CASA will only consider an exemption from the requirement of CAO 82.6 Appendix 1, 11.2 for the individuals outlined in CAO 82.6, Appendix 1, 13a.

11.4.3 CASA will consider an operators proposed training package that provides for an equivalent level of safety in this regard.

12. Competency, recency and NVG capability check flight (CCF) capability

12.1 NVG flight skills are more perishable than day VFR flight skills and therefore require increased NVG recency to retain proficiency. Consequently a robust training and checking programme should cater for the broad cross-section of operating exigencies.

12.2 However, nothing prohibits the operator placing additional requirements and increasing the minimum checking cycles in line with their particular operation or safety and risk management systems. Indeed, CASA actively encourages operators to consider this in their operations – particularly during the start up phases of NVG operations, or where the organisation has little or no corporate experience with the technology.

12.3 In addition, CAO 82.6 requires a detailed recency requirement for NVG operations be included in the operations manual but leaves the determination of recency for operational sequences such as winching, hover exit, etc, to the operator. Accordingly, CASA will only accept operations manual instructions that also specifically address such sequences that are particular to the type of operation conducted. It will generally be acceptable to CASA if the operator should require recency levels equal to or in excess of established un-aided levels.

13. NVG capability check flights

13.1 In accordance with the requirements promulgated in CAO 82.6.

14. Flight testing and issuing endorsements

14.1 In accordance with the requirements promulgated in CAO 82.6.

14.2 Recording of NVG flight time in pilot's and aircrew member's logbooks.

14.3 A NVG flight crewmembers flight time should be recorded in the individual's logbook under a discreet NVG column. Only flight time conducted when 'goggled-up' is to be recorded as NVG flight time.

Further Advice to Appendix 2 of CAO 82.6 – Directions under subregulation 215 (3) of the CAR 1988 about the information, procedures and instructions in an operator’s operations manual

Part 1 – Preliminary

1. Scope and structure

1.1 In accordance with the requirements promulgated in the CAO 82.6.

2. Directions apply

2.1 In accordance with the requirements promulgated in the CAO 82.6.

Part 2 – Directions about information to be contained in an operations manual for NVG operations

3. Operations manual

3.1 In accordance with the requirements promulgated in the CAO 82.6.

4. Operations manual directions

4.1 In accordance with the requirements promulgated in the CAO 82.6.

4.2 Additional information that may assist operators in meeting the CAR 215 directions is set out below. Operators may choose to develop their own procedures which provide for an equivalent standard. (This does not absolve operators from the requirements of CAO 82.6) Guidance about human factors and fatigue is set out in Attachment 2 of this CAAP:

Note: The numbering below does not correspond with CAO 82.6.

1. Night Vision Goggle (NVG) Goggle and De-goggle Procedures

1.1 Airborne

1.1.1 The aircraft is to be at a safe height (generally above 500 ft AGL) prior to conducting the procedure. The procedure is to be initiated by the PIC. The PIC will commence by announcing the aircraft parameters (altitude, heading and airspeed). The PIC will then announce 'crew goggle-up' or 'crew de-goggle' as required. At any time only one member of the crew is to be conducting the procedure, as directed by the PIC. Upon completing the procedure each crewmember will announce their crew position and the term 'goggled-up' or 'de-goggled' as required. This statement will be the executive command for the next crewmember to commence the procedure. The aircraft parameters are to remain unchanged until all crewmembers have completed the procedure.

1.2 On the Ground

1.2.1 A ground (i.e. not in the hover) 'goggle-up' and 'de-goggle' point is to be briefed prior to the flight. The aircraft must be stationary for the conduct of the procedure. The procedure will be as that for airborne, after the PIC announces 'crew goggle-up' or 'crew de-goggle'

1.2.2 CASA recommends operators avoid landing or taking off on trolleys whilst ‘goggled-up’.

2. Emergency Situations

2.1 Night vision imaging systems (NVIS) using NVG generally improve situational awareness and facilitate the crew's workload during emergencies. Should an emergency arise requiring an immediate landing, NVG may provide the crew with a means of locating a suitable landing area to carry out a safe landing. The operator and the pilot-in-command should determine if the use of NVG during certain emergency situations is appropriate. In some situations, it may be advantageous for the crewmembers to remove the NVG during the performance of an emergency procedure. In any event, such detail should be included in the operator's operations manual.

2.1 Loss of Visual Reference During NVG Take-off and Landing

2.1.1 Emergency procedures for loss of visual reference (brownout/whiteout) are to be published in the operator's operations manual. The procedures should involve a restricted visibility vertical instrument takeoff and transition to forward flight, known as a Restricted Instrument Flight Take-off (RIFTO).

2.1.2 The procedures are to be designed to minimise the chance of the helicopter striking obstacles when visibility is inadvertently lost on departure or arrival to an unsealed helicopter landing area. If either of the crewmembers in the cockpit loses visual reference they are to call 'RIFTO'. The flying pilot shall then conduct the procedure with the non-flying crewmember providing regular/cyclical advice regarding:

- Aircraft attitude;
- Aircraft rate of climb;
- Aircraft power;
- When external visual reference is regained; and
- Aircraft position ref the ground and/or obstacles.

2.1.3 When the non-flying crewmember calls 'visual' the flying pilot is to look up and regain visual reference before transitioning to forward flight. Prior to operations being conducted to/from an unsealed helicopter landing site the PIC is to ensure aircraft performance that will allow a positive vertical rate of climb, sufficient to expeditiously climb away from any obstacles, to be maintained in the event of the RIFTO procedure being utilised. The RIFTO procedure shall be reviewed by aircrew prior to each NVG flight when the aircraft will be operated to or from un-sealed landing areas.

2.2 Inadvertent IMC

2.2.1 Despite careful preparation, the potential for inadvertent IMC penetration may exist. It is important that crews are able to recognise subtle changes to the NVG image that occur prior to entry into instrument meteorological conditions (IMC). These include:

- Onset of scintillation;
- Loss of scene detail; and
- Changes in the appearance of halo.

2.2.2 The decision to delay taking avoiding action in deteriorating conditions may reduce safety margins, particularly if at lower altitudes.

3. Risk Assessment

3.1 Operators considering NVIS operations and/or associated training using NVG are required under CAO 82.6 to carry out a risk assessment prior to the commencement of operations or training with these devices. This risk assessment will include identifying those risks with reasonable foreseeability that require treatment and this information is to be collated in a risk register accessible to all crew. Flight crews should also endeavour to identify the hazards that are most likely to occur during the specific circumstances of the forthcoming flying task/s, and to establish whether current mitigators are adequate. If an operation falls outside of the operators documented risk profile, the operator should provide guidance for the crew to further manage the risk.

3.2 For example the operator may require the operating crew to discuss the situation, consider further control measures, and seek further advice from the Chief Pilot and/or Operator Management. The crew may also consider cancelling a flight if the pilot/s considers the risk of continuing is too great.

3.3 In line with the current Australian Standard on Risk Management (AS/NZS 4360:2004), operators need to ensure that all hazards identified during a hazard assessment are driven down in accordance with ALARP (As Low As Reasonably Practicable). This involves ensuring that the risk is reduced as far as possible, stopping only when the cost of obtaining any further benefit is excessive when compared to the resulting benefits.

3.4 In addition, there are numerous sources providing risk assessment process and models to assist in carrying out an assessment. The following documents may be of assistance:

- Standards Australia-Risk Management AS/NZS 4360:2004;
- International Civil Aviation Organisation (ICAO) – Risk Management;
- Civil Aviation Authority (CAA) of the United Kingdom (UK) CAP 712; and
- Transport Canada TPT 13095-Risk Management and Decision making In Civil Aviation.

4. Overwater Operations

4.1 Overwater operations to small offshore islands, ships, decks or offshore platforms are most likely to be conducted in a low contrast environment, which is generally not conducive to the use of NVG. The suitability of NVG use for these overwater operations, particularly those below 500 ft above the surface, should not be carried out unless all aspects have been carefully considered and detailed procedures included in the operations manual. If contemplating such operations, the following additional issues should be included for consideration, but not limited to:

- Sea state and wind velocity/direction;
- The ability of the crew to maintain continuous visual contact using NVG with land or a shoreline, including any illumination levels and potential hover references;
- Any specific training and checking requirements above that required for overland NVG operations;
- If there is sufficient water surface disturbance and/or surface objects, which may provide adequate visual surface contrast to ensure continuous and sufficient visual cues to maintain depth perception, which may assist the crew in maintaining an accurate and safe height;
- Whether the crew are trained for, and use, a height hold function coupled to a serviceable autopilot/stabilisation equipment; and
- Whether the crew are trained for and use an automatic auto hover function coupled to serviceable autopilot/stabilisation equipment.

