European Aviation Safety Agency

COMMENT RESPONSE DOCUMENT (CRD) TO NOTICE OF PROPOSED AMENDMENT (NPA) 2009-02B

for an Agency Opinion on a Commission Regulation establishing the Implementing Rules for air operations of Community operators

and

draft Decision of the Executive Director of the European Aviation Safety Agency on Acceptable Means of Compliance and Guidance Material related to the Implementing Rules for air operations of Community operators

"Part-OPS"

CRD b.4 – Resulting text of Part-SPA (IR, AMC, GM)

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Part-SPA | IR

Subpart A - General requirements

SPA.GEN.100 Competent authority

(a) The authority issuing a specific approval shall be:

(1) for commercial operators the competent authority issuing the air operator certificate (AOC); and

(2) for non-commercial operators the competent authority of the State in which the operators are established or residing.

(b) Notwithstanding (a)(2) above, for non-commercial operators using aircraft registered in a third country, the requirements for the approval for operations in performance-based navigation (PBN), minimum operational performance specifications (MNPS) and reduced vertical separation minima (RVSM) airspace shall not apply if these approvals are issued by a third country State of Registry.

SPA.GEN.105 Application for a specific approval

(a) Applicants for the initial issue of a specific approval shall provide the competent authority with the documentation required in the applicable Subpart, together with the following information:

(1) the official name and/or business name, address and mailing address of the applicant; and

(2) a description of the intended operation.

(b) Applicants for a specific approval shall provide the following evidence to the competent authority:

(1) compliance with the requirements of the applicable Subpart;

(2) that the aircraft and required equipment fulfil the applicable airworthiness requirements in accordance with Regulation (EC) No 1702/2003 and are approved when required by the relevant Subpart;

(3) that a training programme has been established for flight crew and, as applicable, other personnel involved in these operations;

(4) that operating procedures in accordance with the applicable Subpart have been documented; and

(5) that the relevant elements defined in the operational suitability data (OSD) established in accordance with Part-21 are taken into account.

(c) Operators shall retain records relating to the requirements of (a) and (b) above at least for the duration of the operation requiring a specific approval, or, if applicable, in accordance with OR.OPS.MLR.220.

SPA.GEN.110 Privileges of an operator holding a specific approval

The scope of the activity that the operator is approved to conduct shall be documented and specified:

(a) for non-commercial operators in the list of specific approvals; and

(b) for commercial operators in the operations specifications to the AOC.

SPA.GEN.115 Changes to operations subject to a specific approval

When the conditions of a specific approval are affected by changes, operators shall provide the relevant documentation to the competent authority and obtain prior approval for the operation.

SPA.GEN.120 Continued validity of a specific approval

Specific approvals shall be issued for an unlimited duration and shall remain valid subject to the operator remaining in compliance with the requirements associated with the specific approval and taking into account the relevant elements defined in the OSD established in accordance with Part-21.

Subpart B – Performance-based navigation operations (PBN)

SPA.PBN.100 PBN operations

Aircraft shall only be operated in designated airspace, on routes or in accordance with procedures where performance-based navigation (PBN) specifications are established, if the operator has been granted an approval by the competent authority to conduct such operations. No specific approval is required for operations in area navigation 5 (RNAV5 (basic area navigation, B-RNAV)) designated airspace.

SPA.PBN.105 PBN operational approval

To obtain a PBN operational approval from the competent authority, the operator shall provide evidence that:

(a) the relevant airworthiness approval of the RNAV system has been obtained;

(b) a training programme for the flight crew involved in these operations has been established; and

(c) operating procedures have been established specifying:

- (1) the equipment to be carried, including its operating limitations and appropriate entries in the minimum equipment list (MEL);
- (2) flight crew composition and experience requirements;
- (3) normal procedures;
- (4) contingency procedures;
- (5) monitoring and incident reporting; and
- (6) electronic navigation data management.

Subpart C – Operations with specified minimum navigation performance (MNPS)

SPA.MNPS.100 MNPS operations

Aircraft shall only be operated in designated minimum navigation performance specifications (MNPS) airspace in accordance with Regional Supplementary Procedures, where minimum navigation performance specifications are established, if the operator has been granted an approval by the competent authority to conduct such operations.

SPA.MNPS.105 MNPS operational approval

To obtain an MNPS operational approval from the competent authority, the operator shall provide evidence that:

(a) the navigation equipment meets the required performance;

(b) navigation display, indicators and controls are visible and operable by either pilot seated at his/her duty station;

(c) a training programme for the flight crew involved in these operations has been established; and

(d) operating procedures have been established specifying:

  (1) the equipment to be carried, including its operating limitations and appropriate entries in the minimum equipment list (MEL);

  (2) flight crew composition and experience requirements;

  (3) normal procedures;

  (4) contingency procedures including those specified by the authority responsible for the airspace concerned; and

  (5) monitoring and incident reporting.

Subpart D - Operations in airspace with reduced vertical separation minima (RVSM)

SPA.RVSM.100 RVSM operations

Aircraft shall only be operated in designated airspace where a reduced vertical separation minimum of 300 m (1 000 ft) applies between flight level (FL) 290 and FL 410, inclusive, if the operator has been granted an approval by the competent authority to conduct such operations.

SPA.RVSM.105 RVSM operational approval

To obtain an RVSM operational approval from the competent authority, the operator shall provide evidence that:

(a) the RVSM airworthiness approval has been obtained;

(b) procedures for monitoring and reporting height-keeping errors have been established;

(c) a training programme for the flight crew involved in these operations has been established; and

(d) operating procedures have been established specifying:

  (1) the equipment to be carried, including its operating limitations and appropriate entries in the minimum equipment list (MEL);

  (2) flight crew composition and experience requirements;

  (3) flight planning;

  (4) pre-flight procedures;

  (5) procedures prior to RVSM airspace entry;

  (6i) in-flight procedures;

  (7) post-flight procedures;

  (8) incident reporting; and

  (9) specific regional operating procedures.

SPA.RVSM.110 RVSM equipment requirements

In addition to the equipment required by other Parts, aircraft used for operations in RVSM airspace shall be equipped with:

(a) two independent altitude measurement systems;

(b) an altitude alerting system;

(c) an automatic altitude control system; and

(d) a secondary surveillance radar (SSR) transponder with altitude reporting system that can be connected to the altitude measurement system in use for altitude control.

SPA.RVSM.115 RVSM height-keeping errors

(a) Operators shall report recorded or communicated occurrences of height-keeping errors caused by malfunction of aircraft equipment or of operational nature, equal to or greater than:

(1) a total vertical error (TVE) of ±90 m (±300 ft);

(2) an altimetry system error (ASE) of ±75 m (±245 ft); and

(3) an assigned altitude deviation (AAD) of ±90 m (±300 ft).

(b) Reports of such occurrences shall be sent to the competent authority within 72 hours. Reports shall include an initial analysis of causal factors and measures taken to prevent repeat occurrences.

(c) When height-keeping errors are recorded or received, the operator shall take immediate action to rectify the conditions that caused the errors and provide follow-up reports, if requested by the competent authority.

Subpart E - Low visibility operations (LVOs)

SPA.LVO.100 Low visibility operations

The operator shall only conduct the following low visibility operations (LVO) when approved by the competent authority:

(a) low visibility take-off (LVTO) operation;

(b) lower than Standard Category I (LTS CAT I) operation;

(c) Standard Category II (CAT II) operation;

(d) other than Standard Category II (OTS CAT II) operation;

(e) Standard Category III (CAT III) operation; and

(f) approach operation utilising enhanced vision systems (EVS) for which an operational credit on the runway visual range (RVR) minima is applied.

SPA.LVO.105 LVO approval

To obtain competent authority approval for LVOs, the operator shall demonstrate compliance with the requirements of this Subpart.

SPA.LVO.110 General operating requirements

(a) The operator shall only conduct LTS CAT I operations if:

(1) each aircraft concerned is certified for operations to conduct CAT II operations; and

(2) the approach is flown:

(i) auto-coupled to an auto-land which needs to be approved for CAT IIIA operations; or

(ii) using an approved head-up display landing system (HUDLS) to at least 150 ft above the threshold.

(b) The operator shall only conduct CAT II, OTS CAT II or CAT III operations if:

(1) each aircraft concerned is certified for operations with a decision height (DH) below 200 ft, or no DH, and equipped in accordance with the applicable airworthiness requirements;

(2) a system for recording approach and/or automatic landing success and failure is established and maintained to monitor the overall safety of the operation;

(3) the DH is determined by means of a radio altimeter; and

(4) the flight crew consists of at least two pilots.

(c) The operator shall only conduct approach operations utilising an EVS if:

(1) the EVS is certified;

(2) call-out heights below 200 ft above the aerodrome threshold are determined by means of a radio altimeter; and

(3) the flight crew consists of at least two pilots.

SPA.LVO.115 Aerodrome considerations

(a) The operator shall not use an aerodrome for LVOs unless:

(1) the aerodrome has been approved for such operations by the State of the aerodrome; and

(2) low visibility procedures (LVP) have been established.

(b) At aerodromes where the term LVP is not used, the operator shall ensure that there are equivalent procedures that adhere to the requirements of LVP at the aerodrome. This situation shall be clearly noted in the operations manual or procedures manual including guidance to the flight crew on how to determine that the equivalent LVP are in effect.

SPA.LVO.120 Flight crew training and qualifications

The operator shall ensure that, prior to conducting an LVO:

(a) each flight crew member:

(1) complies with the training and checking requirements prescribed in the operations manual, including flight simulation training device (FSTD) training, in operating to the limiting values of RVR/CMV (converted meteorological visibility) and DH specific to the operation and the aircraft type; and

(2) is qualified in accordance with the standards prescribed in the operations manual;

(b) the training and checking is conducted in accordance with a detailed syllabus.

SPA.LVO.125 Operating procedures

(a) The operator shall establish procedures and instructions to be used for LVOs. These procedures shall be included in the operations manual or procedures manual and contain the duties of flight crew members during taxiing, take-off, approach, flare, landing, rollout and missed approach operations, as appropriate.

(b) Prior to commencing an LVO, the pilot-in-command/commander shall be satisfied that:

(1) the status of the visual and non-visual facilities is sufficient;

(2) appropriate LVPs are in force according to information received from air traffic services (ATS); and

(3) flight crew members are properly qualified.

SPA.LVO.130 Minimum equipment

(a) The operator shall include the minimum equipment that has to be serviceable at the commencement of an LVO in accordance with the aircraft flight manual (AFM) or other approved document in the operations manual or procedures manual, as applicable.

(b) The pilot-in-command/commander shall be satisfied that the status of the aircraft and of the relevant airborne systems is appropriate for the specific operation to be conducted.

Subpart F - Extended range operations with two-engined aeroplanes (ETOPS)

SPA.ETOPS.100 ETOPS

In commercial air transport operations, two-engined aeroplanes shall only be operated over routes that contain a position further from an adequate aerodrome that is greater than the threshold distance determined in accordance with CAT.OP.AH.140, if the operator has been granted an ETOPS approval by the competent authority.

SPA.ETOPS.105 ETOPS operational approval

To obtain an ETOPS operational approval from the competent authority, the operator shall provide evidence that:

(a) the aeroplane / engine combination holds an ETOPS type design and reliability approval for the intended operation;

(b) a training programme for the flight crew and all other operations personnel involved in these operations has been established and the flight crew and all other operations personnel involved are suitably qualified to conduct the intended operation;

(c) the operator's organisation and experience are appropriate to support the intended operation; and

(d) operating procedures have been established.

SPA.ETOPS.110 ETOPS en-route alternate aerodrome

(a) An ETOPS en-route alternate aerodrome shall be considered adequate, if, at the expected time of use, the aerodrome is available and equipped with necessary ancillary services such as air traffic services (ATS), sufficient lighting, communications, weather reporting, navigation aids and emergency services and has at least one instrument approach procedure available.

(b) Prior to conducting an ETOPS flight, the operator shall ensure that an ETOPS en-route alternate aerodrome is available, within either the operator's approved diversion time, or a diversion time based on the minimum equipment list (MEL) generated serviceability status of the aeroplane, whichever is shorter.

SPA.ETOPS.115 ETOPS en-route alternate aerodrome planning minima

(a) The operator shall only select an aerodrome as an ETOPS en-route alternate aerodrome when the appropriate weather reports or forecasts, or any combination thereof, indicate that, between the anticipated time of landing until one hour after the latest possible time of landing, conditions will exist at or above the planning minima calculated by adding the additional limits of Table 1.

(b) The operator shall include in the operations manual the method for determining the operating minima at the planned ETOPS en-route alternate aerodrome.

Table 1: Planning minima for the ETOPS en-route alternate aerodrome

Type of approach	Planning minima
Precision approach	**DH/A + 200 ft** **RVR/VIS + 800 m ***
Non-precision approach or **Circling approach**	**MDH/A + 400 ft *** **RVR/VIS + 1 500 m**

*** : VIS: visibility; MDH/A: minimum descent height/altitude**

Subpart G- Transport of dangerous goods

SPA.DG.100 Approval to transport dangerous goods

(a) Except as provided for in Part-NCO, Part-NCC, Part-CAT and Part-SPO, the operator shall only transport dangerous goods by air if it has been approved by the competent authority.

(b) To obtain such approval, the operator shall in accordance with the Technical Instructions:

(1) establish and maintain a training programme for all personnel involved and demonstrate to the competent authority that adequate training has been given to all personnel;

(2) establish operating procedures to ensure the safe handling of dangerous goods at all stages of air transport containing information and instructions on:

(i) the operator's policy to transport dangerous goods;

(ii) the requirements for acceptance, handling, loading, stowage and segregation of dangerous goods;

(iii) the information in the event of an aircraft accident or incident when dangerous goods are being carried;

(iv) the response to emergency situations involving dangerous goods;

(v) the removal of any possible contamination;

(vi) the duties of all personnel involved, especially with relevance to ground handling and aircraft handling;

(vii) inspection for damage, leakage or contamination; and

(viii) dangerous goods accident and incident reporting.

SPA.DG.105 Dangerous goods information and documentation

The operator shall, in accordance with the Technical Instructions:

(a) provide written information to the pilot-in-command/commander:

(1) about dangerous goods to be carried on the aircraft;

(2) for use in responding to in-flight emergencies;

(b) use an acceptance checklist;

(c) ensure that dangerous goods are accompanied by the required dangerous goods transport document(s), as completed by the person offering dangerous goods for air transport, except when the information applicable to the dangerous goods is provided in electronic form;

(d) ensure that where a dangerous goods transport document is provided in written form, a copy of the document is retained on the ground where it will be possible to obtain access to it within a reasonable period until the goods have reached their final destination;

(e) ensure that a copy of the information to the pilot-in-command/commander is retained on the ground and that this copy, or the information contained in it, is readily accessible to the aerodromes of last departure and next scheduled arrival, until after the flight to which the information refers;

(f) retain the acceptance checklist, transport document and information to the pilot-in-command/commander for at least three months after completion of the flight; and

(g) retain the training records of all personnel for at least three years.

Subpart H– Helicopter operations with night vision imaging systems

SPA.NVIS.100 Night vision imaging system (NVIS) operations

(a) Helicopters shall only be operated in night VFR operations with the aid of NVIS if the operator has been approved by the competent authority.

(b) To obtain such approval by the competent authority, the operator shall:

(1) operate in commercial air transport (CAT) and hold a CAT air operator certificate (AOC) in accordance with Part-OR;

(2) demonstrate to the competent authority:

(i) compliance with the applicable requirements contained in this Subpart; and

(ii) the successful integration of all elements of the NVIS.

SPA.NVIS.110 Equipment requirements for NVIS operations

(a) Before conducting NVIS operations each helicopter and all associated NVIS equipment shall have been issued with the relevant airworthiness approval in accordance with Regulation (EC) No 1702/2003.

(b) *Radio altimeter*. The helicopter shall be equipped with a radio altimeter and a low height warning system giving visual and audio warnings selectable by the pilot and discernable during head-up NVIS operation.

(1) The radio altimeter shall:

(i) be of an analogue type display presentation that requires minimal interpretation for both an instantaneous impression of absolute height and rate of change of height;

(ii) be positioned to be instantly visible and discernable from each cockpit crew;

(iii) have an integral visual low height warning that operates at a height selectable by the pilot; and

(iv) have an integral fail/no track indicator with repeater light to give unambiguous warning of radio altimeter fail or no track conditions.

(2) The visual warning system shall:

(i) provide clear visual warning at each cockpit crew station of height below the pilot-selectable warning height; and

(ii) have an instrument panel coaming repeater light at each cockpit crew station to ensure adequate attention-getting-capability for head up operations.

(3) The audio warning system shall:

(i) be unambiguous and readily cancellable;

(ii) not extinguish any visual low height warnings when cancelled; and

(iii) operate at the same pilot selectable height as the visual warning.

(d) *Aircraft NVIS compatible lighting*. To mitigate the reduced peripheral vision cues and the need to enhance situational awareness, the following shall be provided:

(1) NVIS-compatible instrument panel flood-lighting, if installed, that can illuminate all essential flight instruments;

(2) NVIS-compatible hand-held utility lights;

(3) portable NVIS compatible flashlight; and

(4) a means for removing or extinguishing internal NVIS non-compatible lights.

(e) *Additional NVIS equipment*. The following additional NVIS equipment shall be provided:

(1) a back-up or secondary power source for the night vision goggles (NVG);

(2) an NVIS adjustment kit or eye lane;

(3) a helmet with the appropriate NVG attachment.

(f) All required NVG on an NVIS flight shall be of the same type, generation and model.

(g) Continuing airworthiness

(1) Procedures for continuing airworthiness shall contain the information necessary for carrying out ongoing maintenance and inspections on NVIS equipment installed in the helicopter, and shall cover, as a minimum:

(i) helicopter windscreens and transparencies;

(ii) NVIS lighting;

(iii) NVG; and

(iv) any additional equipment that supports NVIS operations.

(2) Any subsequent modification or maintenance to the aircraft shall be in compliance with the NVIS airworthiness approval.

SPA.NVIS.120 NVIS operating minima

(a) Operations shall not be conducted below the visual flight rules (VFR) weather minima for the type of night operations being conducted.

(b) The operator shall establish the minimum transition height from where a change to/from aided flight may be continued.

SPA.NVIS.130 Crew requirements for NVIS operations

(a) *Selection*. The operator shall establish criteria for the selection of crew members for the NVIS task.

(b) *Experience*. The minimum experience for the commander shall not be less than 20 hours VFR at night as pilot-in-command/commander of a helicopter before commencing training.

(c) *Operational training*. All pilots shall have completed the operational training in accordance with the NVIS procedures contained in the operations manual.

(d) *Recency*. All pilots and NVIS technical crew members conducting NVIS operations shall have completed three NVIS flights in the last 90 days. Recency may be reestablished on a training flight in the helicopter or an approved full flight simulator (FFS), which shall include the elements of (f)(1) below.

(e) *Crew composition*. The minimum crew shall be the greater of that specified:

(1) in the aircraft flight manual (AFM);

(2) for the underlying activity; or

(3) in the operational approval for the NVIS operations.

(f) Crew training and checking

(1) Training and checking shall be conducted in accordance with a detailed syllabus approved by the competent authority and included in the operations manual.

(2) Crew members

(i) Crew training programmes shall: improve knowledge of the NVIS working environment and equipment; improve crew coordination; and include measures to minimise the risks associated with entry into low visibility conditions and NVIS normal and emergency procedures.

(ii) The measures referred to in (i) above, shall be assessed during:

(A) night proficiency checks; and

(B) line checks.

SPA.NVIS.140 Information and documentation

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

Subpart I– Helicopter hoist operations

SPA.HHO.100 Helicopter hoist operations (HHO)

(a) Helicopters shall only be operated for the purpose of commercial air transport hoist operations if the operator has been approved by the competent authority.

(b) To obtain such approval by the competent authority, the operator shall:

(1) operate in commercial air transport (CAT) and hold a CAT air operator certificate (AOC) in accordance with Part-OR; and

(2) demonstrate to the competent authority compliance with the requirements contained in this Subpart.

SPA.HHO.110 Equipment requirements for HHO

(a) The installation of all helicopter hoist equipment, including any radio equipment to comply with SPA.HHO.115, and any subsequent modifications shall have an airworthiness approval appropriate to the intended function. Ancillary equipment shall be designed and tested to the appropriate standard as required by the competent authority.

(b) Maintenance instructions for HHO equipment and systems shall be established by the operator in liaison with the manufacturer and included in the operator's helicopter maintenance programme as required by Regulation (EC) No 2042/2003.

