GOOD AVIATION PRACTICE

Night VFR

CIVIL AVIATION AUTHORITY
OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

Every effort is made to ensure that the information in this booklet is accurate and up to date at the time of publishing, but numerous changes can occur with time, especially in regard to airspace and legislation. Readers are reminded to obtain appropriate up-to-date information.

Night VFR

There are more risks and threats flying at night than flying during the day, so it is essential to seek training with a flight instructor specifically for night flying. As an aid to your training and revision, this booklet looks briefly at some underlying principles and practices, including: illusions, planning considerations, and handling emergencies.

This booklet is aimed at the student and private pilot, and briefly examines some of the factors that are different about night flight.

All your usual flight training applies at night, but there will be more emphasis on managing the additional risks that come with darkness and limited visual references. The techniques and disciplines of threat and error management are particularly applicable to this situation and are introduced throughout this booklet.

Always keep in mind:

Aviate – Navigate – Communicate.

Night is defined, for aviation purposes, as the period of darkness from the end of evening civil twilight to the beginning of morning civil twilight. (See Part 1 *Definitions and Abbreviations* for the full definition.) The times for beginning and end of civil twilight are in *AIP New Zealand* GEN 2.7 Daylight Tables.

Contents

CAA Web Site

See the CAA web site for Civil Aviation Rules, Advisory Circulars, Airworthiness Directives, forms, and more safety publications.

www.caa.govt.nz

Vision

A basic understanding of how the eye works at night will help you improve your night vision.

Light-sensitive nerves, called cones and rods, are located at the back of the eye. These nerves connect to the optic nerve, which transmits messages directly to the brain. The cones are located in the centre of the retina, and the rods are concentrated in a ring around the cones.

The function of the cones is to detect colour, details, and faraway objects. The rods function when something is seen out of the corner of the eye, ie for peripheral vision. They detect objects, particularly those that are moving, but do not give detail or colour – only shades of grey. Both the cones and the rods are used for vision during daylight and moonlight.

The rods, however, make night vision possible. Because the rods are distributed in a band around the cones and do not lie directly behind the pupil, off-centre viewing (looking to one side of an object) is important during night flight.

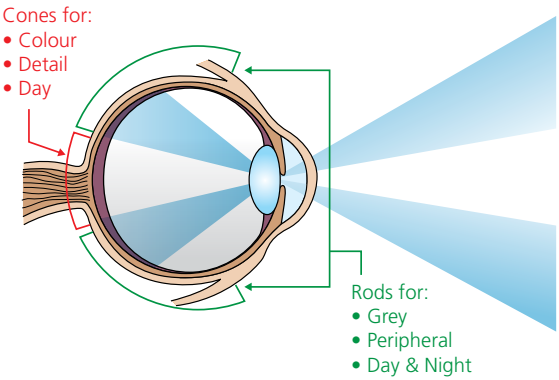
During daylight we rely on our central vision to see fine details, and use our peripheral vision to see general features, and to be aware of changes in movement or brightness. In low light, our central vision does not work as well, so we rely more on our peripheral vision to see things in the dark.

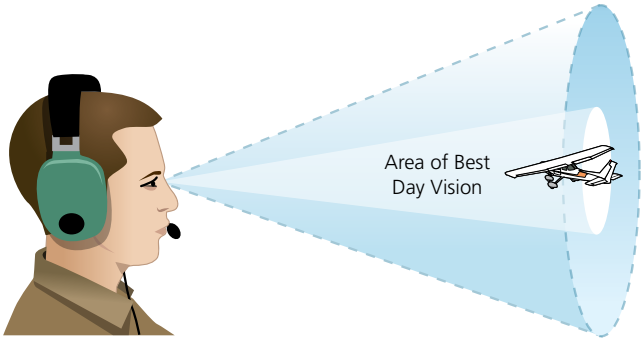
Since our peripheral vision is particularly good at noticing changes, we are more likely to notice objects at night by using our peripheral vision and maintaining a 'scanning' visual motion. When we fly at night we still need to use our central vision, for example when we read instruments or charts, but we also want to preserve as much function as we can in our peripheral vision.