5. Flight Planning and Flight Conduct

5.1 Flight Planning and Flight Conduct General

5.1.1 General – This section provides additional information and guidance on planning issues that should be considered.

5.1.2 Departure/Enroute/Destination Weather - The latest terminal and area forecasts should be obtained and analysed with particular emphasis on temperature/dew point spread, cloud cover and visibility, sunset, civil and nautical twilight, moon phase, moonrise and moonset, and moon and/or lux illumination levels for all phases of flight.

5.1.3 Illumination Criteria - The operator should establish minimum illumination criteria and provide a means for determining illumination levels in the operating area. Clear starlight may provide sufficient light for some operations.

5.1.4 Night VFR/IFR - NVG are intended for use in visual meteorological conditions (VMC), as an adjunct to visual flight at night. It is intended that the flight crew in an IFR category flight may derive an operational advantage from NVG use under the IFR when conducting a landing (after descending from IFR LSALT) or take-off (with the intent of climbing to the IFR LSALT) in accordance with the requirements detailed in the AIP. All other NVG operations below LSALT should be NVFR category. The operations manual procedures should be sufficiently robust to ensure that there is a clear delineation between flight under the IFR and the NVFR operations using NVG.

5.1.5 NVIS - In accordance with the manufacturers requirements.

Documentation required by the NVG manufacturer is to be maintained by the operator.

5.1.6 Aircraft - An inspection should be conducted prior to an NVG flight with emphasis on proper operation of the NVG lighting. The aircraft windshield should also be clean and free of major defects, which might degrade NVG performance.

5.1.7 Equipment - To effectively fly an NVG operation, the minimum equipment required for NVG operations should be those instruments and equipment specified within the applicable regulations for VFR night operations. All NVG equipment is to be maintained in accordance with manufacturer's requirements.

5.1.8 Instrument Functional Checks - Aircraft instrument functional checks are to be carried out prior to NVG flight being conducted. Details of these checks should be specified in the Operations Manual.

5.1.9 Route Planning - The operator and crew should assess factors that will affect the NVG operation. A thorough route study of terrain, obstacle clearance, surface contrast, illumination levels, and reflectivity should be considered, as well as a review of applicable Notice to Airmen (NOTAM).

5.1.10 Low Level Planning Considerations - Operators should be aware of the safety advantages of providing guidelines in relation to the reduction of airspeed commensurate with decreasing altitude. (i.e. 'the lower you go the slower you go')

5.1.11 Obstacles/Power Lines - Although night operations under VFR conditions may be flown unaided, use of NVG should enhance the crew's ability to see and avoid obstacles, and other aircraft. While natural obstacles such as hills and mountains can be seen through NVG, some man-made obstacles are difficult to acquire.

Power lines and wires can be extremely difficult to acquire visually until very close, and usually with insufficient time to take avoiding action. However, similar to day operations, visually acquiring the poles or pylons provides a cue that lines and wires are likely to be strung between the poles/pylons which may present a hazard to flight.

5.1.12 Pre–flight Risk Assessment - In addition to risk assessment requirements placed on an operator relating to the consideration of the NVIS operations using NVG, a risk assessment should be undertaken by the crew prior to each NVG operation. The risk assessment should include as a minimum:

- Illumination level;
- Weather;
- Crew recency and experience;
- Operator experience with NVG operations;
- Crew vision;
- Crew general wellbeing (fitness to fly);
- Windshield/window condition;
- NVG tube performance;
- NVG battery condition;
- Types of operations allowed and to be undertaken;
- External lighting environment;
- Assessment of task duration and consideration given to reasonable alertness assured by the prior sleep wake rule; and

- Pilot has completed company form covering fatigue aspects (see CASA website for further details at www.casa.gov.au).

Attachment 4 of this CAAP is a suggested briefing checklist that incorporates the above issues.

5.2 Departure

5.2.1 Airspace - NVIS operations do not change the requirement to comply with applicable airspace requirements. Operators should include in the operations manual procedures for advising air traffic services (ATS) that NVG operations are to be undertaken irrespective of any other requirements.

5.2.2 Other Agencies - Operators should include in their operations manual, procedures for the use of NVG when operating with other agencies that may have little understanding of NVG and their limitations. This may include the extent of the use of bright and flashing lights which may degrade the NVG image when aircraft using NVG are in close vicinity. Such procedures may differ to a degree from unaided operations and could require additional training of and communication with other agencies.

5.2.3 Helicopter Landing Site (HLS) and Unlit/Unprepared HLS Considerations – A Standard HLS (as described in CAAP 92-2(1) or aerodrome can be used either with or without NVG. They are usually adequately illuminated as well as the obstacles in the approach/departure paths.

Operations on or in the near vicinity of a lit HLS-NVG standard, may be conducted with NVG. There definitions provides that a HLS-NVG standard does not have to meet the lighting or windsock requirements of CAAP 92-2(1) for a standard HLS. Extra care should be given to locating any obstacles during approach or departure.

An unlit/unprepared HLS that does not meet the requirements of CAAP 92-2(1) is defined as HLS-NVG basic (see *Definitions* on page 4 of this CAAP), and requires that extra care be given to locating any obstacles that may be in the approach/departure path. Consideration should also be given to employing additional personnel to scan the sides and rear areas of the helicopter due to limited field of view and field of regard.

5.3 En-route

5.3.1 Elevated Terrain - Safety should be enhanced by NVG during operations near elevated terrain at night. The obscuration of elevated terrain is more easily detected with NVG thereby allowing the crew to make alternate flight path decisions.

5.4 Arrival

5.4.1 Aerodrome and Heliport Landings - Usually there is sufficient light at an aerodrome so that NVG are not required. However, NVG may be used depending on several variables: brightness level of the runway lights; width of the runway; presence of threshold lights; and proximity of brightly illuminated hangers. Whether or not to use NVG for aerodrome or lit HLS operations depends on the effect of these variables and the affect on the quality of the NVG image.

5.4.2 Reconnaissance and Landing at HLS - The reconnaissance phase should involve crew-coordinated use of NVG and white lights, or an infra-red searchlight if fitted. The aircraft external white lights such as landing lights, searchlights, floodlights and infra-red searchlights, should be used during this phase of flight in accordance with the operator's procedures. The crew should select and evaluate approach and departure paths to the site considering wind velocity and direction, and obstacles or indications of obstacles. An approach without use of white light landing/searchlight or infrared searchlights may be undertaken in accordance with the operator's procedures and following crew assessment of the environmental and other operational conditions.

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

Further Advice to Appendix 3 of CAO 82.6 – Night Vision Goggle (NVG) Equipment, Operations, Qualifications and Training

PART 1 – Scope and structure

1. Matters to be complied with

In accordance with the requirements promulgated in Civil Aviation Order (CAO) 82.6.

PART 2 – Minimum equipment and aircraft standards for NVG operations

2. Aircraft lighting standards

In accordance with the requirements promulgated in Civil Aviation Order (CAO) 82.6.

2.1 Design Considerations

2.1.1 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 nanometres 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 Class B and Modified Class B NVGs is more restrictive than that in a Class A NVG, the Class B or Modified Class B NVG can be used with either Class A or Class B cockpit lighting designs.

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2.2 Compatibility

2.2.1 Compatibility, with respect to a night vision imaging system (NVIS), includes a number of different factors:

2.2.2 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:

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

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2.3 Instrument Lighting Brightness Considerations

2.3.1 When viewing the NVG image, the brightness of the image will affect the amount of time taken to adapt to the brightness level of the instrument lighting, thereby affecting the time taken to interpret information provided by the instruments. For example, if the instrument lighting is a reasonably bright level, the time taken to interpret information provided by the instruments may be instantaneous. However, if the brightness of the lighting is set to a low level, several seconds may be required to interpret information, thus increasing the head 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 information. This will likely be a brighter level than that used during normal unaided night operations.

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2.4 External Lighting Provisions

2.4.1 The design and location of the lighting components shall optimize visual performance and minimize adverse effects on NVG performance. The components shall not cause objectionable direct or indirect glare and/or reflections, which interfere with the operators aided or unaided vision.

2.4.2 Position Lights, Anti-collision lights and other exterior lighting may have adverse effects on NVG utilisation. Exterior lighting may cause energy to enter the cockpit and adversely affect NVG performance. For example: position lights located near the cockpit, anti-collision light reflections possible from the main rotor blades, reflections off cloud or dust etc may interfere with NVG performance in the cockpit. Operators should have a thorough understanding as to how the aircraft exterior lighting may be properly modified in accordance with engineering requirements to maximise NVG performance. Proper instruction on how to use the exterior lighting and methods of shielding/blinking exterior lighting to reduce the adverse effects may vary with individual aircraft type.

