Australian Government
Civil Aviation Safety Authority

ADVISORY CIRCULAR
AC 61-05 v1.1

Night VFR rating

Date December 2022

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Advisory circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory circulars should always be read in conjunction with the relevant regulations.

Audience

This advisory circular (AC) applies to:

- pilots and operators who conduct operations at night under the visual flight rules (VFR)
- flight instructors and flight training operators who conduct training for the grant of night VFR ratings and endorsements and night VFR flight reviews
- pilots who undergo training for the grant of night VFR ratings and endorsements, and participate in night VFR rating flight reviews
- flight examiners who conduct night VFR rating flight tests.

Purpose

The purpose of this AC is to provide guidance on the requirements for the grant of night VFR ratings and endorsement as well as the conduct of operations under night VFR (NVFR). The AC highlights the hazards of night flying and provides advice to pilots and others on how to safely conduct night operations.

This AC does not provide advice on the various specialised operations conducted under NVFR.

For further information

For further information, contact CASA's Airworthiness and Engineering Branch (telephone 131 757).

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Status

This version of the AC is approved by the Branch Manager, Airworthiness and Engineering.

Note: Changes made in the current version are not annotated. The document should be read in full.

Version	Date	Details
v1.1	December 2022	Administrative review only.
v1.0	April 2016	Initial release of this AC which incorporates the former Civil Aviation Advisory Publication (CAAP) 5.13-2.

Contents

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Acronym	Description
AC	Advisory Circular
ADF	automatic direction finder
AH	artificial horizon
AIP ENR	Aeronautical Information Publication – En-route Section
AIP GEN	Aeronautical Information Publication - General
ASI	air speed indicator
ATPL	air transport pilot licence - (A) aeroplane category, (H) helicopter category
ATS	air traffic services
CAAP	Civil Aviation Advisory Publication
CAO	Civil Aviation Order
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
CB	cumulonimbus cloud
CFI (HOO)	chief flying instructor (called 'head of operations' under the CASRs)
CFIT	controlled flight into terrain
COM	Communications
ERC	En-route Chart
ERSA	En-route Supplement Australia
ETA	estimated time of arrival
FAA	Federal Aviation Administration (of the USA)
GNSS	global navigation satellite system
HLS	helicopter landing site
HOO	Head of Operations
ICAO	International Civil Aviation Organization
IF	instrument flight
IFR	instrument flight rules
IMC	instrument meteorological conditions
INTER	Intermittent/intermittently (meteorological)
IR	instrument rating

Acronym	Description
LSALT	lowest safe altitude
MOS	Manual of Standards
MPL	Multi-crew Pilot Licence
NDB	non-directional beacon
NM	nautical mile
NOTAM	notice to airmen
NVFR	night visual flight rules
PAL	pilot-activated lighting (aerodrome)
PIR	private instrument rating
RAIM	receiver autonomous integrity monitoring (GPS)
SOP	standard operating procedure
TEM	threat and error management
TEMPO	temporary/temporarily (meteorological)
TS	thunderstorms
TSO	Technical Service Order
UFIT	uncontrolled flight into terrain
VFR	visual flight rules
VHF	very high frequency (30–300 MHz)
VMC	visual meteorological conditions
VOR	VHF omni-range
VSI	vertical speed indicator

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the civil aviation legislation have been reproduced for ease of reference, these are identified by 'grey shading'. Should there be a discrepancy between a definition given in this AC and the civil aviation legislation, the definition in the legislation prevails.

Term	Definition
Aeroplane/aircraft/helicopter is balanced	The skid ball in the balance indicator is less than a quarter of the ball diameter from the centre.
Aircraft is trimmed/Trims aircraft	The aircraft is trimmed within 10 seconds of achieving stabilised and balanced flight, after an attitude, power or configuration change, so that no control input is required from the pilot to maintain this state.
Approved checklist	A checklist derived from information set out in the Flight Manual or Pilot Operating Handbook, placards or other documents provided with the aircraft, necessary to ensure the safe operation of the aircraft.

Term	Definition
Baro-aiding	When the global navigation satellite system (GNSS) receiver uses barometric data to calculate receiver autonomous integrity monitoring (RAIM).
Closure rate	The apparent speed at which an aeroplane, helicopter or gyroplane moves towards a specified point or object.
Controlled corrective action	Timely and coordinated use of controls, without abrupt manoeuvring, is made to achieve specified performance.
Full panel	Flight instrument array of at least an airspeed indicator, artificial horizon (AH), stabilised heading indicator, vertical speed indicator (VSI), altimeter, turn and balance indicator/turn coordinator and engine power indication.
Partial panel	Flight instrument array of at least a magnetic compass, air speed indicator (ASI), VSI, altimeter, turn and balance indicator/turn coordinator and an engine power indication.
Line-up checks	Line-up checks are performed before take-off with the aircraft lined up on the runway. The checks should include: a. compass and heading indicator are aligned with runway direction b. engine instruments indicating engine within operating limits.
Night	For aviation purposes, night is defines as the period of darkness from the end of evening civil twilight to the beginning of morning civil twilight.
Operational requirements	The effects that weather forecasts, availability and serviceability of radio navigation aids and aerodrome lighting status have on the determination of fuel, holding and alternate aerodrome requirements.
Review and brief	During instrument approaches, to study the instrument approach chart, interpret the instructions and self-brief or brief any crew members/assessors about the conduct of the approach procedure.
Safe/safely	Means that a manoeuvre or flight is completed without injury to people, damage to aircraft or property, or breach of aviation safety regulations while meeting the flights standards specified.
Termination point	The 'termination point' associated with a landing, is the point at which a helicopter terminates the approach to the hover.

1.3 References

Legislation

Legislation is available on the Federal Register of Legislation website https://www.legislation.gov.au/

Document	Title
Part 61	Flight crew licensing
Subpart 61.O	Night VFR ratings
Part 91	General operating and flight rules
Future Part 133	Commercial air transport and aerial work operations (rotorcraft)
Future Part 135	

Document	Title
Part 141	Recreational, private and commercial pilot flight training, other than certain integrated training courses
Part 142	Integrated and multi-crew pilot flight training, contracted recurrent training and contracted checking
CASR Dictionary	
Appendices IV, V and VIII of Civil Aviation Order (CAO) 20.18	Aircraft equipment - basic operational requirements
CAO 29.2	Requirements for night training and aerodromes

Advisory material

CASA's advisory materials are available at https://www.casa.gov.au/publications-and-resources/guidance-materials

Document	Title
CAAP 5.23-1(2)	Multi-engine aeroplane operations and training
CAAP 5.59-1(0)	Teaching and Assessing Single Pilot Human Factors and Threat and Error Management
CAAP 179A-1(1)	Guidelines for Navigation using GNSS
CASA VFR Flight Guide	Visual Flight Rules Guide | Civil Aviation Safety Authority (casa.gov.au)

Other reference material

Federal Aviation Administration (faa.gov)

Home | ATSB

Document	Title
Helicopter Flying Handbook (Federal Aviation Administration – FAA- H-8083-21A	Helicopter Night VFR Operations (pages 13-10)
Avoidable Accidents No. 7 (Australian transport Safety Bureau - Report Number AR-2012-122	Avoidable Accidents No. 7 Visual flight at night accidents: What you can't see can still hurt you

1.4 Forms

CASA's forms are available at http://www.casa.gov.au/forms

Form number	Title
CASA Form 61-2I	Notification of issue of a CASR Part 61 operational rating
CASA Form 61-2AE	Notification of addition of an endorsement to an existing operational rating
CASA Form 61-1505	Night VFR rating - aeroplane/helicopter (flight test report)

2 Night visual flight rules

2.1 Introduction

2.1.1 Flight operations conducted at night under VFR—also known as NVFR operations—are not a common practice internationally, mainly due to weather and terrain factors. Flight at night is more commonly conducted under instrument flight rules (IFR).

2.1.2 Compared to other countries, Australia’s weather and low lowest safe altitudes (LSALT) reduce the risks associated with NVFR operations. Coupled with the need for an NVFR alternative to IFR operations in some rural and remote areas, Australia chooses to have additional rules for NVFR operations and a separate pilot qualification that authorises NVFR cross-country operations.

2.1.3 Notwithstanding the safer operational environment found in Australia, there are additional complexities and risks associated with night flying evidenced by the relatively higher rate of night operation accidents. This supports Australia's rules for night operations and the requirement for pilots to undertake specialised training to enable them to gain a night flying qualification.

2.1.4 NVFR operating conditions vary. There may be times when there is bright moonlight or extensive ground lighting available, making a night operation only a little more difficult than flying in daylight. However, there may be dark night conditions (i.e. without moonlight or significant ground lighting) that can make it very difficult to discern the natural horizon and maintain control of the aircraft by reference to external visual references.

2.1.5 The rules augment visual navigation with navigating using instrument navigation systems. Flight under VFR—by day or night—must be conducted in visual meteorological conditions (VMC) and in compliance with minimum inflight visibility standards and prescribed vertical and horizontal distances from cloud.

2.1.6 NVFR operations are not the same as flying at night under IFR, even though proficiency in instrument flying and use of radio navigation systems is required. It is important to remember that NVFR flight is based on visual procedures in VMC.

2.1.7 CASA strongly recommends that NVFR operations take place only in conditions that allow the pilot to discern a natural visual horizon or where the external environment has sufficient cues for the pilot to continually determine the pitch and roll attitude of the aircraft.

> Under previous regulations, there was an NVFR agricultural rating. The equivalent authorisation under Part 61 is the *night aerial application endorsement*, which is attached to an aerial application rating. This AC does not specifically cover night aerial application operations, although some of the content would be relevant, such as night operations and non-technical skills.

2.1.8 Safety case

2.1.8.1 Night flying accidents are not as frequent as daytime flying accidents; however, significantly less flying is done at night. Statistics indicate that an accident at night is about two-and-a-half times more likely to be fatal than an accident during the day. Further, accidents at night that result from controlled flight into terrain (CFIT) or uncontrolled flight into terrain (UFIT) are very likely to be fatal accidents. Loss of control by pilots flying under NVFR has been a factor in a significant number of fatal accidents.

2.2 Safety issues with NVFR

2.2.1 Darkness considerably reduces the external visual references available to a pilot, making aircraft control and navigation more difficult. When the visual horizon is difficult to see and/or there is a lack of external visual reference, a pilot is much more likely to lose control of the aircraft if flying by visual reference only instead of by cross-reference to instruments. Even if visual reference is available at night, it can often be misleading and can further disorient a pilot attempting to fly visually. Integrating visual and basic instrument flying is essential when flying at night under VFR.

2.2.2 Limited visual cues also make the following operations difficult:

- avoidance of flying into cloud cover
- take-off
- landing
- navigation.

2.2.3 It is also important to understand that the flight visibility given in aviation weather forecasts relates only to the transparency of the atmosphere, not to the visibility of obstructions or terrain at the distances specified. To be visible from an aircraft at night, an object must generally be lit by moonlight or artificial lighting, otherwise objects outside the aircraft cannot be seen, no matter how good the visibility.

2.3 Pilot qualifications

2.3.1 Under Part 61, a pilot is authorised to conduct an NVFR operation if they have either:

- a night VFR rating

  or
- an instrument rating (IR).

In either case, the pilot must also hold the appropriate rating endorsement for the aircraft that is being flown.

