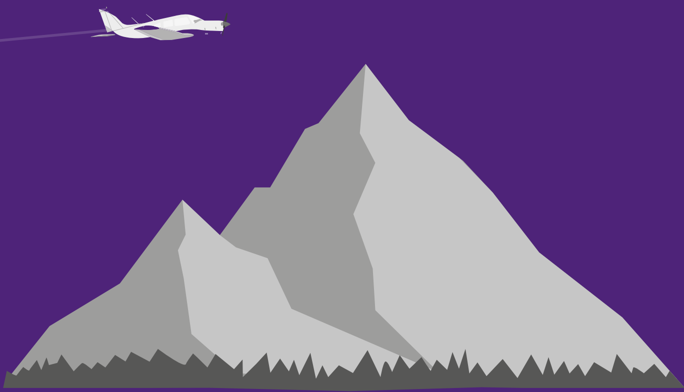
November 24

UK Civil Aviation Authority



MOUNTAIN FLYING SAFETY

SAFETY SENSE

SS35

YOUR SAFETY SENSE LEAFLET FOR:
MOUNTAIN FLYING SAFETY

This Safety Sense Leaflet (SSL) is an introduction to mountain flying techniques and considerations. It is primarily aimed at pilots of powered fixed-wing aircraft.

The highest terrain in the UK is low compared to elsewhere, however phenomena associated with mountain flying are applicable to several areas of the UK such as the Highlands and Lake District. When flying in Europe, you may also encounter high terrain, for which you should be prepared.

The SSL should be read in conjunction with the *Skyway Code* and other Safety Sense Leaflets cited throughout the text.

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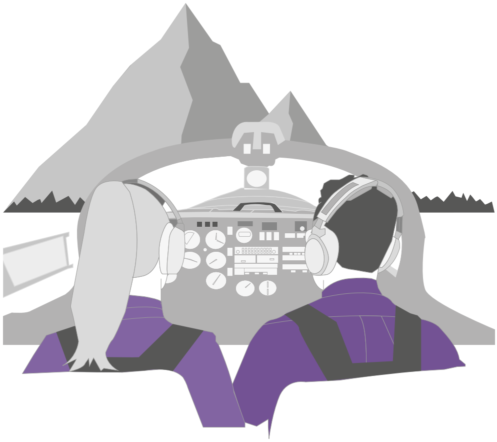


Mountain flying is not a defined term, and the appropriate level of knowledge and practical training will vary depending on the intended area of the flight.

For some scenarios, it may not be possible to assimilate the required skills solely via written material. A flight over the Scottish Highlands should be within the capabilities of a pilot who has conducted effective preflight planning and reviewed the considerations for higher terrain. However, instruction would be strongly recommended for valley flying in the Alps.

A mountain rating is available for licences issued under the European Aircrew Regulation and is a requirement for operating into certain designated mountain aerodromes in Europe.

At the time of writing, there are no training organisations approved to support the addition of a mountain rating to a UK issued pilot's licence, however subject to local regulation, European instructors may still deliver mountain flying training to UK pilots.

High terrain

Terrain clearance

It is recommended that normal Visual Flight Rules (VFR) flights have a terrain and obstacle clearance of at least 500 to 1,000 ft within a horizontal distance of several miles either side of the route. Most ICAO VFR charts display a 'Maximum Elevation Figure' (MEF) for each quadrant – adding a margin to this can be used to establish a minimum safe altitude for a route or area of operation.

In mountainous areas, a clearance of 2,000 ft will provide a greater margin for turbulence or descending air caused by downdrafts or mountain waves. Significant mountain waves can be encountered within and downwind of relatively low hills such as the Pennines.