3. NVG equipment and maintenance standards

3.1 In accordance with the requirements promulgated in CAO 82.6.

3.2 See also 'Performance Standards for Night Vision Imaging Systems' in Attachment 5 of this CAAP.

3.3 NVG are equipment not components. However, their maintenance to the highest standards is critical to safety. In CASAs view, therefore, the requirements for successful operation as regulation 30 of CAR 1988, organisation holding a certificate of approval to carry out maintenance of aircraft or components provide a template against which to measure the suitability of an NVG maintainer.

3.4 To this end, Appendix 3 of CAO 82.6 provides that maintenance of NVG must be carried out by an organisation that complies with regulation 30 of CAR 1988 as if the regulation applied to the organisation for the maintenance of NVG and its related equipment.

3.5 It is also necessary that the organisation is endorsed by the original equipment manufacturer (OEM) of the NVG as an appropriate organisation to carry out maintenance on the NVG.

4. Minimum equipment for NVG aircraft in NVG operations

In accordance with the requirements promulgated in CAO 82.6.

4.1 Airborne Weather or Ground Mapping Radar Systems

4.1.1 The use of airborne weather or ground mapping radar systems can enhance navigation and the operational effectiveness and safety advantages of NVGs. The Civil Aviation Safety Authority (CASA) recommends the use of airborne radar systems where available to augment effective NVG operations by the early detection of environmental hazards relevant to safe NVG operations.

4.2 Radio Altimeter

4.2.1 CASA recommends that the type of Radio Altimeter display used incorporate a needle pointer which the movement of which reflects at a glance a climb or descent.

4.3 Spare Goggles

4.3.1 CASA recommends the carriage of accessible spare NVG units in aircraft for NVG operations wherever possible.

4.4 NVG Battery Usage Plan

4.4.1 Operators should provide batteries and a battery usage system in accordance with manufacturer's requirements.

4.4.2 The Australian Defence Force and many civilian operators have battery usage systems that ensures a fully charged set of NVG batteries are available in the primary and secondary battery compartments of each crewmember's individual battery packs.

PART 3 – Operational limitations for NVG operations

5. Minimum altitude for NVG operations

In accordance with the requirements promulgated in CAO 82.6.

6. Helicopter Landing Site (HLS) – NVG basic and HLS – NVG standard operations

6.1 CAAP 92-2(1) describes HLS that are suitable for day and night. When written CAAP 92-2(1) did not consider pilots using NVG. The use of NVG will allow pilots to use HLS at night that meet the requirements of a Basic HLS or allow them to operate to a Standard HLS with reduced lighting requirements. CAO 82.6 has defined the term HLS–NVG basic and HLS–NVG standard to recognise NVG operations. (refer to the *Definitions* section on page 4 of this CAAP).

7. Carriage of persons

In accordance with the requirements promulgated in CAO 82.6.

7.1 CAO 82.6 allows the carriage of persons who are not aircrew members but are persons whose presence is essential to the success or completion of the operation. This may include police, fire fighting, rescue or medical personnel, patients with supporting relatives, marine pilots in transfer, and persons who are apprehended, evacuated, rescued or being transported as an integral part of the operation. These persons are not required to be NVG trained when they are not participating as members of the operating crew.

7.2 CAO 82.6 allows approved operators to carry a passenger on an NVG flight for the purposes of demonstrating NVG technology. In applying to become an approved operator for such a purpose CASA would expect the operator to have prepared a safety case. If accepted by CASA the safety case procedures, based on risk mitigation for a NVG Demonstration flight should be promulgated as an operations manual amendment for inclusion in the operator's operations manual.

7.3 Paragraph 7 (g) in Appendix 3 of CAO 82.6 allows carriage of a passenger on an NVG flight for the purposes of demonstrating NVG technology only if it is in accordance with the procedures and conditions acceptable to CASA set out in the operator's operations manual.

7.4 In addition, not later than 48 hours before the flight, CASA must be notified in writing of the name, position and organisation of the passenger, and the proposed flight plan.

7.5 To be acceptable to CASA an operations manual would need to be based on the safety case made to obtain the NVG approval that encompassed such operations.

7.6 The operations manual should make it clear that carriage of such passengers was solely for demonstration purposes and could not be combined with any other operation.

7.7 The operations manual should indicate that when planning an NVG demonstration flight the original safety case procedures and conditions should be followed and CASA notified of the passengers and the flight plan.

7.8 The safety case, and the operations manual, would be expected to address, and indicate adherence to, the following minimum procedures and safety limitations:

1. The NVG demonstration flight must be conducted by 2 qualified NVG crew.
2. The pilot in command of the NVG demonstration flight must be the operator's chief pilot (if NVG qualified) or NVG senior pilot.

3. The NVG demonstration flight may only be conducted in a helicopter, with equipment and with a crew:
    a. which complies with the requirements of CAO 82.6; and
    b. who each comply with all applicable endorsement, competency, recency and operational flight requirements of CAO 82.6.
4. The flight must be for the exclusive purpose of carrying passengers to observe an NVG demonstration flight.
5. The NVG demonstration flight must be conducted at, or above, 500 feet above the highest obstacle, except for the take-off and landing.
6. Except for emergencies, each take-off and landing for an NVG demonstration flight must be at a helicopter landing site that has been reconnoitred, and operated to, by the pilot in command during full daylight within seven days prior to the intended flight.
7. Each passenger on an NVG demonstration flight must be given a comprehensive passenger emergency briefing in accordance with requirements contained in the operator's operations manual.
8. No operations outside of autorotative distance from land must be carried out unless all passengers have undergone Helicopter Underwater Escape Training.
9. No more than 2 passengers must be carried at any time.

8. Minimum crewing for NVG operations

8.1 In accordance with the requirements promulgated in CAO 82.6.

8.2 The intent of the requirement for the second crewmember is to ensure that NVG scan sectors are maximised during flight to unlit or unprepared HLS, and to ensure a second set of trained NVG eyes in the unlikely circumstance of goggle failure close to terrain, or loss of NVG visual reference due to brown out, white out, etc. The second crewmember should, in accordance with procedures detailed in the Operations Manual, assist the pilot-in-command (PIC) as required for obstacle clearance, rates of descent, attitudes, power settings, etc.

8.3 The primary role of the NVG aircrew member should be to assist the pilot with his cockpit duties, given the increased workload and physical constraints of flying a helicopter using NVGs. An NVG aircrew member should be trained, and tasked so as to provide assistance to the pilot-in-command in at least the following areas:

- NVG scan, lookout and obstacle reporting;
- Normal and emergency cockpit administration;
- Monitoring of instruments during flight;
- Navigation;
- Radio communications; and
- Interpretation of instrument flight rules (IFR) departure and approach procedure charts.

Note: CASA recommends aircrew members hold at least a Radio Operator Licence and a Class 2 medical.

8.4 An operator wishing to operate below 1000 ft AGL without a second NVG crewmember (ie single person/pilot NVG flight) must submit in writing to CASA a safety case for CASA to accept. If accepted by CASA the safety case procedures, based on risk mitigation, for NVG flight below 1000 ft AGL shall be promulgated as an operations manual amendment for inclusion in the operator's operations manual. In any case, CASA will not consider procedures for NVG flight below 500 ft AGL without a second NVG crew member. In assessing a safety case for NVG operations below 1000 ft AGL without a second NVG crewmember CASA may take into consideration the following:

- The specific location/routes;
- The location/routes must be surveyed for obstacles by day;
- The location/routes, boundary and obstacles must be marked, mapped and included in the ops manual;
- The aircraft must be equipped with a serviceable 'Nitesun'; and/or
- Before operating in the surveyed area by night the crew must brief on the specific location operations manual requirements.

9. Minimum crewing for NVG training operations

In accordance with the requirements promulgated in CAO 82.6

10. NVG flight planning for weather minima, alternate aerodromes and fuel requirements

In accordance with the requirements promulgated in CAO 82.6.

10.1 An operator shall carry appropriate fuel reserves in accordance with their night vision flight rules (NVFR) and instrument flight rules (IFR) (as applicable) fuel policy contained in their operations manual.

10.2 An operator may apply for the standard reduced flight planning weather minima (refer paragraph 10.3 and 10.4 below). Or alternatively, an operator may apply for tailored reduced flight planning minima based on specific operational requirements. In all cases, a reduction in flight planning weather minima will be considered when an operator submits in writing to CASA a safety case, based on risk mitigation, for CASA to accept. If accepted by CASA, the safety case procedures for reduced flight planning weather minima shall be promulgated as an operations manual amendment for inclusion in the operator's operations manual.