2.3.2 Licence holders who do not hold a night VFR rating or an IR may still fly as pilot-in-command at night under VFR subject to the following limitations:

- the licence holder has met the NVFR flight standards for conducting circuits specified in the Part 61 Manual of Standards (MOS)
- the flight is under the direct supervision of a flight instructor nominated by the head of operations (HOO) of a flying school
- the flight takes place within the circuit area of an aerodrome.

3 Night VFR rating - aeroplanes and rotorcraft

3.1 Rating endorsements

3.1.1 A night VFR rating can only be granted if a night VFR endorsement is granted at the same time. A pilot can then obtain additional night VFR endorsements. Table 1[1] describes the available night VFR endorsements and the associated activity authorised.

Table 1: Available night VFR endorsements

Kind of night VFR endorsement	Activity authorised
Single engine aeroplane night VFR endorsement	Pilot an aeroplane of the single engine aeroplane class at night under the VFR
Multi engine aeroplane night VFR endorsement	Pilot an aeroplane at night under the VFR
Helicopter night VFR endorsement	Pilot a helicopter at night under the VFR
Powered lift aircraft night VFR endorsement	Pilot a powered lift aircraft at night under the VFR
Gyroplane night VFR endorsement	Pilot a gyroplane at night under the VFR
Airship night VFR endorsement	Pilot an airship at night under the VFR

3.2 Requirements for grant of rating

3.2.1 Regulation 61.975 specifies that a pilot must meet all of the following requirements to be granted a night VFR rating:

- hold a private, commercial or air transport pilot licence (ATPL)
- meet the requirements for the grant of at least one night VFR endorsement mentioned in paragraph 3.3.1
- as a pilot, have at least 10 hours of aeronautical experience at night in an aircraft or an approved flight simulation training device for the purpose (including at least 5 hours of dual cross-country flight time at night under the VFR in an aircraft).
  - **For aeroplanes**, the dual cross-country flight time must comprise at least two flights, each of which must include at least one landing at an aerodrome, other than the aerodrome from which the flight began, that is remote from extensive ground lighting.
  - **For rotorcraft**, the dual cross-country flight time must comprise at least two flights, each of which must include at least one landing at an aerodrome other than the aerodrome from which the flight began. For rotorcraft not fitted with an autopilot or stabilisation system, the rotorcraft is to be operated with sufficient visual reference to the surface to enable a pilot to maintain the rotorcraft's orientation by the use of visual external cues as a result of lights on the ground or celestial illumination

[1] The list of endorsements and applicable activities is excerpted from regulation 61.980.

– pass the flight test mentioned in Schedule 5 of the Part 61 MOS (see section 4.5 for more information about the NVFR flight test).

3.3 Endorsement requirements

3.3.1 The requirements for the grant of a night VFR endorsement are to:

– complete flight training for the endorsement
– meet the aeronautical experience requirements mentioned in Table 2[2]
– pass the flight test for the endorsement.

Table 2: Aeronautical experience requirements for night VFR endorsements

Night VFR endorsement	Requirements
Single-engine aeroplane night VFR endorsement	At least 5 hours of aeronautical experience[3] at night as pilot of an aeroplane or an approved flight simulation training device for the purpose, including at least one hour of dual flight and one hour of solo night circuits. At least 3 hours of dual instrument time.
Multi-engine aeroplane night VFR endorsement	At least 5 hours of aeronautical experience at night as pilot of a multi-engine aeroplane or an approved flight simulation training device for the purpose, including at least one hour of dual flight and one hour of solo night circuits. At least 3 hours of dual instrument time.
Helicopter night VFR endorsement	At least 10 hours of aeronautical experience at night as pilot of a helicopter or an approved flight simulation training device for the purpose, including at least 3 hours of dual flight and one hour of solo night circuits. At least 3 hours of dual instrument time in a helicopter or approved flight simulation training device for the purpose.
Powered lift aircraft night VFR endorsement	At least 5 hours of aeronautical experience at night as pilot of a helicopter or powered lift aircraft or an approved flight simulation training device for the purpose, including at least 3 hours of dual flight and one hour of solo night circuits. At least 3 hours of dual instrument time.
Gyroplane night VFR endorsement	At least 5 hours of aeronautical experience at night as pilot of a helicopter or gyroplane or an approved flight simulation training device for the purpose, including at least 3 hours of dual flight and one hour of solo night circuits. At least 3 hours of dual instrument time.
Airship night VFR endorsement	At least 5 hours of aeronautical experience at night as pilot of an airship or an approved flight simulation training device for the purpose, including at least 3 hours of dual flight and one hour of solo night circuits.

[2] The night VFR endorsement requirements are excerpted from regulation 61.980.
[3] Aeronautical experience includes flight time in aircraft and flight simulation training devices.

3.3.2 Using an instrument rating

3.3.2.1 The privileges of an IR include piloting an aircraft at night under VFR. The pilot must hold the appropriate instrument endorsement for the aircraft being flown.[4]

3.3.2.2 When a pilot is exercising their IR and conducting a night operation, they must have a current IR and, if the flight involves the carriage of passengers, meet the recent night experience requirements of regulation 61.395.

3.3.3 Using an aeroplane category air transport pilot licence

3.3.3.1 The privileges of the aeroplane category air transport pilot licence (ATPL(A)) include conducting IFR operations and NVFR operations. The pilot must have a current proficiency check and, if the flight involves carrying passengers, meet the recent night experience requirement.

3.3.4 Using a helicopter category air transport pilot licence

3.3.4.1 The privileges of the helicopter category air transport pilot licence (ATPL(H)) do not include conducting IFR operations or NVFR operations. Therefore, the holder of an ATPL(H) must separately hold a current IR or NVFR rating with a helicopter night VFR endorsement and, if the flight involves carrying passengers, meet the night recent experience requirement.

3.3.5 Using a multi-crew pilot licence

3.3.5.1 The privileges of the multi-crew pilot licence (MPL) include conducting IFR operations and NVFR operations as co-pilot. The pilot must have a current proficiency check and, if the flight involves carrying passengers, meet the night recent experience requirement.

3.3.6 Holders of private instrument ratings

3.3.6.1 The holder of a private instrument rating (PIR) must not conduct an NVFR operation without holding a night VFR rating; however, the pilot may conduct an IFR flight at night exercising the privileges of their PIR so long as they hold the night private instrument endorsement.

[4] The list of instrument endorsements can be found in regulation 61.890.

4 Flight training

4.1 Training syllabus

4.1.1 The training syllabus for a night VFR rating should ensure that the pilot gains all of the knowledge and skills necessary to safely operate and navigate an aircraft at night under VFR. This is achieved by training to the competency standards prescribed in Schedule 2 of the Part 61 MOS.

4.1.2 Instructors should note that the aeronautical experience specified in regulations 61.975 and 61.980 is the minimum for the grant of the rating and the applicable endorsement. A training syllabus should be structured by the instructor to ensure that all the night VFR rating competencies are achieved as well as meeting the minimum experience requirements.

4.1.3 If a person already holds a night VFR rating and wants to conduct NVFR operations in an aircraft of another category, they must obtain the night VFR endorsement for that category. This requires the person to:

- complete flight training for the new endorsement
- meet the aeronautical experience specified in the table 3.3.1 above
- pass the endorsement flight test.

These requirements also apply to a multi-engine aeroplane night VFR endorsement where the pilot holds the single-engine aeroplane night VFR endorsement.

4.1.4 A night VFR rating training course must include the fundamentals of navigating using instrument navigation systems. There are various systems available in aircraft ranging from the basic non-directional beacons (NDBs), very high frequency (VHF) omni-range (VOR), and distance measuring equipment to more modern systems that use Global Navigation Satellite Systems (GNSS). Also, instrument configurations vary widely from conventional to glass cockpit systems.

> Part 61 does not specify particular navigation systems for training – it is up to the training operator to decide.

4.1.5 The training must cover:

- how to operate the navigation system
- how to operate malfunctions and failures of the system
- determination of the aircraft’s position
- determination of the aircraft's orientation
- aircraft tracking and homing.

4.1.6 Pilots must be familiar with the systems fitted to their aircraft and their operation. Therefore, consideration must be given to learning how to competently operate all of the systems fitted to the aircraft being flown prior to the flight. Pilots who feel they have knowledge or practical skills gaps should consider undergoing additional training by a suitably qualified instructor. This additional training would be conducted under the general competency requirements of regulation 61.385.

4.2 Aeronautical and underpinning knowledge

4.2.1 There are no mandatory aeronautical knowledge standards prescribed for the night VFR rating. However, there is underpinning knowledge specified for each of the night VFR rating units of competency. Refer to each unit of competency in the Part 61 MOS for a list of underpinning knowledge items.

4.3 Instrument flying

4.3.1 A properly structured training course must provide sufficient training to ensure competency in instrument flying is achieved.

4.3.2 Night operations require proficiency in instrument flight (IF). The competency standards for IF are contained in two units of competency in Section 3 of Schedule 2 of the Part 61 MOS:

- IFF – Full instrument panel manoeuvres
- IFL – Limited instrument panel manoeuvres

4.3.3 Instrument flying skills are intrinsic to night flying; therefore, it is also desirable that IF proficiency be demonstrated before commencing actual night flying.

4.3.4 While NVFR flight must be conducted in VMC, a visual horizon is often not available and a sudden loss of visual reference is also possible (i.e. when turning away from a well-lit area, reduced visibility or even following inadvertent entry into cloud). Night flying training should therefore emphasise the importance of flying the aircraft by reference to the flight instruments integrated with visual flying, even in conditions where external lighting provides adequate visual reference.

4.3.5 NVFR operations are often conducted in single-engine aircraft, in which failure of the vacuum system powering the gyroscopic attitude indicator is a possibility. Instrument flight training should include normal flight manoeuvers and recovery from unusual attitudes using only a partial panel. Training sequences should incorporate scenarios such as:

- no gyroscopic attitude indicator or directional indicator

  or
- a loss of the pressure instruments.

Note: These two scenarios should not be combined in a single exercise.

4.4 Navigation aids

4.4.1 Prior to the introduction of Part 61, night VFR ratings were issued with navigation aid endorsements. The Part 61 night VFR rating doesn't include navigation endorsements—the pilot is responsible for ensuring they are competent to use the navigation systems installed in the aircraft they are flying.

4.4.2 Initial night VFR rating training must include the fundamentals of navigating using instrument navigation systems. Pilots are strongly encouraged to get further training if they plan to fly an aircraft that has unfamiliar navigation systems.

4.5 Training and testing for engine failure in multi-engine aeroplanes

4.5.1 Accident records show that simulation of engine failure in multi-engine aeroplanes at night is a high risk activity and CASA strongly recommends that this exercise not be conducted at night. Engine failure training for night operations in multi-engine aeroplanes is best practiced by day under simulated instrument conditions at a safe height, or in a simulator. Conducting engine failure procedures by day under simulated instrument conditions, or in a simulator, also affords the opportunity to practice engine failure after take-off.

4.6 Instructor qualifications

4.6.1 To be authorised to give night VFR rating training in an aircraft of a particular category, a pilot must hold a current:

- night VFR rating and the appropriate endorsement
- flight instructor rating and the appropriate aircraft category night VFR rating training endorsement.

> For example, to give training in a multi-engine aeroplane, a pilot must hold:
>
> - a night VFR rating
> - a multi-engine aeroplane night VFR endorsement
> - a flight instructor rating with a night VFR rating training (aeroplane) endorsement
> - a multi-engine aeroplane training endorsement.