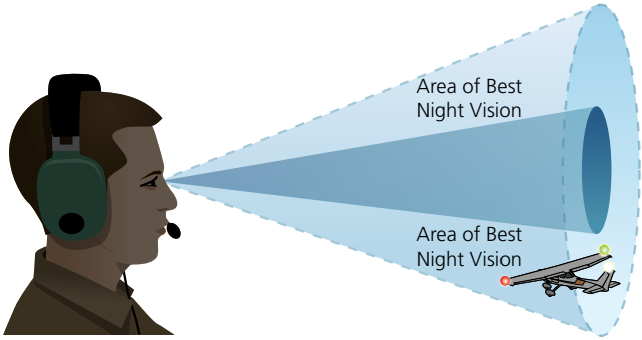
To maximise your visual performance for night flying:

- Maintain good general health – especially important for night flying. Some medications or medical conditions may also impair night vision.
- Avoid things that impair vision performance – eg, cigarette smoking or medications that selectively impair night vision.
- Allow time for your eyes to dark adapt.
- Avoid bright light even when using your central vision – keep cockpit lights and torches as dim as you can without losing your ability to read instruments and documents.
- Use a practised scanning motion when looking outside the aircraft.
- Do not fly at any higher altitude than necessary – visual function is very dependent on oxygen levels, especially at night. Altitude that may be perfectly safe during daytime can result in significant reduction in night vision function. Supplemental oxygen can help to prevent such altitude-related vision problems.

Rods and Cones







Dark Adaptation

Adjusting to low light level is called Dark Adaptation. It takes quite some time to adjust from bright light to low light – but when going from dark light to bright light the effect is rapid and removes any dark adaptation that has taken place. You have probably experienced this when entering and leaving a cinema.

You need to plan for dark adaptation when preparing for night flight. Allow time to adjust to low light after completing any tasks that need to take place in bright light, such as the pre-flight inspection. The rods become fully effective after 30 minutes or so.

Avoid any bright light once you have started adapting to the dark.

In order to preserve your dark adaptation, consider instrument lighting levels, especially if large multi-coloured LCD screens are used. Use caution with mobile phones too, as they can have very bright displays.

Some aircraft are fitted with red lighting to help preserve dark adaptation, although this is controversial. If you do use red light in the cockpit, avoid having it at too high a level, reduce the intensity as you adapt, and be aware that it will distort the colours on navigation charts.

> You need to plan for dark adaptation when preparing for night flight. Allow time to adjust to low light after completing any tasks that need to take place in bright light, such as the pre-flight inspection.

Nothing to Focus On

If there is nothing to focus on, the lens of the eye relaxes to its least stretched position, focusing on a point one to two metres in front of the eye (this is called empty visual field myopia). You may have experienced this when trying to spot an aircraft against a clear sky. A similar effect happens at night – making a strenuous effort to focus on nothing won't work.

The only remedy is to focus on actual objects, for example light sources, further than six metres away. This effect is worse for pilots wearing corrective lenses, particularly bifocals or trifocals.

Illusions

It is good practice to fly at night by regular reference to instruments, even when external lighting provides good visual cues, because visual and spatial illusions can provide misleading information, and visual reference can be suddenly lost. Use your awareness of illusions to avoid these pitfalls.

Visual Illusions

Reflections

Charts placed on the top of the instrument panel can cause reflections that have a disorienting effect. Helicopters with extensive areas of acrylic windscreen are prone to disorienting reflections on the inside of the cockpit canopy.

Flicker Vertigo

Flashing lights or flicker effects from propellers and helicopter rotor blades can cause disorientation. Turning off strobes can help reduce this effect.

Judgement of Distance

Depth perception is impaired in low light. The effect is worse when the only objects visible are points of light, and there is no relative size information.

Auto-Kinesis

Auto-kinesis, or self movement, can occur when looking at a fixed light source against a dark sky, with no surrounding lights or other visual cues. For example, a star, or a single light source in a remote area. After a while, the light may appear to be moving or oscillating, and could be mistaken for an aircraft light. To prevent this illusion, avoid prolonged focusing on any one light, and look to one side to use the peripheral vision provided by the rods.