10.3 The standard reduced flight planning minima for **NVFR** capable aircraft and qualified crews operating on NVG will be to have the cloud weather minima altered to the following:

Cloud: No cloud permitted up to 2000 ft AGL within a 2 nm corridor either side of track.

10.4 for the standard reduces flight planning weather minima for **IFR** capable aircraft and qualified crews operating on NVG under the NVFR will be to have the cloud weather minima altered to the following:

Cloud: No cloud permitted up to 1000 ft above ground level (AGL) within a 2 nm corridor either side of track.

Note 1: CASA interprets the above 2 nm corridor requirement as meaning: that for the purposes of flight planning an area forecast will have no more than SCT cloud in the forecast below the 2000 ft AGL corridor level.

Note 2: An IFR capable aircraft and crew is defined as being an aircraft equipped for the IFR and operated with an IFR crew who are qualified and recent for IFR operations.

10.5 In assessing an application for reduced flight planning weather minima CASA may take into consideration the following:

- The type of operation;
- The operators experience;
- The operators geographical constraints;
- The number of spare goggles accessible to the flying pilot;
- Carriage of a 'Nitesun';
- Two goggled up NVG qualified crew in the front of the aircraft during the entire flight,
- Minimum pilot NVG experience increased for the pilot-in-command (PIC);
- Increased instrument proficiency or training;
- Carriage of un-aided lighting capabilities such as external lighting sources;
- Specific route requirements in terms of terrain or clear areas for precautionary landings;
- Presence of cultural lighting over area; and/or
- Familiarity with route or area of operations.

11. Visibility

In accordance with the requirements promulgated in CAO 82.6.

11.1 Due to the light sensitivity of NVG, lights can be seen over great distances and through obscuration, therefore in-flight visibility is not to be judged by how far a light source can be seen, but rather how far the terrain is clearly visible.

11.2 NVG visibility is also significantly affected by illumination levels and not just environmental obscuration such as smoke and moisture, thus illumination (and shadow areas) shall be considered with regard to in-flight visibility.

11.3 Flight into deteriorating weather/visibility can be recognised as a reduction in visual acuity with the NVGs. This effect is also described as 'NVG Video Noise' and usually indicates the presence of obscurants in the atmosphere.

12. Close proximity flights

In accordance with the requirements promulgated in CAO 82.6.

12.1 Formation flights on NVG will not be approved pending further review during the trial period.

PART 4 – Recognised NVG qualifications for NVG operations (paragraphs 13 – 18 of CAO 82.6)

In accordance with the requirements promulgated in CAO 82.6.

PART 5 – Recency requirements for NVG operations (paragraphs 19 – 23 of CAO 82.6)

In accordance with the requirements promulgated in CAO 82.6.

1. Experience

1.1 High levels of NVIS/NVG proficiency, along with a well balanced NVG experience and knowledge base, will assist in off-setting many of the visual performance degradations associated with night operations. NVG experience is a result of proper training coupled with numerous NVG operations. An experienced NVG crewmember is acutely aware of the NVG 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 NVG training programme which exposes crews to NVG operations conducted under various moon angles, percentage of available illumination, contrast levels, visibility levels, and varying degrees of cloud coverage. A crewmember should be exposed to as many of these variations as practical during the initial NVG qualification programme. Continued exposure during the NVG recurrent training enhances the experience base.

2. Recency

2.1 NVG flight skills are more perishable than day visual flight rules (VFR) flight skills and therefore require increased NVG recency to retain proficiency. Consequently a robust training and checking programme should cater for the broad cross–section of operating exigencies.

2.2 CAO 82.6 establishes the minimum standards that are acceptable to CASA for the operations manual instruction required by the order. However, nothing in those minimums prohibits the operator placing additional requirements, such as increasing the minimum checking cycles in line with their particular operation or safety and risk management systems.

2.3 Operators are encouraged to consider this in their operations – particularly during the start up phases of NVG operations, or where the organisation has little or no corporate experience with the technology.

2.4 In addition, CAO 82.6 requires a detailed recency requirement for NVG operations be included in the operations manual but leaves the determination of recency for operational sequences such as winching, hover exit, etc, to the operator. Accordingly, CASA will only accept operations manual instructions that also specifically address such sequences that are particular to the type of operation conducted. It will generally be acceptable to CASA if the operator should require recency levels equal to or in excess of established un-aided levels.

PART 6 – Minimum requirements for NVG qualification training (Paragraphs 24 – 34 of CAO 82.6)

1. Requirements for training courses

In accordance with the requirements promulgated in CAO 82.6, Appendix 3.

1.1 CAO 82.6 establishes a basic set of training constraints for the design of any NVG course seeking CASA approval. Those basics are established so that NVG endorsements have a uniform minimum competency level for pilots across the industry.

Although aircrew members will only hold a company recognised qualification standardisation of the course through CASA, approval of the minimum competencies of any training should allow for transportability between operators.

1.2 If intending to conduct NVG training outside an authorised flying school or approved CAR 217 Training and Checking organisation, the applicant must also demonstrate a training system that is consistent with the requirements of an AOC flying school or CAR 217 organisation.

1.3 If intending to conduct NVG training, the applicant should clearly promulgate in the operations manual their organisational structure in relation to NVG training. In addition the Chief Pilot should maintain records of all instructional flight crew (including aircrew member instructors).

1.4 CASA will assess these training systems in accordance with the guidelines laid down in the air operator's certificate manual (AOCM).

1.5 Operators are expected to build extra requirements into training syllabi to satisfy any advanced operational sequences particular to their operation, such as specialised coastal rescue, winch and rappelling. As another example, operators may decide that a progression through a period of in-command under supervision (ICUS) is suitable to their operation, and should institute those requirements overlaid on these minimums. Such increases are not limited to the flight sequences, but may also be desired in the ground training phases.

1.6 Attachment 2 of this CAAP provides an example of a flying training course that covers the minimum competencies of CAO 82.6 for a basic NVG endorsement or company qualification on which to build operational competencies if desired. NVG ground training courses syllabi should be constructed in accordance with CAO 82.6. The operations manual of an operator intending to conduct initial NVG qualification training must contain both NVG ground and flight training syllabi. All training systems will be assessed and approved by CASA.

Attachment 2 to CAAP 174-1(0)

TRAINING SYLLABUS

Night vision goggle (NVG) pilot training syllabus

The NVG pilot training will need, as a minimum, to include the following syllabus.

NIGHT VISION IMAGING SYSTEM (NVIS) FLY PILOT 1: *Circuit operations and NVIS familiarisation*

Time (hours)	**Content**		
1.0	• Perform mission planning and flight planning for the flight. • Determine the serviceability of NVIS equipment, including aircraft components. • Perform cockpit drills including switch selection and goggle and de-goggle procedures. • Perform hover, taxi and transit procedures. • Perform crew resource management appropriate to NVIS operations. • Perform circuit operations to a hover and running landing, including normal and steep take-offs and approaches. • Perform NVIS practise malfunctions and emergency procedures. • Perform post-flight shutdown and NVIS procedures.		

NVIS FLY PILOT 2: *Helicopter Landing Site (HLS) operations*

Time (hours)	**Content** *Note: The intent is that the unlit HLS operations should be conducted in areas devoid of significant cultural lighting.*		
1.0	• Perform mission planning and flight planning for the flight. • Perform crew resource management appropriate to NVIS operations. • Consolidate circuit operations. • Consolidate NVIS malfunctions and emergency procedures. • Perform NVIS departure from, navigation to, and arrival at various HLS, including lit, unlit and confined areas. • Perform circuit operations to unlit confined areas located in areas devoid of surrounding cultural lighting. • Perform wire and obstacle detection and avoidance procedures using white light (for example from a steerable searchlight or 'Nitesun'). • Perform sloping ground landings and take-offs. • Perform pinnacle and ridgeline operations. • Introduce inadvertent instrument meteorological system (IMC) penetration procedures and safe recovery to visual flight rules (VFR) flight.		

NVIS FLY PILOT 3: ***Navigation and area operations***

Time (hours)	**Content**		
1.0	• Perform mission planning and flight planning for the flight. • Perform crew resource management appropriate to NVIS operations. • Perform NVIS navigation over pre-planned routes. • Consolidate confined area operations in areas devoid of surrounding cultural lighting. • Introduce and perform loss of visual reference procedures on landing and take-off. • Perform inadvertent instrument meteorological conditions (IMC) penetration procedures and safe recovery to VFR flight. • Introduce NVIS operator specific operations (e.g. emergency, or search and rescue, or winching).		