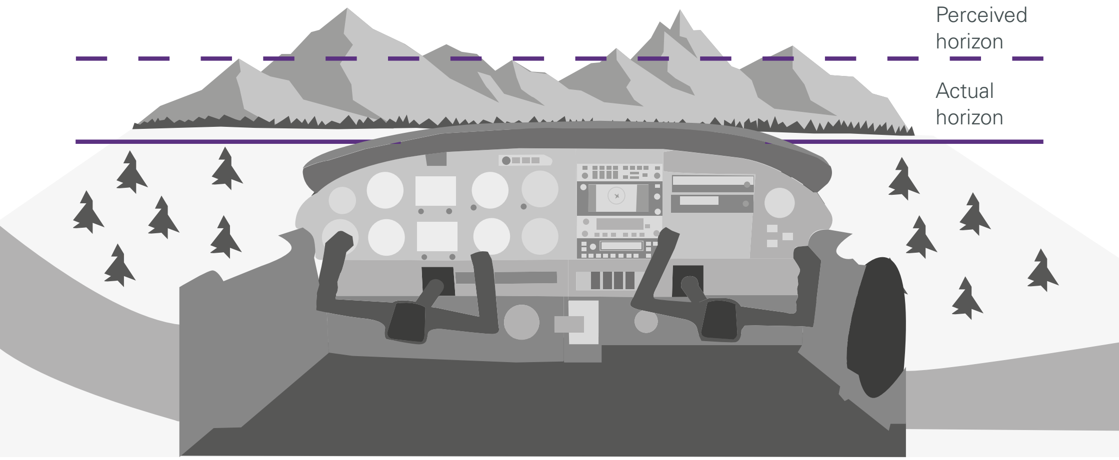
Outside the UK, there may be areas in which climbing above all nearby terrain is not practical due to aircraft performance or lack of supplementary oxygen. You should normally remain at least 1,000 ft above the ground below you, but the lateral margins of clearance may have to be reduced. Navigating such areas could involve flying through valleys and crossing mountain passes, while the peaks of terrain are above you. Such flying requires additional knowledge and planning.

Changing horizons

The horizon is the horizontal line where the land or sea visually appears to meet the sky. When learning to fly, you are taught to control the aircraft with reference to that line. In clear skies and over uniformly flat terrain or the sea, the horizon will normally be well defined.

When surrounded by mountainous terrain, there will not be a representative view of the horizon. You will have to imagine where the true horizon lies and select the appropriate nose attitude accordingly. The lower you are relative to the terrain, the harder it will be to establish the correct horizon. The effect may be worse in a climb due to the limited forward view.

As you approach higher terrain, the horizon can appear to be moving up the windscreen. In response, you might subconsciously apply back pressure to keep the horizon in the normal place. Loss of airspeed and a stall may result, especially under high workload or if distracted from flying the aircraft. If you need to climb whilst approaching high terrain, be cautious in selecting your climb attitude. You can reduce the risk by climbing as high as possible and well in advance of the terrain.



When commencing a climb, follow the process:

- Power – select the correct power for climb;
- Attitude – select the climb attitude, verify the correct airspeed; and
- Trim – trim the aircraft so that the attitude and speed remain stable.

As you climb, aircraft performance will gradually reduce, so the nose attitude will have to be periodically lowered and retrimmed to maintain a safe airspeed.

Valley flying

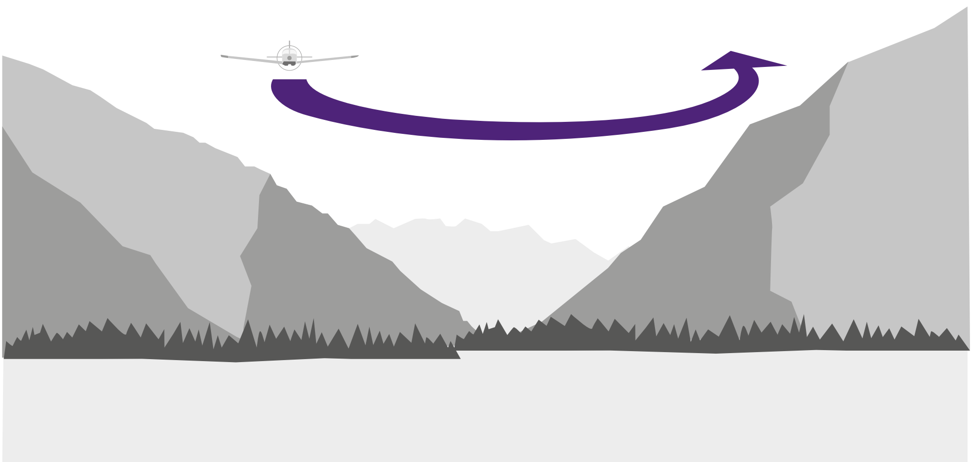
Valley flying should only be conducted in good weather and lighting conditions. You must conduct adequate planning and be assured of terrain clearance. Always have a path back to safety if necessary – do not put yourself in a situation in which you cannot escape rising terrain.