4.7 Flight test

4.7.1 A night VFR rating flight test must be successfully completed for the grant of the rating and the first night VFR endorsement. Separate flight tests are required each time a new endorsement is required.

4.7.2 CASA Form 61-1505 outlines the content of the flight test.

4.7.3 The flight test for a night VFR rating assesses 4 basic areas of competency:

- flying solely by reference to instruments
- night take-off, circuit and landing
- navigation at night by visual reference (both with and without the use of radio navigation aids)
- non-normal and emergency conditions (simulated).

4.7.4 Units of competency relevant to NVFR operations can be found in Schedule 2 of the Part 61 MOS. The night VFR rating flight test standards are prescribed in Schedule 5 of the MOS.

4.7.5 The IF component of the test may be demonstrated by day or night under simulated instrument conditions. Proficiency needs to be demonstrated by the use of appropriate field-of-vision limiting devices, not external visual references.

4.7.6 Before a night VFR rating flight test is conducted, the flight examiner must be satisfied that the applicant is eligible for the test, and that includes having completed the required training, gained the experience and be certified by the HOO of the training operator that the applicant has met those requirements.

4.7.7 Part of the test will assess aeronautical knowledge on relevant NVFR topics.

5 Maintaining currency

5.1 Recent experience requirements

5.1.1 Before exercising the privileges of a night VFR rating, a pilot must meet recent experience and flight review requirements, as prescribed in Subpart 61.O of the regulations.

5.1.2 The pilot can meet the night recent experience requirement by doing one of the following within the previous 6 months:

- conduct at least 1 take-off and landing at night in an aircraft of the same category or
- be assessed as competent to conduct a flight at night in an aircraft of the same category by a flight instructor who holds a night VFR training endorsement.

5.1.3 If the flight involves the carriage of passengers, then the pilot must have conducted at least 3 take-offs and 3 landings at night in an aircraft of the same category within the previous 90 days.

5.2 Instrument flying recency

5.2.1 While instrument flying proficiency is essential to the safe conduct of night flying, there are no regulated IF recency requirements specified for NVFR operations.

5.2.2 As all night flying requires transition to instrument flying immediately after take-off—at least to a certain extent—a pilot must be confident that their instrument flying skills are sharp before undertaking any flight at night, as there is no opportunity to gradually regain proficiency.

5.2.3 A pilot who holds a night VFR rating but not an IR is not permitted to practice instrument flying in VMC under simulated instrument conditions unless the other pilot is a flight instructor. This limits the opportunities for pilots to practice instrument flying. The following methods are suggested to maintain instrument flying skills:

- practise instrument flying under simulated conditions with a flight instructor
- practise instrument flying in a suitable synthetic flight training device.

5.2.4 Consideration may be given to using a home personal computer running a flight simulator program as a supplement. Such activities have shown to be beneficial in maintaining a minimum level of instrument flying proficiency.

5.2.5 Holders of an IR will need to maintain recency in accordance with the requirements specified under Subpart 61.M.

5.3 Flight review requirements

5.3.1 Pilots must have completed an appropriate night VFR rating flight review within the previous 24 months to be authorised to conduct an NVFR operation.

5.3.2 If a pilot is going to conduct an NVFR operation, the flight review must have been conducted in an aircraft of the same category as the aircraft that will be flown for the

NVFR operation (i.e. if the pilot is going to conduct an NVFR operation in a multi-engine aeroplane then the flight review must have been undertaken in a multi-engine aeroplane).

5.3.3 There are several ways of meeting the flight review requirement. Successful completion of any one of the following satisfies the flight review requirement:

- a flight review for the rating in an aircraft of the same category or an approved flight simulator in the previous 24 months
- a flight test for the initial grant of a night VFR rating, conducted in the previous 24 months
- a flight test for the grant of an additional night VFR endorsement (i.e. pilot already holds the rating), conducted in the previous 24 months, as long as the flight test for the additional night VFR endorsement was conducted more than 6 months after the flight test for the issue of the night VFR rating
- an operator proficiency check, which covers NVFR operations, was conducted within the previous 24 months
- the pilot is successfully participating in an operator's approved training and checking system that covers NVFR operations.

The following is an example of how a pilot meets the requirements:

Jane passes a night VFR rating flight test in a single-engine aeroplane on 15 February 2015. That means Jane can conduct NVFR operations in single-engine aeroplanes until 28 February 2017.

To continue flying aeroplanes under the NVFR after 28 February 2017, Jane will need to complete a night VFR flight review in an aeroplane. The review needs to have been completed within 24 months prior to of the day she conducts the flight.

Jane passes a multi-engine aeroplane night VFR endorsement flight test on 14 April 2015. This does not meet the flight review requirement because it was done within 6 months of doing the initial rating flight test. Therefore, Jane still needs to complete a night VFR rating flight review in an aeroplane to continue flying aeroplanes under the NVFR after 28 February 2017.

If Jane wants to fly multi-engine aeroplanes under the NVFR after 28 February 2017, the flight review will need to have been completed in a multi-engine aeroplane.

If the multi-engine aeroplane night VFR endorsement flight test was done on 20 August 2015 (that is more than 6 months after the initial NVFR flight test), then Jane would be able to fly single-engine and multi-engine aeroplanes under the NVFR up to 31 August 2017.

Jane is a pilot with an operator that conducts night VFR operations. Jane completes the operator's proficiency check and it includes night VFR operations. That means Jane can continue conducting night VFR operations for 24 months after the check is done.

6 Hazards and risks

6.1 Introduction

6.1.1 The limited visual reference available at night introduces additional hazards (or threats) for NVFR pilots and these need to be known and understood so that counter-measures can be adopted to manage the threats.

6.2 Night vision

6.2.1 Good night vision is not the basis for controlling an aircraft, but is necessary for visual navigation, and traffic and weather avoidance.

6.2.2 Dark adaptation

6.2.2.1 The human eye can take up to 30 minutes to fully adjust to darkness. To maintain dark adaptation, lighting levels need to be kept low both before and during flight. Cockpit lighting should be set at the minimum illumination necessary for a pilot to read flight instruments and documentation.

6.2.2.2 The use of red cockpit lighting may assist in maintaining dark adaptation; however, the pilot should be aware that red lines or printing on maps may not be visible.

6.2.2.3 Exposure to bright light will cause the eyes to immediately lose dark adaptation and may cause temporary blindness. If a bright light cannot be avoided, dark adaption can be partially maintained by closing one eye to preserve the adaptation in that eye.

6.2.2.4 Night vision is also adversely affected by lower oxygen levels at altitudes above 4,000 ft and can be further exacerbated by the effects of cigarette smoking.

6.2.3 Scanning

6.2.3.1 Pilots should understand that the eye sees differently at night. Daylight visual receptors in the eye are at the centre of the field of vision, while night receptors are at the periphery. A continuous visual scanning technique should be used at night, as looking directly at an object does not use night vision receptors. However, even with proper scanning and dark adaptation, the human eye is not capable of seeing unlit objects on a dark night.

6.3 Visual illusions

6.3.1 Visual illusions can occur when flying at night or in limited visibility, and have been the cause of a number of loss-of-control accidents.

6.3.2 Common visual illusions and associated hazards that may be encountered at night include:

- **false horizon**—A sloping cloudbank or sloping terrain can create a false perception of the horizon and lead to disorientation. A similar effect can be caused by confusing scattered ground lights with stars.

- **reflections**—Reflections on the inside of the cockpit canopy can be disorienting. Rotorcraft with extensive areas of perspex are particularly prone to this.
- **flicker vertigo**—In some circumstances, flashing lights or flicker effects from propellers and rotorcraft rotor blades are known to cause disorientation.
- **autokinesis**—This results from concentrating on a single light source against a dark background. The eyes need to continually adjust focus to use the night vision receptors, which can cause the light to appear to move erratically. Attempts to align the aircraft with the apparent movement of the light can cause disorientation; continual scanning both inside and outside the aircraft helps to reduce this effect.
- **empty field myopia**—Conditions where there are no discernible objects in view (e.g. on a dark night or in cloud) cause the eyes to lose focus and possibly not see distant objects. Constant scanning inside and outside the aircraft eliminates this problem.
- **landing illusions**, including:
  - black-hole illusion—Occurs at aerodromes where there is little or no ground lighting in the vicinity of the aerodrome to provide visual cues that assist the pilot with depth perception or estimation of height and distance. Studies have shown that when approaching to land under these conditions there is a strong tendency to descend below the correct approach path and undershoot the runway.
  - runway width illusion—Narrow runways can give the pilot an impression of being too high on the approach while wider runways can create the opposite effect.
  - sloping runway—A runway sloping upwards can also give the impression that the approach is too high and a 'down sloping' runway can have the opposite effect.
  - rain on windscreen—This can cause a refraction effect which makes it appear that the aircraft is too high on the approach.

6.3.3 Aeroplane operations

6.3.3.1 The effective method of avoiding or overcoming disorienting visual illusions is to use the flight attitude indicator. When flying at night, it is good practice to always fly by cross reference to instruments, even when external lighting provides good visual cues, because:

- visual illusions can provide misleading information
- visual reference can be suddenly and unexpectedly lost
- flying with reference to instruments helps maintain instrument flying skills.

6.3.4 Rotorcraft operations

6.3.4.1 The pilot must be able to maintain the rotorcraft's orientation by use of visual external cues as a result of lights on the ground or celestial illumination, unless the aircraft is fitted with an autopilot, stabilisation system or is operated by a two-pilot crew.

6.3.4.2 When flying at night, it is good practice to select a route via high visual cueing areas, such as a populated or lighted area, or a major highway or town that will make navigation easier and offer more options in the event of an emergency.

6.4 Black-hole operations

6.4.1 Black-hole conditions exist where insufficient external visual cues are present to allow for aircraft orientation. An approach to land at an aerodrome in 'black-hole' conditions is possibly the most challenging aspect of night flying as there is likely to be insufficient or no ground lighting / ground reflection of ambient lighting on the approach path or in the vicinity of the aerodrome. There have been a number of accidents in Australia where an aircraft has been flown into terrain well below the normal approach path, for no obvious reason other than misjudgement of the aircraft's height or distance from the runway.

6.5 Rotorcraft NVFR flights - additional considerations

6.5.1 While ceiling and visibility significantly affect safety in NVFR operations, lighting conditions also have a profound effect on safety. In conditions where visibility and ceiling are determined to be VMC, the ability to discern unlit or low contrast objects and terrain at night may still be compromised.

6.5.2 The ability to discern objects and terrain, together with their availability, is referred to as the 'visual cueing environment' and is related to the amount of natural and manmade lighting available, and the contrast, reflectivity, and texture of surface terrain and obstruction features.

6.5.3 High visual cueing environment

6.5.3.1 A 'high visual cueing environment' exists when one of the following sets of conditions is present:

- the sky cover is less than broken (i.e. less than 5⁄8 cloud cover), the time is between local moon rise and moon set, and the lunar disk is at least 50 percent illuminated

  or
- the aircraft is operated over surface lighting that, at a minimum, illuminates prominent obstacles, permits identification of terrain features (i.e. shorelines, valleys, hills, mountains, slopes) and allows perception of a horizontal reference by which the pilot may control the rotorcraft.