NVIS FLY PILOT 4: ***Emergency sequences***

Time (hours)	**Content**		
1.0	• Perform mission planning and flight planning for the flight. • Perform crew resource management appropriate to NVIS operations. • Consolidate previous sequences. • Perform practice aircraft emergency procedures, under NVIS conditions, applicable to the aircraft type, including engine failure in the hover or hover taxi and in forward flight in the circuit.		

NVIS FLY PILOT 5: ***Competency Consolidation***

Time (hours)	**Content**		
1.0	Trainee to demonstrate competency in: • mission planning and flight planning for the flight; • determining the serviceability of NVIS equipment, including aircraft components; • performing cockpit drills including switch selection and goggle and de-goggle procedures, performing hover, taxi and transit procedures; • performing crew resource management appropriate to NVIS operations; • performing NVIS practice malfunctions and emergency procedures; • performing NVIS departure and navigation; • performing circuit operations to unlit confined areas located in areas devoid of surrounding cultural lighting; • Perform wire and obstacle detection and avoidance procedures using white light (for example from a steerable searchlight or 'Nitesun'). • performing loss of visual reference procedures on landing and take-off; • performing inadvertent IMC penetration procedures and safe recovery to NVFR flight by sole reference to the aircraft instruments; and • performing a selection of practice aircraft emergency procedures, under NVIS conditions, applicable to the aircraft type.		

NVIS FLY PILOT 6: ***Flight Test***

Time (hours)	**Content**		
1.5	Trainee to demonstrate competency in: • mission planning and flight planning for the flight including a sound knowledge of the rules, regulations and operations manual instructions relating to NVG; • determining the serviceability of NVIS equipment, including aircraft components; • performing cockpit drills including switch selection and goggle/de-goggle' procedure; • performing hover, taxi and transit procedures; • performing crew resource management appropriate to NVIS operations; • performing NVIS practice malfunctions and emergency		

	procedures; • performing NVIS departure and navigation; • performing circuit operations to HLS—NVG basic located in areas devoid of surrounding cultural lighting; • Perform wire and obstacle detection and avoidance procedures using white light (for example from a steerable searchlight or 'Nitesun'). • performing loss of visual reference procedures on landing and take off; • perform procedures for flight into deteriorating in-flight visibility situations; • perform procedures for safe recovery to VFR flight following inadvertent entry to IMC; and • perform a selection of practice aircraft emergency procedures, under NVIS conditions, applicable to the aircraft type.		

NVG AIRCREW MEMBER TRAINING SYLLABUS

The NVG aircrew member training must, as a minimum, cover the following syllabus.

NVIS FLY AIRCREW 1 and 2: ***NVIS operations***

Time (hours)	**Content**		
2.0 *Note: can be done in two one hour trainin g sorties.*	• Assist mission planning and flight planning for the flight. • Determine the serviceability of NVIS equipment, including aircraft components. • Perform drills including switch selection and goggle and de-goggle procedures. • Perform crew resource management appropriate to NVIS operations. • Perform aircrew member duties for hover, taxi and transit procedures. • Perform aircrew member duties for descent, reconnaissance, and circuit operations to and from unlit confined areas located in areas devoid of surrounding cultural lighting. • Perform wire and obstacle detection and avoidance procedures using white light (for example from a steerable searchlight or 'Nitesun'). • Perform NVIS practice malfunctions and emergency procedures. • Accurately recognise, identify, announce, and provide verbal correction (the con) to the pilot for drift, rates of climb or descent, obstacle avoidance, and ground hazards for example dust and debris. • Accurately con the aircraft during confined area manoeuvring, slope landings.		

	• if an NVG aircrew member’s operational role requires him or her to sit in the front seat of the aircraft and provide assistance to the pilot — assisting the pilot: (a) during procedures for flight into deteriorating in-flight visibility situations; and (b) during in-flight safe recovery to V.M.C. flight after inadvertent entry to I.M.C.; • Perform aircrew member duties during a selection of practice aircraft emergency procedures, under NVIS conditions, applicable to the aircraft type. • Perform post-flight shutdown and NVIS procedures.		

NVIS FLY AIRCREW 3: ***Flight Test***

Time (hours)	**Content:** *Note: The intent is that the unlit HLS operations should be conducted in areas devoid of significant cultural lighting.*		
1.0	As a minimum, trainee to demonstrate competency in: • assisting the pilot in mission planning and flight planning; • determining the serviceability of NVIS equipment, including aircraft components; • performing cockpit drills including switch selection and goggle/de-goggle procedure; • performing crew resource management appropriate to NVIS operations; • performing NVIS practice malfunctions and emergency procedures; • performing aircrew member duties for descent, reconnaissance, and circuit operations to and from unlit confined areas located in areas devoid of surrounding cultural lighting; • Perform wire and obstacle detection and avoidance procedures using white light (for example from a steerable searchlight or 'Nitesun'). • provide a timely and accurate con to the pilot for drift, rates of climb and descent, obstacle avoidance, and ground hazards including dust and debris. • if an NVG aircrew member’s operational role requires him or her to sit in the front seat of the aircraft and provide assistance to the pilot — assisting the pilot: (a) during procedures for flight into deteriorating in-flight visibility situations; and (b) during in-flight safe recovery to V.M.C. flight after inadvertent entry to I.M.C.;		

Attachment 3 to CAAP 174-1(0)

HUMAN FACTORS AND PHYSIOLOGICAL LIMITATIONS

1. General

1.1 Appendix 2 of Civil Aviation Order (CAO) 82.6 requires an approved operator operations manual to contain detailed training programmes and planning regimes for human factors and fatigue.

1.2 This section provides information and guidance on the minimum physiological and associated human factors that should be considered for this purpose. It should be considered that the following human factors and physiological limitations can be exacerbated by increasing fatigue.

2. Situational Awareness

2.2 Situational awareness is 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.' (Endsley, 1998). Basically, good situational awareness is obtained by understanding what is happening around you, and how the situation will develop in the future.

2.3 Situational awareness may be diminished due to a number of human factors associated with night vision goggles (NVG) use, especially fatigue impairment of flight crews.

2.4 If situational awareness is diminished by these factors, strategies can be put in place to assist in mitigating the effects.

3. Crew Resource Management (CRM)

3.1 Due to the inherent limitations of night vision imaging system (NVIS) operations, emphasis should be placed on good communication. This applies to both single-pilot and multiple-crew cockpit environments. NVG flight particularly requires effective CRM between all crewmembers, not just aircrew. Therefore, CRM procedures and training should include all crew on board. CRM procedures should be addressed in detail in the operations manual and covered as part of the briefing package.

3.2 Operators should produce specific NVG CRM procedures (including standard crew duties and phrases) involving all NVG aircrew in all phases of flight.

4. Threat and Error Management

4.1 Within Threat and Error Management (TEM), a threat is defined as 'an event or error that… [is] outside the influence of the flight crew, increases operational complexity and requires crew attention and management if safety margins are to be maintained' (Merritt & Klinect, 2006).

4.2 Error is defined as 'a crew action or inaction that leads to a deviation from crew or organisational intentions or expectations' (Merritt & Klinect, 2006).

4.3 As such, TEM is aimed at helping flight crew manage threats and errors that may lead to an undesired aircraft state (the result of threats or errors that go unnoticed by flight crew), and also helping to manage the undesired aircraft state if and when it occurs.

4.4 Flight crews should be familiar with the TEM concept because it can help combat complacency and improve situational awareness. For this reason, training in TEM is recommended for all crews involved in NVG operations.

5. Complacency and Overconfidence

5.1 Compared to other types of flight operations, there may be an increased tendency by a crewmember to overestimate the capabilities of both the NVG equipment, and what this enables pilots to do. This can potentially result in complacency and overconfidence in the equipment. Similar to other specialised flight operations, complacency and overconfidence may lead to an acceptance of situations that would normally not be permitted. For example, attention span and vigilance maybe reduced, important elements in a task series overlooked, and scanning patterns, which are essential for situational awareness, break down. Critical but routine tasks can often be skipped or overlooked.

5.2 Consequently, both operators and individual crewmembers should remain vigilant to the onset of any overconfidence and/or complacency during operations. This may be achieved by regular flight checks and refresher training and during flight operations by crew monitoring and CRM procedures that allow all crewmembers to query the actions of the pilot flying. Examples of such procedures include Threat and Error Management (such as the three strike rule).