SPA.HHO.115 HHO communication

Two-way radio communication shall be established with the organisation for which the HHO is being provided and, where possible, a means of communicating with ground personnel at the HHO operating site for:

(a) day and night offshore operations; and

(b) night onshore operations, except for HHO at a helicopter emergency medical services (HEMS) operating site.

SPA.HHO.125 Performance requirements for HHO

Except for HHO at a HEMS operating site, HHO shall be capable of sustaining a critical engine failure with the remaining engine(s) at the appropriate power setting without hazard to the suspended person(s)/cargo, third parties, or property.

SPA.HHO.130 Crew requirements for HHO

(a) *Selection*. The operator shall establish criteria for the selection of flight crew members for the HHO task, taking previous experience into account.

(b) *Experience*. The minimum experience level for the commander conducting HHO flights shall not be less than:

(1) Offshore:

(i) 1 000 hours as pilot-in-command/commander of helicopters, or 1 000 hours as co-pilot in HHO of which 200 hours is as pilot-in-command under supervision; and

(ii) 50 hoist cycles conducted offshore, of which 20 cycles shall be at night if night operations are being conducted, where a hoist cycle means one down-and-up cycle of the hoist hook.

(2) Onshore:

(i) 500 hours as pilot-in-command/commander of helicopters, or 500 hours as co-pilot in HHO of which 100 hours is as pilot-in-command under supervision;

(ii) 200 hours' operating experience in helicopters gained in an operational environment similar to the intended operation; and

(iii) 50 hoist cycles, of which 20 cycles shall be at night if night operations are being conducted.

(c) *Operational training and experience*. Successful completion of training in accordance with the HHO procedures contained in the operations manual and relevant experience in the role and environment under which HHO are conducted.

(d) *Recency*. All pilots and HHO crew members conducting HHO shall have completed in the last 90 days:

(1) when operating by day: any combination of three day or night hoist cycles, each of which shall include a transition to and from the hover; and

(2) when operating by night: three night hoist cycles, each of which shall include a transition to and from the hover.

(e) *Crew composition*. The minimum crew for day or night operations shall be as stated in the operations manual. The minimum crew will be dependent on the type of helicopter, the weather conditions, the type of task, and, in addition for offshore operations, the HHO site environment, the sea state and the movement of the vessel. In no case shall the minimum crew be less than one pilot and one HHO crew member.

(f) Training and checking

(1) Training and checking shall be conducted in accordance with a detailed syllabus approved by the competent authority and included in the operations manual.

(2) Crew members

(i) Crew training programmes shall: improve knowledge of the HHO working environment and equipment; improve crew coordination; and include measures to minimise the risks associated with HHO normal and emergency procedures and static discharge.

(ii) The measures referred to in (i) above, shall be assessed during visual meteorological conditions (VMC) day proficiency checks, or VMC night proficiency checks when night HHO are undertaken by the operator.

SPA.HHO.135 HHO Passenger briefing

Prior to any HHO flight, or series of flights, HHO passengers shall have been briefed and made aware of the dangers of static electricity discharge and other HHO considerations.

SPA.HHO.140 Information and documentation

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

(b) Relevant extracts from the operations manual shall be available to the organisation for which the HHO is being provided.

Subpart J - Helicopter emergency medical service operations

SPA.HEMS.100 Helicopter emergency medical service (HEMS)operations

(a) Helicopters shall only be operated for the purpose of HEMS operations if the operator has been approved by the competent authority.

(b) To obtain such approval by the competent authority, the operator shall:

(1) operate in commercial air transport (CAT) and hold a CAT air operator certificate (AOC) in accordance with Part-OR; and

(2) demonstrate to the competent authority compliance with the requirements contained in this Subpart.

SPA.HEMS.110 Equipment requirements for HEMS operations

The installation of all helicopter dedicated medical equipment and any subsequent modifications and, where appropriate, its operation shall be approved in accordance with Regulation (EC) No 1702/2003.

SPA.HEMS.115 Communication

In addition to that required by CAT.IDE.H, helicopters conducting HEMS flights shall have communication equipment capable of conducting two-way communication with the organisation for which the HEMS is being conducted and, where possible, to communicate with ground emergency service personnel.

SPA.HEMS.120 HEMS operating minima

(a) HEMS flights operated in performance class 1 and 2 shall comply with the weather minima in Table 1 for dispatch and en-route phase of the HEMS flight. In the event that during the en-route phase the weather conditions fall below the cloud base or visibility minima shown, helicopters certificated for flights only under visual meteorological conditions (VMC) shall abandon the flight or return to base. Helicopters equipped and certificated for instrument meteorological conditions (IMC) operations may abandon the flight, return to base or convert in all respects to a flight conducted under IFR, provided the flight crew are suitably qualified.

Table 1: HEMS operating minima

2 PILOTS		**1 PILOT**	
DAY			
Ceiling	**Visibility**	**Ceiling**	**Visibility**
500 ft and above	**As defined by the applicable airspace VFR**	**500 ft and above**	**As defined by the applicable airspace VFR**

2 PILOTS		1 PILOT	
	minima		**minima**
499 - 400 ft	**1 000 m***	**499 – 400 ft**	**2 000 m**
399 - 300 ft	**2 000 m**	**399 – 300 ft**	**3 000 m**
NIGHT			
Cloud base	**Visibility**	**Cloud base**	**Visibility**
1 200 ft **	**2 500 m**	**1 200 ft****	**3 000 m**

* **During the en-route phase visibility may be reduced to 800 m for short periods when in sight of land and if the helicopter is manoeuvred at a speed that will give adequate opportunity to observe any obstacles in time to avoid a collision.**

** **During the en-route phase, cloud base may be reduced to 1 000 ft for short periods.**

(b) The weather minima for the dispatch and en-route phase of a HEMS flight operated in performance class 3 shall be a cloud ceiling of 600 ft and a visibility of 1 500 m. Visibility may be reduced to 800 m for short periods when in sight of land if the helicopter is manoeuvred at a speed that will give adequate opportunity to observe any obstacle and avoid a collision.

SPA.HEMS.125 Performance requirements for HEMS operations

(a) Performance class 3 operations shall not be conducted over a hostile environment.

(b) Take-off and landing

(1) Helicopters conducting operations to/from an aerodrome at a hospital that is located in a hostile environment shall be operated in accordance with performance class 1, except when the operator holds an approval in accordance with CAT.POL.H.225.

(2) Helicopters conducting operations to/from a HEMS operating site located in a hostile environment shall be operated in accordance with performance class 2, and exempt from the approval required by CAT.POL.H.305(a), provided compliance is shown with CAT.POL.H.305, (b)(2) and (3).

(3) The HEMS operating site shall be big enough to provide adequate clearance from all obstructions. For night operations, the site shall be illuminated to enable the site and any obstructions to be identified.

SPA.HEMS.130 Crew requirements

(a) *Selection*. The operator shall establish criteria for the selection of flight crew members for the HEMS task, taking previous experience into account.

(b) *Experience*. The minimum experience level for the commander conducting HEMS flights shall not be less than:

(1) either:

(i) 1 000 hours as pilot-in-command/commander of aircraft of which 500hours are as pilot-in-command/commander on helicopters; or

(ii) 1 000 hours as co-pilot in HEMS operations of which 500 hours are as pilot-in-command under supervision and 100 hours pilot-in-command/commander of helicopters;

(2) 500 hours operating experience in helicopters, gained in an operational environment similar to the intended operation; and

(3) for pilots engaged in night operations, 20 hours of VMC at night as pilot-in-command/commander.

(c) *Operational training*. Successful completion of operational training in accordance with the HEMS procedures contained in the operations manual.

(d) *Recency*. All pilots conducting HEMS operations shall have completed a minimum of 30 minutes' flight by sole reference to instruments in a helicopter or in a flight simulation training device (FSTD) within the last six months.

(e) Crew composition

(1) *Day flight*. The minimum crew by day shall be one pilot and one HEMS technical crew member.

(i) This may be reduced to one pilot only when:

(A) at a HEMS operating site the commander is required to fetch additional medical supplies. In such case the HEMS technical crew member may be left to give assistance to ill or injured persons while the commander undertakes this flight;

(B) after arriving at the HEMS operating site, the installation of the stretcher precludes the HEMS technical crew member from occupying the front seat; or

(C) the medical passenger requires the assistance of the HEMS technical crew member in flight.

(ii) In the cases described in (i), the operational minima shall be as defined by the applicable airspace requirements; the HEMS operating minima contained in Table 1 of SPA.HEMS.120 shall not be used.

(iii) Only in the case described in (i)(A) may the commander land at a HEMS operating site without the technical crew member assisting from the front seat.

(2) *Night flight*. The minimum crew by night shall be:

(i) two pilots; or

(ii) one pilot and one HEMS technical crew member in specific geographical areas defined by the operator in the operations manual taking into account the following:

(A) adequate ground reference;

(B) flight following system for the duration of the HEMS mission;

(C) reliability of weather reporting facilities;

(D) HEMS minimum equipment list;

(E) continuity of a crew concept;

(F) minimum crew qualification, initial and recurrent training;

(G) operating procedures, including crew coordination;

(H) weather minima; and

(I) additional considerations due to specific local conditions.

(f) Crew training and checking

(1) Training and checking shall be conducted in accordance with a detailed syllabus approved by the competent authority and included in the operations manual.

(2) Crew members

(i) Crew training programmes shall: improve knowledge of the HEMS working environment and equipment; improve crew coordination; and include measures to minimise the risks associated with en-route transit in low visibility conditions, selection of HEMS operating sites, and approach and departure profiles.

(ii) The measures referred to in (i) above shall be assessed during:

(A) VMC day proficiency checks, or VMC night proficiency checks when night HEMS operations are undertaken by the operator; and

(B) line checks.

SPA.HEMS.135 HEMS medical passenger and other personnel briefing

(a) *Medical passenger*. Prior to any HEMS flight, or series of flights, the medical passenger shall have been briefed to ensure that they are familiar with the HEMS working environment and equipment, can operate on-board medical and emergency equipment and can take their part in normal and emergency entry and exit procedures.

(b) *Ground emergency service personnel*. The operator shall take all reasonable measures to ensure that ground emergency service personnel are familiar with the HEMS working environment and equipment and the risks associated with ground operations at a HEMS operating site.

SPA.HEMS.140 Information and documentation

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

(b) Relevant extracts from the operations manual shall be made available to the organisation for which the HEMS is being provided.

SPA.HEMS.145 HEMS operating base facilities

(a) If crew members are required to be on standby with a reaction time of less than 45 minutes, dedicated suitable accommodation shall be provided close to each operating base.

(b) At each operating base the pilots shall be provided with facilities for obtaining current and forecast weather information and shall be provided with satisfactory communications with the appropriate air traffic services (ATS) unit. Adequate facilities shall be available for the planning of all tasks.

SPA.HEMS.150 Fuel supply

(a) When the HEMS mission is conducted under VFR within a local and defined geographical area, standard fuel planning can be employed provided the operator establishes final reserve fuel to ensure that, on completion of the mission the fuel remaining is not less than an amount of fuel sufficient for:

 (1) 30 minutes of flying time at normal cruising conditions; or

 (2) when operating within an area providing continuous and suitable precautionary landing sites, 20 minutes of flying time at normal cruising conditions.

SPA.HEMS.155 Refuelling with passengers embarking, on board or disembarking

When the commander considers refuelling with passengers on board to be necessary, it can be undertaken either rotors stopped or rotors turning provided the following requirements are met:

(a) door(s) on the refuelling side of the helicopter shall remain closed;

(b) door(s) on the non-refuelling side of the helicopter shall remain open, weather permitting;

(c) fire fighting facilities of the appropriate scale shall be positioned so as to be immediately available in the event of a fire; and

(d) sufficient personnel shall be immediately available to move patients clear of the helicopter in the event of a fire.

Part-SPA | AMC/GM

Subpart A- General requirements

AMC1-SPA.GEN.105(b)(4) Application for a specific approval

DOCUMENTATION

1. Operating procedures should be documented in the operations manual.
2. If an operations manual is not required, operating procedures may be described in a procedures manual.

Subpart B – Performance-based navigation operations (PBN)

GM1-SPA.PBN.100 PBN operations

GENERAL

1. There are two kinds of navigation specifications: area navigation (RNAV) and required navigation performance (RNP). These specifications are similar. The key difference is that a navigation specification that includes a requirement to have an on-board performance monitoring and alerting system is referred to as an RNP specification. An RNAV specification does not have such a requirement. The performance-monitoring and alerting system provides some automated assurance functions to the flight crew. These functions monitor system performance and alert the flight crew when the required RNP requirements are not met, or cannot be guaranteed with a sufficient level of integrity. RNAV and RNP performance is expressed by the total system error (TSE). This is the deviation from the nominal or desired position and the aircraft's true position, measured in nautical miles. The TSE should remain equal to or less than the required accuracy expected to be achieved at least 95% of the flight time by the population of aircraft operating within the airspace, route or procedure.

2. The structure of RNAV and RNP navigation specifications can be classified by phases of flight as detailed in Table 1. Some of these special approvals are in current use, some are under development, and some apply to emerging standards for which AMC-20 material has yet to be defined.

3. The following RNAV and RNP navigation specifications are considered:

   a. Oceanic/Remote, RNAV10 (Designated and Authorised as RNP10)

      Acceptable means of compliance for RNAV10 (RNP10) are provided in EASA AMC 20-12, "Recognition of FAA order 8400.12a for RNP10 Operations". Although RNAV10 airspace is, for historical reasons, also called RNP10 airspace, there is no requirement for on-board monitoring and alerting systems. RNAV10 can support 50 NM track spacing. For an aircraft to operate in RNAV10 (RNP10) airspace it needs to be fitted with a minimum of two independent long range navigation systems (LRNS). Each LRNS should in principle have a flight management system that utilises positional information from either an approved global navigation satellite system (GNSS) or an approved inertial reference system (IRS) or mixed combination. The mix of sensors (pure GNSS, pure IRS or mixed IRS/GNSS) determines pre-flight and in-flight operation and contingencies in the event of system failure.

   b. Oceanic/Remote, RNP4

      This is an emerging RNP standard. Guidance is provided in ICAO DOC 9613. RNP4 is the oceanic/remote navigation specification to support 30 NM track spacing. To meet this more accurate navigation requirement, two independent LRNS are required for which GNSS sensors are mandatory. Additional aircraft requirements over and above high frequency (HF) may also be required in order to operate in RNP4 designated airspace, and the appropriate Air Information Publication should be consulted. These requirements may include use of automatic dependent surveillance (ADS) and/or controller pilot direct data link communication (CPDLC).

c. RNAV5 (B-RNAV)

Acceptable means of compliance for RNAV5 are provided in AMC 20-4, "Airworthiness Approval and Operational Criteria for the Use of Navigation Systems in European Airspace Designated for the Basic-RNAV Operations". No specific approval required.

d. RNAV2

This is a non-European en-route standard.

e. RNAV1 (P-RNAV)

Acceptable means of compliance for RNAV1 (P-RNAV) are provided in JAA TGL-10 "Airworthiness and Operational approval for precision RNAV operations in designated European Airspace," planned to be replaced by AMC 20-16.

f. Basic–RNP1

This is a future standard yet to be implemented. Guidance material is provided in ICAO Doc 9613.

g. RNP APCH (RNP Approach)

Non-precision approaches supported by GNSS and APV (approach with vertical guidance) which are themselves divided in two types of APV approaches: APV Baro and APV SBAS.

RNP APCH is charted as RNAV (GNSS). A minima line is provided for each of the available types of non-precision approaches and the APV procedure at a specific runway:

- Non-precision approach – lateral navigation (LNAV) or localiser performance (LP) minima line;
- APV Baro - LNAV/VNAV (vertical navigation) minima line; and
- APV SBAS - LPV minima line.

Non-precision approaches to LNAV minima and APV approaches to LNAV/VNAV minima are addressed in AMC 20-27, "Airworthiness Approval and Operational Criteria for RNP approach (RNP APCH) operations including APV Baro VNAV operations".

APV approaches to LPV minima are addressed in AMC 20-28 "Airworthiness Approval and. Operational Criteria for RNAV GNSS approach operation to LPV minima using SBAS".

Non-precision approaches to LP minima have not yet been addressed in AMC 20.

h. RNP AR APCH (approach)

RNP AR criteria have been developed to support RNP operations to RNP minima using RNP less than or equal to 0.3 NM or fixed radius turns (RF). The vertical performance is defined by a vertical error budget based upon Baro VNAV. Equivalent means of compliance using SBAS may be demonstrated.

RNP AR APCH is charted as RNAV (RNP). A minima line is provided for each available RNP value.

Acceptable Means of Compliance for RNP AR are provided in AMC20-26 "Airworthiness Approval and Operational Criteria for RNP Authorisation Required (RNP AR) Operations".

Each RNP AR approach requires a special approval.

4. Guidance material for the global performances specifications, approval process, aircraft requirement (e.g. generic system performances, accuracy, integrity, continuity, signal-in-space, RNP navigation specifications required for the on-board performance monitoring and alerting system), requirements for specific sensor technologies, functional requirements, operating procedures, flight crew knowledge and training and navigation databases integrity requirements, can be found in:

   a. ICAO Doc 9613 Performance-Based Navigation (PBN) Manual; and

   b. Table 1.

Table 1: Overview of PBN specifications

FLIGHT PHASE

	Enroute		Arrival	Approach				Departure	EASA AMC
	Oceanic/ Remote	Continental		Initial	Intermediate	Final	Missed		
RNAV10	10								AMC 20-12
RNP 4	4								To be developed
RNAV 5		5	5						AMC 20-4
RNAV2		2	2					2	To be developed
RNAV1 (P-RNAV)			1	1	1		1	1	To be developed (future AMC 20-16)
BASIC-RNP 1			1	1	1		1	1	To be developed (future AMC 20-16)
RNP APCH (LNAV & LNAV/VNAV)				1	1	0.3	1		AMC 20-27
RNP APCH (LPV)						0.02	0.3		AMC 20-28
RNP AR APCH				1-0.1	1-0.1	0.3-0.1	1-0.1		AMC 20-26

Subpart D - Operations in airspace with reduced vertical separation minima

AMC1-SPA.RVSM.105 RVSM operational approval

CONTENT OF OPERATOR RVSM APPLICATION

The following material should be made available to the competent authority, in sufficient time to permit evaluation, before the intended start of RVSM operations:

1. Airworthiness documents

   Documentation that shows that the aircraft has RVSM airworthiness approval. This should include an AFM amendment or supplement.

2. Description of aircraft equipment

   A description of the aircraft appropriate to operations in an RVSM environment. Further standards are provided in AMC1-SPA.RVSM.110.

3. Training programmes and operating practices and procedures

   The operator should submit training syllabi for initial and recurrent training programmes together with other relevant material to the competent authority. The material should show that the operating practices, procedures and training items, related to RVSM operations in airspace that requires State operational approval, are incorporated. Further standards are provided in AMC2-SPA.RVSM.105.

4. Operations manuals and checklists

   The appropriate manuals and checklists should be revised to include information/guidance on standard operating procedures. Manuals should contain a statement of the airspeeds, altitudes and weights considered in RVSM aircraft approval, including identification of any operating limitations or conditions established for that aircraft group. Manuals and checklists may need to be submitted for review by the competent authority as part of the application process. Further standards are provided in AMC2-SPA.RVSM.105.

5. Past performance

   Relevant operating history, where available, should be included in the application. The applicant should show that any required changes have been made in training, operating or maintenance practices to improve poor height-keeping performance.

6. Minimum equipment list

   Where applicable, a minimum equipment list (MEL), adapted from the master minimum equipment list (MMEL) and relevant operational regulations, should include items pertinent to operating in RVSM airspace.

7. Plan for participation in verification/monitoring programmes

   The operator should establish a plan for participation in any applicable verification/monitoring programme acceptable to the competent authority. This plan should include, as a minimum, a check on a sample of the operator's fleet by an independent height-monitoring system.

AMC2-SPA.RVSM.105 RVSM operational approval

OPERATING PROCEDURES

1. Flight planning

   a. During flight planning the flight crew should pay particular attention to conditions that may affect operation in RVSM airspace. These include, but may not be limited to:

      i. verifying that the airframe is approved for RVSM operations;

      ii. reported and forecast weather on the route of flight;

      iii. minimum equipment requirements pertaining to height-keeping and alerting systems; and

      iv. any airframe or operating restriction related to RVSM approval.