  For example, surface lighting may be the result of:
  - extensive cultural lighting (manmade, e.g. a built-up area of a city)
  - significant reflected cultural lighting (e.g. the illumination caused by a major metropolitan area’s lighting being reflected off a cloud ceiling)
  - limited cultural lighting combined with a high level of naturally reflected celestial illumination, such as that provided by a snow-covered surface or a desert surface.

6.5.3.2 Some areas may be considered a high visual cueing environment only in specific circumstances. For example, some surfaces normally have little reflectivity—such as a forest with limited cultural lighting—and require significant illumination by moonlight to provide a high visual cueing condition. However, the same forest covered with snow may offer enough reflectivity from starlight to provide a high visual cueing condition.

6.5.3.3 Similarly, a desolate area with little cultural lighting—such as a desert—may have such inherent natural reflectivity that it may be considered a high visual cueing area regardless of season, provided the cloud cover does not prevent starlight from being reflected from the surface.

6.5.3.4 Other surfaces, such as areas of open water, may never have enough reflectivity or cultural lighting to ever be characterised as a high visual cueing environment.

6.5.4 Degraded visual cueing environment

6.5.4.1 A degraded visual cueing environment exists when high visual cueing conditions are not present (i.e. in conditions where the ability to discern objects and terrain is compromised).

6.5.4.2 Operations in a degraded visual cueing environment result in a perceived degradation in the effective rotorcraft handling qualities. The degraded handling qualities result in a substantial increase in pilot workload just to control the rotorcraft, leaving little excess workload capacity to maintain adequate situational awareness. This workload can easily exceed 100 percent of the pilot's capacity, a situation which significantly increases the probability of a serious error.

6.5.4.3 Increased stabilisation has a substantial positive effect on reducing pilot workload in conditions of degraded visual cueing. A stabilisation system or autopilot would be required for certification of a rotorcraft for single pilot operation in a degraded visual cueing environment (e.g. instrument meteorological conditions (IMC)).

6.5.5 Requirements for flight

6.5.5.1 Due to the lack of inherent stability in rotorcraft, it is a requirement for rotorcraft not fitted with an autopilot or stabilisation system, or operated by a two pilot crew; to be operated with sufficient visual reference to the surface to enable a pilot to maintain the rotorcraft's orientation by the use of visual external cues available as a result of lights on the ground or celestial illumination

6.5.5.2 In order to conduct operations safely and legally at night in a rotorcraft, the visual cueing environment must be accounted for in the planning and execution of NVFR rotorcraft operations.

6.5.5.3 Through the accumulation of night flying experience in a particular area, a pilot will develop the ability to determine before departure those areas that can be considered to provide either a high or degraded visual cueing environment. Without that experience, a degraded visual cueing environment should be assumed by pilots for both pre-flight planning and operations until high visual cueing conditions are observed or determined to be regularly available.

6.5.6 Selection of a route via high visual cueing areas—such as a populated or lighted area, or a major highway or town—will not only offer the pilot more options in the event of an emergency but also assist with navigation. A course comprised of slight zigzags to stay close to suitable landing sites and well-lit areas only adds a little more time and distance to an otherwise straight course.

6.5.7 Whilst it is not a requirement for aeroplane night VFR operations, it is strongly recommended that the availability of external cues to aid with aircraft orientation is also considered during the planning and execution of night VFR operations.

6.6 Sensory illusions and spatial disorientation

6.6.1 Flying at night with limited visual reference can produce powerful sensory illusions that can cause even the most experienced pilot to become disoriented. Any pilot intending to fly at night should be familiar with the sensations involved and the methods used to retain orientation.

6.6.2 The sensory systems used by the body to establish orientation are generally classified as:

- visual—the eyes
- vestibular—the inner ear balance organs
- somatic—nerves in the skin, muscles and joints that sense gravity and other pressures on the body.

6.6.3 During visual flight, the visual sense is normally able to correct conflicting signals from the other senses; but when visual reference is unavailable or misleading the other sensory inputs can quickly become flawed.

6.6.4 Sensory illusions are caused by the balance mechanisms of the body being unable to distinguish between normal gravitational forces and those produced by the accelerative forces acting on the aircraft in flight. Because the vestibular and somatic senses cannot distinguish between gravitational force and the accelerative forces felt during flight manoeuvres, pilots relying solely on these senses can quickly become disoriented. In a University of Illinois study[5] of pilots untrained in instrument flight, the average time for the pilots to lose control of an aircraft after losing visual reference was 178 seconds.

6.6.5 The types of sensory illusions commonly encountered in NVFR flight include:

- The leans—this term generally refers to a situation where a balanced turn has been sustained for long enough that the body feels a sensation of level flight. On rolling out of the turn the illusion is a feeling of banking in the opposite direction even though the wings may be level.
- Coriolis—moving the head excessively during instrument flight confuses the balance mechanism in the ears, producing a tumbling sensation. The effect is minimised by scanning with eye movements rather than head movements.
- Somatogravic effects—caused by changes in forward speed that are misinterpreted as feelings of climbing or descending (i.e. the acceleration after take-off can give a sensation of climbing too steeply).

6.6.6 The primary defence against sensory illusions during instrument flight in an aeroplane is to ignore the physical sensations and to maintain orientation by reference to the flight instruments. Attempting to use external visual reference at night can cause further confusion. Correct instrument scanning technique uses the flight attitude indicator (i.e. artificial horizon) in place of the natural horizon as the primary source of attitude

[5] Bryan, L. A, Stonecipher, J and Aron, K, University of Illinois Institute of Aviation: Aeronautics Bulletin Number 11; 180-Degree Turn Experiment.

information. Performance instruments, air-speed indicator (ASI), altimeter (ALT) indicator and vertical speed indicator (VSI) are used to confirm that the attitude being maintained is providing the desired aircraft performance.

6.6.7 In the case of rotorcraft, pilots should plan to operate the rotorcraft only in a visual cueing environment that provides sufficient external visual cues for the pilot to maintain orientation of the rotorcraft.

6.6.8 Using the attitude indicator correctly is a very effective means of overcoming sensory illusions because it provides visual input to correct the other senses. When the attitude indicator is functioning correctly, the horizon bar will be level with the real horizon, and the aircraft symbol will correspond to the attitude of the aircraft in roll and pitch. While this may seem obvious, incorrect interpretation could have disastrous results.

6.6.9 Many private category light aircraft being flown under NVFR have only one attitude indicator and one power source (normally a vacuum pump). Failure of either of these devices will leave the pilot without a direct source of attitude indication. Accordingly, NVFR rating holders should ensure that they also acquire and maintain the skills required to fly on limited panel instruments (i.e. without an attitude indicator or directional indicator).

6.7 Sensory hazards

6.7.1 Pilots who fail to cross-reference flight instruments immediately after take-off expose themselves to the effects of visual and/or spatial disorientation.

6.7.2 Somatogravic illusion is more commonly encountered in high performance aircraft and occurs during take-off and on acceleration to climb speed. The acceleration is incorrectly sensed by the pilot as a feeling of climbing too steeply, leading to a strong urge to lower the nose. A number of accidents where aircraft have been flown into the ground after take-off have been attributed to the somatogravic illusion. Maintaining aircraft attitude and confirming positive rate of climb by reference to instruments is the best method of avoiding this illusion.

6.7.3 Another significant threat on take-off is an aerodrome where the external ground lighting appears to be sufficient to allow the pilot to conduct the take-off and initial climb by visual reference. However, a high nose attitude after take-off or a climbing turn away from the well-lighted area can result in sudden loss of visual reference and rapid disorientation. At low altitude, the margin for recovery is small and a number of accidents have been attributed to this cause.

6.7.4 Transitioning to instrument flight immediately on lift-off should be the standard procedure for all take-offs, and is effective in overcoming take-off illusions.

6.8 Weather

6.8.1 Hazardous weather conditions are more difficult to see and avoid at night, and the risk of inadvertent entry into IMC is greater. In dark night conditions, entry into cloud can be sudden and unexpected. Extensive high cloud cover may also block moonlight and result in dark night conditions. Weather forecasts including moon phase should be carefully studied during pre-flight planning to ensure that the flight can be conducted in VMC.

6.8.2 Cloud forecast and planning

6.8.3 During the pre-planning stage, the pilot should consider the amount of cloud, the cloud base and tops, and the extent of cloud coverage over the intended route. When reviewing forecast cloud, other considerations include:

- Forecast cloud should allow the cruise level to be planned above LSALT and with 1,000 ft clearance below or above the cloud layer(s).
- The planned cruise level should not be at the same level as the cloud layer.
- whether the forecast cloud is below LSALT or below the planned cruising level. Cruise above cloud in VMC is possible but:
  - the pilot must ascertain from the forecast (and other information) that they will be able to climb and descend in VMC, as they need to be very confident that descent in VMC will be possible
  - the pilot must determine how they will navigate, as visual navigation is generally not possible over more than scattered cloud
  - NVFR flight over more than scattered cloud for more than short periods is not advisable, even if VMC can be maintained on top.

6.8.4 Hazardous weather

6.8.5 Pilots should check for fronts, thunderstorms (TS), cumulonimbus (CB) and turbulence. Thunderstorms are easier to see at night due to lightning, but may produce misleading automatic direction finder (ADF) indications.

6.8.6 The pilot must also fly well clear of thunderstorms and avoid planning NVFR flight through areas where thunderstorms are either:

- forecast to be frequent

  or
- aligned along a front or squall line.

6.8.7 Lower temperatures at night may increase the risk of carburettor or airframe ice. Flight above the freezing level may result in airframe icing if the aircraft inadvertently enters cloud. The pilot should take into consideration that:

- light winds, low temperatures and moisture are conducive to fog
- dry and wet bulb temperatures close together on the aerodrome forecast may indicate the probability of fog
- aerodrome lighting that can be easily seen through fog from overhead the aerodrome may be completely obscured on approach to land.

6.8.8 Destination weather

6.8.9 When determining the destination, the pilot should consider the following:

- Does the forecast indicate that a visual approach and landing at the destination in VMC can be undertaken?

- What is the forecast cloud ceiling and visibility at the aerodrome, and is the crosswind within aircraft limitations?
- If destination weather is marginal, are there suitable alternate aerodromes available?

6.9 Flight from VMC into IMC

6.9.1 Due to the difficulty of detecting cloud on a dark night, inadvertent entry into IMC is a real possibility if there is significant cloud cover. Unintended entry into IMC is well recognised as a major contributing factor in many NVFR accidents.

6.9.2 Pre-flight planning must be based on conducting and completing the flight in VMC. To minimise the risk, pilots should plan to avoid flying at levels where cloud is forecast and consider not flying at all if the cloud base is not higher than LSALT + 1,000 ft.

6.9.3 If inadvertent flight into cloud occurs, pilots should follow these steps:

a. do not panic
b. continue to fly on instruments
c. turn pitot heat on (if fitted)
d. turn off flashing or rotating beacon and strobe lights (if disorienting)
e. maintain an altitude above LSALT
f. execute a 180° turn to exit cloud, or continue straight ahead if in CB
g. determine heading, LSALT, navigation and fuel requirements for diversion in VMC to the nearest suitable aerodrome or return to the departure aerodrome
h. if unable to exit cloud, declare an emergency and request assistance as necessary
i. maintain control of the aircraft by reference to instruments as the first priority
j. navigate to establish VMC and land at the nearest suitable aerodrome
k. maintain terrain clearance until established visually in the aerodrome circuit area.