Confusing Ground and Star Light

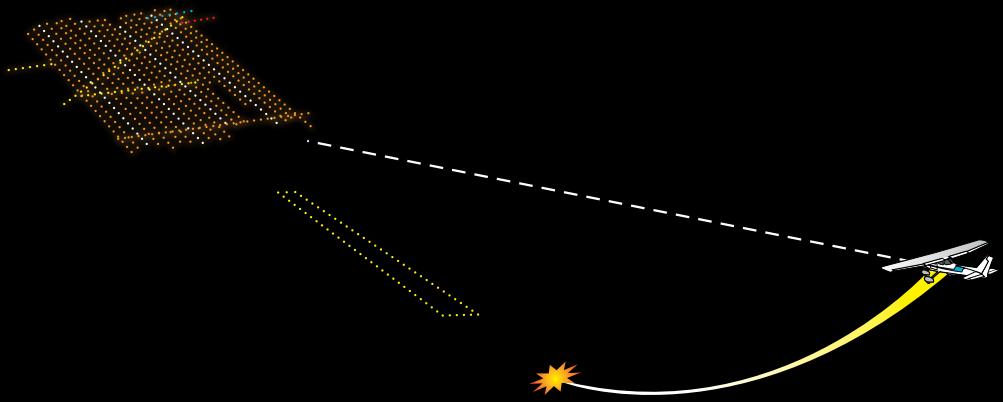
At night, ground lights can be confused with stars. This can lead pilots to manoeuvre the aircraft into an unusual attitude in an effort to put the ground lights above them. In areas with sparse ground lighting, isolated lights can also be mistaken for stars, which can make the aircraft appear to be in a nose-high attitude, or have one wing low. When overcast conditions block any view of stars, unlighted areas of the terrain can appear to be part of the sky. Flight over

water makes you more vulnerable to this effect, and in parts of New Zealand, the lights on fishing boats can be mistaken for stars.

The Black Hole

The visual cues available to a pilot approaching a lighted area at night over unlit terrain (the 'black hole') are misleading and inadequate. The most common example of this is an approach to an aerodrome over water or unlit area. Without peripheral visual cues to help, you will have trouble orienting yourself relative to the earth. The runway can seem out of position (down-sloping or up-sloping) and in the worst case, results in landing short of the runway.

If an electronic glide slope or visual approach slope indicator (VASI/PAPI) is available, it should be used. If navigation aids are unavailable, careful attention should be given to using the flight instruments to assist in maintaining orientation and a normal approach profile. If at any time you are unsure of your position or altitude, a go-around should be carried out.



This illustrates a classic black hole, where there are no visual references before the aerodrome, but town lights beyond it.

Sensory Illusions and Spatial Disorientation

During flight, as well as during time spent on the ground, we maintain our orientation in space and time through the subconscious integration of sensory information – from the eyes, ears, nose, skin and joints, and the 'vestibular' balance organs. Vision is the main sense used during flight, with vestibular (from the balance organs in the inner ear), and somatic (from the skin and the joints) senses playing a secondary role.

When flying at night, there is less visual information available to assist with orientation. This reduction in visual information has the potential to result in sensory illusions, and these illusions can be very powerful and disorienting. Sensory illusions are caused by a mismatch between the information that the brain receives from the different sensory organs.

Night flight sensory illusions include:

» **The Leans** – Generally, a situation where a balanced turn has been sustained for long enough that the body compensates and incorrectly perceives the turn as being level flight. On rolling out of the turn, the sensation is of banking in the opposite direction, even though the wings are level.

» **Somatogravic Illusion** – When an aircraft accelerates in level flight, or during takeoff, our vestibular organs are not able to distinguish between the acceleration and gravity. This can result in an illusion that the aircraft's attitude is more nose-high than it is. The pilot can incorrectly apply nose-down control inputs until the flight feels right – and the aircraft descends and impacts the ground.

» **Somatogyral Illusion** – This is a false sensation of rotation. A classic example of this illusion is the 'graveyard spiral', where the illusion of an opposite-direction turn occurs after a pilot has returned to straight-and-level. The pilot can incorrectly adjust for the false rotation, and can enter a progressively tighter spiral in the opposite direction, resulting in aircraft breakup or ground impact.

» **Coriolis Illusion** – Moving the head excessively, especially during in-flight turns, confuses the balance mechanism in the ears, and can produce a tumbling sensation.