2. Pre-flight procedures

   a. The following actions should be accomplished during the pre-flight procedure:

      i. Review technical logs and forms to determine the condition of equipment required for flight in the RVSM airspace. Ensure that maintenance action has been taken to correct defects to required equipment.

      ii. During the external inspection of aircraft, particular attention should be paid to the condition of static sources and the condition of the fuselage skin near each static source and any other component that affects altimetry system accuracy. This check may be accomplished by a qualified and authorised person other than the pilot (e.g. a flight engineer or ground engineer).

      iii. Before take-off, the aircraft altimeters should be set to the QNH (atmospheric pressure at nautical height) of the airfield and should display a known altitude, within the limits specified in the aircraft operating manuals. The two primary altimeters should also agree within limits specified by the aircraft operating manual. An alternative procedure using QFE (atmospheric pressure at aerodrome elevation/runway threshold) may also be used. The maximum value of acceptable altimeter differences for these checks should not exceed 23 m (75 ft). Any required functioning checks of altitude indicating systems should be performed.

      iv. Before take-off, equipment required for flight in RVSM airspace should be operative, and any indications of malfunction should be resolved.

3. Prior to RVSM airspace entry

   a. The following equipment should be operating normally at entry into RVSM airspace:

      i. two primary altitude measurement systems. A cross-check between the primary altimeters should be made. A minimum of two will need to agree within ±60 m (±200 ft). Failure to meet this condition will require that the altimetry system be reported as defective and air traffic control (ATC) notified;

ii. one automatic altitude-control system;

iii. one altitude-alerting device; and

iv. operating transponder.

b. Should any of the required equipment fail prior to the aircraft entering RVSM airspace, the pilot should request a new clearance to avoid entering this airspace.

4. In-flight procedures

a. The following practices should be incorporated into flight crew training and procedures:

i. Flight crew will need to comply with any aircraft operating restrictions, if required for the specific aircraft type, e.g. limits on indicated Mach number, given in the RVSM airworthiness approval.

ii. Emphasis should be placed on promptly setting the sub-scale on all primary and standby altimeters to 1013.2 (hPa) /29.92 inHg when passing the transition altitude, and rechecking for proper altimeter setting when reaching the initial cleared flight level.

iii. In level cruise it is essential that the aircraft is flown at the cleared flight level. This requires that particular care is taken to ensure that ATC clearances are fully understood and followed. The aircraft should not intentionally depart from cleared flight level without a positive clearance from ATC unless the crew are conducting contingency or emergency manoeuvres.

iv. When changing levels, the aircraft should not be allowed to overshoot or undershoot the cleared flight level by more than 45 m (150 ft). If installed, the level off should be accomplished using the altitude capture feature of the automatic altitude-control system.

v. An automatic altitude-control system should be operative and engaged during level cruise, except when circumstances such as the need to re-trim the aircraft or turbulence require disengagement. In any event, adherence to cruise altitude should be done by reference to one of the two primary altimeters. Following loss of the automatic height-keeping function, any consequential restrictions will need to be observed.

vi. Ensure that the altitude-alerting system is operative.

vii. At intervals of approximately one hour, cross-checks between the primary altimeters should be made. A minimum of two will need to agree within ±60 m (±200 ft). Failure to meet this condition will require that the altimetry system be reported as defective and ATC notified:

A. the usual scan of flight deck instruments should suffice for altimeter crosschecking on most flights; and

B. before entering RVSM airspace, the initial altimeter cross check of primary and standby altimeters should be recorded.

viii. In normal operations, the altimetry system being used to control the aircraft should be selected for the input to the altitude reporting transponder transmitting information to ATC.

ix. If the pilot is notified by ATC of a deviation from an assigned altitude exceeding ±90 m (±300 ft) then the pilot should take action to return to cleared flight level as quickly as possible.

b. Contingency procedures after entering RVSM airspace are as follows:

i. The pilot should notify ATC of contingencies (equipment failures, weather) which affect the ability to maintain the cleared flight level, and co-ordinate a plan of action appropriate to the airspace concerned. Detailed guidance on contingency procedures is contained in the relevant publications dealing with the airspace. Refer to specific regional procedures.

ii. Examples of equipment failures which should be notified to ATC are:

A. failure of all automatic altitude-control systems aboard the aircraft;

B. loss of redundancy of altimetry systems;

C. loss of thrust on an engine necessitating descent; or

D. any other equipment failure affecting the ability to maintain cleared flight level.

iii. The pilot should notify ATC when encountering greater than moderate turbulence.

iv. If unable to notify ATC and obtain an ATC clearance prior to deviating from the cleared flight level, the pilot should follow any established contingency procedures for the region of operation and obtain ATC clearance as soon as possible.

5. Post-flight procedures

a. In making technical log entries against malfunctions in height-keeping systems, the pilot should provide sufficient detail to enable maintenance to effectively troubleshoot and repair the system. The pilot should detail the actual defect and the crew action taken to try to isolate and rectify the fault.

b. The following information should be recorded when appropriate:

i. primary and standby altimeter readings;

ii. altitude selector setting;

iii. subscale setting on altimeter;

iv. autopilot used to control the aircraft and any differences when an alternative autopilot system was selected;

v. differences in altimeter readings, if alternate static ports selected;

vi. use of air data computer selector for fault diagnosis procedure; and

vii. the transponder selected to provide altitude information to ATC and any difference noted when an alternative transponder was selected.

6. Crew training

a. The following items should also be included in flight crew training programmes:

i. knowledge and understanding of standard ATC phraseology used in each area of operations;

ii. importance of crew members cross-checking to ensure that ATC clearances are promptly and correctly complied with;

iii. use and limitations in terms of accuracy of standby altimeters in contingencies. Where applicable, the pilot should review the application of static source error correction/position error correction through the use of correction cards; such correction data should be available on the flight deck;

iv. problems of visual perception of other aircraft at 300 m (1 000 ft) planned separation during darkness, when encountering local phenomena such as northern lights, for opposite and same direction traffic, and during turns;

v. characteristics of aircraft altitude capture systems which may lead to overshoots;

vi. relationship between the aircraft's altimetry, automatic altitude control and transponder systems in normal and abnormal conditions; and

vii. any airframe operating restrictions, if required for the specific aircraft group, related to RVSM airworthiness approval.

GM1-SPA.RVSM.105 RVSM operational approval

SPECIFIC REGIONAL PROCEDURES

1. The areas of applicability (by Flight Information Region) of RVSM airspace in identified ICAO regions is contained in the relevant sections of ICAO Document 7030/4. In addition these sections contain operating and contingency procedures unique to the regional airspace concerned, specific flight planning requirements, and the approval requirements for aircraft in the designated region.

2. For the North Atlantic minimum navigation performance specification (MNPS) airspace, where RVSM have been in operation since 1997, further guidance (principally for competent authorities) is contained in ICAO Document NAT 001 T13/5NB.5 with comprehensive operational guidance (aimed specifically at operators) in the North Atlantic MNPS Airspace Operational Manual.

3. Comprehensive guidance on operational matters for European RVSM airspace is contained in EUROCONTROL Document ASM ET1.ST.5000 entitled “The ATC Manual for a Reduced Vertical Separation (RVSM) in Europe” with further material included in the relevant State aeronautical publications.

AMC1-SPA.RVSM.110 RVSM equipment requirements

TWO INDEPENDENT ALTITUDE MEASUREMENT SYSTEMS

Each system should be composed of the following components:

1. cross-coupled static source/system, with ice protection if located in areas subject to ice accretion;
2. equipment for measuring static pressure sensed by the static source, converting it to pressure altitude and displaying the pressure altitude to the flight crew:
3. equipment for providing a digitally encoded signal corresponding to the displayed pressure altitude, for automatic altitude reporting purposes;
4. static source error correction (SSEC), if needed to meet the performance criteria for RVSM flight envelopes; and
5. signals referenced to a flight crew selected altitude for automatic control and alerting. These signals will need to be derived from an altitude measurement system meeting the performance criteria for RVSM flight envelopes.

Subpart E – Low visibility operations (LV0)

AMC1-SPA.LVO.100 Low visibility operations

LVTO OPERATIONS

1. Aeroplanes

   In addition to the take-off standards specified in Part-CAT, Part-SPO, Part-NCC, Part-NCO and subject to the approval of the competent authority, the operator may conduct:

   a. a low visibility take-off(LVTO) with a runway visual range(RVR) below 400 m if the criteria specified in Table 1.A are met;

   b. an LVTO with an RVR below 150 m to 125 m if:

      i. high intensity runway centreline lights spaced 15 m or less and high intensity edge lights spaced 60 m or less are in operation;

      ii. a 90 m visual segment is available from the flight crew compartment at the start of the take-off run; and

      iii. the required RVR value has been achieved for all of the relevant RVR reporting points;

   c. an LVTO with an RVR below 125m to 75m, if:

      i. runway protection and facilities equivalent to CAT III landing operations are available; and

      ii. the aircraft is equipped either with:

         A. an approved lateral guidance system; or,

         B. an approved head-up display / head-up display landing system (HUD / HUDLS) for take-off.

Table 1.A: LVTO – aeroplanes
RVR/CMV (converted meteorological visibility)

Facilities	RVR/CMV (m) *, **
Day: runway edge lights and runway centreline markings **Night: runway edge lights or runway centreline lights and runway end lights**	**300**
Runway edge lights and runway centreline lights	**200**
Runway edge lights and runway centreline lights and relevant RVR information * **	**TDZ, MID, rollout 150**
High intensity runway centreline lights spaced 15 m or less and high intensity edge lights	**TDZ, MID, rollout 125**

Facilities	RVR/CMV (m) *, **
spaced 60 m or less are in operation ***	
Runway protection and facilities equivalent to CAT III landing operations are available and the aircraft is equipped either with an approved lateral guidance system or an approved HUD / HUDLS for take-off.	**TDZ, MID, rollout 125**

***: The reported RVR/CMV (converted meteorological visibility) value representative of the initial part of the take-off run can be replaced by pilot assessment.**

****: Multi-engined aeroplanes which in the event of an engine failure at any point during take-off can either stop or continue the take-off to a height of 1 500 ft above the aerodrome while clearing obstacles by the required margins.**

*****: The required RVR value to be achieved for all relevant RVRs**

TDZ: touchdown zone

MID: midpoint

2. Helicopters

In addition to the take-off standards specified in Part-CAT, Part-SPO, Part-NCC, Part-NCO and subject to the approval of the competent authority, the operator may conduct take-offs if the criteria specified in Table 1.H are met.

Table 1.H: Take-off – helicopters with LVTO approval RVR/CMV

Onshore aerodromes with IFR departure procedures	RVR/ CMV (m)
No light and no markings (day only)	250 or the rejected take-off distance, whichever is the greater
No markings (night)	800
Runway edge/FATO light and centreline marking	200
Runway edge/FATO light, centreline marking and relevant RVR information	150

Offshore helideck *	
Two-pilot operations	**250**
Single-pilot operations	**500**

***: The take-off flight path to be free of obstacles.**

FATO: final approach and take-off area

LTS CAT I OPERATIONS

1. For lower than Standard Category I(LTS CAT I) operations the following standards should apply:

   a. The decision height (DH) of an LTS CAT I operation should not be lower than the highest of:

      i. the minimum DH specified in the aircraft flight manual (AFM), if stated;

      ii. the minimum height to which the precision approach aid can be used without the required visual reference;

      iii. the applicable obstacle clearance height (OCH) for the category of aeroplane;

      iv. the DH to which the flight crew is qualified to operate; or

      v. 200 ft.

   b. An instrument landing system / microwave landing system (ILS/MLS) which supports an LTS CAT I operation should be an unrestricted facility with a straight-in course, ≤3º offset, and the ILS should be certified to:

      i. class I/T/1 for operations to a minimum of 450 m RVR; or

      ii. class II/D/2 for operations to less than 450 m RVR.

      Single ILS facilities are only acceptable if Level 2 performance is provided.

   c. The lowest RVR/CMV minima to be used by the operator for LTS CAT I operations are specified in Table 1.

Table 1:LTS CAT I operation minima
RVR/CMV vs. approach light system

DH (ft)	Class of light facility *			
	FALS	IALS	BALS	NALS
	RVR/CMV (m)			
200-210	400	500	600	750
211-220	450	550	650	800
221-230	500	600	700	900
231-240	500	650	750	1 000
241-249	550	700	800	1 100

***: The visual aids comprise standard runway day markings, approach lights, runway edge lights, threshold lights, runway end lights and, for operations below 450 m, should include touch-down zone and/or runway centreline lights.**

FALS: full approach landing system

IALS: intermediate approach landing system

BALS: basic approach lighting system

NALS: no approach light system

CAT II AND OTS CAT II OPERATIONS

1. For CAT II and other than Standard Category II (OTS CAT II) operations the following facility standards should apply:

   a. The ILS / MLS that supports OTS CAT II operation should be an unrestricted facility with a straight in course (≤ 3º offset) and the ILS should be certified to Class II/D/2.

      Single ILS facilities are only acceptable if Level 2 performance is provided.

   b. The operator should ensure that the DH for CAT II and OTS CAT II operation is not lower than the highest of:

      i. the minimum DH specified in the AFM, if stated;

      ii. the minimum height to which the precision approach aid can be used without the required visual reference;

iii. the applicable OCH for the category of aeroplane;

iv. the DH to which the flight crew is qualified to operate; or

v. 100 ft.

c. The operator should use the following RVR minima:

i. for CAT II operations as specified in Table 2; and

ii. for OTS CAT II operations as specified in Table 3.

d. For OTS CAT II operations, the operator should verify that the terrain ahead of the runway threshold has been surveyed.

Table 2: CAT II operation minima - aeroplanes
RVR vs. DH

DH (ft)	Auto-coupled / approved HUDLS to below DH *	
	Aeroplane categories A, B, C RVR (m)	Aeroplane category D RVR (m)
100 – 120	300	300/350**
121 – 140	400	400
141 – 199	450	450

***: Continued use of the automatic flight control system or the HUDLS down to a hei ght of 80% o f the DH. Airw orthiness requ irements may, thr ough minimum engagement height for the automatic flight control system, affect the DH to be applied.**

****: 300 m may be used for a category D aeroplane conducting an auto-land.**

Table 3: OTS CAT II operation minima - aeroplanes
RVR vs. approach light system

	Autoland or approved HUDLS utilised to touchdown				
	Class of light facility *				
	FALS		IALS	BALS	NALS
	Categories A – C	Category D	Categories A – D	Categories A – D	Categories A - D
DH (ft)	RVR (m)				
100 - 120	350	400	450	600	700
121 - 140	400	450	500	600	700
141 - 160	400	500	500	600	750
161 - 199	400	500	550	650	750

***: The visual aids required to conduct OTS CAT II operations comprise standard runway day markings and approach and runway lights as specified in Table 1 for LTS CAT I: runway edge lights, threshold lights, runway end lights.**

For operations below 450 m, they should include touch-down zone and/or runway centreline lights.

For operations in RVR of 400 m or less, they should include centreline lights.

CAT III OPERATIONS

1. The following standards should apply to CAT III operations:

   a. Where the DH and RVR do not fall within the same Category, the RVR will determine in which Category the operation is to be considered.

   b. For operations in which a DH is used, the DH should not be lower than:

      i. the minimum DH specified in the AFM, if stated;

      ii. the minimum height to which the precision approach aid can be used without the required visual reference; or

      iii. the DH to which the flight crew is qualified to operate.

c. Operations with no DH should only be conducted if:

   i. the operation with no DH is specified in the AFM;

   ii. the approach aid and the aerodrome facilities can support operations with no DH; and

   iii. the operator has an approval for CAT III operations with no DH.

d. The lowest RVR minima to be used by operators for CAT III operations are specified in Table 4.

Table 4: CAT III operations minima
RVR vs. DH and rollout control/guidance system

CAT	DH (ft) *	Rollout control/guidance system	RVR (m)
IIIA	Less than 100	Not required	200
IIIB	Less than 100	Fail-passive	150**
IIIB	Less than 50	Fail-passive	125
IIIB	Less than 50 or no DH	Fail-operational ***	75

***: Flight con trol s ystem r edundancy is deter mined under CS-AWO by the minimum certified DH.**

****: For aeroplanes cer tified in accordance wi th CS-AWO 3 21(b)(3) or equivalent.**

*****: The fail-oper ational system r eferred t o may cons ist of a fail-operati onal hybrid system.**

OPERATIONS UTILISING EVS

1. The pilot using a certified enhanced vision system (EVS) in accordance with the procedures and limitations of the AFM may:

   a. continue an approach below DH/MDH to 100 ft above the threshold elevation of the runway provided that a visual reference is displayed and identifiable on the EVS image; and

   b. reduce the calculated RVR/CMV for the approach from the value in column 1 of Table 5 to the value in column 2 for ILS, MLS, precision approach radar (PAR), GBAS landing system (GLS) and APV operations with a DH not lower than 200 ft and an approach flown using approved vertical flight path guidance to a DH/MDH no lower than 250 ft.

2. For operations where call-outs below 200 ft above the threshold are necessary, the operator should verify that the terrain ahead of the runway threshold has been surveyed.

Table 5: Operations utilising EVS
RVR/CMV reduction vs. normal RVR/CMV

RVR/CMV (m) normally required	RVR/CMV (m) utilising EVS
550	350
600	400
650	450
700	450
750	500
800	550
900	600
1 000	650
1 100	750
1 200	800
1 300	900
1 400	900
1 500	1 000
1 600	1 100
1 700	1 100
1 800	1 200
1 900	1 300
2 000	1 300
2 100	1 400
2 200	1 500

RVR/CMV (m) normally required	RVR/CMV (m) utilising EVS
2 300	1 500
2 400	1 600
2 500	1 700
2 600	1 700
2 700	1 800
2 800	1 900
2 900	1 900
3 000	2 000
3 100	2 000
3 200	2 100
3 300	2 200
3 400	2 200
3 500	2 300
3 600	2 400
3 700	2 400
3 800	2 500
3 900	2 600
4 000	2 600
4 100	2 700
4 200	2 800
4 300	2 800
4 400	2 900
4 500	3 000
4 600	3 000

RVR/CMV (m) normally required	**RVR/CMV (m) utilising EVS**
4 700	**3 100**
4 800	**3 200**
4 900	**3 200**
5 000	**3 300**

FAILED OR DOWNGRADED EQUIPMENT

1. General

   These instructions are intended for use both pre-flight and in-flight. It is however not expected that the pilot-in-command/commander would consult such instructions after passing 1 000 ft above the aerodrome. If failures of ground aids are announced at such a late stage, the approach could be continued at the pilot-in-command/commander's discretion. If failures are announced before such a late stage in the approach, their effect on the approach should be considered as described in Table 6, and the approach may have to be abandoned.

2. Conditions applicable to the tables below:

   a. multiple failures of runway/FATO lights other than indicated in Table 6 should not be acceptable;

   b. deficiencies of approach and runway/FATO lights are treated separately;

   c. CAT II or CAT III operations. A combination of deficiencies in runway/FATO lights and RVR assessment equipment should not be permitted; and

   d. failures other than ILS, MLS affect RVR only and not DH.

Table 6: Failed or downgraded equipment – effect on landing minima Operations with an LVO approval

Failed or downgraded equipment	**Effect on landing minima**			
	CAT IIIB (no DH)	**CAT IIIB**	**CAT IIIA**	**CAT II**
ILS/MLS stand-by transmitter	**Not allowed**	**RVR 200 m**	**No effect**	
Outer marker	**Not allowed except if replaced by equivalent position**			
Middle		**No effect**		

Failed or downgraded equipment	Effect on landing minima			
	CAT IIIB (no DH)	CAT IIIB	CAT IIIA	CAT II
marker				
RVR assessment systems	At least one RVR value to be available on the aerodrome	On runways equipped with 2 or more RVR assessment units, one may be inoperative		
Approach lights	No effect	Not allowed for operations with DH >50 ft		Not allowed
Approach lights except the last 210 m	No effect			Not allowed
Approach lights except the last 420 m	No effect			
Standby power for approach lights	No effect			
Edge lights, threshold lights and runway end lights	No effect		Day - no effect	Day - no effect
			Night - min RVR 550 m	Night – not allowed
Centreline lights	Day - RVR 200 m	Not allowed	Day -RVR 300 m	Day -RVR 350 m
	Night - not allowed		Night – RVR 400 m	Night – RVR 550 m (400 m with HUDLS or auto-

Failed or downgraded equipment	Effect on landing minima			
	CAT IIIB (no DH)	CAT IIIB	CAT IIIA	CAT II
				land)
Centreline lights spacing increased to 30 m	RVR 150 m		No effect	
Touchdown zone lights	No effect	Day - RVR 200 m	Day - RVR 300 m	
		Night – RVR 300 m	Night – RVR 550 m;	
			350 m with HUDLS or auto-land	
Taxiway light system	No effect			

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DOCUMENTS CONTAINING INFORMATION RELATED TO LOW VISIBILITY OPERATIONS

The following documents provide further information to low visibility operations (LVO):

1. ICAO Annex 2 / Rules of the Air;
2. ICAO Annex 6 / Operation of Aircraft;
3. ICAO Annex 10 / Telecommunications Vol. 1;
4. ICAO Annex 14 / Aerodromes Vol. 1;
5. ICAO Doc 8168 / PANS - OPS Aircraft Operations;
6. ICAO Doc 9365 / AWO Manual;
7. ICAO Doc 9476 / SMGCS Manual (surface movement guidance and control systems);
8. ICAO Doc 9157 / Aerodrome Design Manual;
9. ICAO Doc 9328 / Manual of RVR Observing and Reporting Practices;

10. ICAO EUR Doc. 013: EUROPEAN GUIDANCE MATERIAL ON AERODROME OPERATIONS UNDER LIMITED VISIBILITY CONDITIONS
11. ECAC Doc 17, Issue 3; and
12. CS-AWO (Airworthiness Certification).