6. Depth Perception and Distance Estimation

6.1 It is important for crews to be able to accurately employ both depth perception and distance estimation techniques. To accomplish this, NVG users utilise both binocular and monocular vision.

7. Instrument Lighting Brightness Considerations

7.1 When viewing the NVG image, the brightness of the image will affect the amount of time taken to adapt to the brightness level of the instrument lighting, thereby affecting the time taken to interpret information provided by the instruments. For example, if the instrument lighting is a reasonably bright level, the time taken to interpret information provided by the instruments may be instantaneous. However, if the brightness of the lighting is set to a low level, several seconds may be required to interpret information, thus increasing the head 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 information. This will likely be a brighter level than that used during normal unaided night operations.

8. Dark Adaptation Time from NVG to Unaided Operations

8.1 When viewing an NVG image, both the eyes rods and cones are being stimulated (mesopic vision), but the brightness of the image is reducing the effectiveness of rod cells. If the outside scene is bright (urban area, bright landing pad), 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 (rural area with scattered cultural lights), the outside scene will not be bright enough to stimulate the cones and some time will be required for the rods to fully adapt, possibly taking up to two minutes for the rods to fully adapt for the best acuity. If the outside scene is very dark (no cultural lights or moon), it may take up to five minutes to fully adapt to the outside scene after removing the NVG. The preceding are general guidelines and the time to fully adapt to the outside scene on removing NVG depends on may variables; the length of time the NVG have been used, whether or not the crewmember 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 note the time requirements for any given operation.

9. Monochromatic Adaptation

9.1 Upon re-entering a high ambient light environment, after wearing the NVGs for an extended period of time, the operator may experience a brownish tint or discolouration of objects viewed with the unaided eye. This is a normal physiological phenomenon, it causes no discomfort and it will disappear after a few minutes.

10. Fatigue Management

10.1 Human biological limitations that are prevalent during the hours of darkness, along with the limitations associated with NVG, may have an impact on the level of risk associated with an NVG operation. Some of these limitations are the effects of fatigue, stress, eyestrain, and working when crews are biologically predisposed to sleep (circadian rhythm). Early onset of fatigue may be caused by increased helmet weight or NVG mounting device, scanning techniques associated with NVG operational use, or various ergonomic factors that may have a direct influence on how the particular crewmember works in the aircraft while wearing NVGs. These risks must be mitigated through proper training, recent experience, personal adaptation to night flying, prior sleep, risk treatment strategies, and crew rosters that recognise the propensity for sleep of individuals during the day.

10.2 Present operator flight and duty limitations for night and/or instrument flight rules (IFR) operations, and specifically for night operations remain unchanged when using NVG.

10.3 Operators may find that as part of their risk management process, there is a need to be more restrictive than current flight and duty limitations require. Prescriptive limitations may arise depending on the outcome of the NVG trial.

10.4 Various workload factors common to the use of NVG by low experience crewmembers (less than 100 hours for NVG pilots and less than 50 hours for NVG aircrew members), may introduce the early onset of fatigue. Accordingly operators should consider reducing flight limits for low experience NVG crew or those lacking in recency.

10.5 Operators should give guidance via the operations manual, in limiting NVG flight time per duty period for low NVG experienced crew or single pilot operations for operations below 500 ft above terrain or obstacles. For example, it may be appropriate for activities where NVG use only occurs in the arrival phase of flight to have a limitation on sectors flown, or to limit the overall flight time for NVG operations that occur wholly below LSALT. Notwithstanding any prescriptive limitations an operator may impose, further flight time reductions must be considered should crews feel fatigue impaired or exhibit behavioural indications consistent with fatigue impairment.

11. Human Factor (HF)/ Fatigue Recommended Training:

- A Human Factors Plan, to address any human factors issues associated with NVG flight that limits the performance of a flight crewmember. This may include ergonomic issues, interface/coordination issues, crew communication and fatigue resulting from NVG operation
- Chief Pilot/Safety Manager training
    - How to investigate adverse events and determine contributing factors
    - How to determine and monitor the effectiveness of corrective action as necessary
- Crew training
    - How to effectively forward rotate a roster and minimise fatigue
    - How to assure alertness via the prior sleep wake rule
    - How to recognise behavioural patterns in-flight crewmembers due to increasing fatigue
    - How to manage sleep debt
    - How to manage sleep hygiene
    - How to assess physical and mental wellbeing with fatigue as a context
    - to provide information regarding internal company reporting system

Note: Advice to operators for establishing the above HF criteria is contained on the Civil Aviation Safety Authority (CASA) website (www.casa.gov.au).

Attachment 4 to CAAP 174-1(0)

NIGHT VISION GOGGLES (NVG) - GENERAL INFORMATION

1. System Description-Night Vision Imaging Systems (NVIS)/(NVG)

1.1 Night Vision Goggles

1.1.1 NVG are head-worn (helmet or other approved mounting device), and consist of a binocular imaging assembly, a mounting interface, user controls, a power module and a low-power indicator. The binocular imaging assembly is attached to a head-borne platform (usually a flight helmet) via the mounting interface. Generally, the mounting interface allows the binocular to detach during adverse gravity (G)-loading conditions. Controls enable the user to position the binocular for optimum line of sight, field of view and focus. A battery power module provides sufficient electrical power for operation of the binocular and includes both primary and secondary sources. Each source is capable of independently operating the binocular for equal duration and may also include provisions to interface with an external power source. In this case, the power module supplies uninterrupted power to the binocular in the event of failure of the external power source. A low-power indicator signals the user to select the spare power module source when primary power is insufficient to operate the binocular. The low-power indicator is visible to the user.

1.1.2 The binocular consists of two independent channels, with each channel presenting collimated scene information directly to one eye. Filters designed to facilitate the compatibility of cockpit lighting are provided in each channel. Channels contain one (or more) objective lens(es), image intensifier tube(s) and eyepiece lens(es). Binoculars may include other optical components, including: combiners, prisms, beam-splitters, cameras, and displays. In addition to scene information, binoculars may present injected head up display (HUD) information. Each channel contains one (or more) image intensifier tube(s). The image intensifier consists of a photo-cathode, micro-channel plate, phosphor screen and power supply. The power supply automatically adjusts gain for optimized performance. In some cases the image intensifier power supply is remotely located with the image intensifier not susceptible to electromagnetic interference.

1.2 NVG Head Up Display (NVG HUD)

1.2.1 The NVG HUD provides critical, real-time, flight, navigation, and aircraft data in the field of view of the NVG. The NVG HUD enables the crew to obtain-flight information while using the NVG, minimising the requirement to look under the NVG. This further improves situational awareness and spatial orientation while reducing workload during NVG operations.

1.3 NVIS Capabilities - General

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

1.3.2 Forward looking infra red (FLIR) devices, synthetic vision devices and aircraft head up displays (HUD) can also provide imagery and information useful during night operations. However, the scope of Civil Aviation Order (CAO) 82.6 and this Civil Aviation Advisory Publication (CAAP) concentrates on NVIS when using NVG.

1.3.3 **Critical Elements** - The following critical elements are the underlying assumptions in the system description for NVG:

- Aircraft internal and external lighting has been modified or initially designed to be compatible, and the NVG have been properly maintained in accordance with the manufacturer approved data;
- Environmental conditions are adequate for the use of NVG (e.g. sufficient illumination is present and favourable weather conditions);
- The NVG has been properly maintained in accordance with the minimum operational performance standards;
- A proper has been performed on the NVG confirming operation in accordance with the continued airworthiness standards and training guidelines;
- The crews involved have been properly trained and meet recency and experience requirements; and
- Organisations utilising NVGs have in place strategies to limit, as far as practical, impairment to crews as a result of fatigue and other human factors.

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

1.3.5 The typical unaided eye with a daytime visual acuity of 20/20 may yield a night-time unaided visual acuity to 20/20 or worse. The improved resolution capability of later generation NVG may allow for a comparative visual acuity of 20/30 or better under optimal conditions.

1.4 Detection and Identification of Obstacles

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

1.4.2 Being able to visually locate and in some cases, identify objects or areas critical to operational success will also enhance operational effectiveness. NVG also may allow crewmembers to readily detect other aircraft.

2. NVG Limitations

2.1 NVG Design Characteristics

2.1.1 While there are certain limitations inherent in current NVG design, the enhanced visual capabilities generally outweigh the disadvantages.

2.2 Visual Acuity

2.2.1 Visual acuity with NVG is less than normal daytime visual acuity, however visual acuity is greater using NVGs than otherwise under unaided night flight. However it is reasonable to expect, given the scope of operation of these devices, that concentration of crews will be greater, giving rise to an earlier onset of fatigue.