> The reduction in visual information has the potential to result in sensory illusions, and these illusions can be very powerful and disorientating.

To reduce the likelihood of these illusions:

» Prepare yourself pre-flight: What situations in this flight are likely to lead to illusions? What will I do if I have a problem? Am I in good health and okay for this flight?

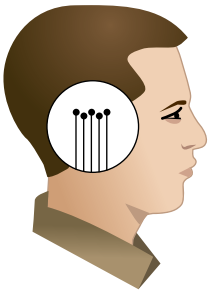
» Minimise head movements: During the scanning of your instruments, and outside, try to keep head movements to a minimum and move your eyes instead. Don't make big head movements while turning. Where practicable, make turns and other flight path adjustments as gentle as you can, and for relatively short durations.

» Use the visual horizon where it is available and reliable: Vision is the most powerful sense for orientation.

» Get onto your instruments, and rely on them: Whenever you don't have a reliable visual horizon, whenever you're doing manoeuvres that can lead to illusions, and whenever you've recognised any sort of illusion or possible disorientation.

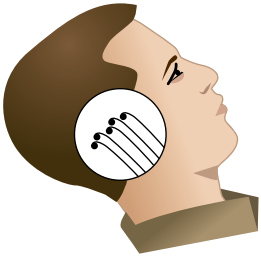
Somatogravic Illusion

Head stationary and upright



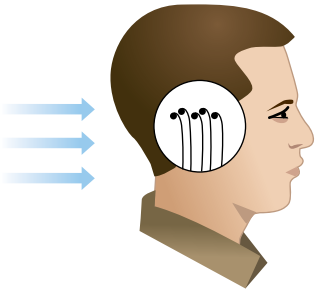
The impression is "I'm stationary and upright"

Head tilted up



The impression is "I'm pitching up"

Forward acceleration



The false impression is "I'm pitching up"

Recovery from Spatial Disorientation

If you experience confusing sensations at any time in flight, scan all relevant instruments before making control inputs. Start with the Attitude Indicator (AI). The AI provides the main picture of what your aircraft is doing. See where the nose is, and where the wings are in relation to the horizon. Note the airspeed, vertical speed, and altitude. Should they indicate improper control of the aircraft, follow these steps:

» Level the wings.

» If losing or gaining altitude quickly, check to assure you're not reaching critical airspeeds.

» Adjust power if necessary for airspeed, then smoothly apply back or forward pressure to stop vertical deviation, putting the nose of the aircraft on the AI's horizon.

» When the VSI reads zero, the aircraft is in the proper attitude for level flight.

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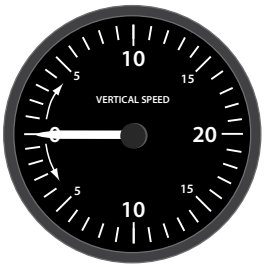


Preparation

Rules

The rules for flying VFR at night are contained in various Civil Aviation Rules, while general guidance about standards, practices, and procedures is in the Advisory Circulars (ACs).

These rules and ACs are not explored in depth in this booklet – anyone thinking about night VFR flight must understand the current requirements and abide by them – they are there for your safety.

Part 61 *Pilot licences and ratings* will give you the information about prerequisites for night flight, including basic instrument time, and currency requirements. Use the related ACs for further information.

Part 91 *General Operating and Flight Rules* includes the required aircraft light and instrumentation requirements, the use of aerodromes, and meteorological minima for night flight.

Some sport and recreation aircraft are not permitted to fly at night, so check the rule applicable to your activity, for example Part 103 for microlights, and Part 106 for hang gliders. Holders of a Recreational Pilot Licence are not permitted to fly as pilot-in-command at night (Part 61).

Passengers

Your passenger briefing is important at night. Warn your passengers against using bright lights, such as torches and mobile phones, that may affect your dark adaptation. When moving passengers to the aircraft, be conscious that they may not be aware of props and struts, and may not see them in the dark.

Photo courtesy of Paul Harrison Kiwi Air Research

Equipment

A torch (and spare batteries) for every flight crew member is a requirement (Part 91). A torch is useful in the cockpit for checking a chart detail, or an unlit gauge, etc. If you shop around, you may be able to find torches (often the LED type) with variable power settings, and some are supplied with a red filter. It is a good idea to have two torches, or at least a second set of batteries. Your choice of torch should take into account that you may need to use it in an emergency situation, such as an electrical failure. Some people tie a pencil style torch around their neck, some will hold one in their mouth when needing their hands, and the headband style torches are becoming more popular.