Consider the emergency landing options – a narrow valley may not have any safe areas for a forced landing, which presents an additional risk. Observe any local rules; for example, in many states you must fly on the right-hand side of a valley.

Common reasons for valley accidents include:

- The valley floor rises or ends in terrain that exceeds aircraft climb performance;
- Insufficient space to manoeuvre, for example when attempting to reverse direction;
- Entering a different valley than intended;
- Stall and loss of control while manoeuvring;
- Striking obstacles such as power lines.

When entering a valley, confirm you are proceeding in the right direction. Cross check heading against your flight log and look for prominent ground features. It is good practice to perform an orbit to verify your turn diameter, before committing to a valley or area of reduced width. If you need to reverse course, position the aircraft high and to one side of the valley wall before turning.



HIGH TERRAIN

Consider your airspeed and ground speed – the higher your airspeed the greater the turn diameter will be for the same bank angle. At 100 kts and with a 30° angle of bank, the turn diameter will be approximately 0.5 NM. Halving the angle of bank to 15° would approximately double the diameter to 1 NM.

Reducing airspeed will reduce the turn radius, but always maintain a safe margin above the stall – in a level turn the stall speed increases with bank angle. Be aware how the wind will impact your turn – turning into wind will reduce the turn diameter, but turning downwind will increase it and potentially move you closer to terrain.

Before and during manoeuvring in a terrain confined area, ensure you have:

- Adequate airspeed
- Safe separation between the aircraft and terrain
- Slip ball central, avoiding too much ‘into turn’ rudder

Case Study

A group of four aircraft from the UK were flying through the French Alps, enroute to Italy. They were following a valley, but the terrain was rising, and they needed to cross a mountain pass above their current level.

To gain height, the aircraft began to climb while circling near a village in the valley. Once at a higher altitude, they proceeded towards the pass but encountered rising terrain that was higher than anticipated. They had turned in the wrong direction and entered a different valley, possibly disorientated by the circling.

When the error was realised, they decided to turn around. The pilot of the lowest aircraft considered that he did not have sufficient room in the valley to safely turn, and carried out a forced landing, surviving without injury.

Shortly after the forced landing, another pilot in the group commenced a steep turn, during which control was lost and the aircraft struck the ground. Both occupants suffered fatal injuries.

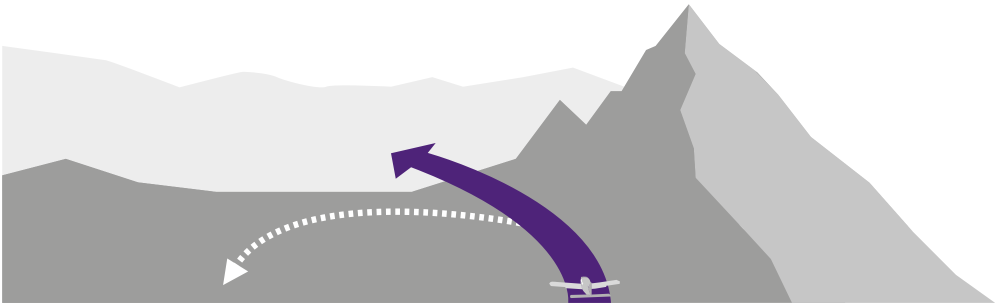
The investigation identified several contributing factors:

- The absence of a natural horizon, a feature of mountain flying which the pilot would not have been accustomed to, may have contributed to the loss of control.
- The pilots did not detect the navigation error which led them into terrain that exceeded the performance capabilities of the aircraft.