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USE OF ENHANCED VISION SYSTEMS (EVS)

1. Introduction
   a. Enhanced vision systems use sensing technology to improve a pilot's ability to detect objects, such as runway lights or terrain, which may otherwise not be visible. The image produced from the sensor and/or image processor can be displayed to the pilot in a number of ways including use of a HUD. The systems can be used in all phases of flight and can improve situational awareness. In particular, infrared systems can display terrain during operations at night, improve situational awareness during night and low-visibility taxiing, and may allow earlier acquisition of visual references during instrument approaches.
2. Background to EVS provisions
   a. The provisions for EVS were developed after an operational evaluation of two different EVS systems, along with data and support provided by the FAA. Approaches using EVS were flown in a variety of conditions including fog, rain and snow showers, as well as at night to aerodromes located in mountainous terrain. The infrared EVS performance can vary depending on the weather conditions encountered. Therefore, the provisions take a conservative approach to cater for the wide variety of conditions which may be encountered. It may be necessary to amend the provisions in the future to take account of greater operational experience.
   b. Provisions for the use of EVS during take-off have not been developed. The systems evaluated did not perform well when the RVR was below 300 m. There may be some benefit for use of EVS during take-off with greater visibility and reduced light; however, such operations would need to be evaluated.
   c. Provisions have been developed to cover use of infrared systems only. Other sensing technologies are not intended to be excluded; however, their use will need to be evaluated to determine the appropriateness of this, or any other provision. During the development, it was envisaged what minimum equipment should be fitted to the aircraft. Given the present state of technological development, it is considered that a HUD is an essential element of the EVS equipment.
   d. In order to avoid the need for tailored charts for approaches utilising EVS, it is envisaged that the operator will use AMC1-SPA.LVO.110 Table 5 – Approach utilising EVS RVR/CMV reduction vs. normal RVR/CMV to determine the applicable RVR at the commencement of the approach.

3. Additional operational considerations

   a. Enhanced vision system equipment should have:

      i. a head-up display system (capable of displaying, airspeed, vertical speed, aircraft attitude, heading, altitude, command guidance as appropriate for the approach to be flown, path deviation indications, flight path vector, and flight path angle reference cue and the EVS imagery);

      ii. a head-down view of the EVS image, or other means of displaying the EVS-derived information easily to the pilot monitoring the progress of the approach; and

      iii. the pilot monitoring is kept in the 'loop' and crew resource management (CRM) does not break down.

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CREW ACTIONS IN CASE OF AUTOPILOT FAILURE AT OR BELOW DH IN FAIL-PASSIVE CAT III OPERATIONS

For operations to actual RVR values less than 300 m, a missed approach procedure is assumed in the event of an autopilot failure at or below DH. This means that a missed approach procedure is the normal action. However, the wording recognises that there may be circumstances where the safest action is to continue the landing. Such circumstances include the height at which the failure occurs, the actual visual references, and other malfunctions. This would typically apply to the late stages of the flare. In conclusion, it is not forbidden to continue the approach and complete the landing when the pilot-in-command/commander or the pilot to whom the conduct of the flight has been delegated, determines that this is the safest course of action. The operator's policy and the operational instructions should reflect this information.

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ESTABLISHMENT OF MINIMUM RVR FOR CAT II AND CAT III OPERATIONS

1. General

   a. When establishing minimum RVR for CAT II and CAT III operations, operators should pay attention to the following information that originates in ECAC Doc 17 3rd Edition, Subpart A. It is retained as background information and, to some extent, for historical purposes although there may be some conflict with current practices.

   b. Since the inception of precision approach and landing operations various methods have been devised for the calculation of aerodrome operating minima in terms of DH and runway visual range. It is a comparatively straightforward matter to establish the DH for an operation but establishing the minimum RVR to be associated with that DH so as to provide a high probability that the required visual reference will be available at that DH has been more of a problem.

c. The methods adopted by various States to resolve the DH/RVR relationship in respect of CAT II and CAT III operations have varied considerably. In one instance there has been a simple approach which entailed the application of empirical data based on actual operating experience in a particular environment. This has given satisfactory results for application within the environment for which it was developed. In another instance a more sophisticated method was employed which utilised a fairly complex computer programme to take account of a wide range of variables. However, in the latter case, it has been found that with the improvement in the performance of visual aids, and the increased use of automatic equipment in the many different types of new aircraft, most of the variables cancel each other out and a simple tabulation can be constructed which is applicable to a wide range of aircraft. The basic principles which are observed in establishing the values in such a table are that the scale of visual reference required by a pilot at and below DH depends on the task that he/she has to carry out, and that the degree to which his/her vision is obscured depends on the obscuring medium, the general rule in fog being that it becomes more dense with increase in height. Research using FSTDs coupled with flight trials has shown the following:

   i. most pilots require visual contact to be established about three seconds above DH though it has been observed that this reduces to about one second when a fail-operational automatic landing system is being used;

   ii. to establish lateral position and cross-track velocity most pilots need to see not less than a three light segment of the centreline of the approach lights, or runway centreline, or runway edge lights;

   iii. for roll guidance most pilots need to see a lateral element of the ground pattern, i.e. an approach light cross bar, the landing threshold, or a barrette of the touchdown zone light; and

   iv. to make an accurate adjustment to the flight path in the vertical plane, such as a flare, using purely visual cues, most pilots need to see a point on the ground which has a low or zero rate of apparent movement relative to the aircraft.

   v. With regard to fog structure, data gathered in the United Kingdom over a twenty-year period have shown that in deep stable fog there is a 90 % probability that the slant visual range from eye heights higher than 15 ft above the ground will be less than the horizontal visibility at ground level, i.e. RVR. There are at present no data available to show what the relationship is between the slant visual range and RVR in other low visibility conditions such as blowing snow, dust or heavy rain, but there is some evidence in pilot reports that the lack of contrast between visual aids and the background in such conditions can produce a relationship similar to that observed in fog.

2. CAT II operations

The selection of the dimensions of the required visual segments which are used for CAT II operations is based on the following visual requirements:

a. a visual segment of not less than 90 m will need to be in view at and below DH for pilot to be able to monitor an automatic system;

b. a visual segment of not less than 120 m will need to be in view for a pilot to be able to maintain the roll attitude manually at and below DH; and

c. for a manual landing using only external visual cues, a visual segment of 225 m will be required at the height at which flare initiation starts in order to provide the pilot with sight of a point of low relative movement on the ground.

Before using a CAT II ILS for landing, the quality of the localiser between 50 ft and touchdown should be verified.

3. CAT III fail-passive operations

a. CAT III operations utilising fail-passive automatic landing equipment were introduced in the late 1960's and it is desirable that the principles governing the establishment of the minimum RVR for such operations be dealt with in some detail.

b. During an automatic landing the pilot needs to monitor the performance of the aircraft system, not in order to detect a failure which is better done by the monitoring devices built into the system, but so as to know precisely the flight situation. In the final stages the pilot should establish visual contact and, by the time the pilot reaches DH, the pilot should have checked the aircraft position relative to the approach or runway centre-line lights. For this the pilot will need sight of horizontal elements (for roll reference) and part of the touchdown area. The pilot should check for lateral position and cross-track velocity and, if not within the pre-stated lateral limits, the pilot should carry out a missed approach procedure. The pilot should also check longitudinal progress and sight of the landing threshold is useful for this purpose, as is sight of the touchdown zone lights.

c. In the event of a failure of the automatic flight guidance system below DH, there are two possible courses of action; the first is a procedure which allows the pilot to complete the landing manually if there is adequate visual reference for him/her to do so, or to initiate a missed approach procedure if there is not; the second is to make a missed approach procedure mandatory if there is a system disconnect regardless of the pilot's assessment of the visual reference available:

i. If the first option is selected then the overriding requirement in the determination of a minimum RVR is for sufficient visual cues to be available at and below DH for the pilot to be able to carry out a manual landing. Data presented in Doc 17 showed that a minimum value of 300 m would give a high probability that the cues needed by the pilot to assess the aircraft in pitch and roll will be available and this should be the minimum RVR for this procedure.

ii. The second option, to require a missed approach procedure to be carried out should the automatic flight-guidance system fail below DH, will permit a lower minimum RVR because the visual reference requirement will be less if there is no need to provide for the possibility of a manual landing. However, this option is only acceptable if it can be shown that the probability of a system failure below DH is acceptably low. It should be recognised that the inclination of a pilot who experiences such a failure would be to continue the landing manually but the results of flight trials in actual conditions and of simulator experiments show that pilots do not always recognise that the visual cues are inadequate in such situations and present recorded data reveal that pilots' landing performance reduces progressively as the RVR is reduced below 300 m. It should further be recognised that there is some risk in carrying out a manual missed approach procedure from below 50 ft in very low visibility and it should therefore be accepted that if an RVR lower than 300 m is to be approved, the flight deck procedure should not normally allow the pilot to continue the landing manually in such conditions and the aircraft system should be sufficiently reliable for the missed approach procedure rate to be low.

d. These criteria may be relaxed in the case of an aircraft with a fail-passive automatic landing system which is supplemented by a head-up display which does not qualify as a fail-operational system but which gives guidance which will enable the pilot to complete a landing in the event of a failure of the automatic landing system. In this case it is not necessary to make a missed approach procedure mandatory in the event of a failure of the automatic landing system when the RVR is less than 300 m.

4. CAT III fail operational operations - with a DH

a. For CAT III operations utilising a fail-operational landing system with a DH, a pilot should be able to see at least one centreline light.

b. For CAT III operations utilising a fail-operational hybrid landing system with a DH, a pilot should have a visual reference containing a segment of at least three consecutive lights of the runway centreline lights.

5. CAT III fail operational operations - with no DH

a. For CAT III operations with No DH the pilot is not required to see the runway prior to touchdown. The permitted RVR is dependent on the level of aircraft equipment.

b. A CAT III runway may be assumed to support operations with no DH unless specifically restricted as published in the AIP or NOTAM.

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ILS CLASSIFICATION

The ILS classification system is specified in ICAO Annex 10.

AMC1-SPA.LVO.105 LVO approval

GENERAL STANDARDS

1. The following procedures should apply to the introduction and approval of LVO. The standards for CAT II should apply to OTS CAT II in the same way.

OPERATIONAL DEMONSTRATION - AEROPLANES

2. The purpose of the operational demonstration is to determine or validate the use and effectiveness of the applicable aircraft flight guidance systems, including HUDLS if appropriate, training, flight crew procedures, maintenance programme, and manuals applicable to the CAT II/III programme being approved.

   a. At least 30 approaches and landings should be accomplished in operations using the CAT II/III systems installed in each aircraft type if the requested DH is 50 ft or higher. If the DH is less than 50 ft, at least 100 approaches and landings should be accomplished.

   b. If the operator has different variants of the same type of aircraft utilising the same basic flight control and display systems, or different basic flight control and display systems on the same type of aircraft, the operator should show that the various variants have satisfactory performance, but need not conduct a full operational demonstration for each variant. The number of approaches and landings may be based on credit given for the experience gained by another operator, using the same aeroplane type or variant and procedures.

   c. If the number of unsuccessful approaches exceeds 5% of the total, e.g. unsatisfactory landings, system disconnects, etc., the evaluation programme should be extended in steps of at least 10 approaches and landings until the overall failure rate does not exceed 5%.

3. The operator should establish a data collection method to record approach and landing performance. The resulting data and a summary of the demonstration data should be made available to the competent authority for evaluation.

4. Unsatisfactory approaches and/or automatic landings should be documented and analysed.

OPERATIONAL DEMONSTRATION - HELICOPTERS

5. The operator should comply with the provisions prescribed below when introducing a helicopter type that is new to the European Union into CAT II or III service.

   a. Operational reliability

      The CAT II and III success rate should not be less than that required by CS-AWO or equivalent.

   b. Criteria for a successful approach

      An approach is regarded as successful if:

      i. the criteria are as specified in CS-AWO or equivalent are met; and

      ii. no relevant helicopter system failure occurs.

   For helicopter types already used for CAT II or III operations in another Member State, the in-service proving programme in 9. should be used instead.

6. Data collection during airborne system demonstration - general

   a. The operator should establish a reporting system to enable checks and periodic reviews to be made during the operational evaluation period before the operator is approved to conduct CAT II or III operations. The reporting system should cover all successful and unsuccessful approaches, with reasons for the latter, and include a record of system component failures. This reporting system should be based upon flight crew reports and automatic recordings as prescribed in 7. and 8. below.

b. The recordings of approaches may be made during normal line flights or during other flights performed by the operator.

7. Data collection during airborne system demonstration – operations with DH not less than 50 ft

a. For operations with DH not less than 50 ft, data should be recorded and evaluated by the operator and evaluated by the competent authority when necessary.

b. It is sufficient for the following data to be recorded by the flight crew:

i. FATO and runway used;

ii. weather conditions;

iii. time;

iv. reason for failure leading to an aborted approach;

v. adequacy of speed control;

vi. trim at time of automatic flight control system disengagement;

vii. compatibility of automatic flight control system, flight director and raw data;

viii. an indication of the position of the helicopter relative to the ILS, MLS centreline when descending through 30 m (100 ft); and

ix. touchdown position.

c. The number of approaches made during the initial evaluation should be sufficient to demonstrate that the performance of the system in actual airline service is such that a 90% confidence and a 95% approach success will result.

8. Data collection during airborne system demonstration – operations with DH less than 50 ft or no DH

a. For operations with DH less than 50 ft or no DH, a flight data recorder (FDR), or other equipment giving the appropriate information, should be used in addition to the flight crew reports to confirm that the system performs as designed in actual airline service. The following data should be recorded:

i. distribution of ILS, MLS deviations at 30 m (100 ft), at touchdown and, if appropriate, at disconnection of the rollout control system and the maximum values of the deviations between those points; and

ii. sink rate at touchdown.

b. Any landing irregularity should be fully investigated using all available data to determine its cause.

9. In-service proving

The operator fulfilling the provisions of 6.above should be deemed to have met the in-service proving contained in this subparagraph.

a. The system should demonstrate reliability and performance in line operations consistent with the operational concepts. A sufficient number of successful landings should be accomplished in line operations, including training flights, using the auto-land and rollout system installed in each helicopter type.

b. The demonstration should be accomplished using a CAT II or CAT III ILS. Demonstrations may be made on other ILS, MLS facilities if sufficient data are recorded to determine the cause of unsatisfactory performance.

c. If the operator has different variants of the same type of helicopter utilising the same basic flight control and display systems, or different basic flight control and display systems on the same type of helicopter, the operator should show that the variants comply with the basic system performance criteria, but the operator need not conduct a full operational demonstration for each variant.

d. Where the operator introduces a helicopter type that has already been approved by the competent authority of any Member State for CAT II and/or CAT III operations a reduced proving programme may be acceptable.

CONTINUOUS MONITORING – ALL AIRCRAFT

10. Continuous monitoring

a. After obtaining the initial approval, the operations should be continuously monitored by the operator to detect any undesirable trends before they become hazardous. Flight crew reports may be used to achieve this.

b. The following information should be retained for a period of 12 months:

i. the total number of approaches, by aircraft type, where the airborne CAT II or III equipment was utilised to make satisfactory, actual or practice, approaches to the applicable CAT II or III minima; and

ii. reports of unsatisfactory approaches and/or automatic landings, by aerodrome and aircraft registration, in the following categories:

A. airborne equipment faults;

B. ground facility difficulties;

C. missed approaches because of ATC instructions; or

D. other reasons.

c. The operator should establish a procedure to monitor the performance of the automatic landing system or HUDLS to touchdown performance, as appropriate, of each aircraft.

MAINTENANCE OF CAT II, CAT III AND LVTO EQUIPMENT

11. Maintenance instructions for the on board guidance systems should be established by the operator, in liaison with the manufacturer, and included in the operator's aircraft maintenance programme in accordance with Part-M.

ELIGIBLE AERODROMES AND RUNWAYS

12. Eligible aerodromes and runways

   a. Each aircraft type/runway combination should be verified by the successful completion of at least one approach and landing in CAT II or better conditions, prior to commencing CAT III operations.

   b. For runways with irregular pre-threshold terrain or other foreseeable or known deficiencies, each aircraft type/runway combination should be verified by operations in CAT I or better conditions, prior to commencing LTS CAT I, OTS CAT II or CAT III operations.

   c. If the operator has different variants of the same type of aircraft in accordance with 13.d. below, utilising the same basic flight control and display systems, or different basic flight control and display systems on the same type of aircraft in accordance with 12.d. below, the operator should show that the variants have satisfactory operational performance, but need not conduct a full operational demonstration for each variant/runway combination.

   d. For the purpose of this AMC, an aircraft type or variant of an aeroplane type should be deemed to be the same type/variant of aircraft if that type/variant has the same or similar:

      i. level of technology, including the:

         A. flight control/guidance system (FGS) and associated displays and controls;

         B. FMS and level of integration with the FGS; and

         C. use of HUDLS;

      ii. operational procedures, including:

         A. alert height;

         B. manual landing /automatic landing;

         C. no DH operations; and

         D. use of HUD/HUDLS in hybrid operations;

      iii. handling characteristics, including:

         A. manual landing from automatic or HUDLS guided approach;

         B. manual missed approach procedure from automatic approach; and

         C. automatic/manual rollout.

   e. Operators using the same aircraft type/class or variant of a type in accordance with 12.d. above may take credit from each other’s experience and records in complying with this subparagraph.

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OPERATIONAL DEMONSTRATION AND DATA COLLECTION/ANALYSIS

1. General

   a. Demonstrations may be conducted in line operations or any other flight where the operator's procedures are being used.

   b. In unique situations where the completion of 100 successful landings could take an unreasonably long period of time due to factors such as a small number of aircraft in the fleet, limited opportunity to use runways having CAT II/III procedures, or inability to obtain ATS sensitive area protection during good weather conditions, and equivalent reliability assurance can be achieved, a reduction in the required number of landings may be considered on a case-by-case basis. Reduction of the number of landings to be demonstrated requires a justification for the reduction. However, at the operator's option, demonstrations may be made on other runways and facilities. Sufficient information should be collected to determine the cause of any unsatisfactory performance (e.g. sensitive area was not protected).

   c. If the operator has different variants of the same type of aircraft utilising the same basic flight control and display systems, or different basic flight control and display systems on the same type or class of aircraft, the operator should show that the various variants have satisfactory performance, but need not conduct a full operational demonstration for each variant.

   d. Not more than 30% of the demonstration flights should be made on the same runway.

2. Data collection for operational demonstrations

   a. Data should be collected whenever an approach and landing is attempted utilising the CAT II/III system, regardless of whether the approach is abandoned, unsatisfactory, or is concluded successfully.

   b. The data should, as a minimum, include the following information:

      i. Inability to initiate an approach. Identify deficiencies related to airborne equipment which preclude initiation of a CAT II/III approach.

      ii. Abandoned approaches. Give the reasons and altitude above the runway at which approach was discontinued or the automatic landing system was disengaged.

      iii. Touchdown or touchdown and rollout performance. Describe whether or not the aircraft landed satisfactorily within the desired touchdown area with lateral velocity or cross track error which could be corrected by the pilot or automatic system so as to remain within the lateral confines of the runway without unusual pilot skill or technique. The approximate lateral and longitudinal position of the actual touchdown point in relation to the runway centreline and the runway threshold, respectively, should be indicated in the report. This report should also include any CAT II/III system abnormalities which required manual intervention by the pilot to ensure a safe touchdown or touchdown and rollout, as appropriate.