Consider carrying a set of spare fuses (and know where they are).

Review equipment for use in a dark cockpit. For example, you may want your pen attached to your flight log with string so you can retrieve it if dropped. A spare pen is a good idea.

If possible, carry a hand-held VHF transceiver for backup. If you have a comms failure, this will enable you to communicate and also to switch on aerodrome lights. Some pilots will carry a hand-held GPS receiver as a backup too (pre-set the brightness to minimise disruption to your dark adaptation).

A mobile phone is useful, but be cautious if you need to use it, as their screens can be very bright and could affect your dark adaptation. Store any numbers that might be useful in it, especially Airways' National Briefing Office and any control towers relative to your route. It is a good idea to have numbers of locals who can turn on aerodrome lighting, should the pilot-activated lighting fail. Avoid using your phone as a torch, as that will drain the batteries of a device you may need later.

You should already carry a good watch or timing device, and survival kit. Warm clothing should be considered for you and your passengers, as temperatures are usually lower at night.

A headband torch with red filter being used for cockpit lighting.

Pilot

One of the first practical steps to be taken by the prospective night pilot is to become familiar with the aircraft systems, controls, and switches. Ideally, you should be able to operate them blindfolded – literally. To ensure that items such as starters or retractable undercarriages are not operated, carry out the exercise in daylight on a 'dead' aircraft, with a safety pilot assisting. Note that aircraft of similar types may have differences in layout.

Identify and preset avionic equipment that you know how to use (VOR, ADF, DME). You need to be familiar with the use of this equipment in daylight before using it at night.

The ability to fly the aircraft by regular reference to instruments is inherent to safe, and legal, night VFR operations.

You should also have a familiar routine for where you stow items, such as torches, pens, charts, etc.

Consider your state of health, and fatigue. Don't plan night flying if you've been working all day.

You may have your own 'personal minimums' for flight during the day. Now you may like to develop another set for night, taking into account terrain, and the different Met minima and reserve fuel requirements (Part 91).

Photo courtesy of Paul Harrison Kiwi Air Research

Pre-flight Inspection

If you are flying at night, it is a good idea to carry out the pre-flight inspection during daylight. You need to be able to secure the aircraft afterwards.

If you have to carry out the inspection at night, a light mounted on a headband will free your hands for checking the oil, locking cowlings, etc. Take into account the time for dark adaptation after the inspection.

Take great care with the pre-flight inspection at night, as items of general condition that might easily catch your attention by day, may be disguised by the conditions at night. Plan the departure so that the pre-flight inspection does not have to be hurried.

All required lighting, for example strobes and navigational lights, should be checked and functioning.

Set cockpit warning lights to 'dim' (if available), and reset them to bright when daylight returns. It may be necessary to physically diffuse some lights that cannot be dimmed electrically, by placing a paper mask over them, for example.

Make certain the windscreen is clean. If you are not the first person to fly the aircraft that night, check that a build-up of film, bugs, etc, has not occurred. Pay particular attention to static vents for blockages.

If you must do the pre-flight inspection at night, use a bright light, but remember to leave time for dark adaptation before flight.

Photo courtesy of Paul Harrison Kiwi Air Research

Flight Planning

The key to successful visual navigation at night is good planning. A good rule of thumb is: Don't attempt to fly a route at night that you haven't flown during the day.

If flying cross-country at night, it is highly recommended that you file a flight plan, or have flight following in place. In the case of flight following, it is vital that the person nominated knows exactly what to do, and when to do it.

Normal flight planning considerations apply, weather and *AIP Supplements* and NOTAMs, etc, but there are a number of special considerations for flight at night.

Weather

Weather is one of the most serious considerations in planning a flight at night. It is often difficult or impossible to see clouds, so inadvertent IMC is a major risk factor. You must seriously consider this when deciding whether or not to fly cross-country at night. One recommendation is to climb to the IFR Minimum Safe Altitude (MSA) above the departure aerodrome, and if you cannot see your destination, don't go. Another is to look up the IFR MSA for your route, and fly at that altitude, because of the built-in terrain clearance.