Crossing passes

Mountain flying may involve crossing passes or saddles between the peaks. Recommended practice is to climb well in advance of a pass and have a height margin of at least 1,000 ft. If winds aloft are significant, a 2,000 ft clearance provides more safety from downdrafts.

You must always verify that you will clear the pass, before committing to crossing. Approaching at a 45º angle will give a better view and allow you to turn away should the need arise – for example if you encounter windshear or a downdraft. Naturally aspirated piston aircraft will have limited climb performance at higher altitudes, so even mild descending air may cause a loss of height.



Each mountain pass will have a different shape and surrounding terrain. Plan your approach direction and consider escape options. It may not always be possible to approach at a 45º angle but try to avoid coming head on since it makes it harder to judge the clearance, and may restrict options for turning away.

Hidden wires

Power lines and similar wire obstructions are difficult to spot from the air and there have been many accidents involving collisions with them. Note the route the wires are taking. You may find the wires are going up the side of a mountain. Larger pylons should be marked on your chart with individual heights. Increasing your separation from the valley floor and mountain sides will reduce the risk. If you are crossing wires, try and pass over the supporting pylons – they will be easier to identify.

If you find yourself unable to outclimb terrain for some reason, above all do not allow the aircraft to stall. Terrain contact may be survivable if you maintain control and minimise your descent rate.

Low sun

Flying directly towards a low sun while surrounded by high terrain can be very dangerous. Your depth perception is negatively impacted as well as reduced ability to see any danger ahead.

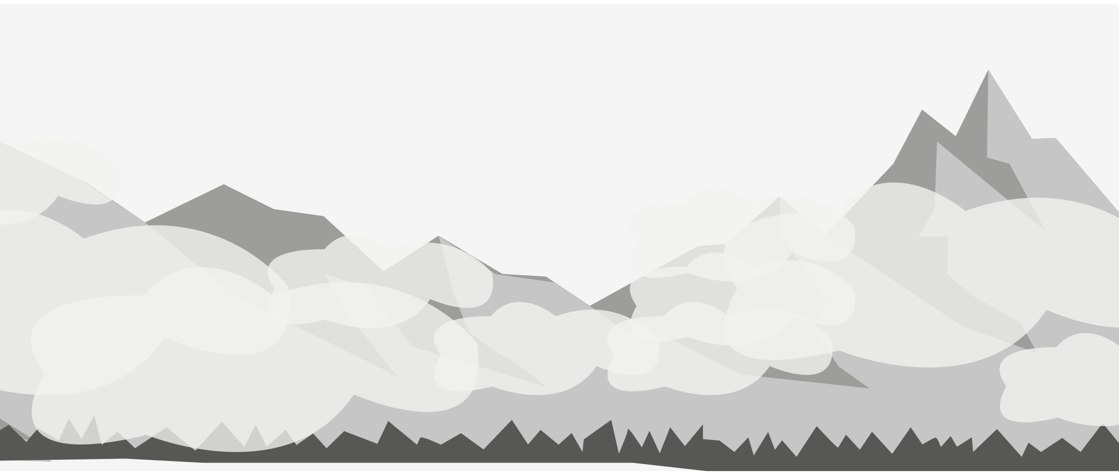
While you are planning your flight, check sunset times and consider the position of potential low sun on your route. If low sun obstructs your view, you should climb to a safer altitude and remain above any obstacles in the area.

Low cloud

Low cloud over mountainous terrain presents a serious risk. You should be confident that there is no significant cloud at the intended operating altitude along your route – unlike in lowland areas, your options for descending, manoeuvring, or reversing course may be very limited if you encounter instrument meteorological conditions (IMC). You should always have a margin of clear air between you and the cloud base above.

Cloud cover in the mountains may vary in height considerably, even over short distances. Fog may form in valleys, despite skies being clear elsewhere. Flying into a lowering cloud base could result in a collision with terrain or loss of control in IMC. For more guidance on avoiding VFR into IMC guidance, see SSL 33 – VFR Flight into IMC.