3. Data analysis

   Unsuccessful approaches due to the following factors may be excluded from the analysis:

   a. ATS factors. Examples include situations in which a flight is vectored too close to the final approach fix/point for adequate localiser and glide slope capture, lack of protection of ILS sensitive areas, or ATS requests the flight to discontinue the approach.

   b. Faulty navaid signals. Navaid (e.g. ILS localiser) irregularities, such as those caused by other aircraft taxiing, over-flying the navaid (antenna).

   c. Other factors. Any other specific factors that could affect the success of CAT II/ III operations that are clearly discernible to the flight crew should be reported.

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CRITERIA FOR A SUCCESSFUL CAT II, OTS CAT, CAT III APPROACH AND AUTOMATIC LANDING

1. The purpose of this GM is to provide operators with supplemental information regarding the criteria for a successful approach and landing to facilitate fulfilling the requirements prescribed in SPA.LVO.105.

2. An approach may be considered to be successful if:

   a. from 500 ft to start of flare:

      i. speed is maintained as specified in AMC-AWO 231, paragraph 2 'Speed Control'; and

      ii. no relevant system failure occurs; and

   b. from 300 ft to DH:

      i. no excess deviation occurs; and

      ii. no centralised warning gives a missed approach procedure command (if installed).

3. An automatic landing may be considered to be successful if:

   a. no relevant system failure occurs;

   b. no flare failure occurs;

   c. no de-crab failure occurs (if installed);

   d. longitudinal touchdown is beyond a point on the runway 60 m after the threshold and before the end of the touchdown zone light (900 m from the threshold);

   e. lateral touchdown with the outboard landing gear is not outside the touchdown zone light edge;

   f. sink rate is not excessive;

   g. bank angle does not exceed a bank angle limit; and

h. no rollout failure or deviation (if installed) occurs.

4. More details can be found in CS-AWO 131, CS-AWO 231 and AMC-AWO 231.

AMC1-SPA.LVO.120 Flight crew training and qualifications

GENERAL STANDARDS

1. The operator should ensure that flight crew member training programmes for LVO include structured courses of ground, FSTD and/or flight training.

    a. Flight crew members with no CAT II or CAT III experience should complete the full training programme prescribed in 2., 3., and 4. below.

    b. Flight crew members with CAT II or CAT III experience with a similar type of operation (auto-coupled/auto-land, HUDLS/hybrid HUDLS or EVS) or CAT II with manual land, if appropriate, with another European Union operator may undertake an:

        i. abbreviated ground training course if operating a different type or class from that on which the previous CAT II or CAT III experience was gained;

        ii. abbreviated ground, FSTD and/or flight training course if operating the same type or class and variant of the same type or class on which the previous CAT II or CAT III experience was gained. The abbreviated course should include at least the standards of 4.a., 4.b.i. or 4.b.ii. as appropriate and 4.c.i.. The operator may reduce the number of approaches/landings required by 4.b.i. if the type/class or the variant of the type or class has the same or similar:

            A. level of technology - flight control/guidance system (FGS);

            B. operating procedures;

            C. handling characteristics;

            D. use of HUDLS/hybrid HUDLS; and

            E. use of EVS

        as the previously operated type or class, otherwise the standards of 4.b.i. should be met.

    c. Flight crew members with CAT II or CAT III experience with the operator may undertake an abbreviated ground, FSTD and/or flight training course.

        i. When changing aircraft type or class, the abbreviated course should include at least the standards of 4.a., 4.b.i. or 4.b.ii. as appropriate and 4.c.i..

        ii. When changing to a different variant of aircraft within the same type or class rating that has the same or similar:

            A. level of technology - flight control/guidance system (FGS);

            B. operating procedures - integrity;

            C. handling characteristics;

            D. use of HUDLS/Hybrid HUDLS; and

            E. use of EVS,

as the previously operated type or class, a difference course or familiarisation appropriate to the change of variant should fulfil the abbreviated course standards.

iii. When changing to a different variant of aircraft within the same type or class rating that has a significantly different:

A. level of technology - flight control/guidance system (FGS);
B. operating procedures - integrity;
C. handling characteristics;
D. use of HUDLS/Hybrid HUDLS; or
E. use of EVS,

the standards of 4.a., 4.b.i. or 4.b.ii. as appropriate and 4.c.i. should be fulfilled.

d. The operator should ensure when undertaking CAT II or CAT III operations with different variant(s) of aircraft within the same type or class rating that the differences and/or similarities of the aircraft concerned justify such operations, taking account at least the following:

i. the level of technology, including the:

A. FGS and associated displays and controls;
B. FMS and its integration or not with the FGS; and
C. use of HUD/HUDLS with hybrid systems and/or EVS;

ii. operating procedures, including:

A. fail-passive / fail-operational, alert height;
B. manual landing / automatic landing;
C. no DH operations; and
D. use of HUD/HUDLS with hybrid systems;

iii. handling characteristics, including:

A. manual landing from automatic HUDLS and/or EVS guided approach;
B. manual missed approach procedure from automatic approach; and
C. automatic/manual rollout.

GROUND TRAINING

2. The initial ground training course for LVO should include at least:

a. the characteristics and limitations of the ILS and/or MLS;

b. the characteristics of the visual aids;

c. the characteristics of fog;

d. the operational capabilities and limitations of the particular airborne system to include HUD symbology and EVS characteristics if appropriate;

e. the effects of precipitation, ice accretion, low level wind shear and turbulence;

f. the effect of specific aircraft/system malfunctions;

g. the use and limitations of RVR assessment systems;

h. the principles of obstacle clearance requirements;

i. recognition of and action to be taken in the event of failure of ground equipment;

j. the procedures and precautions to be followed with regard to surface movement during operations when the RVR is 400 m or less and any additional procedures required for take-off in conditions below 150 m (200 m for Category D aeroplanes);

k. the significance of DHs based upon radio altimeters and the effect of terrain profile in the approach area on radio altimeter readings and on the automatic approach/landing systems;

l. the importance and significance of alert height, if applicable, and the action in the event of any failure above and below the alert height;

m. the qualification requirements for pilots to obtain and retain approval to conduct LVOs; and

n. the importance of correct seating and eye position.

FSTD TRAINING AND/OR FLIGHT TRAINING

3. FSTD training and/or flight training

a. FSTD and/or flight training for LVO should include at least:

i. checks of satisfactory functioning of equipment, both on the ground and in flight;

ii. effect on minima caused by changes in the status of ground installations;

iii. monitoring of:

A. automatic flight control systems and auto-land status annunciators with emphasis on the action to be taken in the event of failures of such systems; and

B. HUD/HUDLS/EVS guidance status and annunciators as appropriate, to include head-down displays;

iv. actions to be taken in the event of failures such as engines, electrical systems, hydraulics or flight control systems;

v. the effect of known unserviceabilities and use of MELs;

vi. operating limitations resulting from airworthiness certification;

vii. guidance on the visual cues required at DH together with information on maximum deviation allowed from glide path or localiser; and

viii. the importance and significance of alert height if applicable and the action in the event of any failure above and below the alert height.

b. Flight crew member should be trained to carry out their duties and instructed on the coordination required with other crew members. Maximum use should be made of suitably equipped FSTDs for this purpose.

c. Training should be divided into phases covering normal operation with no aircraft or equipment failures but including all weather conditions which may be encountered and detailed scenarios of aircraft and equipment failure which could affect CAT II or III operations. If the aircraft system involves the use of hybrid or other special systems, such as HUD/HUDLS or enhanced vision equipment, then flight crew members should practise the use of these systems in normal and abnormal modes during the FSTD phase of training.

d. Incapacitation procedures appropriate to LVTO and CAT II and CAT III operations should be practised.

e. For aircraft with no FSTD available to represent that specific aircraft, operators should ensure that the flight training phase specific to the visual scenarios of CAT II operations is conducted in a specifically approved FSTD. Such training should include a minimum of four approaches. Thereafter, the training and procedures that are type specific should be practised in the aircraft.

f. Initial CAT II and III training should include at least the following exercises:

   i. approach using the appropriate flight guidance, autopilots and control systems installed in the aircraft, to the appropriate DH and to include transition to visual flight and landing;

   ii. approach with all engines operating using the appropriate flight guidance systems, autopilots, HUDLS and/or EVS and control systems installed in the aircraft down to the appropriate DH followed by missed approach; all without external visual reference;

   iii. where appropriate, approaches utilising automatic flight systems to provide automatic flare, hover, landing and rollout; and

   iv. normal operation of the applicable system both with and without acquisition of visual cues at DH.

g. Subsequent phases of training should include at least:

   i. approaches with engine failure at various stages on the approach;

   ii. approaches with critical equipment failures, such as electrical systems, auto flight systems, ground and/or airborne ILS, MLS/GLS systems and status monitors;

   iii. approaches where failures of auto flight equipment and/or HUD/HUDLS/EVS at low level require either;

      A. reversion to manual flight to control flare, hover, landing and rollout or missed approach; or

      B. reversion to manual flight or a downgraded automatic mode to control missed approaches from, at or below DH including those which may result in a touchdown on the runway;

   iv. failures of the systems which will result in excessive localiser and/or glide slope deviation, both above and below DH, in the minimum visual conditions specified for the operation. In addition, a continuation to a manual landing should be practised if a head-up display forms a downgraded mode of the automatic system or the head-up display forms the only flare mode; and

v. failures and procedures specific to aircraft type or variant.

h. The training programme should provide practice in handling faults which require a reversion to higher minima.

i. The training programme should include the handling of the aircraft when, during a fail-passive CAT III approach, the fault causes the autopilot to disconnect at or below DH when the last reported RVR is 300 m or less.

j. Where take-offs are conducted in RVRs of 400 m and below, training should be established to cover systems failures and engine failure resulting in continued as well as rejected take-offs.

k. The training programme should include, where appropriate, approaches where failures of the HUDLS and/or EVS equipment at low level require either:

i. reversion to head down displays to control missed approach; or

ii. reversion to flight with no, or downgraded, HUDLS guidance to control missed approaches from DH or below, including those which may result in a touchdown on the runway.

l. When undertaking LVTO, LTS CAT I, OTS CAT II, and CAT II and CAT III operations utilising a HUD/HUDLS or hybrid HUD/HUDLS or an EVS, the training and checking programme should include, where appropriate, the use of the HUD/HUDLS in normal operations during all phases of flight.

CONVERSION TRAINING

4. Flight crew members should complete the following LVPs training if converting to a new type or class or variant of aircraft in which LVTO, LTS CAT I, OTS CAT II, approach operations utilising EVS with an RVR of 800 m or less and CAT II and CAT III operations will be conducted. Conditions for abbreviated courses are prescribed in 1.b., 1.c. and 1.d. above.

a. Ground training

The appropriate standards prescribed in 2. above, taking into account the flight crew member's CAT II and CAT III training and experience.

b. FSTD training and/or flight training

i. A minimum of six, respectively eight for HUDLS with or without EVS, approaches and/or landings in an FSTD. The standards for eight HUDLS approaches may be reduced to six when conducting hybrid HUDLS operations.

ii. Where no FSTD is available to represent that specific aircraft, a minimum of three, respectively five for HUDLS and/or EVS, approaches including at least one missed approach procedure is required on the aircraft. For hybrid HUDLS operations a minimum of three approaches are required, including at least one missed approach procedure.

iii. Appropriate additional training if any special equipment is required such as head-up displays or enhanced vision equipment. When approach operations utilising EVS are conducted with an RVR of less than 800 m, a minimum of five approaches, including at least one missed approach procedure are required on the aircraft.

c. Flight crew qualification

The flight crew qualification standards are specific to the operator and the type of aircraft operated.

i. The operator should ensure that each flight crew member completes a check before conducting CAT II or III operations.

ii. The check specified in 4.c.i. above may be replaced by successful completion of the FSTD and/or flight training specified in 4.b. above.

d. Line flying under supervision

Flight crew member should undergo the following line flying under supervision (LIFUS):

i. For CAT II when a manual landing or a HUDLS approach to touchdown is required, a minimum of:

A. three landings from autopilot disconnect; and

B. four landings with HUDLS used to touchdown;

except that only one manual landing, respectively two using HUDLS to touchdown is required when the training required in 4.b. above has been carried out in an FSTD qualified for zero flight time conversion.

ii. For CAT III, a minimum of two auto-lands except that:

A. only one auto-land is required when the training required in sub-paragraph 4.b. above has been carried out in an FSTD qualified for zero flight time conversion;

B. no auto-land is required during LIFUS when the training required in sub-paragraph 4.b. above has been carried out in an FSTD qualified for zero flight time (ZFT) conversion and the flight crew member successfully completed the ZFT type rating conversion course; and

C. the flight crew member, trained and qualified in accordance with paragraph B. above, is qualified to operate during the conduct of LIFUS to the lowest approved DA/H and RVR as stipulated in the operations manual.

iii. For CAT III approaches using HUDLS to touchdown a minimum of four approaches.

TYPE AND COMMAND EXPERIENCE

5. Type and command experience

a. Before commencing CAT II operations, the following additional standards should be applicable to pilots-in-command/commanders, or pilots to whom conduct of the flight may be delegated, who are new to the aircraft type or class:

i. 50 hours or 20 sectors on the type, including LIFUS; and

ii. 100 m should be added to the applicable CAT II RVR minima when the operation requires a CAT II manual landing or use of HUDLS to touchdown until:

A. a total of 100 hours or 40 sectors, including LIFUS has been achieved on the type; or

B. a total of 50 hours or 20 sectors, including LIFUS has been achieved on the type where the flight crew member has been previously qualified for CAT II manual landing operations with an European Union operator;

C. for HUDLS operations the sector standards in 5.a. and 5.b.i. should always be applicable, the hours on type or class does not fulfil the standard.

b. Before commencing CAT III operations, the following additional standards should be applicable to pilots-in-command/commanders, or pilots to whom conduct of the flight may be delegated, who are new to the aircraft type:

i. 50 hours or 20 sectors on the type, including LIFUS; and

ii. 100 m should be added to the applicable CAT II or CAT III RVR minima unless he/she has previously qualified for CAT II or III operations with an European Union operator, until a total of 100 hours or 40 sectors, including LIFUS, has been achieved on the type.

RECURRENT TRAINING AND CHECKING

7. Recurrent training and checking – LVO

a. The operator should ensure that, in conjunction with the normal recurrent training and operator's proficiency checks, the pilot's knowledge and ability to perform the tasks associated with the particular category of operation, for which the pilot is authorised by the operator, is checked. The required number of approaches to be undertaken in the FSTD within the validity period of the operator's proficiency check should be a minimum of two, respectively four when HUDLS and/or EVS is utilised to touchdown, one of which should be a landing at the lowest approved RVR. In addition one, respectively two for HUDLS and/or operations utilising EVS, of these approaches may be substituted by an approach and landing in the aircraft using approved CAT II and CAT III procedures. One missed approach should be flown during the conduct of an operator proficiency check. If the operator is approved to conduct take-off with RVR less than 150 m at least one LVTO to the lowest applicable minima should be flown during the conduct of the operator's proficiency check.

b. For CAT III operations the operator should use an FSTD approved for this purpose.

c. For CAT III operations on aircraft with a fail-passive flight control system, including HUDLS, a missed approach should be completed by each flight crew member at least once over the period of three consecutive operator proficiency checks as the result of an autopilot failure at or below DH when the last reported RVR was 300 m or less.

LVTO OPERATIONS

6. LVTO with RVR less than 400 m

   a. Prior to conducting take-offs in RVRs below 400 m, the flight crew should undergo the following training:

      i. normal take-off in minimum approved RVR conditions;

      ii. take-off in minimum approved RVR conditions with an engine failure:

         A. for aeroplanes between V_1 and V_2(take-off safety speed), or as soon as safety considerations permit;

         B. for helicopters at or after take-off decision point (TDP);and

      iii. take-off in minimum approved RVR conditions with an engine failure:

         A. for aeroplanes before V_1 resulting in a rejected take-off;

         B. for helicopters before the TDP.

   b. The operator approved for LVTOs with an RVR below 150 m should ensure that the training specified by 6.a. above is carried out in an FSTD. This training should include the use of any special procedures and equipment.

   c. The operator should ensure that a flight crew member has completed a check before conducting LVTO in RVRs of less than 150 m. The check may be replaced by successful completion of the FSTD and/or flight training prescribed in 6.a. on conversion to an aircraft type.

LTS CAT I, OTS CAT II, OPERATIONS UTILISING EVS

8. Additional training standards

   a. General

      Operators conducting LTS CAT I operations, OTS CAT II operations and operations utilising EVS with RVR of 800 m or less should comply with the standards applicable to CAT II operations and include the standards applicable to HUDLS, if appropriate. The operator may combine these additional standards where appropriate provided that the operational procedures are compatible.

   b. LTS CAT I

      During conversion training the total number of approaches should not be additional to the requirements of OR.OPS.FC provided the training is conducted utilising the lowest applicable RVR. During recurrent training and checking the operator may also combine the separate requirements provided the above operational procedure standard is met and at least one approach using LTS CAT I minima is conducted at least once every 18 months.

   c. OTS CAT II

      During conversion training the total number of approaches should not be less than those to complete CAT II training utilising a HUD/HUDLS. During recurrent training and checking the operator may also combine the separate standards provided the above operational procedure requirement is met and at least one approach using OTS CAT II minima is conducted at least once every 18 months.

c. Operations utilising EVS with RVR of 800 m or less

During conversion training the total number of approaches required should not be less than that required to complete CAT II training utilising a HUD. During recurrent training and checking the operator may also combine the separate standards provided the above operational procedure standard is met and at least one approach utilising EVS is conducted at least once every 12 months.

GM1-SPA.LVO.120 Flight crew training and qualifications

FLIGHT CREW TRAINING

The number of approaches referred to in AMC1-SPA.LVO.120, 7.a.includes one approach and landing that may be conducted in the aircraft using approved CAT II/III procedures. This approach and landing may be conducted in normal line operation or as a training flight.

AMC1-SPA.LVO.125 Operating procedures

GENERAL

1. LVOs should include:

   a. manual take-off, with or without electronic guidance systems or HUDLS/hybrid HUD/HUDLS;

   b. approach flown with the use of a HUDLS/hybrid HUD/HUDLS and/or EVS;

   c. auto-coupled approach to below DH, with manual flare, hover, landing and rollout;

   d. auto-coupled approach followed by auto-flare, hover, auto-landing and manual rollout; and

   e. auto-coupled approach followed by auto-flare, hover, auto-landing and auto-rollout, when the applicable RVR is less than 400 m.

PROCEDURES AND INSTRUCTIONS

2. The operator should specify detailed operating procedures and instructions in the operations manual.

   a. The precise nature and scope of procedures and instructions given should depend upon the airborne equipment used and the flight deck procedures followed. The operator should clearly define flight crew member duties during take-off, approach, flare, hover, rollout and missed approach in the operations manual. Particular emphasis should be placed on flight crew responsibilities during transition from non-visual conditions to visual conditions, and on the procedures to be used in deteriorating visibility or when failures occur. Special attention should be paid to the distribution of flight deck duties so as to ensure that the workload of the pilot making the decision to land or execute a missed approach enables him/her to devote himself/herself to supervision and the decision making process.

b. The instructions should be compatible with the limitations and mandatory procedures contained in the AFM and cover the following items in particular:

   i. checks for the satisfactory functioning of the aircraft equipment, both before departure and in flight;

   ii. effect on minima caused by changes in the status of the ground installations and airborne equipment;

   iii. procedures for the take-off, approach, flare, hover, landing, rollout and missed approach;

   iv. procedures to be followed in the event of failures, warnings to include HUD/HUDLS/EVS and other non-normal situations;

   v. the minimum visual reference required;

   vi. the importance of correct seating and eye position;

   vii. action that may be necessary arising from a deterioration of the visual reference;

   viii. allocation of crew duties in the carrying out of the procedures according to 2.b.i. to iv. and vi. above, to allow the pilot-in-command/commander to devote himself/herself mainly to supervision and decision making;

   ix. the requirement for all height calls below 200 ft to be based on the radio altimeter and for one pilot to continue to monitor the aircraft instruments until the landing is completed;

   x. the requirement for the localiser sensitive area to be protected;

   xi. the use of information relating to wind velocity, wind shear, turbulence, runway contamination and use of multiple RVR assessments;

   xii. procedures to be used for:

      A. LTS CAT I;

      B. OTS CAT II;

      C. approach operations utilising EVS; and

      D. practice approaches and landing on runways at which the full CAT II or CAT III aerodrome procedures are not in force;

   xiii. operating limitations resulting from airworthiness certification; and

   xiv. information on the maximum deviation allowed from the ILS glide path and/or localiser.