There are different legal minima at night, but if you are getting close to them, you increase your chances of inadvertent IMC, so consider landing or turning back. Consider what your own personal minimums will be for night flight. The weather at your alternates must be part of your plan.

It is important that you check the temperature/dew point split (difference) as part of your assessment of up-to-date weather information. When the temperature drops to the dew point, or close to it, it is likely that the cloud base will lower and there could be rain or fog.

Fuel

Increased reserves are required at night. Consider your own personal minimum above this. Plan for diversion to your alternates. Consider availability of fuel at destination and alternates, should you need to refuel.

Aerodrome Lighting

You need lighting at your departure and destination, and also your alternates. You should familiarise yourself with the type of aerodrome lighting when planning, to aid your recognition of it in flight. You need a plan should the pilot activated lighting fail.

Alternates

Alternates must have lighting. What is the weather forecast for your alternates? Is fuel available?

Emergencies

Are there places you can land? Do you have the right equipment, and backups? Do you have plans in place for typical situations, such as a vacuum or electrical failure?

Airspace

Plan to fly as high as possible, as this will give you better terrain clearance, and more forced-landing options. The visual navigation charts have Maximum Elevation Figures (MEFs) in each quadrangle, shown in thousands and hundreds of feet above mean sea level. The MEF is based on the highest known feature in each quadrangle, including terrain and obstructions (trees, towers, etc). Treat MEFs as representing solid obstacles. Add your safety margin to the MEF to determine a minimum safe altitude in the rectangle.

In planning your route, take into account the terrain, and location of townships, considering suitable places for a forced landing, and to improve your ability to identify features and confirm your position. It is better to take a longer route over level terrain than a direct route over mountainous terrain.

Know which features you will use as visual checks, and highlight them clearly on your chart. Features that can show up well at night are coastlines, rivers, towns, major roads, and aerodromes. It is good to use these features even if they are off-track. Mark time intervals so you know when to expect them.

Large areas of water can be hazardous because of loss of horizon, lack of landmarks for situational awareness, and reflections of stars can contribute to disorientation.

Finally, as you complete your planning, remember that it will take 30 minutes to adapt night vision fully to low light levels.

Operating at Night

A VFR night flight should not be made under any circumstances during poor or marginal weather conditions.

A visual horizon will not always be available at night. Use your instruments so that sudden loss of a visual horizon will not disrupt your navigation and control of the aircraft. For turning, use a medium angle of bank (not more than 30 degrees) so you don't lose orientation.

Higher relative humidity at night requires closer carb heat monitoring.

Startup, Taxiing, and Takeoff

If there is a reasonable time between pre-flight and takeoff, be prepared for heavy dew to form on the windscreen. If the aircraft undergoes a temperature change, eg from inside a hangar to the cool air outside, beware of cockpit misting.

Make sure all the materials you may want to use on the flight are accessible, eg charts, torch, etc. You should be able to locate them by feel.

During startup, be certain to check the electrical system, eg battery condition and generator or alternator charging rate.

Instrument checks are essential for night flight.

Use aircraft lights appropriately for the circumstances – to light your path without distracting other pilots. Your landing light, if left on, could affect the dark adaptation of other pilots.

Your impression of distance and speed will be distorted at night while taxiing. Consciously taxi at a slower speed.

Just before takeoff, when lined up, observe your perspective view of the runway lights, especially those beside your ears in your peripheral vision. This is the view you will use on landing to estimate the point of touchdown.

For takeoff, use the runway lighting for guidance. When airborne you must transfer some of your attention to monitoring the aircraft attitude (positive rate of climb), direction, and speed, on instruments in order to avoid takeoff illusions. With limited visual reference, track on a heading allowing for drift.

If your home aerodrome has a full suite of lights, it is a good idea to do some practice circuits at an aerodrome with just the basic rectangle of lights. Sometime you may need to use such an aerodrome.

Operating in the Circuit

During the downwind leg, the runway lighting is the focus of attention. Use it to adjust the circuit pattern and, in particular, to allow for crosswind. If the runway lights are unidirectional, they will not be visible from the downwind leg, and circuit tracking will have to be either by reference to the direction indicator (DI), or to any available lighting in the vicinity.