2.3 Field of View

2.3.1 Field of View (FOV) in current NVG systems is approximately 40 degrees. This reduction can increase the likelihood of susceptibility to misperceptions and illusions. As such, proper scanning techniques must be employed to mitigate against this outcome.

Note: As the FOV is diminished when using NVGs, it is anticipated that pilot workload will increase. This may give rise to work induced fatigue.

2.4 Field of Regard

2.4.1 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.).

2.5 NVG Weight and Centre of Gravity (CG)

2.5.1 The increased weight and forward CG projection of head supported devices may have detrimental effects on user performance due to neck muscle strain. Any physical stressors place on a flight crewmember will give rise to the earlier onset of fatigue. There maybe an increased risk of neck injury in the event of an accident.

2.6 Monochromatic Image

2.6.1 The NVG image appears in shades of green, termed 'monochromatic'. This colour was chosen 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.

2.7 Ambient or Artificial Light

2.7.1 The NVG requires some degree of light (energy) in order to function. Low light levels, non-compatible aircraft lighting and poor windshield/window light transmissivity, diminish the performance capability of the NVG. The pilot-in-command is ultimate responsibility to determine when to transition from aided to unaided flight, due to unacceptable NVG performance in accordance with the company operations manual.

2.8 Daytime Use for NVG

2.8.1 NVG are intended to be used at night; are not designed for daytime use and are unlikely to aid a user in decreased daytime visibility conditions. Further, exposure to bright daylight sources for extended periods may damage or significantly reduce the life of the intensifier tube.

3. Scanning Procedures

3.1 Scanning

3.1.1 When using NVG there are three different scan patterns to consider and each is used for different reasons:

- instrument scan;
- aided scan outside; and
- unaided scan outside.

3.1.2 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, visual acquisition can possibly be made unaided or with the NVG. Whether to use the NVG or unaided vision depends on many variables. A proper scan depends on the situation and variables present, and that scanning outside is critical when close to another aircraft. For a multi-crew environment, coordination of scan responsibilities is vital.

3.2 Instrument Crosscheck Scan

3.2.1 It is important to predict conditions under which an instrument crosscheck scan will be required. This should commence during 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 any event, experience, training and constant attention to the situation are vital contributors to the operator assessment of the situation.

3.3 NVG Scan

3.3.1 To counteract the limited field of view, crews should continually scan throughout the field of regard to build a mental image of the surrounding environment. The rate at which 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, at low altitude in mountainous terrain, the scan should be more 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 crew is anticipating a turn more attention may be placed in the area around the turn point, or in the direction of the intended heading or track. In this situation, the scan will be limited briefly to only a portion of the field of regard.

3.3.2 As with an instrument scan, it is important to anticipate and plan ahead. It may be possible to determine when the scan may be interrupted due to other tasks, or when it is possible to become fixated on a specific task, or when it is important to maximize the outside scan. An important lesson regarding the NVG scan is when not to rely totally on visual information.

3.3.3 It is easy to overestimate how well one can see with NVG, especially on high illumination nights, and it is vital to maintain a constant awareness of ones own limitations. This should be continually emphasised during training and should be reinforced as an item when briefing NVG flights. Distance estimation may be difficult when relying solely on NVG, especially when remote cultural lighting is being viewed.

3.4 Unaided Scan

3.4.1 Under certain conditions, unaided scan may be as important as aided scan. 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 external lights is masking aircraft detail on the NVG image. Additionally, there are other times when unaided information can be used in lieu of or may augment NVG and instrument information.

3.5 Scan Patterns

3.5.1 Environmental factors may influence scan by limiting what may be seen in specific directions or by degrading the overall image. If the NVG image is degraded, aircrew may scan more frequently in a subconscious attempt to obtain more information, or to avoid the chance of missing information that suddenly appears and/or disappears.

3.5.2 The operation itself may influence the scan pattern. Scanning for another aircraft, HLS, or aerodrome 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 crewmembers responsibility for scanning of specific sectors.

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

4. Environmental considerations

4.1 Weather and Atmospheric Obscurants

4.1.1 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.

4.2 Weather

4.2.1 During NVG operations, users can see areas of moisture that are dense (cloud, thick fog), but may not see areas that are less dense (thin fog, light rain showers). The inability to see some areas of moisture may lead to hazardous flight conditions during NVG 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 NVG operations.

For example:

- 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.
- Light rain or mist may not be observed with NVG but will affect contrast, distance estimation, and depth perception. Heavy rain is more easily perceived due to large droplet size and energy attenuation.
- 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 more effectively than the terrain it covers and thus increase the level of illumination.

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

4.3 Deteriorating Weather

4.3.1 Crews should remain cognisant to changes in the weather when using NVG. It is possible to 'see through' some areas of light moisture when using NVG, thus increasing the risk of inadvertently entering instrument meteorological conditions (IMC). Some ways to assist reducing this possibility include:

- 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;
- Obtain a thorough weather brief with emphasis on NVG effects;
- Be familiar with weather patterns in the area of operations; and
- Occasionally scan the outside scene. The unaided eye may detect weather conditions that are not detectable to the NVG.

4.3.2 In the event of inadvertent IMC penetration, crews should quickly resort to operations manual procedures to recover the aircraft.

4.4 Thunderstorms

4.4.1 CAO 82.6 requires guidance for thunderstorm avoidance be given in the operations manual. Thunderstorms should be avoided by a minimum of 5 nautical miles (nm) which, under most circumstances should avoid the majority of the hazardous effects. While 5 nm is considered to be a minimum to avoid most hazards and likely adverse effects, crews and operators should consider extending this distance, particularly in areas of more severe thunderstorm activity such as tropical areas.

4.4.2 Distances from thunderstorms may be difficult to estimate visually when using NVG. Consequently, operators should consider the fitment of airborne weather radar or other electronic detection devices to their aircraft. In addition, it should be noted that the NVG image may be adversely affected by lightning flashes. Given that CAO 82.6 also requires the flight to be capable of being conducted by night vision flight rules (NVFR) or instrument flight rules (IFR) if capable, the presence of thunderstorm activity may affect the ability to conduct the mission at all.

4.4.3 In addition it should be noted that the NVG image may be adversely affected by lightning flashes.

4.5 Airborne Obscurants

4.5.1 Apart from weather, there may be other obscurants in the atmosphere that may 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:

- High winds during the day can uplift considerable dust in the air that may still be present at night;
- Bush or forest fires produce heavy volumes of smoke that may cover areas well displaced from the fire source;
- The effects of rotor wash may be more pronounced when using NVG depending on the type of material, such as sand, snow or dust; and
- Air pollution in and around major cultural areas and cities may have an adverse effect on NVG performance.

4.6 Winter Operations

4.6.1 Winter conditions provide unique issues and challenges to crews.

4.7 Snow

4.7.1 Due to its reflective nature, snow presents crews with significant visual challenges both enroute and in the area of operations or intended landing area. During the enroute phase of a flight snow may cause distractions to the crew if any aircraft external lights (anti-collision beacons/strobes, position lights, landing lights) are not compatible with NVG. In the area of operations or landing area, the hazards associated with 'whiteout' landings using NVG is not diminished, and may be more disorienting due to lights reflecting from the billowing snow around the aircraft during the landing phase. Any emergency vehicle lighting or airport lighting in the landing area may exaggerate the effects.

4.8 Ice Fog

4.8.1 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.

4.9 Icing

4.9.1 Airframe icing is difficult to detect while looking through NVG. Crews should develop a proper crosscheck to ensure airframe icing does not exceed operating limits. Crews should already be aware of icing indicator points on their aircraft.

4.10 Low Ambient Temperatures

4.10.1 Depending on the cockpit heating system, fogging of NVG may arise which could significantly reduce goggle effectiveness. There is potential for reduced battery duration associated with low temperatures which may require additional battery resources.

4.11 Illumination

4.11.1 NVG require illumination, either natural or artificial, to produce an image. Although current NVG technology has significantly improved low light-level performance, some illumination, is required.

4.12 Natural Illumination

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

4.13 Moon Phase

4.13.1 The moon provides the greatest source of natural illumination during the night. Moon phase and elevation determines the amount of moonlight which will be available, while moonrise and moon rise and set 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 (25% illumination does not mean the same as a quarter moon). Percent lunar illumination may only be obtained from limited sources.

4.14 Lunar Azimuth and Elevation

4.14.1 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 the day. 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 planning. Shadowing, another effect of lunar azimuth and elevation, is discussed separately.

4.15 Shadowing

4.15.1 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.

4.16 Benefits of Shadows

4.16.1 Shadows alert crews 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 expanses and high sand dunes may go unnoticed in the absence of contrast. The contrast provided by shadows helps make the NVG scene appear more natural.