6.9.4 No matter what the emergency or abnormal situation, it is important to broadcast the circumstances using either a ‘Mayday’ or ‘Pan’ call. Do not hesitate to do this and ask for assistance. Air traffic services (ATS) and other aircraft can assist with navigational, weather and technical advice that will reduce the workload and allow the pilot to concentrate on flying the aircraft and resolving the situation safely.

6.10 Controlled flight into terrain

6.10.1 Controlled flight into terrain is the result of a loss of situational awareness and is a significant problem worldwide both in NVFR and IFR operations. The common factor in this type of accident is that, due to the pilot's lack of awareness of either the horizontal or the vertical position of the aircraft, it is flown into the ground or water under full control.

6.10.2 NVFR procedures depend on maintaining a safe height above terrain rather than the pilot's ability to visually avoid terrain, as visual assessment alone is unreliable and hazardous. The pilot should:

- maintain height above LSALT or 1,000 ft above the highest terrain within a 10 nautical mile (NM) radius

- plan departures and arrivals to clear terrain laterally and vertically until above LSALT or within the circuit area
- not go below LSALT on descent until they have positively established that high terrain/obstacles have been passed, then establish the new LSALT for continuation of descent until in the circuit area
- if visual reference is lost, maintain an altitude above LSALT and declare an emergency if visual reference cannot be regained
- maintain situational awareness
- be aware of the direction that is being flown in relation to terrain
- be aware of the LSALT for the route sector
- be aware of the critical terrain and obstacles for the flight
- prepare a 'mud map' as it is particularly useful to aid situational awareness.

6.11 Uncontrolled flight into terrain

6.11.1 Uncontrolled flight into terrain is also a significant cause of night accidents. Triggers leading to spatial disorientation and loss of control can be some or all of the following:

- sudden or unexpected loss of visual reference
- sensory or visual illusions
- unexpected distractions or emergencies
- turbulence.

6.11.2 Maintaining control at night depends on:

- the pilot having current instrument flight skills (including limited panel)
- serviceable instruments
- serviceable lighting.

6.11.3 The pilot should manage all procedures, distractions, abnormal situations and emergencies by making aircraft control the first priority and flying the aircraft by reference to instruments.

6.12 Engine failure

6.12.1 Single-engine failure

6.12.2 Many fatalities following engine failure result from loss of control while attempting to manoeuvre to a suitable landing area.

6.12.3 Engine failure during single-engine aircraft operations is by far the most serious night time emergency. As with day VMC operations, careful pre-flight planning to avoid inhospitable terrain gives the best chance of survival in a single-engine failure emergency.

6.12.4 The same basic principles are applicable to both aeroplanes and rotorcraft:

- Planning to fly at a higher altitude will increase the options available.
- Continuing to fly by reference to instruments is essential to maintaining control.

6.12.5 Configuring the aircraft for optimum glide into wind towards the least inhospitable terrain should be planned with the aim of achieving ground contact in controlled descent at the minimum forward groundspeed. Maintaining control of the aircraft throughout the emergency landing is critical to a successful outcome; the use of landing lights in the final stages may assist in making ground contact and avoiding obstacles.

6.12.6 Multi-engine aircraft

6.12.7 When undertaking pre-flight planning for multi-engine aircraft operations, pilots need to ensure that the aircraft's single-engine service ceiling is higher than the route LSALT, so as to preserve the advantage of having more than one engine. If the aircraft's single-engine performance at the operating weight of a particular flight makes it incapable of reaching a suitable aerodrome following engine failure then the procedures for single-engine aircraft apply.

6.12.8 Maintaining control of the aircraft is essential. Keeping in current practice in asymmetric flight by reference to instruments is the best possible insurance.

6.13 Electrical failure

6.13.1 Electrical failure is a serious but controllable abnormal situation. The electrical generating system should be checked for normal operation before flight and at frequent intervals during flight. Failure to check the system in flight could lead to the pilot being unaware of an electrical failure until the lights go out.

6.13.2 As a backup, it is essential to have an appropriate torch(es) fitted with fresh batteries and ensure it is immediately accessible for use in an emergency.

6.13.3 Instrument lighting, radio communications (COM), navigation equipment and the turn indicator all depend on the electrical system. When a generator or alternator fails, the useful life of the aircraft battery can be extended by turning off unnecessary electrical equipment. It is also advisable to make appropriate radio calls early, while sufficient battery power is still available.

6.13.4 If electrical power is needed to lower flaps or landing gear, then battery conservation is particularly important, as is familiarity with the emergency landing gear extension system.

6.14 Instrument failure

6.14.1 Another serious abnormal situation is the failure of flight instruments, as this can lead to loss of control of the aircraft. Vacuum pump failure is a common cause of instrument failure; therefore, the vacuum gauge should be checked pre-flight and frequently monitored for proper operation.

6.14.2 The attitude indicator is unlikely to fail instantaneously but may give inaccurate indications for a time, which could be disorienting. Any indication of loss of vacuum should be cause to use the attitude indicator with caution. If the attitude indicator is sluggish or topples, the performance of the indicator should be confirmed by reference to the turn coordinator or to the turn and balance indicator. If a fault is detected, it is advisable to cover the attitude indicator to avoid any distraction.

6.14.3 Continued flight is possible using the turn indicator or a standby attitude indicator powered by an alternate power source; however, as a number of fatal uncontrolled flight into terrain accidents attributable to vacuum pump failure have demonstrated, it is essential that the pilot has current practice in instrument flying by reference to a limited instrument panel.

6.14.4 Unreliable pressure instruments can be a special hazard at night as there may not be any external reference to confirm the accuracy of the attitude instruments, and they may provide incorrect data to aircraft with more sophisticated avionics. Scenarios involving failure of pressure instruments should be simulated—either in flight or in a simulator—during training and reviews.

7 Threat and error management

7.1 Concepts

7.1.1 Threat and error management (TEM) is an operational concept that encompasses the traditional role of airmanship, but provides for a structured and proactive approach for pilots to use in identifying and managing threats and errors that may affect the safety of flight operations. TEM uses many tools, including training, standard operating procedures (SOPs), checklists, briefings and crew resource management principles to assist pilots to manage flight with increased safety. TEM is widely accepted in the airline industry as an effective method of improving flight safety and is now required by the International Civil Aviation Organization (ICAO) as an integral part of pilot training at all licence levels, from student to airline transport pilot.

7.1.2 Threats

7.1.2.1 In the TEM model, threats are events whose occurrence is outside the control of the pilot(s) and which may compromise the safety of flight. Threats must be managed to maintain normal flight safety margins. Threats and errors that are not detected and managed correctly can lead to an undesired aircraft state, which is a deviation from flight path or aircraft configuration that reduces normal safety margins. An undesired aircraft state can still be recovered to normal flight but, if not managed appropriately, may lead to an accident or incident.

7.1.2.2 Threats may be anticipated or they may be unexpected, and may even be latent in the operational system. Pilots need to have good situational awareness to anticipate and to recognise threats as they occur. Threats must be managed to maintain normal flight safety margins.

7.1.3 Errors

7.1.3.1 The TEM model accepts that human error is unavoidable. Errors may be intended or unintended actions or inactions on the part of the pilot(s), and can be classified as either handling errors, procedural errors or communications errors. External threats can also lead to errors on the part of the pilot(s). While errors may be inevitable, safety of flight demands that errors that do occur are identified and managed before flight safety margins are compromised.

7.1.4 Countermeasures

7.1.4.1 Good TEM requires the pilot to plan and use appropriate countermeasures to prevent threats and errors from leading to an undesired aircraft state. Countermeasures used in TEM include many standard aviation practices, which may be categorised as:

- **planning countermeasures**, including:
  - flight planning
  - briefing
  - contingency planning
- **execution countermeasures**, including:
  - monitoring

  - o cross checking
  - o workload and automation management
- **review countermeasures**, including:
  - o evaluating and modifying plans as the flight proceeds
  - o inquiry and assertiveness to identify and address threats and errors in a timely way.

7.2 Application of TEM

7.2.1 Threats and errors occur during every flight. This has been demonstrated by the IATA Operational Safety Audit (IOSA) program study in observing threats and errors in flight operations worldwide, which revealed that around 50% of crew errors go undetected.

7.2.2 TEM should be integral to every flight, including anticipation of potential for threats and errors and planning of countermeasures. Pilots should include potential threats and errors, and appropriate countermeasures, in the self-briefing process at each stage of flight. All threats, including those commonly encountered, should be included so as to avoid becoming complacent about threats that are commonly encountered.

7.2.3 Error management requires an acceptance that errors are unavoidable. The use of SOPs, checklists, monitoring and cross checking procedures all help to minimise the risk of errors and assist with the detection and management of those that do occur. Good situational awareness is essential to TEM.

7.2.4 Pilots can prepare to manage threats and errors by

- endeavouring to anticipate possible threats and errors associated with each night VFR flight
- briefing (self-brief) planned procedures before flight and before every change of flight path or aircraft configuration. The briefing should include anticipated threats and appropriate countermeasures (section 7.3.4).

7.2.5 Pilots should not fixate on TEM to the exclusion of aircraft control and maintenance of flightpath.

7.2.6 Successful TEM involves:

- continuously monitoring and cross checking instrument indications and flight progress (situational awareness) to confirm that all is going to plan
- prioritising tasks and managing workload during flight to maintain situational awareness
- identifying and managing threats and errors:
  - o identify the threat/error
  - o maintain control of the aircraft and flight path by reference to instruments
  - o manage the threat error
  - o monitor the flight progress to confirm that all is going to plan
  - o identify and manage undesired aircraft states
  - o aircraft control and flightpath are the first priority
  - o do not fixate on error management
  - o confirm recovery to planned flight and normal safety margins.

7.3 Risk management and TEM

7.3.1 TEM is an operational concept applied to the conduct of a flight. However, risk management is a process that can be applied even before deciding to undertake a proposed flight. To determine whether or not an NVFR flight should be conducted or its plan modified, an assessment of the risk is required. The basic question that risk management addresses is whether the level of risk for a proposed flight is acceptable or if it can be managed to make it acceptable.

7.3.2 Risk management provides a structured method of assessing and mitigating risks associated with an activity. The process of risk management involves:

- identifying the risks
- considering the likelihood and consequences of events arising from the risk;
- developing plans to mitigate risks
- implementing plans
- reviewing the performance of plans.

7.3.3 There is obviously overlap between risk management and TEM at the stage of developing and implementing plans to mitigate risks and in reviewing the progress of the flight.

7.3.4 Threats and errors

7.3.4.1 A review of reports from Australia and overseas has identified a number of threats/errors that are common to accidents and incidents that have occurred during flight at night in VMC:

- controlled flight into terrain
- uncontrolled flight into terrain
- loss of light sources
- dark night or black-hole conditions
- inadvertent entry into cloud or other hazardous weather
- electrical failure
- failure of any of the instrument power sources
- failure to recognise instrument failure
- engine power loss
- mid-air collisions
- misjudged approach, landing or baulked approach
- heavy landings
- gear up landings
- collisions on the ground.

7.3.4.2 Pilots should be aware that loss of control is often the result of lack of visual reference and other factors, such as aircraft systems malfunctions, which place higher demands on the pilot in terms of managing the emergency and controlling the aircraft. Mid-air collisions are a small but significant factor. Controlled flight into terrain includes accidents in the approach and landing phase, but also descent into the water at night during low level emergency medical service operations. Other landing accidents that occur at night, such as heavy or gear up landings, may have had darkness as a contributing factor.