Flying over mountains with significant cloud below also carries risk – consider your options if you have an emergency and need to descend or land. Entering cloud in temperatures below freezing will likely cause ice formation on the aircraft, negatively impacting performance and causing control difficulties.



[1] Note that in airspace classes E and above you are required to maintain 1000 ft vertically and 1500 m horizontally from cloud.

Aircraft Performance

Aircraft performance is an important element of mountain flying. Higher altitudes will bring increased takeoff distances and reduce rates of climb. It is important to anticipate this and build it into your preflight planning.

Aircraft engines may also suffer a loss of performance with age – this may go unnoticed at typical UK altitudes and temperatures but become more apparent in more 'hot and high' environments. For more guidance on performance, see SSL 9 – Weight, balance and performance.

Density and pressure

Aircraft performance figures are normally quoted with reference to the International Standard Atmosphere (ISA) mean sea level pressure of 1013 hPa and outside air temperature of 15°C. Increased temperatures or lower pressures from standard will reduce performance. UK pilots are often unfamiliar with the effect of higher air temperatures and operating altitudes.

Two definitions are key:

- Pressure altitude refers to the altitude displayed when 1013 hPa is set on the altimeter; and
- Density altitude is pressure altitude corrected for temperature, effectively the altitude the aircraft experiences for performance purposes.

Most aircraft performance graphs use pressure altitude as a reference – when the sea level air pressure is lower than 1013 hPa, the pressure altitude becomes higher than altitude above mean sea level (QNH). Pressure altitude should be used for performance purposes.

Speeds

It is important to understand the relationship between:

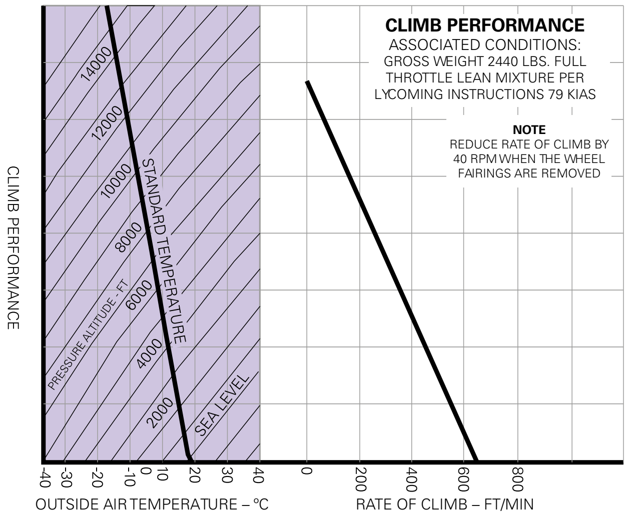
- Indicated Airspeed (IAS) – the speed displayed on the airspeed indicator (ASI);
- True Airspeed (TAS) – the speed of the aircraft relative to the surrounding air; and
- Ground Speed (GS) – the speed of the aircraft relative to the ground.

As an aircraft climbs, the TAS increases compared to the IAS. This is due to the air density reducing – the difference in static and ram air pressure measured by the airspeed indicator (ASI) is no longer representative of the aircraft's speed relative to the surrounding air. A useful rule of thumb for TAS is that it exceeds IAS by 2% for every 1000 ft increase in altitude.

Ground speed is TAS adjusted for the wind speed relative to the ground – with a tail wind your ground speed will exceed your TAS, but with a headwind it will be less.

Climb performance

Ensure you know the required climb performance to ensure terrain and obstacle clearance in the prevailing conditions. A typical single engine piston climb performance graph from an Aircraft Flight Manual (AFM) is shown below:



The example graph is referenced to maximum take-off weight (MTOW) – data for lighter weights may not be provided. You will see that at sea level, the rate of climb is around 600 ft/m. Note how the rate of climb decays with altitude.

At 10,000 ft the aircraft will climb at less than 200 ft/m – a significant difference. To put that into context, if the aircraft had to clear a mountain or ridge by climbing from 10,000 ft to 12,000 ft, it would take over 15 minutes. At sea level, a 2,000 ft climb takes just over 3 minutes.