Subpart G - Transport of dangerous goods

AMC1-SPA.DG.100(b)(1) Approval to transport dangerous goods

TRAINING PROGRAMME

1. The operator should indicate for the approval of the training programme how the training will be carried out. For formal training courses, the course objectives, the training programme syllabus/curricula and examples of the written examination to be undertaken should be included.
2. Instructors should have knowledge of training techniques as well as in the field of transport of dangerous goods by air so that the subject is covered fully and questions can be adequately answered.
3. Training intended to give general information and guidance may be by any means including handouts, leaflets, circulars, slide presentations, videos, computer based training, etc., and may take place on-the-job or off-the-job. The person being trained should receive an overall awareness of the subject. This training should include a written, oral or computer based examination covering all areas of the training programme, showing that a required minimum level of knowledge has been acquired.
4. Training intended to give an in-depth and detailed appreciation of the whole subject or particular aspects of it should be by formal training courses, which should include a written examination, the successful passing of which will result in the issue of the proof of qualification. The course may be by means of tuition or as a self-study program or a mixture of both. The person being trained should gain knowledge so as to be able to apply the detailed requirements of the Technical Instructions.
5. Training in emergency procedures should include as a minimum:
   a. for personnel other than crew members:
      i. dealing with damaged or leaking packages; and
      ii. other actions in the event of ground emergencies arising from dangerous goods;
   b. for flight crew members:
      i. actions in the event of emergencies in flight occurring in the passenger cabin or in the cargo compartments; and
      ii. the notification to ATS should an in-flight emergency occur.
   c. for crew members other than flight crew members:
      i. dealing with incidents arising from dangerous goods carried by passengers; or
      ii. dealing with damaged or leaking packages in flight.
6. Training should be conducted at intervals of no longer than two years.

AMC1-SPA.DG.100(b)(2)(ii) Approval to transport dangerous goods

ACCEPTANCE OF DANGEROUS GOODS

1. The operator should not accept dangerous goods unless:
   a. the package, overpack or freight container has been inspected in accordance with the acceptance procedures in the Technical Instructions;
   b. except when otherwise specified in the Technical Instructions, they are accompanied by two copies of a dangerous goods transport document or the information applicable to the consignment is provided in electronic form; and
   c. the English language is used for:
      i. package marking and labelling; and
      ii. the dangerous goods transport document

   in addition to any other language requirements.
2. The operator or his/her handling agent should use an acceptance checklist which allows for:
   a. all relevant details to be checked; and
   b. the recording of the results of the acceptance check by manual, mechanical or computerised means.

AMC1-SPA.DG.100(b)(2)(iv) Approval to transport dangerous goods

PROVISION OF INFORMATION IN THE EVENT OF AN IN-FLIGHT EMERGENCY

If an in-flight emergency occurs the pilot-in-command/commander should, as soon as the situation permits, inform the appropriate ATS unit of any dangerous goods carried as cargo on board the aircraft as specified in the Technical Instructions.

GM1-SPA.DG.100(b)(1) Approval to transport dangerous goods

PERSONNEL

Personnel include all persons involved in the transport of dangerous goods, whether they are employees of the operator or not.

AMC1-SPA.DG.105(a) Dangerous goods information and documentation

INFORMATION TO THE PILOT-IN-COMMAND/COMMANDER

If the volume of information provided to the pilot-in-command/commander is such that it would be impracticable to transmit it in the event of an in-flight emergency, a summary of the information should be provided to the pilot-in-command/commander by the operator, containing at least the quantities and class or division of the dangerous goods in each cargo compartment.

Subpart H – Helicopter operations with night vision imaging systems

GM1-SPA.NVIS.110(f) Equipment requirements for NVIS operations

MODIFICATION OR MAINTENANCE TO THE HELICOPTER

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

GM1-SPA.NVIS.130 Crew requirements for NVIS operations

UNDERLYING ACTIVITY

Examples of an underlying activity are:

1. commercial air transport;
2. helicopter emergency medical service (HEMS); and
3. helicopter hoist operation (HHO).

GM1-SPA.NVIS.130(e) Crew requirements for NVIS operations

OPERATIONAL APPROVAL

When determining the composition of the minimum crew, the competent authority should take account of the type of operation that is to be conducted. The minimum crew should be part of the operational approval.

If the operational use of NVIS is limited to the en-route phase of a commercial air transport flight, a single-pilot operation might be approved.

Where operations to/from a HEMS operating site are to be conducted, a crew of at least one pilot and one NVIS technical crew member would be necessary (this could be the suitably qualified HEMS technical crew member).

A similar assessment could be made for night HHO, when operating to unprepared sites.

AMC1-SPA.NVIS.130(f)(1) Crew requirements for NVIS operations

TRAINING AND CHECKING SYLLABUS

1. The flight crew training syllabus should include the following items:
    a. NVIS working principles, eye physiology, vision at night, limitations and techniques to overcome these limitations;
    b. preparation and testing of NVIS equipment;
    c. preparation of the helicopter for NVIS operations;
    d. normal and emergency procedures including all NVIS failure modes;
    e. maintenance of unaided night flying;

   f. crew co-ordination concept specific to NVIS operations;
   g. practice of the transition to and from NVG procedures;
   h. awareness of specific dangers relating to the operating environment; and
   i. risk analysis, mitigation and management.

2. The flight crew checking syllabus should include:
   a. night proficiency checks, including emergency procedures to be used on NVIS operations; and
   b. line checks with special emphasis on the following:
      i. local area meteorology;
      ii. NVIS flight planning;
      iii. NVIS in-flight procedures;
      iv. transitions to and from night vision goggles (NVG);
      v. normal NVIS procedures; and
      vi. crew coordination specific to NVIS operations.

3. Whenever the crew is required to also consist of an NVIS technical crew member, he/she should be trained and checked in the following items:
   a. NVIS working principles, eye physiology, vision at night, limitations, and techniques to overcome these limitations;
   b. duties in the NVIS role, with and without NVG;
   c. the NVIS installation;
   d. operation and use of the NVIS equipment;
   e. preparing the helicopter and specialist equipment for NVIS operations;
   f. normal and emergency procedures;
   g. crew co-ordination concepts specific to NVIS operations;
   h. awareness of specific dangers relating to the operating environment; and
   i. risk analysis, mitigation and management.

AMC1-SPA.NVIS.130(f) Crew requirements

CHECKING OF NVIS CREW MEMBERS

The checks required in SPA.NVIS.130(f) may be combined with those checks required for the underlying activity.

GM1-SPA.NVIS.130(f) Crew requirements

TRAINING GUIDELINES AND CONSIDERATIONS

1. Purpose

The purpose of this GM is to recommend the minimum training guidelines and any associated considerations necessary for the safe operation of a helicopter while operating with night vision imaging systems (NVISs).

To provide an appropriate level of safety, training procedures should accommodate the capabilities and limitations of the NVIS and associated systems as well as the restraints of the operational environment.

2. Assumptions

The following assumptions were used in the creation of this material:

a. Most civilian operators may not have the benefit of formal NVIS training, similar to that offered by the military. Therefore, the stated considerations are predicated on that individual who has no prior knowledge of NVIS or how to use them in flight. The degree to which other applicants who have had previous formal training should be exempted from this training will be dependent on their prior NVIS experience.

b. While NVIS are principally an aid to visual flight rules (VFR)_ night flight, the 2 dimensional nature of the NVG image necessitates frequent reference to the flight instruments for spatial and situational awareness information. The reduction of peripheral vision and increased reliance on focal vision exacerbates this requirement to monitor flight instruments. Therefore, any basic NVIS training syllabus should include some instruction on basic instrument flight.

3. Two-tiered approach: basic and advance training

To be effective, the NVIS training philosophy would be based on a two-tiered approach: basic and advanced NVIS training. The basic NVIS training would serve as the baseline standard for all individuals seeking an NVIS endorsement. The content of this initial training would not be dependent on any operational requirements. The training required for any individual pilot should take into account the previous NVIS flight experience. The advanced training would build on the basic training by focusing on developing specialized skills required to operate a helicopter during NVIS operations in a particular operational environment. Furthermore, while there is a need to stipulate minimum flight hour requirements for an NVIS endorsement, the training should also be event based. This necessitates that operators be exposed to all of the relevant aspects, or events, of NVIS flight in addition to acquiring a minimum number of flight hours. NVIS training should include flight in a variety of actual ambient light and weather conditions.

4. Training requirements

a. Flight crew ground training

The ground training necessary to initially qualify a pilot to act as the pilot of a helicopter using night vision goggles should include at least the following subjects:

i. Applicable aviation regulations that relate to NVIS limitations and flight operations.

ii. Aero-medical factors relating to the use of NVG to include how to protect night vision, how the eyes adapt to operate at night, self-imposed stresses that affect night vision, effects of lighting (internal and external) on night vision, cues utilized to estimate distance and depth perception at night, and visual illusions.

iii. NVG performance and scene interpretation.

iv. Normal, abnormal, and emergency operations of NVG.

v. NVIS operations flight planning to include night terrain interpretation and factors affecting terrain interpretation.

The ground training should be the same for flight crew and crew members other than flight crew. An example of a ground training syllabus is presented in Table 1.

b. Flight crew flight training

The flight training necessary to initially qualify a pilot to act as the pilot of a helicopter using NVG may be performed in a helicopter or FSTD approved for the purpose, and should include at least the following subjects:

i. Preparation and use of internal and external helicopter lighting systems for NVIS operations.

ii. Pre-flight preparation of NVG for NVIS operations.

iii. Proper piloting techniques (during normal, abnormal, and emergency helicopter operations) when using NVG during the take-off, climb, en-route, descent, and landing phases of flight that includes unaided flight and aided flight.

iv. Normal, abnormal, and emergency operations of the NVIS during flight.

Crew members other than flight crew should be involved in relevant parts of the flight training. An example of a flight training syllabus is presented in Table 2.

c. Training crew members other than flight crew

Crew members other than flight crew (including the technical crew member) should be trained to operate around helicopter employing NVIS. These individuals should complete all phases of NVIS ground training that is given to flight crew. Due to the importance of crew coordination, it is imperative that all crew members are familiar with all aspects of NVIS flight. Furthermore, these crew members may have task qualifications specific to their position in the helicopter or areas of responsibility. To this end, they should demonstrate competency in those areas, both on the ground and in flight.

d. Ground personnel training

Non-flying personnel who support NVIS operations should also receive adequate training in their areas of expertise. The purpose is to ensure, for example, that correct light discipline is used when helicopters are landing in a remote area.

e. Instructor qualifications

A NVIS flight instructor should at least have the following licences and qualifications:

i. at least flight instructor (FI(H)) or type rating instructor (TRI(H)) with the applicable type rating on which NVIS training will be given; and

ii. logged at least 100 NVIS flights or 30 hours' flight time under NVIS as pilot-in-command/commander.

g. NVIS equipment minimum requirements (training)

While minimum equipment lists and standard NVIS equipment requirements may be stipulated elsewhere, the following procedures and minimum equipment requirements should also be considered:

i. NVIS: the following is recommended for minimum NVIS equipment and procedural requirements:

A. back-up power supply;

B. NVIS adjustment kit or eye lane;

C. use of helmet with the appropriate NVG attachment;

D. both the instructor and student should wear the same NVG type, generation and model.

ii. Helicopter NVIS compatible lighting, flight instruments, and equipment: given the limited peripheral vision cues and the need to enhance situational awareness, the following is recommended for minimum compatible lighting requirements:

A. NVIS compatible instrument panel flood lighting that can illuminate all essential flight instruments;

B. NVIS compatible hand-held utility lights;

C. portable NVIS compatible flashlight;

D. a means for removing or extinguishing internal NVIS non-compatible lights;

E. NVIS pre-flight briefing/checklist (an example of a NVIS pre-flight briefing/checklist is in Table 1 of GM4-SPA.NVIS.130(f));

F. training references:

a number of training references are available, some of which are listed below:

- DO 295 US CONOPS civil operator training guidelines for integrated NVIS equipment
- United States Marine Corp MAWTS-1 Night Vision Device (NVD) Manual;
- U.S. Army Night Flight (TC 1-204);
- U.S. Army NVIS Operations, Exportable Training Package;
- U.S. Army TM 11-5855-263-10;

- Air Force TO 12S10-2AVS6-1;
- Navy NAVAIR 16-35AVS-7; and
- U.S. Border Patrol, Helicopter NVIS Ground and Flight Training Syllabus.

There may also be further documents available from European civil or military sources.

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INSTRUCTION - GROUND TRAINING AREAS OF INSTRUCTION

A detailed example of possible subjects to be instructed in a NVIS ground instruction is included below. (The exact details may not always be applicable, e.g. due to goggle configuration differences.)

Table 1: Ground training areas of instruction

Item	Subject Area	Subject Details	Recommen-ded Time
1	**General Anatomy and Characteristics of the Eye**	Anatomy: • Overall structure of the eye: • Cones • Rods Visual Deficiencies: • Myopia; • Hyperopia; • Astigmatism; • Presbyopia. Effects of Light on Night Vision & NV Protection Physiology: • Light levels ~ Illumination; ~ Luminance; ~ Reflectance; ~ Contrast. • Types of vision: ~ photopic; ~ mesopic; ~ scotopic. • Day versus night vision • Dark adaptation process: ~ Dark Adaptation; ~ Pre-adaptive State. • Purkinje Shift • Ocular Chromatic Aberration • Photochromatic Interval	**1 hour**

Item	Subject Area	Subject Details	Recommen-ded Time
2	**Night Vision Human Factors**	• Night blind spot (as compared to day blind spot) • Field of view and peripheral vision • Distance estimation and depth perception: ~ Monocular cues; ~ Motion parallax; ~ Geometric perspective; ~ Size constancy; ~ Overlapping contours or interposition of objects. • Aerial perspective: ~ Variations in colour or shade; ~ Loss of detail or texture; ~ Position of light source; and ~ Direction of shadows. • Binocular cues • Night vision techniques: ~ Off-centre vision; ~ Scanning; ~ Shapes and silhouettes.	**1 hour**
		• Vestibular Illusions • Somatogyral Illusions: ~ Leans; ~ Graveyard Spin; ~ Coriolis Illusion. • Somatogravic Illusions: ~ Oculographic Illusions; ~ Elevator Illusion; ~ Oculoagravic Illusions. • Proprioceptive Illusions • Dealing with Spatial Disorientation • Visual Illusions: ~ Auto kinetic illusion; ~ Confusion with ground lights; ~ Relative motion; ~ Reversible perspective illusion; ~ False vertical and horizontal cues; ~ Altered planes of reference; ~ Height /Depth perception illusion; ~ Flicker vertigo; ~ Fascination (Fixation); ~ Structural illusions; and ~ Size-distance illusion. • Helicopter Design Limitations: ~ Windscreen condition; ~ Helicopter instrument design;	

Item	Subject Area	Subject Details	Recommen-ded Time
		~ Helicopter structural obstruction; ~ Interior lights; and ~ Exterior lights. • Self-imposed stresses: ~ Drugs; ~ Exhaustion; ~ Alcohol; ~ Tobacco; ~ Hypoglycaemia; ~ Injuries; ~ Physical Fitness. • Stress & Fatigue: ~ Acute vs. Chronic; ~ Prevention. • Hypoxia Issues and Night Vision • Weather/Environmental conditions: ~ Snow (white-out); ~ Dust (brown-out); ~ Haze; ~ Fog; ~ Rain; ~ Light levels. • Astronomical Lights (moon, star, northern lights); and • Effects of cloud cover.	
3	**NVIS General Characteristics**	• Definitions and types of NVIS: ~ Light spectrum; ~ Types of NVIS. • Thermal-imaging devices • Image-intensifier devices • Image-intensifier operational theory • Types of Image intensifier systems: ~ Generation 1; ~ Generation 2; ~ Generation 3; ~ Generation 4; ~ Type I / II; ~ Class A & B Minus Blue Filter. • NVIS Equipment ~ Shipping and storage case; ~ Carrying case; ~ Binocular Assembly; ~ Lens Caps; ~ Lens Paper; ~ Operators Manual; ~ Power Pack (Dual Battery); and	**1 hour**

Item	Subject Area	Subject Details	Recommen-ded Time
		~ Batteries. • Characteristics of NVIS: ~ Light amplification; ~ Light intensification; ~ Frequency sensitivity; ~ Visual range acuity; ~ Unaided peripheral vision; ~ Weight; ~ Flip-up device; ~ Break-away feature; ~ Neck cord; ~ Maintenance Issues ~ Human Factor Issues • Description and Functions of NVIS components: ~ Helmet visor cover and extension strap; ~ Helmet NVIS mount and attachment points; ~ Different Mount options forvarious helmets; ~ Lock release button; ~ Vertical adjustment knob; ~ Low battery indicator; ~ Binocular assembly; ~ Monocular Tubes; ~ Fore and aft adjustment knob; ~ Eye span knob; ~ Tilt adjustment Lever; ~ Objective focus rings; ~ Eyepiece focus rings; and ~ Battery pack.	
4	**NVIS Care & Cleaning**	• Handling procedures; • NVIS operating instructions: ~ Pre-mounting inspection; ~ Mounting procedures; ~ Focusing procedures; ~ Faults. • Post-Flight Procedures; • Deficiencies: Type and Recognition of Faults: ~ Acceptable faults: - Black spots; - Chicken wire; - Fixed pattern noise (honeycomb effect);	**1 hour**

Item	Subject Area	Subject Details	Recommen-ded Time
		- Output brightness variation; - Bright spots; - Image disparity; - Image distortion ; - Emission points. ~ Unacceptable faults: - Shading; - Edge glow; - Fashing, flickering or intermittent operation. • Cleaning Procedures; • Care of Batteries; • Hazardous Material Considerations;	
5	**Pre & Post Flight Procedures**	• Inspect NVIS; • Carrying case condition; • Nitrogen purge due date; • Collimation test due date; and • Screens diagram(s) of any faults; • NVIS kit: complete; • NVIS binocular assembly condition; • Battery pack and quick disconnect condition; and • Batteries life expended so far. • Mount battery pack onto helmet: ~ Verify no LED showing (good battery); and ~ Fail battery by opening cap and L.E.D. illuminates (both compartments). • Mount NVIS onto helmet; • Adjust and focus NVIS; • Eye-span to known inter-pupillary distance; • Eye piece focus ring to Zero; • Adjustments: ~ Vertical; ~ Fore and aft; ~ Tilt; and ~ Eye-span (fine-tuning). • Focus (one eye at a time at 20 Ft, then at 30 Ft from an eye chart); ~ Objective focus ring; ~ Eye piece focus ring; ~ Verify both images are harmonised; and ~ Read eye-chart 20/40 line from 20	**1 hour**

Item	Subject Area	Subject Details	Recommen-ded Time
		feet. • NVIS Mission Planning; • NVIS Light Level Planning; • NVIS Risk Assessment;	
6	**NVIS Terrain Interpretation and Environmental Factors**	• Night Terrain Interpretation; • Light sources: ~ Natural; ~ Lunar; ~ Solar; ~ Starlight; ~ Northern lights; ~ Artificial; ~ Cultural; ~ Infra-red. • Meteorological conditions: ~ Clouds/Fog; ~ Indications of restriction to visibility: ~ Loss of celestial lights; ~ Loss of ground lights; ~ Reduced ambient light levels; ~ Reduced visual acuity; ~ Increase in video noise; and ~ Increase in halo effect. • Cues for visual recognition: ~ Object size; ~ Object shape; ~ Contrast; ~ Ambient light; ~ Colour; ~ Texture; ~ Background; and ~ Reflectivity. • Factors affecting terrain interpretation: ~ Ambient light; ~ Flight Altitudes; ~ Terrain Type. • Seasons; • Night Navigation cues: ~ Terrain relief; ~ Vegetation; ~ Hydrographical features; and ~ Cultural features.	**1 hour**
7	**NVIS Training and Equipment Requirements**	Cover the relevant regulations and guidelines that pertain to night and NVIS flight to include as a minimum: • Crew experience requirements;	**1 hour**

Item	Subject Area	Subject Details	Recommen-ded Time
		• Crew training requirements; • Airspace requirements; • Night / NVIS MEL; • NVIS / night weather limits; • NVIS equipment minimum standard requirements.	
8	**NVIS Emergency Procedures**	Cover relevant emergency procedures: • Inadvertent IMC procedures; • NVIS goggle failure; • Helicopter emergencies; ~ With goggles; ~ Transition from goggles.	**1 hour**
9	**NVIS Flight Techniques**	Respective flight techniques for each phase of flight for the type and class of helicopter used for NVIS training	**1 hour**
10	**Basic Instrument Techniques**	Present and confirm understanding of basic instrument flight techniques: • Instrument scan; • Role of instruments in NVIS flight; • Unusual attitude recovery procedures.	**1 hour**
11	**Blind Cockpit Drills**	Perform Blind Cockpit Drills • Switches; • Circuit Breakers; • Exit mechanisms; • External / Internal Lighting; • Avionics.	**1 hour**

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FLIGHT TRAINING - AREAS OF INSTRUCTION

A detailed example of possible subjects to be instructed in a NVIS flight instruction is included below.