Human fatigue

7.3.4.3 Human fatigue is a well-recognised risk to safe flying operations. Apart from the effect on performance, fatigue introduces an extraneous pressure on the pilot that may adversely influence their decision-making process. For example, a pilot may be influenced by fatigue not to divert to an alternate aerodrome when conditions at the destination are unsuitable.

7.3.4.4 There is some evidence that pilots can compensate for fatigue by a high level of arousal at times of high activity (e.g. during approach and landing) and that the effects of fatigue are more likely to be a threat at times of low activity.

7.3.4.5 Many flights are conducted after dark because the pilot was too busy during the day with work commitments. A common threat to safe NVFR operations is the expectation that an NVFR flight can be undertaken following a full day's activities, whether flight-related or not. NVFR flight is demanding, even under optimal conditions.

7.3.4.6 Fatigue should be managed to minimise the risk of the pilot's skill and judgment being affected to the extent that flight safety margins are compromised. Studies indicate that quality restorative sleep is by far the most significant single factor that permits the body to recover from fatigue. Napping has short-term benefits, especially when scheduled during the night. Activities such as rest and recreation, while important for wellbeing, do not reduce fatigue.

7.3.4.7 Pilots need to allow adequate time for rest and preparation before a flight, particularly if it will extend into the pilot's normal sleep cycle. If night flying has interfered with normal sleeping patterns, only sleep will reduce or eliminate fatigue.

7.3.5 Situational awareness

7.3.5.1 Situational awareness involves three elements: the past, the present and the future. Situational awareness is about knowing what has happened to the aircraft, what is happening to it in the present and what could happen to the aircraft in the immediate future. It requires good anticipation and asking “what if?”.

7.3.5.2 Situational awareness is the awareness of all the elements of the operating environment and how they affect the flight or could affect the flight in the future. Situational awareness at night includes the pilot’s mental picture of the aircraft relative to its three dimensional operational environment, including:

- both horizontal and vertical navigation, particularly in relation to terrain clearance
- the configuration of the aircraft
- the 'health' and mode of operation of the aircraft systems.

7.3.6 Situational awareness is a continual process during a flight and provides a vital source of information for reasoned decision-making. The pilot should avoid fixating on one particular aspect of the flight operation as doing so reduces overall situational awareness.

7.3.7 Because there is less visual information available at night, situational awareness at night must include greater emphasis on maintaining control of the aircraft and predicting the flight path.

7.3.7.1 Situational awareness at night involves an awareness of:

- aircraft attitude—reference to flight instruments
- external lighting—effect of ambient lighting conditions, including possible illusions
- aircraft position—visual and radio navigation
- the intended flight path—heading, distance, time and terrain clearance
- weather—pre-flight and inflight forecasts, reports and observations
- aircraft systems serviceability—engine, electrical, vacuum, pitot-static systems
- destination—lighting facilities, navaids, weather, alternate requirements, arrival procedures
- alternate options
- fuel state.

7.3.7.2 To maintain situational awareness, pilots should use all sources of available information, such as pre-flight briefings and information from ATS or other aircraft. Wherever possible, instrument indications—particularly navigational and altitude information—should be cross-checked to confirm accuracy.

7.3.8 Task management

7.3.8.1 Task management is an important skill for all pilots. During periods of high workload, the ability to prioritise tasks is essential so that important flight safety issues are not overlooked. Pre-flight planning, cockpit organisation and self-briefing—if properly managed—contribute significantly to the reduction of in-flight workload.

7.3.8.2 A single pilot flying under NVFR in a light aircraft must be able to plan ahead to ensure that their capacity to manage all tasks is not affected during periods of high workload.

7.3.9 Decision-making

7.3.9.1 The ability to assess a situation, identify the need to make a decision, and then to make and implement the decision in the time available is an essential element of aircraft operation. Good decision-making relies on good situational awareness and the ability to identify available options and decide on the best plan without being influenced by extraneous pressures.

7.3.9.2 As circumstances deteriorate and cockpit stress levels rise, the challenge for pilots is to maintain a strategic outlook that enables a safer choice to be made. At times of heightened stress, it is important that pilots avoid making decisions based on an emotional reaction to a situation. Instead, the use of a logical and structured decision-making process will reduce the likelihood of emotions clouding or confusing the result. Decisions can be proactive (i.e. anticipating a problem) or reactive (i.e. dealing with an unexpected problem) but the decision-making process always involves:

- identifying the problem
- collecting relevant information
- generating and analysing options
- deciding on the most appropriate option

- implementing the decision
- monitoring progress against intended outcomes and modifying actions as required.

7.3.9.3 Commencing an NVFR flight with no other plan than to reach the destination potentially locks the pilot into a single course of action and reduces their ability to consider other options due to changing circumstances. An NVFR flight will generally have fewer options than a similar flight by day; therefore, careful contingency planning and an acceptance that diversion may be necessary are essential to managing the risk.

7.3.9.4 Unrealistic passenger or pilot expectations (e.g. deadlines for arrival at the destination) may also cause pressure and limit the pilot's ability to consider safer options during the flight. Pilots should ensure before departure that all passengers and other interested parties are aware of the constraints and options applicable to the flight, so that they are free to make decisions based on safety outcomes.

7.3.9.5 The pilot must also ensure that appropriate facilities will be available at possible alternate aerodromes. These include essentials such as aerodrome lighting, transport and accommodation should an unplanned overnight stop prove necessary.

8 Aircraft requirements

8.1 Approvals

8.1.1 The pilot should check the aircraft maintenance release to determine whether the aircraft is approved for NVFR flight (i.e. either IFR or NVFR).

8.1.2 Rotorcraft

8.1.2.1 Rotorcraft intended for flight under NVFR will not necessarily be certificated for instrument flight conditions. In some circumstances, the rotorcraft may be certified for flight conditions which assume a good visual cue environment.

8.1.2.2 Some rotorcraft have highly unstable static and dynamic longitudinal stability characteristics, creating a considerable pilot workload in a degraded visual cue environment (e.g. dark night conditions).

8.1.2.3 In contrast, rotorcraft certified for instrument flight conditions include systems to manage inherent static and dynamic instability, often through the addition of augmentation systems and/or an autopilot. Such rotorcraft may be operated by sole reference to cockpit instruments and are thus suited to situations in which there is no visual horizon and insufficient visual cues (lighting) on the ground to allow safe flight by visual reference. It is for this reason that NVFR operations in a rotorcraft are only permitted when the pilot either can discern a visual horizon (for specialised NVFR operations such as the use of imaging systems see section 10.4.4) or has sufficient visual cues to continually determine the pitch and roll attitude of the rotorcraft.

8.2 NVFR aircraft equipment

8.2.1 During the pre-flight inspection, the pilot should check that the aircraft is properly equipped and that the required equipment is serviceable.

8.2.2 Additional aircraft equipment for NVFR falls into four categories:

- external and internal aircraft lighting
- flight instruments
- radio communication and navigation equipment
- auto-flight and stability systems for rotorcraft.

8.2.3 Table 3 details the requirements for the additional NVFR equipment.

Table 3: Aircraft equipment required for NVFR flight operations

Additional equipment	Requirements for NVFR flight operations
Aircraft lighting	Refer Appendix V of CAO 20.18.
External lighting	• one landing light (or for charter flights with passengers, two landing lights or a lamp with two separately energised filaments) • position lights (red, green and white navigation lights) • anti-collision light (a flashing light or rotating beacon)
Internal lighting	• instrument lights for all essential instruments and equipment • Two sources of power for instrument lights (normally the generating system and a battery) • pilot and passenger compartment lights adequate to read maps and documents.
Emergency lighting	• a shock-proof electric torch is required for each crew member (a second torch and/or spare batteries are recommended).
Flight instruments	The minimum serviceable instruments required for NVFR flight in aeroplanes are: • an airspeed indicator • an altimeter • a direct reading magnetic compass • an accurate clock (or watch) • a vertical speed indicator • an outside air temperature indicator • an attitude indicator (artificial horizon) • a heading indicator (directional gyroscope) • a turn and slip indicator or second AH with slip indicator • a means of indicating whether the power supply to the gyroscopic instruments is working satisfactorily • for rotorcraft, a standby attitude indicator or a turn indicator.
Radio communication and navigation equipment	Refer Aeronautical Information Publication (AIP) GEN 1.5 Radio Communication and Navigation Systems
Radio	VHF communication is required for all NVFR flights in all classes of airspace. Other radio communication equipment requirements are the same as for day VFR.

<table>
<tr><th>Additional equipment</th><th>Requirements for NVFR flight operations</th></tr>
<tr><td>Navigation aids</td><td>NVFR aircraft must be equipped with at least one of the following radio navigation aids, which is serviceable:
ADF
VOR
GNSS.
Note: ADF or VOR equipment must be approved for IFR or NVFR operations. A GNSS for NVFR operations must be an IFR approved receiver. Pilots must be competent in the operation of the navigation systems fitted in the aircraft.

Note: IFR GNSS receivers incorporate a RAIM function which provides a warning to the pilot when navigation information is unreliable due to satellite geometry, other receivers do not have this function.</td></tr>
<tr><td>Rotorcraft auto-flight and stability systems</td><td>Refer CAO 20.18.</td></tr>
</table>

9 Planning NVFR operations

9.1 Flight planning

9.1.1 Night flying, whether in the circuit or cross-country, presents particular threats and errors and has a unique set of requirements. Careful and comprehensive pre-flight preparation will result in an in-flight workload that is both safe and manageable.

Note: As well as the AIP references provided in this AC, CASA's VFR Flight Guide has a section on the planning and conduct of NVFR operations.

9.1.2 Route selection

9.1.2.1 A direct route is not necessarily the best option, particularly at night. The pilot must take into account the following factors when choosing the route, especially in regard to maintaining the safest options in event of an emergency:

- navigation requirements
- terrain
- weather
- alternate aerodromes
- airspace.

9.1.2.2 The pilot may plan a suitable route using World Aeronautical Charts or may use the routes shown on lower limit en-route charts (ERC LOW); however, topographical charts that show terrain along the proposed and possible alternate routes are essential for NVFR navigation.

9.1.2.3 Navigation under NVFR may be by visual reference or by reference to radio navigation aids.[6] If visual navigation is to be used then the pilot must be able to obtain visual fixes along the route at not greater than 30 minute intervals. This may require deviation from the direct route to enable the aircraft's position to be fixed over landmarks visible at night (i.e. towns). If radio navigation aids are to be used for navigation, the pilot must plan to fix the aircraft's position at regular intervals and should only use radio navigation aids within their rated coverage.[7]

9.1.3 Position fixing requirements

9.1.3.1 The maximum allowable time (as well as the distance limitation) between radio position fixes is 2 hours. This distance between radio position fixes must not exceed that which enables the pilot to arrive within the rated coverage of an on-track radio navigation aid after making allowance for possible tracking errors from the last positive fix.[8] Some routes shown on planning charts will require a minimum ground speed to be maintained to meet the position fixing requirement.

9.1.4 A position fix using radio navigation aids may be obtained by either:

- station passage over an aid

  or

[6] See *AIP* ENR 1.1, section 19 (Navigation Requirements).
[7] As specified in AIP GEN 1.5, section 2 (Radio Navigation Requirements) and AIP ERSA.
[8] See AIP ENR 1.1, section 19 (Navigation Requirements).