You may need to establish the distance required for a climb prior to terrain. Always leave a margin between you and the ground – at least 1,000 ft is recommended. If your AFM has a 'Time, Fuel, Distance to Climb' graph, this can be used to establish the still air climb distance.

Alternatively, calculate the distance required via the climb performance graph (ft/min):

1. Establish an overall rate of climb by taking the average of the start, end and intermediate altitudes throughout the climb;

2. To calculate the time taken to climb, divide the required altitude gain by the rate of climb;

3. Multiply your time taken to climb by the anticipated average ground speed. Remember to account for the increase in TAS and any tailwind.

AIRCRAFT PERFORMANCE

For example, climbing from 10,000 ft to 12,000 ft:

- Average rate of climb: 130 ft/min
- Time to climb 2,000 ft: 15 minutes (0.25 hours)
- Average ground speed: 96 kts
- 96 kts x 0.25 = 24 NM travelled.

With typical light aircraft climb performance, the inaccuracy caused by not accounting for the climb angle relative to the ground can be disregarded.

Climb gradient

It may also be useful to consider the climb gradient – the amount by which the aircraft needs to climb over a certain distance. Gradient can be expressed as either a percentage or height per distance:

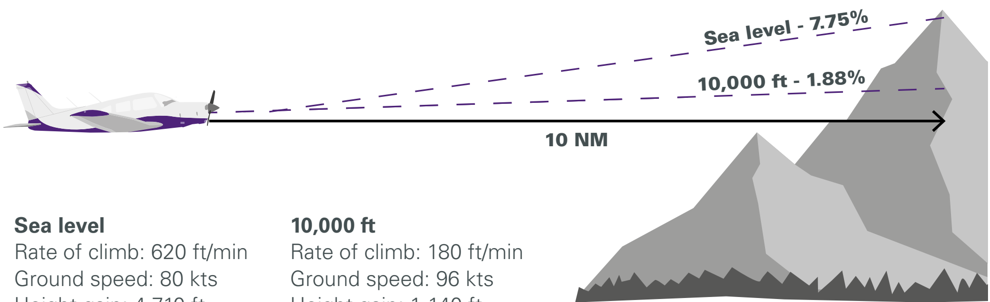
$$\textbf{Climb gradient} = \frac{\textbf{Rate of climb}}{\textbf{Ground speed}} \qquad \textbf{Climb gradient (ft/NM)} = \frac{\textbf{height (ft)}}{\textbf{distance (NM)}}$$

A 1% climb gradient would mean the aircraft was climbing 1 ft for every 100 ft of forward travel. The gradient that an aircraft can achieve will reduce with altitude. This is due to reduced engine performance, but also the increase in TAS for a given IAS.

Assuming you are climbing at 80 kts IAS at 10,000 ft, your TAS is 96 kts – a 20% increase. In still air, the ground speed will also be 96 kts, resulting in a lower climb gradient. The aircraft will stall at approximately the same IAS as it would at sea level, so you cannot significantly reduce the climb speed to compensate.

Comparison of still air climb gradients over a 10 NM distance:

Sea level vs 10,000 ft



Sea level
Rate of climb: 620 ft/min
Ground speed: 80 kts
Height gain: 4,710 ft

10,000 ft
Rate of climb: 180 ft/min
Ground speed: 96 kts
Height gain: 1,140 ft

Not to scale

Departure gradients

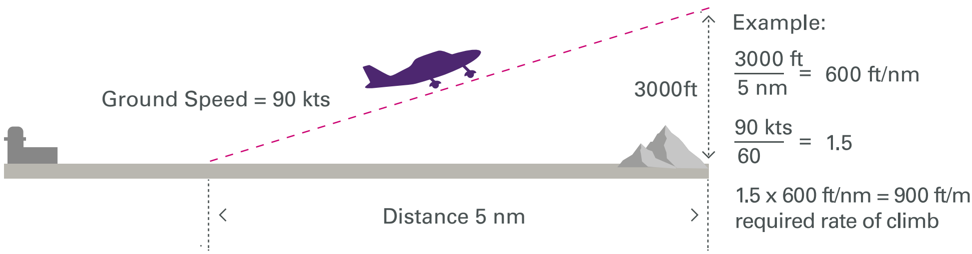
Another scenario is where you have a fixed distance available for a climb, and you need to establish whether it is possible to achieve the required height within that distance. This can be done by calculating the climb gradient, and from that a minimum rate of climb.