Table 1: Flight training areas of instruction

Item	Subject Area	Subject Details	Recommended Time
1	**Ground Operations**	• NVIS equipment assembly; • Pre-flight Inspection of NVISs; • Helicopter pre-flight; • NVIS flight planning: ~ Light Level Planning; ~ Meteorology; ~ Obstacles and known hazards ; ~ Risk analysis matrix; ~ CRM concerns; ~ NVIS EP Review. • Start-up/Shut down; • Goggling and Degoggling.	1 hour
2	**General Handling**	• Level turns, climbs, and descents; • For helicopters, confined areas and sloped landings; • Operation specific flight tasks; • Transition from aided to unaided flight; • Demonstration of NVIS related ambient and cultural effects.	1 hour
3	**Takeoffs and Landings**	• At both improved illuminated areas such as airports/airfields and unimproved unlit areas such as open fields; • Traffic pattern; • Low speed manoeuvres for helicopters.	1 hour
4	**Navigation**	• Navigation over variety of terrain and under different cultural lighting conditions.	1 hour
5	**Emergency Procedures**	• Goggle failure; • Helicopter emergencies; • Inadvertent IMC; • Unusual attitude recovery.	1 hour

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NVIS PRE-FLIGHT BRIEFING/CHECKLIST

A detailed example of a pre-flight briefing/checklist is included below.

Table 1: NVIS pre-flight briefing/checklist

Item	Subject
1	**Weather:** • METAR/Forecast; • Cloud cover/dew point spread/precipitation.
2	**OPS Items:** • NOTAMs; • IFR publications backup/Maps; • Goggles adjusted using test set (RTCA Document DO-275 [NVIS MOPS] Appendices G & H gives suggested NVG pre-flight and adjustment procedures and a ground test checklist).
3	**Ambient Light:** • Moon rise/set/phase/position/elevation; • % illumination and MLX for duration of flight; • Recommended minimum MLX: 1.5.
4	**Mission:** • Mission outline; • Terrain appreciation; • Detailed manoeuvres; • Flight timings; • Start/airborne/debrief; • Airspace coordination for NVIS; • Obstacles/minimum safe altitude; • NVIS goggle up/degoggle location/procedure; • Instrument IFR checks.
5	**Crew:** • Crew day/experience; • Crew position; • Equipment: NVIS, case, video, flashlights; • Lookout duties: LS – left 90 to R45, RS – right 90 to L45; • Calling of hazards/movements landing light; • Transfer of control terminology;

Item	Subject
	• Below 100 ft AGL – NFP ready to assume control.
6	**Helicopter:** • Helicopter configuration; • Fuel & CG.
7	**Emergencies:** • NVIS failure: cruise and low level flight; • Inadvertent IMC/IFR Recovery; • Helicopter Emergency: critical & non-critical.

AMC1-SPA.NVIS.140 Information and documentation

OPERATIONS MANUAL

The operations manual should include:

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

GM1-SPA.NVIS.140 Information and documentation

CONCEPT OF OPERATIONS

Night Vision Imaging System for Civil Operators

Foreword

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

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

In addition, many of the technical standards already covered in the Minimum Operational Performance Standards (MOPS) for Integrated Night Vision Imaging System Equipment (DO-275) have been deleted in this European CONOPS.

Executive summary

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

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

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

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

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

Table of contents

1 Terminology

1.1 Night vision goggles

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

1.1.1 Type

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

1.1.2 Class

Class is a terminology used to describe the filter present on the NVG objective lens. The filter restricts the transmission of light below a determined frequency. This allows the cockpit lighting to be designed and installed in a manner that does not adversely affect NVG performance.

1.1.2.1 Class A

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

1.1.2.2 Class B

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

1.1.2.3 Modified class B

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

1.1.3 Generation

Generation refers to the technological design of an image intensifier. Systems incorporating these light-amplifying image intensifiers were first used during WWII and were operationally fielded by the US military during the Vietnam era. These systems were large, heavy and poorly performing devices that were unsuitable for aviation use, and were termed Generation I (Gen I). Gen II devices represented a significant technological advancement and provided a system that could be head-mounted for use in ground vehicles. Gen III devices represented another significant technological advancement in image intensification, and provided a system that was designed for aviation use. Although not yet fielded, there are prototype NVG that include technological advances that may necessitate a Gen 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.

1.1.4 OMNIBUS

The term 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 V. 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. Because of these variations, NVG will not be referred to by the OMNIBUS designation.

1.1.5 Resolution and visual acuity

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

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

1.2 Aviation night vision imaging system (NVIS)

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

1.2.1 Look under (under view)

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

1.3 NVIS lighting

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

1.3.1 Design considerations

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

B or Modified Class B NVG can be used with either Class A or Class B cockpit lighting designs.

1.3.2 Compatible

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

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

NVIS lighting compatibility can be achieved in a variety of ways that can include, but is not limited to, modification of light sources, light filters or by virtue of location. Once aircraft lighting is modified for using NVG, 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.

1.4. NVIS operation

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

1.4.1 Aided

Aided flight is flight with NVG in an operational position.

1.4.2 Unaided

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

2 System description

2.1 NVIS capabilities

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

2.1.1 Critical elements

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

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

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

2.1.2 Situation awareness

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

2.1.2.1 Environment detection and identification

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

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

2.1.3 Emergency situations

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

2.2.1 NVG design characteristics

There are limitations inherent in the current NVG design.

2.2.1.1 Visual acuity

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

2.2.1.2 Field of view

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

2.2.1.3 Field of regard

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

2.2.1.4 NVG weight & centre of gravity

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

2.2.1.5 Monochromatic image

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

2.2.1.6 Ambient or artificial light

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

2.2.2 Physiological and other conditions

2.2.2.1 Cockpit resource management

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

2.2.2.2 Fatigue

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

2.2.2.3 Over-confidence

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

2.2.2.4 Spatial orientation

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

2.2.2.5 Depth perception & distance estimation

When flying, it is important for pilots to be able to accurately employ depth perception and distance estimation techniques. To accomplish this, pilots use both binocular and monocular vision. Binocular vision requires the use of both eyes working together, and, practically speaking, is useful only out to approximately 100 ft.

Binocular vision is particularly useful when flying close to the ground and/or near objects (e.g. landing a helicopter in a small landing zone). Monocular vision can be accomplished with either eye alone, and is the type of vision used for depth perception and distance estimation when viewing beyond approximately 100 ft. Monocular vision is the predominant type of vision used when flying fixed wing aircraft, and also when flying helicopters and using cues beyond 100 ft. When viewing an NVG image, the two eyes can no longer provide accurate binocular information, even though the NVG used when flying is a binocular system. This has to do with the way the eyes function physiologically (e.g. accommodation, stereopsis, etc.) and the design of the NVG (i.e. a binocular system with a fixed channel for each eye). Therefore, binocular depth perception and distance estimation tasking when viewing terrain or objects with an NVG within

100 ft is significantly degraded. Since monocular vision does not require both eyes working together, the adverse impact on depth perception and distance estimation is much less, and is mostly dependent on the quality of the NVG image. If the image is very good and there are objects in the scene to use for monocular cueing (especially objects with which the pilot is familiar), then distance estimation and depth perception tasking will remain accurate. However, if the image is degraded (e.g., low illumination, airborne obscurants, etc.) and/or there are few or unfamiliar objects in the scene, depth perception and distance estimation will be degraded to some extent. In summary, pilots using NVG will maintain the ability to accurately perceive depth and estimate distances, but it will depend on the distances used and the quality of the NVG image.

Pilots maintain some ability to perceive depth and distance when using NVG by employing monocular cues. However, these capabilities may be degraded to varying degrees.

2.2.2.6 Instrument lighting brightness considerations

When viewing the NVG image, the brightness of the image will affect the amount of time it takes to adapt to the brightness level of the instrument lighting, thereby affecting the time it takes to interpret information provided by the instruments. For example, if the instrument lighting is fairly bright, the time it takes to interpret information provided by the instruments may be instantaneous. However, if the brightness of the lighting is set to a very low level, it may take several seconds to interpret the information, thus increasing the heads-down time and increasing the risk of spatial disorientation. It is important to ensure that instrument lighting is kept at a brightness level that makes it easy to rapidly interpret the information. This will likely be brighter than one is used to during unaided operations.

2.2.2.7 Dark adaptation time from NVG to unaided operations

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

2.2.2.8 Complacency

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

2.2.2.9 Experience

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

3 Operations

Operations procedures should accommodate the capabilities and limitations of the systems described in Section 3 of this GM as well as the restraints of the operational environment.

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

3.1 Pilot eligibility

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

3.2 Operating environment considerations

3.2.1 Weather and atmospheric obscurants

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

3.2.1.1 Weather

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

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

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

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

3.2.1.2 Deteriorating weather

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

1. 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.
2. Obtain a thorough weather brief with emphasis on NVG effects prior to flight.

3. Be familiar with weather patterns in the flying area.
4. Occasionally scan the outside scene. The unaided eye may detect weather conditions that are not detectable to the NVG.

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

3.2.1.3 Airborne obscurants

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

1. high winds during the day can place a lot of dust in the air that will still be present at night when the wind may have reduced in intensity;
2. forest fires produce heavy volumes of smoke that may cover areas well away from the fire itself;
3. the effects of rotor wash may be more pronounced when using NVG depending on the material (e.g. sand, snow, dust, etc.); and
4. pollution in and around major cultural areas may have an adverse effect on NVG performance.

3.2.1.4 Winter operations

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

3.2.1.4.1 Snow

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

3.2.1.4.2 Ice fog

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

3.2.1.4.3 Icing

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

3.2.1.4.4 Low ambient temperatures

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

3.2.2 Illumination

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

3.2.2.1 Natural illumination

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

3.2.2.1.1 Moon phase

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

3.2.2.1.2 Lunar azimuth and elevation

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

3.2.2.1.3 Shadowing

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

3.2.2.1.3.1 Benefits of shadows

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

3.2.2.1.3.2 Disadvantages due to shadows

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

3.2.2.1.4 Sky glow

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

3.2.2.2 Artificial illumination

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

3.2.3 Terrain contrast

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

3.3 Aircraft considerations

3.3.1 Lighting

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

3.3.2 Cockpit ergonomics

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

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

3.3.3 Windshield reflectivity

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

3.4 Generic operating considerations

This section lists operating topics and procedures, which should be considered when employing NVIS. The list and associated comments are not to be considered all inclusive. NVIS operations vary in scope widely and this section is not intended to instruct a prospective operator on how to implement an NVIS programme.

3.4.1 Normal procedures

3.4.1.1 Scanning

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

3.4.1.1.1 Instrument crosscheck scan

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

3.4.1.1.2 NVG scan

To counteract the limited field of view, pilots should continually scan throughout the field of regard. This allows aircrew to build a mental image of the surrounding environment. How quickly the outside scene is scanned to update the mental image is determined by many variables. For example, when flying over flat terrain where the highest obstacle is below the flight path, the scan may be fairly slow. However, if flying low altitude in mountainous terrain, the scan will be more aggressive and rapid due to the presence of more information and the increased risk. How much of the field of regard to scan is also determined by many variables. For example, if a pilot is anticipating a turn, more attention may be placed in the area around the turn point, or in the direction of the new heading. In this situation, the scan will be limited briefly to only a portion of the field of regard.

As with the instrument scan, it is very important to plan ahead. It may, for example, be possible to determine when the scan may be interrupted due to other tasks, when it may be possible to become fixated on a specific task, or when it is important to maximise the outside scan. An important lesson to learn regarding the NVG scan is when not to rely on visual information. It is easy to overestimate how well one can see with NVG, especially on high illumination nights, and it is vital to maintain a constant awareness regarding their limitations. This should be pointed out often during training and, as a reminder, should be included as a briefing item for NVG flights.

3.4.1.1.3 Unaided scan

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

3.4.1.1.4 Scan patterns

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

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

3.4.1.2 Pre-flight planning

3.4.1.2.1 Illumination criteria

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

3.4.1.2.2 NVIS operations

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

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

3.4.1.2.3 Aircraft pre-flight

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

3.4.1.2.4 Equipment

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

3.4.1.2.5 Risk assessment

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

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

3.4.1.3 Flight operations

4.4.1.3.1 Elevated terrain

Safety may 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 pilot to make alternate flight path decisions.

3.4.1.3.2 Over-water

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

3.4.1.4 Remote area considerations

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

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

3.4.1.5 Reconnaissance

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

3.4.1.6 Sources of high illumination

Sources of direct high illumination may 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.

3.4.2 Emergency procedures

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

3.4.3 Inadvertent IMC

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

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

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

4 Training

To provide an appropriate level of safety, training procedures must accommodate the capabilities and limitations of the systems described in Section 3 of this GM as well as the restraints of the operational environment.

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

5. Continuing airworthiness

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

Acronyms used in this GM

AC	Advisory Circular
AGL	above ground level
ATC	air traffic control
CONOPs	concept of operations
CG	centre of gravity
CRM	cockpit resource management
DOD	Department of Defence
DOT	Department of Transportation
EFIS	electronic flight instrumentation systems
EMS	emergency medical service
FAA	Federal Aviation Administration
FLIR	forward looking infrared radar
FOR	field of regard
FOV	field of view
GEN	generation
HUD	head-up display
IFR	instrument flight rules
IMC	instrument meteorological conditions
IR	infrared
JAA	Joint Aviation Authorities
MOPS	Minimum Operational Performance Standard
NAS	national airspace system
NOTAMS	Notices to Airmen
NVD	night vision device
NVED	night vision enhancement device
NVG	night vision goggles
NVIS	night vision imaging system
SC	special committee

TFR	temporary flight restrictions
VA	visual acuity
VFR	visual flight rules
VMC	visual meteorological conditions

Glossary of terms used in this GM

1. ’Absorptance’: the ratio of the radiant energy absorbed by a body to that incident upon it.
2. ’Albedo’: the ratio of the amount of light reflected from a surface to the amount of incident light.
3. ‘Automatic brightness control (ABC)’: one of the automatic gain control circuits found in second and third generation NVG devices. It attempts to provide consistent image output brightness by automatic control of the micro channel plate voltage.
4. ‘Automatic gain control (AGC)’: comprised of the automatic brightness control and bright source protection circuits. Is designed to maintain image brightness and protect the user and the image tube from excessive light levels. This is accomplished by controlling the gain of the intensifier tube.
5. ‘Blackbody’: an ideal body of surface that completely absorbs all radiant energy falling upon with no reflection.
6. ‘Blooming’: common term used to denote the “washing out” of all or part of the NVG image due to de-gaining of the image intensifier tube when a bright light source is in or near the NVG field of view.
7. ‘Bright source protection (BSP)’: protective feature associated with second and third generation NVG that protects the intensifier tube and the user by controlling the voltage at the photo cathode.
8. ‘Brownout’: condition created by blowing sand, dust, etc., which can cause the pilots to lose sight of the ground. This is most commonly associated with landings in the desert or in dusty LZs.
9. ‘Civil nautical twilight’: the time when the true altitude of the centre of the sun is six degrees below the horizon. Illuminance level is approximately 3.40 lux and is above the usable level for NVG operations.
10. ‘Diopter’: a measure of the refractive (light bending) power of a lens.
11. ‘Electro-optics (EO)’: the term used to describe the interaction between optics and electronics, leading to transformation of electrical energy into light or vice versa.
12. ‘Electroluminescent (EL)’: referring to light emission that occurs from application of an alternating current to a layer of phosphor.
13. ‘Foot-candle’: a measure of illuminance; specifically, the illuminance of a surface upon which one lumen is falling per square foot.
14. ‘Foot-Lambert’: a measure of luminance; specifically the luminance of a surface that is receiving an illuminance of one foot-candle.

15. ‘Gain’: when referring to an image intensification tube, the ratio of the brightness of the output in units of foot-lambert, compared to the illumination of the input in foot-candles. A typical value for a GEN III tube is 25,000 to 30,000 Fl/fc. A “tube gain” of 30,000 Fl/fc provides an approximate “system gain” of 3,000. This means that the intensified NVG image is 3,000 times brighter to the aided eye than that of the unaided eye.
16. ‘Illuminance’: also referred to as illumination. The amount, ratio or density of light that strikes a surface at any given point.
17. ‘Image intensifier’: an electro-optic device used to detect and intensify optical images in the visible and near infrared region of the electromagnetic spectrum for the purpose of providing visible images. The component that actually performs the intensification process in a NVG. This component is composed of the photo cathode, MCP, screen optic, and power supply. It does not include the objective and eyepiece lenses.
18. ‘Incandescent’: refers to a source that emits light based on thermal excitation, i.e., heating by an electrical current, resulting in a very broad spectrum of energy that is dependent primarily on the temperature of the filament.
19. ‘Infrared’: that portion of the electromagnetic spectrum in which wavelengths range from 0.7 microns to 1 mm. This segment is further divided into near infrared (0.7-3.0 microns), mid infrared (3.0-6.0 microns), far infrared (6.0-15 microns), and extreme infrared (15 microns-1 mm). A NVG is sensitive to near infrared wavelengths approaching 0.9 microns.
20. ‘Irradiance’: the radiant flux density incident on a surface. For the purpose of this document the terms irradiance and illuminance shall be interchangeable.
21. ’Lumen’: a measurement of luminous flux equal to the light emitted in a unit solid angle by a uniform point source of one candle intensity.
22. ’Luminance’: the luminous intensity (reflected light) of a surface in a given direction per unit of projected area. This is the energy used by NVG.
23. ’Lux’: a unit measurement of illumination. The illuminance produced on a surface that is one-meter square, from a uniform point source of one candle intensity, or one lumen per square meter.
24. ‘Microchannel plate’: a wafer containing between 3 and 6 million specially treated microscopic glass tubes designed to multiply electrons passing from the photo cathode to the phosphor screen in second and third generation intensifier tubes.
25. ‘Micron’: a unit of measure commonly used to express wavelength in the infrared region; equal to one millionth of a meter.
26. ‘Nanometer (nm)’: a unit of measure commonly used to express wavelength in the visible and near infrared region; equal to one billionth of a meter.
27. ‘Night vision device (NVD)’: an electro-optical device used to provide a visible image using the electromagnetic energy available at night.
28. ‘Photon’: a quantum (basic unit) of radiant energy (light).
29. ‘Photopic vision’: vision produced as a result of the response of the cones in the retina as the eye achieves a light adapted state (commonly referred to as day vision).

30. 'Radiance': the flux density of radiant energy reflected from a surface. For the purposes of this manual the terms radiance and luminance shall be interchangeable.
31. 'Reflectivity': the fraction of energy reflected from a surface.
32. 'Scotopic vision': that vision produced as a result of the response of the rods in the retina as the eye achieves a dark-adapted state (commonly referred to as night vision).
33. 'Situational awareness (SA)': degree of perceptual accuracy achieved in the comprehension of all factors affecting an aircraft and crew at a given time.
34. 'Starlight': the illuminance provided by the available (observable) stars in a subject hemisphere. The stars provide approximately 0.00022 lux ground illuminance on a clear night. This illuminance is equivalent to about one-quarter of the actual light from the night sky with no moon.
35. 'Stereopsis': visual system binocular cues that are used for distance estimation and depth perception. Three dimensional visual perception of objects. The use of NVG seriously degrades this aspect of near-depth perception.
36. 'Transmittance': the fraction of radiant energy that is transmitted through a layer of absorbing material placed in its path.
37. 'Ultraviolet': that portion of the electromagnetic spectrum in which wavelengths range between 0.1 and 0.4 microns.
38. 'Wavelength': the distance in the line of advance of a wave from any one point to the next point of corresponding phase; is used to express electromagnetic energy including IR and visible light.
39. 'Whiteout': a condition similar to brownout but caused by blowing snow.