- the intersection of bearing lines from at least two navigation aids while the aircraft is within rated coverage of both aids. Pre-planning the appropriate bearings will assist in position fixing by this method.

9.1.4.1 An approved GNSS is capable of providing position fixes anywhere over mainland Australia *most of the time*. However, if planning to navigate using GNSS, the unit must be approved for IFR navigation and the receiver autonomous integrity monitoring (RAIM) availability should be checked for the time of the flight.[9] Non-IFR approved GNSS receivers should not be relied on as the main means of navigation as they may not provide a warning of unreliable navigation information. These units should only be used to assist with visual navigation or navigation using ground-based radio navigation aids.

9.1.5 Lowest safe altitude

9.1.5.1 Regulations require that an aircraft flying under NVFR must be flown at a height at least 1,000 ft above the highest obstacle within a 10 NM radius of the aircraft in flight, unless it is necessary for taking off or landing. Therefore, part of the flight planning process must be to plan an LSALT to ensure that this requirement can be met. One of two methods can be used to determine the LSALT for an NVFR flight:

- **For visual navigation**, plan an LSALT 1,000 ft above all obstacles within a 10 NM radius of the planned track, including the departure and destination aerodrome.

  or
- **For radio navigation**, use the IFR LSALT specified on ERC charts or the procedure specified in AIP GEN Lowest Safe Altitude for determining IFR LSALT on other routes.

9.1.5.2 If the pilot of an NVFR flight can determine, by means of an in-flight visual fix, that a critical obstacle has been passed, then the aircraft can descend to a lower altitude provided that the 1,000 ft obstacle clearance is maintained for obstacles ahead of the current position. This 'stepped descent' can be used for arrival at the destination aerodrome but is best planned pre-flight.

9.1.5.3 Climb to, or descent below, the planned LSALT should only be made in the vicinity of the departure or destination aerodrome and, with the aerodrome in sight, using a procedure that maintains clearance from obstacles and terrain.

> Maintaining an accurate track and not descending below LSALT is the best defence against CFIT.

9.2 Chart preparation

9.2.1 The pilot must ensure that they have current copies of all relevant charts for the proposed flight, with tracks and the LSALT clearly marked using colours that will be visible in reduced light.

[9] Refer to AIP GEN 1.5 (Area Navigation Systems Approvals and Operations) for requirements.

9.2.2 Preparation of a 'mud map' or 'sketch map' that highlights essential features and information can assist the pilot to develop and maintain full situational awareness and manage the flight. The mud map/sketch map would generally show such items as:

- departure, destination and alternate aerodromes
- tracks and distances
- LSALT and high terrain or obstacles
- step down LSALT for arrival
- controlled airspace boundaries
- radio communication and navigation aids and frequencies
- prominent visual features
- radio bearings to aid visual fixing.

9.2.3 Weather interpretation

9.2.3.1 Pilots should obtain area forecasts covering the intended route and aerodrome forecasts for destination and alternate aerodromes (if available). They should check for the possibility of adverse weather, including:

- low cloud
- thunderstorms
- excessive crosswind component
- reduced visibility in rain, dust, smoke or fog.

Note: A temperature forecast close to dew point may indicate the likelihood of fog later in the night.

9.2.3.2 Extra care should be taken in the interpretation of meteorological reports to assess the likelihood of any phenomena that could reduce in-flight visibility, particularly as cloud is more difficult to see at night during flight. If the forecast reveals cloud at less than 1,000 ft above LSALT, the pilot should consider not proceeding with the flight.

9.2.3.3 If cloud is forecast as broken or greater, the pilot will be unable to maintain VMC at the level of the cloud layer. Flight may be planned above a cloud layer with the appropriate vertical clearance for VMC; however, it is unwise to plan flights above more than scattered cloud unless it is limited in extent and the forecast indicates extensive clear areas that will allow for VMC on climb to and descent from cruising level. Navigation requirements must still be able to be met.

9.2.3.4 If extensive cloud is forecast, the pilot should check freezing level as airframe icing could be encountered on inadvertent entry into cloud above the freezing level. Carburettor icing can also be a possibility well below the freezing level.

> Encountering adverse weather conditions at night is potentially much more hazardous than in daylight. If there are any doubts about the suitability of the weather, there should be no hesitation to cancel a flight.

9.3 Aerodrome requirements

9.3.1 For night operations at any aerodrome, it is essential to check that the facilities are available, suitable and serviceable. Aerodrome lighting information is found in the AIP

En-route Supplement Australia (AIP ERSA) and Notices to Airmen (NOTAMs); these should be checked for unserviceabilities.

9.3.2 Elements to check include:

- aerodrome elevation
- type and availability of runway lighting
- airfield layout, including lighted runways, taxiways, movement areas and holding points
- location of windsock
- method of activating lighting
- whether standby power is available or not
- local procedures or restrictions (i.e. curfews)
- potential hazards (i.e. high terrain or obstructions—lit or unlit—in the vicinity of the aerodrome).

9.3.3 Taxiing on an aerodrome at night can be confusing, with the added risk of runway incursion and collision with unlit aircraft or objects. Familiarity with the aerodrome layout is essential.

9.3.4 Alternate aerodromes

9.3.4.1 Planning for an alternate aerodrome provides the pilot with another option if, for some reason, it is not possible to land at the intended destination.[10]

9.3.4.2 NVFR planning includes the requirement for the aircraft to carry sufficient fuel to fly to an alternate aerodrome if any of the following three elements at the intended destination is below the standard specified:

- radio navigation aids
- weather

  or
- aerodrome lighting.

Note: An aerodrome cannot be used as an alternate if that aerodrome also requires an alternate.

9.4 Radio navigation aid requirements

9.4.1 The pilot must be able to navigate to the destination aerodrome using either an NDB a VOR located at the aerodrome, or an IFR-approved GNSS receiver. If the aerodrome is not served by a radio navigation aid (NDB or VOR) or the pilot is not competent to operate the approved GNSS receiver fitted in the aircraft, then the pilot must plan to be able to fly to an alternate aerodrome within one hour’s flight time of the destination.

9.5 Weather conditions

9.5.1 Alternate aerodrome weather minima provide a small buffer above the minimum conditions required for NVFR flight at the aerodrome. Aerodrome forecast (or area forecast if no aerodrome forecast is available) should be checked to ensure that the

[10] AIP ENR 1.1 (Alternate Aerodromes) includes detailed NVFR alternate planning requirements.

weather conditions are forecast to be above the alternate aerodrome minima at the planned arrival time.

9.5.2 The pilot must plan to carry sufficient fuel to fly to an alternate aerodrome if the conditions at the intended destination are forecast to be below any element of the alternate minima at the time of planned arrival (and up to 30 minutes beforehand).

9.5.3 The following weather conditions forecast at the intended destination would require the pilot to plan for an alternate aerodrome:

- more than scattered cloud below a ceiling of 1,500 ft
- forecast or percentage probability of visibility less than 8 km
- crosswind component greater than the maximum for the aircraft

  or
- thunderstorms or associated severe turbulence (or their probability) are forecast.

9.5.4 The specified NVFR alternate aerodrome minima allow for very marginal conditions for night flying, it may be advisable to reconsider whether to conduct the flight at all if the weather is forecast close to or below these minima.

9.5.5 If weather conditions are below the alternate aerodrome minima, but are forecast to improve at a specific time, then an alternate aerodrome need not be planned if sufficient fuel is carried to allow the aircraft to hold until that time plus another 30 minutes.

9.5.6 Sometimes weather conditions are above the alternate aerodrome minima, but are forecast to deteriorate below the minima for short periods. The pilot does not need to plan for an alternate aerodrome if sufficient fuel is carried to hold for the expected periods of deterioration. The additional holding fuel requirements are:

- for deteriorations forecast as intermittent (INTER): 30 minutes
- for deteriorations forecast as temporary (TEMPO): 60 minutes

Note: Thunderstorms are forecast as either INTER or TEMPO and the same holding requirements apply.

9.6 Runway lighting

> NOTAMs should be consulted prior to flight to ensure serviceability of intended destination and alternate aerodrome lighting systems.

9.6.1 The pilot must check that aerodrome lighting will be available at the destination at the planned time of arrival. For aerodromes with a lighting system other than pilot activated lighting (PAL), this means for a period 30 minutes prior to the estimated time of arrival (ETA) until landing and taxiing is completed.[11]

9.6.2 To guard against unexpected lighting unserviceability, an alternate aerodrome should be planned if any of the following criteria apply to the runway lighting system:

- portable runway lighting: alternate required unless a responsible person will be in attendance

[11] Details of the type of lighting available at specific aerodromes can be found in AIP ERSA.

- no standby power: alternate required unless a responsible person is in attendance to display portable lighting
- PAL activation: alternate required unless a responsible person[12] is in attendance to manually activate the lighting and the aerodrome has standby power.

9.6.3 An aerodrome with PAL lighting can only be nominated as an alternate if one of the following requirements are met:

- the aircraft is equipped with dual VHF radio
- the aircraft is equipped with one very high frequency (VHF), one high frequency (HF) radio and carries 30 minutes holding fuel

  or
- a responsible person is in attendance to manually activate the lighting.

9.6.4 Pilot activated lighting

9.6.4.1 AIP ERSA specifies those aerodromes equipped with a PAL system that allows the runway lighting to be activated by a radio transmission consisting of three 3-second pulses, within 25 seconds, on a specific VHF channel. Some aerodromes have PAL associated with an aerodrome frequency response unit (also known as a 'beep back' unit), which has a different transmission requirement for activation (also specified in AIP ERSA Aerodrome and Approach Lighting).

9.6.4.2 PAL should normally be activated before taxiing for departure, or within 15 NM and at LSALT for arrival.

9.6.5 Once activated, the runway lights will remain on for 30 minutes, after which they are automatically switched off. The windsock light will start flashing as a warning 10 minutes before the lights automatically switch off, and the system may be reactivated in the normal way at any time for another 30 minutes.

9.7 Flight notification

9.7.1 Flight notification and search and rescue (SAR) requirements for private and aerial work NVFR operations are the same as for day VFR flights, with the exception of flights proceeding more than 120 NM from the aerodrome of departure. Such flights are required to submit a search and rescue time (SARTIME) to ATS or leave a flight note with a responsible person.[13]

[12] A responsible person is a person who is capable of activating the lighting system and who is in attendance at the aerodrome from at least 30 minutes before the planned ETA until landing and taxiing is completed.

[13] Refer AIP ENR 1.10 (Flight Notification).

10 Conducting NVFR operations

10.1 Pre-flight

10.1.1 The pre-flight inspection for NVFR flight should be conducted in a well-lit area (if possible) and with the aid of a torch. In addition to a normal pre-flight inspection, the following items should be checked for serviceability before boarding the aircraft:

- all internal and external aircraft lighting is operational
- radio navigation aid antennae
- pitot heat (if fitted)
- windscreen is clean
- emergency lighting (torch), ensuring it is accessible.

10.1.2 Note should be taken of:

- passengers while on the movement area, to ensure they are closely supervised and are not in danger from other aircraft
- the position of any other aircraft and rough ground, by surveying the aircraft parking area
- any other personnel on the movement area
- any obstructions
- where to taxi to avoid collision.

10.1.3 After boarding the aircraft, the pilot should:

- adjust the aircraft lighting to suit
- ensure that that instruments and controls are illuminated and discernible
- organise the cockpit so that maps, navigational equipment and flight plans are accessible
- switch on the navigation lights and rotating beacon
- set the park brake and clear the area before starting the engine.