4.17 Disadvantages Due to Shadows

4.17.1 Within a shadow area, terrain detail can be significantly degraded, with objects in or around shadowed areas subject to loss of terrain detail to NVG users. During flight under adequate illumination, users expect to see a certain level of detail.

Flight into a shadow area while the operator is preoccupied with other matters (communication, radar), may result in possible loss in terrain detail which is immediately detected. A user may perceive the reduced detail is due to an increase in-flight altitude and begin a descent - even though at a low altitude. Consideration during mission planning to factors such as lunar azimuth and elevation, terrain type (mountainous, flat), and the location of items significant to operation success (ridgelines, pylons, targets, waypoints), will assist in predicting the location of shadows and potential adverse effects.

4.18 Sky glow

4.18.1 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.

4.18.2 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 could be for extended periods of times during seasons when the sun does not travel far below the horizon. Unlike sky glow after sunset, sky glow associated with sunrise does not have an obvious effect on NVG performance until close to official sunrise. The difference is related with the length of time the atmosphere is exposed to the suns irradiation, which causes ionisation processes that release near- ice on runway (IR) energy. These effects should be taken into account during planning as they have most significance when looking west around sunset and may extend for a period of time.

4.19 Artificial Illumination

4.19.1 The NVG are sensitive to any source of energy in the visible and near infrared spectrums, and there are also many types of artificial illumination sources (flares, IR, searchlights, cultural lighting). As with any illumination source, these can have both positive and detrimental effects on the NVG. For example, viewing a scene indirectly illuminated by a searchlight may enable the user 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 area of operations to avoid adverse effects, but to be able to make use of the advantages. Also, it is important to know how to properly use artificial light sources (i.e. 'Nitesun', searchlights etc.). As artificial light sources may not always be available or dependable, this should be taken into consideration.

4.20 Terrain Contrast

4.20.1 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 (forests, cultivated fields) 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 (flat featureless desert, snow-covered fields, water) contains few albedo variations, thus the NVG image will contain fewer levels of contrast and less detail.

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Attachment 5 to CAAP 174-1(0)

NIGHT VISION IMAGING SYSTEMS/NIGHT VISION GOGGLES (NVIS/NVG) – SUGGESTED PREFLIGHT BRIEFING CHECKLIST

Item	Subject	Considerations
1	**Weather**	• Area/aerodrome forecast/aviation routine weather report (TAF/METAR)/forecast/duration • Cloud cover/dew point spread/precipitation/thunderstorm activity/other adverse conditions/visual meteorological conditions (VMC)
2	**Operational issues**	• Notice to airmen (NOTAM) • all publication including maps, charts and other documentation • NVIS/NVG adjusted using test set • NVIS/NVG and serviceability checks • personal equipment, including NVIS/night vision device (NVD), flashlights, lip/finger lights/spare batteries • area of operations, including daylight reconnaissance of the area as applicable • known or expected hazards at the destination/area of operations and enroute, including terrain • recovery plan in the event of instrument meteorological conditions (IMC) penetration • alternate requirements • fuel planning and requirements • other potentially conflicting traffic • use of landing lights/search lights applicable to the operators operations manual • environmental issues enroute, at the destination/area of operations that may affect the NVG
3	**Ambient Light**	• moon rise/set/phase/position/elevation • % illumination for the duration of flight • other anticipated ambient light sources
4	**Mission/Flight planning**	• mission/flight plan profile • terrain appreciation/area of operation • detailed manoeuvres/specialised operations • light timings (lunar)/ambient light conditions • start/airborne/debrief • airspace coordination for NVIS/NVG (if required) • obstacles/ hazards/lowest safe altitude (LSALT)/minimum altitude to be flown • NVIS/NVIS goggle procedures/phases of flight • return to base (RTB) procedures • post-flight debrief

Item	Subject	Considerations
5	**Crew considerations**	• crew names/pilot-in-command (PIC)/co-pilot/aircrew member • crew recency/currency • crew duty limitations/fatigue • crew experience for the mission • crew resource management (CRM) issues • crew position equipment • NVIS/NVG spare set if required • crew duties, including lookout/clearance calls/crew scanning techniques • calling of hazards/movements/other traffic • transfer of control terminology (handover take over drills) • below 500 ft air operator (AO)-co-pilot (if carried) ready to assume control
6	**Aircraft**	• aircraft serviceability for NVIS/NVG flight • aircraft configuration for the mission, including specialised equipment • fuel & centre of gravity (CG) considerations
7	**Emergencies**	• NVIS/NVG failure/malfunctions during flight above and below LSALT • inadvertent IMC penetration and recovery to VMC • RTB recovery or to alternate • aircraft emergencies – critical and non critical

Attachment 6 to CAAP 174-1(0)

PERFORMANCE STANDARDS FOR NIGHT VISION IMAGING SYSTEMS

1. References

- Civil Aviation Regulations (CAR) 1988, regulation 207
- Civil Aviation Safety Regulations 1998 (CASR) Part 21, 23, 25, 27, 29,
- Civil Aviation Order (CAO) 82.06
- RTCA Document RTCA/DO-275 dated 12 October 2001
- FAA TSO C164 dated 30 September 2004

2. Purpose

This CAAP attachment is intended to provide guidance on the minimum operational performance standards acceptable to CASA for the selection of night vision imaging systems (NVIS) for use in Australia.

3. Background

The RTCA developed a minimum operational performance specification in 2001. The United States Federal Aviation Administration (FAA) issued a Technical Standard Order (TSO) C164 referencing the RTCA document. Further technological advances have been made improving the performance significantly.

4. Applicability

This CAAP attachment is applicable to operators intending to utilise night vision imaging systems in accordance with Civil Aviation Order 82.6. It provides guidance on the minimum acceptable performance standards considered necessary to conduct approved operations in Australian airspace.

5. Related Reading Materials

RTCA/DO-278 Concept of Operations, NVIS for Civil Operators.

6. Minimum operational performance standards

The specifications in RTCA/DO-275, dated 12 October 2001, as modified by column 3 of Table 1 of this CAAP attachment, are endorsed by CASA as an appropriate minimum performance standard for night vision imaging systems. The modifications have been incorporated to reflect the developments within the night vision industry since the release of RTCA/DO-275 and are representative of current commercially available equipment.

Note: Copies of RTCA/DO-275 may be purchased via the RTCA website: http://www.rtca.org/.

Table 1: Amendments to RTCA/DO 275 MOPS

RTCA/DO-275 Minimal Operational Performance Standard (MOPS) Reference		Amended Performance Requirement
Para 2.2.1.1 System Resolution	1.0 cycles per milliradian (cy/mr). At 14º off axis = 0.81 cy/mr With a variable focus @ through infinity = 0.49cy/mr	1.3 cy/mr
Para 2.2.1.2 System Luminance Gain	= 2,500 foot-Lamberts (fL) per fL at an input light level of 1 x 10^{-4} fL	= 5500 foot-Lamberts (fL) per fL at an input light level of 1 x 10^{-4} fL
Para 2.2.1.3 Field-of-View	38º vertical and horizontal	40º
Para 2.2.1.4 Magnification	1:1 +/- 2%	1:1
Para 2.2.1.7.1 Spectral Transmission	Meet Class B filter requirements	Class A/B filter
Para 2.2.1.10 Eyepiece Dioptre Range	Adjustable +1.0 to –2.0, or Fixed –0.5 and –1.0	+2 to -6
Para 2.2.1.12 Objective Focus Range	Adjustable from beyond infinity to no greater than 45 cm close range	25 cm close
Para 2.2.13 Exit Pupil/Eye Relief	Type I - 25 mm, Type II - 20mm	25 mm
Para 2.2.2.3 Flip-Up/Flip Down	Required capability	Push button
Para 2.2.2.4 Fore-and-Aft Adjustment	Sufficient to align with users eyes	27mm total
Para 2.2.2.4 Tilt Adjustment	Sufficient to align with users eyes	10 degrees
Para 2.2.2.5 Interpupillary Adjustment	Desired but not required. If not installed, exit pupil must be large enough to see full FOV	51 to 72mm
Para 2.2.2.6 Voltage Required	2.7 – 3.0 V DC 50mA nominal Backup power supply required	2.7 – 3.0 V DC 50mA nominal Backup available
Technology	Intensifier tubes not specified	GEN III Image intensifier tubes or equivalent
Photosensitivity	Not specified	1800 uA/lm
Tube Resolution	Not specified	64 line pairs per millimetre (lp/mm)
Signal to Noise Ratio	Not specified	21:1