Early in the airborne phase, ie downwind in the circuit, or clear of the circuit if vacating, carry out an orientation look-around. Identify small communities for orientation and as an indicator of changing weather conditions.

The base turns and base leg are flown primarily with reference to the runway lighting, assisted by any approach, circling guidance, or lead-in lights that may be part of the aerodrome lighting.

Training in the circuit for night VFR will often be carried out with no air traffic control. It is more convenient in winter when it's dark earlier, so when there's a fine night there can be a lot of traffic vying for the circuit. It is best if training organisations liaise and agree on a maximum number of aircraft to be in the circuit, and also consult other operators on the aerodrome who may be operating at night.

Flying neighbourly helps everyone, so consider noise and height in relation to nearby housing.

Leaving the Circuit

Dead-reckoning navigation should be backed up by another navigation tool such as GPS, ADF, VOR, or DME. Monitor your position, time estimates, and fuel consumed.

Your preparation may have assured you the weather would remain clear for your flight, but conditions can change rapidly. You need to be vigilant for any change in the weather, but this can be difficult because it will often be invisible – the only time you will see fog, mist, cloud or rain is when they are situated over a lit area. It is very easy to enter cloud without realising it.

Usually, the first indication of flying into restricted visibility conditions is the gradual disappearance of lights on the ground. If the lights begin to take on an appearance of being surrounded by a halo or glow, you should use caution in attempting further flight in that same direction. Such a halo or glow around lights on the ground is indicative of ground fog.

Watch for any township light patterns that adopt a different shape from that expected, which change their shape while you watch, or which disappear altogether. In such cases, you should suspect low cloud, fog, or terrain.

It's important that you monitor the temperature/dew point split, and access up-to-date weather. Learn to read the signs.

If bad weather does appear unexpectedly, good airmanship and a sound knowledge of weather phenomena will dictate whether you should turn back or divert to the nearest aerodrome that is open. If you are in any way unsure of conditions, play it safe and land.

Approach and Landing

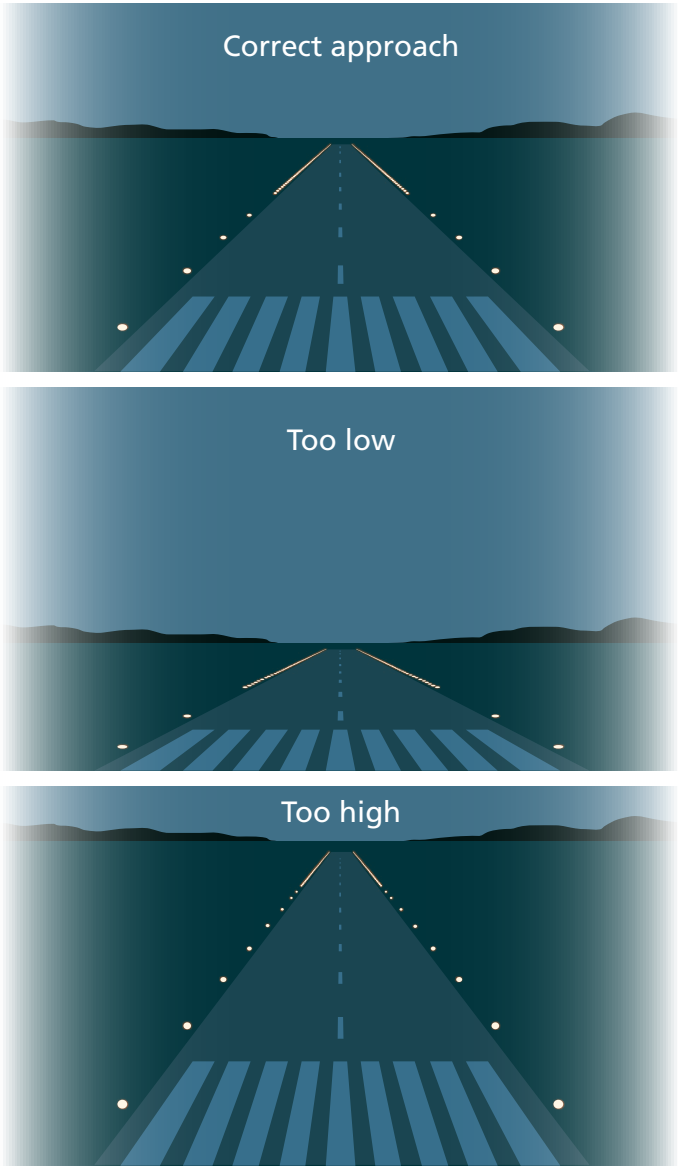
On final, the correct angle of approach is maintained by reference to the approach and runway lights, unless life is made easier by installation of some form of approach slope indicating lights.