10.1.4 For night operations, it is critical that generators/alternators and instrument power sources (vacuum gauges) are checked and functioning normally.

> A rotating propeller is even more difficult to see at night. It is essential to be aware of the activities of personnel in the parking area.

10.2 Taxiing

10.2.1 There is a tendency to taxi faster at night because it is more difficult to gauge taxi speed. Pilots should:

- switch on the taxi light before taxiing and monitor and control taxi speeds while taxiing
- use the taxiway lighting and reflected navigation lights to judge speed; looking at the wingtips can help
- avoid pointing taxi and landing lights at other aircraft.

10.2.2 As the pilot's perception of aircraft movement is impeded at night, it is difficult to detect slow creeping movement. It is best to always set the park brake when holding or performing a run-up.

10.2.3 The pilot should check the operation of gyroscopic instruments while taxiing and also the indications of radio navigation aids for serviceability, when this is possible.

10.3 Night circuits

10.3.1 Take-off

10.3.1.1 Although take-off preparations and the take-off should be conducted in the same way day or night, there are some additional aspects that require consideration before and during a night take-off. These are to:

- re-check the windsock and consider the effects of the wind on the departure path
- conduct a comprehensive TEM briefing, including:
  - any emergency considerations
  - the planned departure procedure with provision for terrain clearance
- display anti-collision lights when crossing an active runway
- switch on landing lights before entering the take-off runway
- confirm that the attitude and heading indications are correct after lining up in the centre of the runway
- maintain direction by reference to the runway lights (and centreline markings when available)
- immediately after becoming airborne:
  - in an aeroplane, transition to the flight instruments
  - in a rotorcraft, cross-reference to the flight instruments
- check that the aircraft establishes a positive rate of climb
- be mindful of sensory illusions and maintain flight by reference to instruments
- initiate the crosswind leg turn by reference to flight instruments
- check aircraft position by reference to the runway lights.

10.3.1.2 When flying in the circuit, the pilot should control the aircraft by cross-reference to flight instruments, and position the aircraft in the circuit by reference to heading, altitude and the runway lights. The pilot must maintain a lookout for other aircraft and lighted obstructions.

10.3.1.3 CASA recommends the practice of keeping landing lights switched on while flying in the circuit to assist in making the aircraft conspicuous to other traffic.

10.3.2 Downwind

10.3.2.1 The pilot should position the aircraft on the downwind leg in the normal way. It is good practice to limit turns to rate 1 at night.

10.3.2.2 There may be a tendency for the pilot to think they are closer to the runway at night. Correct aircraft positioning should be maintained by the use of known visual cues, such as the position of the runway lights in relation to a reference point on the airframe.

10.3.2.3 The turn onto base leg can be judged by either timing the aircraft past the runway threshold (i.e. 30-40 seconds) or by angular displacement from it (45°).

10.3.2.4 It is important to maintain an effective lookout and complete all checks without rushing.

10.3.3 Base leg and final approach

10.3.3.1 The pilot should normally plan the descent onto base leg so that the aircraft is positioned to start the turn onto final at about 600-700 ft above ground level. The aircraft should not descend below pre-planned critical heights until established on a stabilised approach and at the appropriate position on the approach path.

10.3.3.2 Maintain a visual scan and fly by cross-reference to instruments when turning onto final approach. This is particularly important in black-hole conditions, when fixation on the approach lights may cause the autokinesis illusion. This can be avoided by maintaining a visual scan (that includes flight instruments) on approach.

10.3.3.3 Select an aiming point well into the runway, keeping in mind the tendency to undershoot in the absence of ground lighting and approach slope guidance. Use the apparent shape of the flare path on final approach as an aid to establishing the correct approach path, keeping in mind that narrow or sloping runways may give a different picture.

10.3.3.4 If aircraft attitude is kept constant and the approach path is being maintained, the aiming point should appear to remain stationary in the windscreen. As the aircraft approaches the runway, the lights ahead and behind the aiming point will appear to expand away from the aiming point in the pilot's field of vision.

10.3.3.5 Judgment of the landing flare will be aided by retaining a picture of the flare path as seen from the position on the runway. Landing lights can be used to assist, but landings should be able to be accomplished without them.

> Accident statistics show that gear up landings are also prevalent at night. Pilots should ensure that normal pre-landing checks are accomplished using standard procedures.

10.3.4 Landing

10.3.4.1 The flare, hold-off and landing is probably best judged by the perspective of runway side lighting rising in the pilot's peripheral vision. There are a number of techniques for judging this part of the landing, with practice and repetition being an important factor.

10.3.4.2 At the point where the runway edge lighting starts rising in the pilot's peripheral vision, it is important for the pilot to transfer sight to the centre of the far end of the runway and:

- avoid fixating on the area of the runway illuminated by the landing lights
- reduce power to idle and adjust the attitude to arrest the descent rate while maintaining directional control
- after touchdown, stay on the centre line until the aircraft has slowed to a safe speed and vacate the runway.

> Heavy landings feature prominently in night accident statistics. Good judgement of landings will take time and practice to achieve and to maintain.

10.3.5 Go-around

10.3.5.1 A go-around at night is not so different to one conducted in daylight. Make the decision to go-around as early as possible and apply power and an appropriate flap setting. As the nose is raised to the climb attitude, the runway lights may disappear, so it is critical to resume flight by reference to instruments. Be aware of the possibility of sensory illusions and complete the after take-off procedures at a safe height.

10.4 Night navigation

10.4.1 Departure

10.4.1.1 In night operations, where many factors need to be considered and visual feedback is limited, a comprehensive TEM briefing prior to every major change of flight path or aircraft configuration is recommended practice.

10.4.1.2 The departure plan must take into consideration how to:

- intercept the departure track within 5 NM of the aerodrome
- maintain terrain clearance while climbing to LSALT.

10.4.1.3 If the aerodrome is surrounded by limited lighted areas, it may be necessary to gain height in the circuit area prior to departure to:

- ensure obstacle clearance
- gain sight of surrounding ground lighting to aid spatial orientation.

10.4.1.4 When flying a multi-engine aircraft, the pilot must plan the departure to accommodate a possible engine failure and return to the aerodrome.

10.4.1.5 Due to the potential for high workload during departure, it is important for the pilot not to be distracted from the task of controlling the aircraft at low altitude. The pilot should maintain reference to the flight instruments.

10.4.1.6 The pilot should maintain aircraft control by:

- referring to flight instruments
- maintaining visual scanning procedures to include the flight instruments
- keeping a lookout for other aircraft
- positioning the aircraft by reference to ground features
- recording the departure time from a known position, either on track or from overhead the aerodrome.

10.4.2 En-route

10.4.2.1 For en-route navigation, it is important that the pilot maintains situational awareness with an emphasis on anticipating future actions. It is important to 'stay ahead of the aircraft' and having a linear sequence of navigation and management tasks. The pilot should use all facilities and aids (i.e. autopilot, if fitted) to make the task of flying the aircraft easier.

10.4.2.2 The basis of good navigation, whether day or night, is knowing the aircraft's position and where it is going. This can be achieved by:

- flying a constant heading
- maintaining a known airspeed
- being aware of the passage of time.

10.4.2.3 These steps help the pilot to maintain a mental picture of flight progress and to predict the arrival time at pre-planned positions along the route, which may be used to fix position with radio navigation aids or by visual means. If navigating by visual reference, it is important to select a route that has features that are easily recognisable at night, such as:

- rivers
- lakes
- highways
- coastlines
- beacons.

10.4.2.4 Prominent light sources (i.e. towns) assist navigation at night; however, in dark night conditions, unlighted features may be difficult to see and should not be relied upon.

10.4.2.5 In addition to visual techniques, radio-aids also support navigation at night. Used correctly, they can provide tracking, position and groundspeed information and significantly simplify the navigation task. The most beneficial navigation aid is GNSS; however, pilots should always cross-check navigation information obtained from radio navigation aids or GNSS wherever possible.

10.4.2.6 An important aspect of navigation at night is terrain awareness. Pilots should maintain:

- awareness of the intended flight path laterally and vertically in relation to terrain
- an altitude at least 1,000 ft above all obstacles within a 10 NM radius of the aircraft LSALT.

10.4.3 Descent and arrival

10.4.3.1 Careful planning of the descent, approach and landing is essential to ensure that descent below LSALT does not commence until the aircraft is within 3 NM of the aerodrome and the aerodrome is in sight.

10.4.3.2 NVFR procedures allow for a stepped descent based on revision to the LSALT when the aircraft's position has been positively determined by a visual fix such as having passed a critical en-route obstacle. The new LSALT is based on 1,000 ft clearance above all obstacles within a 10 NM radius *ahead* of the aircraft. This procedure provides more flexibility for NVFR flights to descend earlier than aircraft maintaining the IFR LSALT, but it requires a visual fix to determine each successive new LSALT. The pilot should carefully plan step down arrival procedures pre-flight. Terrain clearance is the sole responsibility of the pilot.

10.4.3.3 In controlled airspace, ATS may authorise a visual approach at night when within 30 NM of the aerodrome, but the pilot remains responsible for terrain and obstacle clearance and compliance with the LSALT requirements.[14] In this case, descent may be conducted using the step down procedure, as long as the aircraft does not descend below the current LSALT until within 3 NM of the aerodrome.

10.4.3.4 To conduct a visual approach in controlled airspace, the following conditions also apply:

- the aircraft must remain clear of cloud
- the aircraft must be in sight of ground or water
- the pilot must have the aerodrome in sight
- flight visibility should be at least 5 km.

10.4.3.5 Once the aircraft is established in the circuit area, normal approach and landing procedures for night operations apply.

10.4.4 Specialised NVFR operations

10.4.4.1 Various specialised operations are conducted under NVFR. A detailed discussion of such specialised NVFR operations is beyond the scope of this AC; however, the accident record both in Australia and overseas reflects the need for appropriate pilot training and the application of risk management and TEM principles for the conduct of such operations.

Risk management of specialised NVFR operations

10.4.4.2 The tasks associated with specialised NVFR operations demand a high level of pilot skill that goes beyond that normally required for the issue of an NVFR rating. There may also be a higher level of risk associated with these operations. This is justified by the nature of an emergency or law enforcement task. Operations involving a higher level of risk may combine one or more of the following:

- operations below LSALT
- operations at poorly lit, or unlit, helicopter landing sites (HLSs)
- operations at night in rugged terrain
- operations in adverse weather
- operations in dark night conditions.

10.4.4.3 Operators should consider the following controls in relation to specialised high risk NVFR operations:

- a formal risk assessment and management process to assess the risk of typical operations and to identify control measures
- inclusion of the risk assessment and control measures for typical operations in the company's operations manual
- a process for formal task approval that involves the chief pilot, where operational scenarios differ from those identified in the operations manual or involve greater risk
- a safety management system, involving all personnel and supported by management, to identify and deal with ongoing safety issues
- development of a human fatigue risk management system suitable to operational requirements

[14] Refer AIP GEN 3.3 (Lowest Safe Altitude).

- inclusion of TEM (including the provision of training) in the operations manual and SOPs
- provision of multi-crew coordination training for all crew members
- requirement for pilots to hold an instrument rating
- provision of additional instruments and safety equipment in aircraft
- provision of recurrent training in instrument flight and dark night operations
- provision of initial and recurrent training in specialised equipment and roles.