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Subpart I – Helicopter hoist operations

AMC1-SPA.HHO.110(a) Equipment requirements for HHO

AIRWORTHINESS APPROVAL FOR HUMAN EXTERNAL CARGO

1. Hoist installations that have been certificated according to any of the following standards should be considered to satisfy the airworthiness criteria for human external cargo (HEC) operations:
   a. CS 27.865 or CS 29.865;
   b. JAR 27 Amendment 2 (27.865) or JAR 29 Amendment 2 (29.865) or later;
   c. FAR 27 Amendment 36 (27.865) or later - including compliance with CS 27.865(c)(6); or
   d. FAR 29 Amendment 43 (29.865) or later.
2. Hoist installations that have been certificated prior to the issuance of the airworthiness criteria for HEC as defined in 1. may be considered as eligible for HHO provided that following a risk assessment either:
   a. the service history of the hoist installation is found satisfactory to the competent authority; or
   b. for hoist installations with an unsatisfactory service history, additional substantiation to allow acceptance by the competent authority should be provided by the hoist installation certificate holder (TC or STC) on the basis of the following requirements:
      i. The hoist installation should withstand a force equal to a limit static load factor of 3.5, or some lower load factor, not less than 2.5, demonstrated to be the maximum load factor expected during hoist operations, multiplied by the maximum authorised external load.
      ii. The reliability of the primary and back-up quick release systems at helicopter level should be established and failure mode and effect analysis at equipment level should be available. The assessment of the design of the primary and back-up quick release systems should consider any failure that could be induced by a failure mode of any other electrical or mechanical rotorcraft system.
      iii. The operations or flight manual contains one-engine-inoperative (OEI) hover performance data and procedures for the weights, altitudes, and temperatures throughout the flight envelope for which hoist operations are accepted.
      iv. Information concerning the inspection intervals and retirement life of the hoist cable should be provided in the instructions for continued airworthiness.
      v. Any airworthiness issue reported from incidents or accidents and not addressed by i., ii., iii. and iv. should be addressed.

AMC1-SPA.HHO.130(a)(2) Crew requirements for HHO

RELEVANT EXPERIENCE

The experience considered should take into account the geographical characteristics (sea, mountain, big cities with heavy traffic, etc.).

AMC1-SPA.HHO.130(a)(5) Crew requirements for HHO

CRITERIA FOR TWO PILOT HHO

A crew of two pilots should be used when:

1. the weather conditions are below visual flight rules (VFR) minima at the offshore vessel or structure;
2. there are adverse weather conditions at the HHO site (i.e. turbulence, vessel movement, visibility); and
3. the type of helicopter requires a second pilot to be carried because of:
    - i. cockpit visibility;
    - ii. handling characteristics; or
    - iii lack of automatic flight control systems.

AMC1-SPA.HHO.130(f)(1) Crew requirements for HHO

TRAINING AND CHECKING SYLLABUS

1. The flight crew training syllabus should include the following items:
    - a. fitting and use of the hoist;
    - b. preparing the helicopter and hoist equipment for HHO;
    - c. normal and emergency hoist procedures by day and, when required, by night;
    - d. crew coordination concepts specific to HHO;
    - e. practice of HHO procedures; and
    - f. the dangers of static electricity discharge.
2. The flight crew checking syllabus should include:
    - a. proficiency checks, which should include procedures likely to be used at HHO sites with special emphasis on:
        - i. local area meteorology;
        - ii. HHO flight planning;
        - iii. HHO departures;
        - iv. a transition to and from the hover at the HHO site;
        - v. normal and simulated emergency HHO procedures; and
        - vi. crew coordination.

3. HHO technical crew members should be trained and checked in the following items:
   a. duties in the HHO role;
   b. fitting and use of the hoist;
   c. operation of hoist equipment;
   d. preparing the helicopter and specialist equipment for HHO;
   e. normal and emergency procedures;
   f. crew coordination concepts specific to HHO;
   g. operation of inter-communication and radio equipment;
   h. knowledge of emergency hoist equipment;
   i. techniques for handling HHO passengers;
   j. effect of the movement of personnel on the centre of gravity and mass during HHO;
   k. effect of the movement of personnel on performance during normal and emergency flight conditions;
   l. techniques for guiding pilots over HHO sites;
   m. awareness of specific dangers relating to the operating environment; and
   n. the dangers of static electricity discharge.

AMC1-SPA.HHO.140 Information and documentation

OPERATIONS MANUAL

The operations manual should include:

1. performance criteria;
2. if applicable, the conditions under which offshore HHO transfer may be conducted including the relevant limitations on vessel movement and wind speed;
3. the weather limitations for HHO.
4. the criteria for determining the minimum size of the HHO site, appropriate to the task;
5. the procedures for determining minimum crew; and
6. the method by which crew members record hoist cycles.

Subpart J - Helicopter emergency medical service operations

GM1-SPA.HEMS.100(a) Helicopter emergency medical service (HEMS)operations

THE HEMS PHILOSOPHY

1. Introduction

   This GM outlines the HEMS philosophy. Starting with a description of acceptable risk and introducing a taxonomy used in other industries, it describes how risk has been addressed in this Subpart to provide a system of safety to the appropriate standard. It discusses the difference between HEMS and air ambulance - in regulatory terms. It also discusses the application of operations to public interest sites in the HEMS context.

2. Acceptable risk

   The broad aim of any aviation legislation is to permit the widest spectrum of operations with the minimum risk. In fact it may be worth considering who/what is at risk and who/what is being protected. In this view three groups are being protected:

   a. third parties (including property) - highest protection;

   b. passengers (including patients);

   c. crew members (including technical crew members) – lowest.

   It is for the Legislator to facilitate a method for the assessment of risk - or as it is more commonly known, safety management (refer to Part-OR).

3. Risk management

   Safety management textbooks[1] describe four different approaches to the management of risk. All but the first have been used in the production of this section and, if it is considered that the engine failure accountability of performance class 1 equates to zero risk, then all four are used (this of course is not strictly true as there are a number of helicopter parts - such as the tail rotor which, due to a lack of redundancy, cannot satisfy the criteria):

   a. Applying the taxonomy to HEMS gives:

      i. zero risk; no risk of accident with a harmful consequence – performance class 1 (within the qualification stated above) - the HEMS operating base.

      ii. de minimis; minimised to an acceptable safety target - for example the exposure time concept where the target is less than 5×10^{-8} (in the case of elevated final approach and take-off areas (elevated FATOs) at hospitals in a congested hostile environment the risk is contained to the deck edge strike case - and so in effect minimised to an exposure of seconds).

[1] Managing the Risks of Organizational Accidents – Professor James Reason.

iii. comparative risk; comparison to other exposure - the carriage of a patient with a spinal injury in an ambulance that is subject to ground effect compared to the risk of a HEMS flight (consequential and comparative risk).

iv. as low as reasonably practicable; where additional controls are not economically or reasonably practicable - operations at the HEMS operating site (the accident site).

b. HEMS operations are conducted in accordance with the requirements contained in Part-CAT and Part-OR, except for the variations contained in SPA.HEMS, for which a specific approval is required. In simple terms there are three areas in HEMS operations where risk, beyond that allowed in Part-CAT and Part-OR are identified and related risks accepted:

i. in the en-route phase, where alleviation is given from height and visibility rules;

ii. at the accident site, where alleviation is given from the performance and size requirement; and

iii. at an elevated hospital site in a congested hostile environment, where alleviation is given from the deck edge strike - providing elements of the CAT.POL.H.305 are satisfied.

In mitigation against these additional and considered risks, experience levels are set, specialist training is required (such as instrument training to compensate for the increased risk of inadvertent entry into cloud); and operation with two crew (two pilots, or one pilot and a HEMS technical crew member) is mandated. (HEMS crews - including medical passengers - are also expected to operate in accordance with good crew resource management (CRM) principles.)

4. Air ambulance

In regulatory terms, air ambulance is considered to be a normal transport task where the risk is no higher than for operations to the full OPS.CAT and Part-OR compliance. This is not intended to contradict/complement medical terminology but is simply a statement of policy; none of the risk elements of HEMS should be extant and therefore none of the additional requirements of HEMS need be applied.

To provide a road ambulance analogy:

a. if called to an emergency; an ambulance would proceed at great speed, sounding its siren and proceeding against traffic lights - thus matching the risk of operation to the risk of a potential death (= HEMS operations).

b. for a transfer of a patient (or equipment) where life and death (or consequential injury of ground transport) is not an issue; the journey would be conducted without sirens and within normal rules of motoring - once again matching the risk to the task (= air ambulance operations).

The underlying principle is; the aviation risk should be proportionate to the task.

It is for the medical professional to decide between HEMS or air ambulance - not the pilot! For that reason, medical staff who undertake to task medical sorties should be fully aware of the additional risks that are (potentially) present under

HEMS operations (and the pre-requisite for the operator to hold a HEMS approval). (For example in some countries, hospitals have principal and alternative sites. The patient may be landed at the safer alternative site (usually in the grounds of the hospital) thus eliminating risk - against the small inconvenience of a short ambulance transfer from the site to the hospital.)

Once the decision between HEMS or air ambulance has been taken by the medical professional, the commander makes an operational judgement over the conduct of the flight.

Simplistically, the above type of air ambulance operations could be conducted by any operator holding an AOC (HEMS operators hold an AOC) - and usually are when the carriage of medical supplies (equipment, blood, organs, drugs etc.) is undertaken and when urgency is not an issue.

5. Operating under a HEMS approval

There are only two possibilities; transportation as passengers or cargo under the full auspices of OPS.CAT and Part-OR (this does not permit any of the alleviations of part OPS.SPA.HEMS - landing and take-off performance should be in compliance with the performance Subparts of Part OPS.CAT); or operations under a HEMS approval as contained in this subpart.

6. HEMS operational sites

The HEMS philosophy attributes the appropriate levels of risk for each operational site; this is derived from practical considerations and in consideration of the probability of use. The risk is expected to be inversely proportional to the amount of use of the site. The types of site are:

a. HEMS operating base: from which all operations will start and finish. There is a high probability of a large number of take-offs and landings at this HEMS operating base and for that reason no alleviation from operating procedures or performance rules are contained in this subpart.

b. HEMS operating site: because this is the primary pick up site related to an incident or accident, its use can never be pre-planned and therefore attracts alleviations from operating procedures and performance rules, when appropriate.

c. The hospital site: is usually at ground level in hospital grounds or, if elevated, on a hospital building. It may have been established during a period when performance criteria were not a consideration. The amount of use of such sites depends on their location and their facilities; normally, it will be greater than that of the HEMS operating site but less than for a HEMS operating base. Such sites attract some alleviation under this subpart.

7. Problems with hospital sites

During implementation of the original HEMS rules contained in JAR-OPS 3, it was established that a number of States had encountered problems with the impact of performance rules where helicopters were operated for HEMS. Although States accept that progress should be made towards operations where risks associated with a critical engine failure are eliminated, or limited by the exposure time concept, a number of landing sites exist which do not (or never can) allow operations to performance class 1 or 2 requirements.

These sites are generally found in a congested hostile environment:

a. in the grounds of hospitals; or

b. on hospital buildings.

The problem of hospital sites is mainly historical and, whilst the authority could insist that such sites not be used - or used at such a low weight that critical engine failure performance is assured, it would seriously curtail a number of existing operations.

Even though the rule for the use of such sites in hospital grounds for HEMS operations attracts alleviation, it is only partial and will still impact upon present operations.

Because such operations are performed in the public interest, it was felt that the authority should be able to exercise its discretion so as to allow continued use of such sites provided that it is satisfied that an adequate level of safety can be maintained - notwithstanding that the site does not allow operations to performance class 1 or 2 standards. However, it is in the interest of continuing improvements in safety that the alleviation of such operations be constrained to existing sites, and for a limited period.

It is felt that the use of public interest sites should be controlled. This will require that a State directory of sites be kept and approval given only when the operator has an entry in the route manual section of the operations manual.

The directory (and the entry in the operations manual) should contain for each approved site:

i. the dimensions;

ii. any non-conformance with Annex 14;

iii. the main risks; and

iv. the contingency plan should an incident occur.

Each entry should also contain a diagram (or annotated photograph) showing the main aspects of the site.

8. Summary

In summary, the following points are considered to be germane to the HEMS philosophy and HEMS regulations:

a. absolute levels of safety are conditioned by society;

b. potential risk must only be to a level proportionate to the task;

c. protection is afforded at levels appropriate to the occupants;

d. this subpart addresses a number of risk areas and mitigation is built in;

e. only HEMS operations are dealt with by this section;

f. there are three main categories of HEMS sites and each is addressed appropriately; and

g. State alleviation from the requirement at a hospital site is available but such alleviations should be strictly controlled by a system of registration.

GM1-SPA.HEMS.120 HEMS Operating Minima

REDUCED VISIBILITY

(a) In the rule the ability to reduce the visibility for short periods has been included. This will allow the commander to assess the risk of flying temporarily into reduced visibility against the need to provide emergency medical service, taking into account the advisory speeds included in Table 1. Since every situation is different it was not felt appropriate to define the short period in terms of absolute figures. It is for the commander to assess the aviation risk to third parties, the crew and the aircraft such that it is proportionate to the task, using the principles of GM1-SPA.HEMS.100(a).

(b) When flight with a visibility of less than 5 km is permitted, the forward visibility should not be less than the distance travelled by the helicopter in 30 seconds so as to allow adequate opportunity to see and avoid obstacles (see table below).

Table 1: Operating minima – reduced visibility

Visibility (m)	Advisory speed (kt)
800	50
1 500	100
2 000	120

GM1-SPA.HEMS.125(b)(2) Performance requirements for HEMS operations

PERFORMANCE CLASS 2 OPERATIONS AT A HEMS OPERATING SITE

As the risk profile at a HEMS operating site is already well known, operations without an assured safe forced landing capability do not need a separate approval and the requirements does not call for the additional risk assessment that is specified in CAT.POL.H.305, (b)(1).

AMC1-SPA.HEMS.125(b)(3) Performance requirements for HEMS operations

HEMS OPERATING SITE DIMENSIONS

1. When selecting a HEMS operating site it should have a minimum dimension of at least 2 x D (the largest dimensions of the helicopter when the rotors are turning). For night operations, unsurveyed HEMS operating sites should have dimensions of at least 4 x D in length and 2 x D in width.

2. For night operations, the illumination may be either from the ground or from the helicopter.

AMC1-SPA.HEMS.130(a)(2) Crew requirements for HEMS operations

EXPERIENCE

The minimum experience level for a commander conducting HEMS flights should take into account the geographical characteristics of the operation (sea, mountain, big cities with heavy traffic, etc.).

AMC1-SPA.HEMS.130(a)(4) Crew requirements for HEMS operations

RECENCY

This recency may be obtained in a visual flight rules (VFR) helicopter using vision limiting devices such as goggles or screens, or in an FSTD.

AMC1-SPA.HEMS.130(e)(2) (ii)(B) Crew requirements for HEMS operations

FLIGHT FOLLOWING SYSTEM

A flight following system is a system providing contact with the helicopter throughout its operational area.

AMC1-SPA.HEMS.130(e) Crew requirements for HEMS operations

HEMS TECHNICAL CREW MEMBER

1. When the crew is composed of one pilot and one HEMS technical crew member, the latter should be seated in the front seat (co-pilot seat) during the flight, so as to be able to carry out his/her primary task of assisting the commander in:
   a. collision avoidance;
   b. the selection of the landing site; and
   c. the detection of obstacles during approach and take-off phases.
2. The commander may delegate other aviation tasks to the HEMS technical crew member, as necessary:
   a. assistance in navigation;
   b. assistance in radio communication/radio navigation means selection;
   c. reading of checklists; and
   d. monitoring of parameters.
3. The commander may also delegate to the HEMS technical crew member tasks on the ground:
   a. assistance in preparing the helicopter and dedicated medical specialist equipment for subsequent HEMS departure; or
   b. assistance in the application of safety measures during ground operations with rotors turning (including: crowd control, embarking and disembarking of passengers, refuelling etc.).

4. There may be exceptional circumstances when it is not possible for the HEMS technical crew member to carry out his/her primary task as defined under 1. above.

   This is to be regarded as exceptional and is only to be conducted at the discretion of the pilot-in-command/commander, taking into account the dimensions and environment of the HEMS operating site.)

5. When two pilots are carried, there is no requirement for a HEMS technical crew member, provided that the pilot monitoring performs the aviation tasks of a technical crew member.

GM1-SPA.HEMS.130(e)(2)(ii) Crew requirements for HEMS operations

SPECIFIC GEOGRAPHICAL AREAS

In defining those specific geographical areas, the operator should take account of the cultural lighting and topography. In those areas where the cultural lighting an topography make it unlikely that the visual cues would degrade sufficiently to make flying of the aircraft problematical, a HEMS technical crew member is assumed to be able to sufficiently assist the pilot, since under such circumstances instrument and control monitoring would not be required. In those cases where instrument and control monitoring would be required the operations should be conducted with two pilots.

AMC1-SPA.HEMS.130(f)(1) Crew requirements for HEMS operations

TRAINING AND CHECKING SYLLABUS

1. The flight crew training syllabus should include the following items:
   a. meteorological training concentrating on the understanding and interpretation of available weather information;
   b. preparing the helicopter and specialist medical equipment for subsequent HEMS departure;
   c. practice of HEMS departures;
   d. the assessment from the air of the suitability of HEMS operating sites; and
   e. the medical effects air transport may have on the patient.
2. The flight crew checking syllabus should include:
   a. proficiency checks, which should include landing and take-off profiles likely to be used at HEMS operating sites; and
   b. line checks, with special emphasis on the following:
      i. local area meteorology;
      ii. HEMS flight planning;
      iii. HEMS departures;
      iv. the selection from the air of HEMS operating sites;
      v. low level flight in poor weather; and
      vi. familiarity with established HEMS operating sites in the operator’s local area register.

3. HHO technical crew members should be trained and checked in the following items:
   a. duties in the HEMS role;
   b. map reading, navigation aid- principles and use;
   c. operation of radio equipment;
   d. use of on board medical equipment;
   e. preparing the helicopter and specialist medical equipment for subsequent HEMS departure;
   f. instrument reading, warnings, use of normal and emergency checklists in assistance of the pilot as required;
   g. basic understanding of the helicopter type in terms of location and design of normal and emergency systems and equipment;
   h. crew coordination;
   i. practice of response to HEMS call out;
   j. conducting refuelling and rotors running refuelling;
   k. HEMS operating site selection and use;
   l. techniques for handling patients, the medical consequences of air transport and some knowledge of hospital casualty reception;
   m. marshalling signals;
   n. underslung load operations as appropriate;
   o. winch operations as appropriate;
   p. the dangers to self and others of rotor running helicopters including loading of patients; and
   q. the use of the helicopter inter-communications system.

AMC1-SPA.HEMS.130(f)(2)(ii)(B) Crew requirements for HEMS operations

LINE CHECKS

Where due to the size, the configuration, or the performance of the helicopter, the line check cannot be conducted on an operational flight, it may be conducted on a specially arranged representative flight. This flight may be immediately adjacent to, but not simultaneous with, one of the biannual proficiency checks.

AMC1-SPA.HEMS.135(a) HEMS medical passenger and other personnel briefing

HEMS MEDICAL PASSENGER BRIEFING

The briefing should ensure that the medical passenger understands his/her role in the operation, which includes:

1. familiarisation with the helicopter type(s) operated;
2. entry and exit under normal and emergency conditions both for self and patients;

3. use of the relevant onboard specialist medical equipment;
4. the need for the commander's approval prior to use of specialised equipment;
5. method of supervision of other medical staff;
6. the use of helicopter inter-communication systems; and
7. location and use of on board fire extinguishers.

AMC2-SPA.HEMS.135(a) HEMS medical passenger and other personnel briefing

HEMS MEDICAL PASSENGER BRIEFING

The operator may also make use of a training programme as mentioned in AMC1-CAT.OP.AH.170.

AMC1-SPA.HEMS.135(b) HEMS medical passenger and other personnel briefing

GROUND EMERGENCY SERVICE PERSONNEL

1. The task of training large numbers of emergency service personnel is formidable. Wherever possible, helicopter operators should afford every assistance to those persons responsible for training emergency service personnel in HEMS support. This can be achieved by various means, such as, but not limited to, the production of flyers, publication of relevant information on the operator's web site and provision of extracts from the operations manual.
   2. The elements that should be covered include:
   a. two-way radio communication procedures with helicopters;
   b. the selection of suitable HEMS operating sites for HEMS flights;
   c. the physical danger areas of helicopters;
   d. crowd control in respect of helicopter operations; and
   e. the evacuation of helicopter occupants following an on-site helicopter accident.

AMC1-SPA.HEMS.140 Information and documentation

OPERATIONS MANUAL

The operations manual should include:

1. the use of portable equipment on board;
2. guidance on take-off and landing procedures at previously unsurveyed HEMS operating sites;
3. the final reserve fuel, in accordance with SPA.HEMS.150;
4. operating minima;
5. recommended routes for regular flights to surveyed sites, including the minimum flight altitude;

6. guidance for the selection of the HEMS operating site in case of a flight to an unsurveyed site;
7. the safety altitude for the area overflown; and
8. procedures to be followed in case of inadvertent entry into cloud.