At night, the judgement of height, speed, and sink rate, is impaired because there are few observable objects in the landing area. The inexperienced pilot may have a tendency to round out too high until attaining familiarity with the proper height for the correct round-out.

Maintain the correct approach profile using the runway lights. If your approach is on the desired profile, the runway lights will appear to converge slightly with spacing visible between the initial lights. Flare with the lights coming up to your peripheral vision level as you observed prior to takeoff.

You need to be vigilant for any change in the weather, but this can be difficult because it will often be invisible – the only time you will see fog, mist, cloud or rain is when they are situated over a lit area.

Runway Perspective on Approach



Emergencies at Night

Night emergencies are similar to daytime ones, except that some solutions are more difficult at night. The basic principle to Aviate – Navigate – Communicate is as important as ever. In other words fly the aircraft, and seek assistance.

A communications failure is serious at night, which is why we have recommended taking a spare hand-held VHF transceiver. You should be familiar with *AIP New Zealand* ENR 1.15 para 5.2 VFR Communications Failure. The transponder squawk code for comms failure is 7600. A mobile phone can be useful in this situation.

An electrical failure is particularly serious. You can't see the instrument panel, and you may lose use of flaps and landing gear. If you lose navigation lighting, others will not be able to see you. And, as if that isn't enough, you may lose communication.

Inadvertent IMC should be covered by a pre-planned procedure. Turn off the rotating beacon and strobes because they may cause flicker vertigo in cloud or mist – use the autopilot if you have one – make a 180-degree level turn – scan the instruments – monitor and control altitude – trust your instruments.

It is a good idea to practise your inadvertent IMC procedure in daylight, and get yourself checked out in this by an instructor from time to time.

The loss of attitude flight (gyroscopic) instruments could seriously affect your ability to control the aircraft. Monitor the vacuum gauge regularly. If the attitude indicator is sluggish or topples, the performance of the indicator should be confirmed by reference to the turn coordinator, or turn and slip indicator. If a fault is detected, it is advisable to cover the attitude indicator to avoid any distraction. Continued flight should still be possible using the turn indicator, or a standby attitude indicator powered by an alternate power source. Being current in limited panel instrument flying is essential.

Engine failure should be treated the same as in daytime. If you are not within gliding distance of a known aerodrome or airstrip for your emergency landing, choose an area that is unlit (unpopulated), but near lights (close to assistance), if possible.

If making a precautionary or emergency landing at night, delay turning on the landing light if it could upset your night vision. Also delay turning off the master switch until you are on the ground, so you have lighting assistance until landed.

For helicopters, it is recommended to autorotate by night using 'constant attitude autorotation'. This technique guards against flaring too late and landing with excess forward speed. With a large or normal flare, the landing light will flare with the aircraft and be useless to the pilot at the time when it is most needed. The constant attitude autorotation therefore helps with lighting near the ground. If you can see enough of the surface, flare slightly to ensure that the landing light still illuminates the ground beneath you. If you're having difficulty seeing the ground, then maintain the aircraft's attitude and raise the collective to cushion the landing. If you are going to land in trees, try to enter the tree canopy with no forward speed and at minimum rate of descent, and if possible slightly nose-high.

References and Further Information

For more information on Threat and Error Management, a good start is to see the CASA document, CAAP 5.59-1(0). A search on their web site (below) will list it.

Documents used to source information and illustrations, with thanks:

- Civil Aviation Safety Authority (CASA), www.casa.gov.au
- Federal Aviation Administration (USA), www.faa.gov
- Aircraft Owners and Pilots Association, www.aopa.org

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See our web site, www.caa.govt.nz, for details of more CAA safety publications.

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