To convert a gradient in ft/NM to a required rate of climb:

1. Divide the average ground speed by 60;

2. Multiple the above result by the gradient.

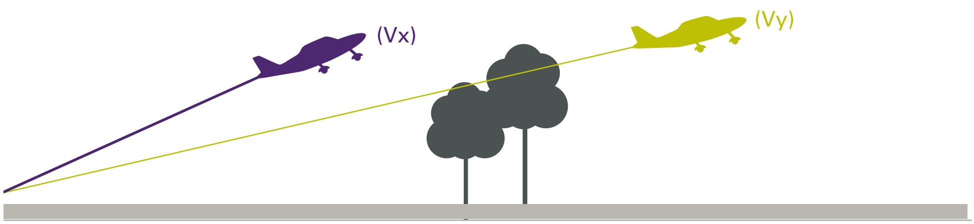
In the example below, the aircraft might be taking off from an aerodrome in a valley and for terrain reasons, needs to gain 3,000 ft over 5 NM. The actual terrain is 2,000 ft above the takeoff surface.



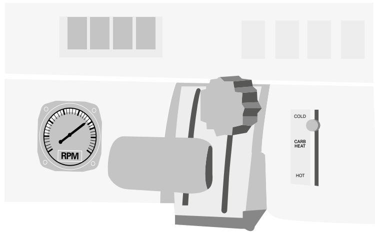
In many light aircraft, an average of 900 ft/min over a 3,000 ft climb will not be achievable, and an alternative route must be found. If the terrain allows, one option may be to climb in an orbit. This will reduce the rate of climb but allows height to be gained while staying in the same area. However, orbiting brings other risks, such as disorientation, midair collision, or failure to monitor airspeed if you are focused on the ground.

Vx and Vy

Know your maximum angle of climb (Vx) and rate of climb speeds (Vy). The AFM climb performance data will normally use Vy, but in circumstances in which terrain clearance is reduced, flying at the slower Vx will achieve a steeper gradient. Speed control at Vx is critical – your margin above the stall speed is reduced and the higher nose attitude will obstruct the horizon.



Engine management

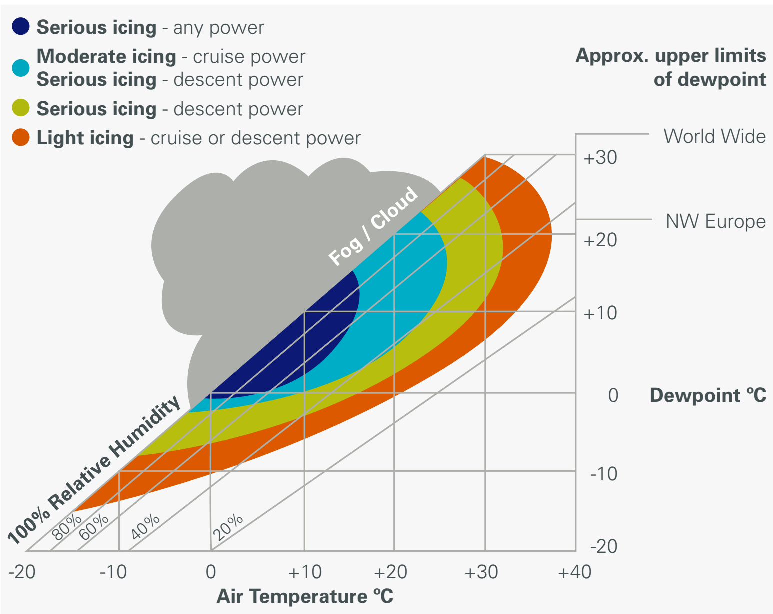


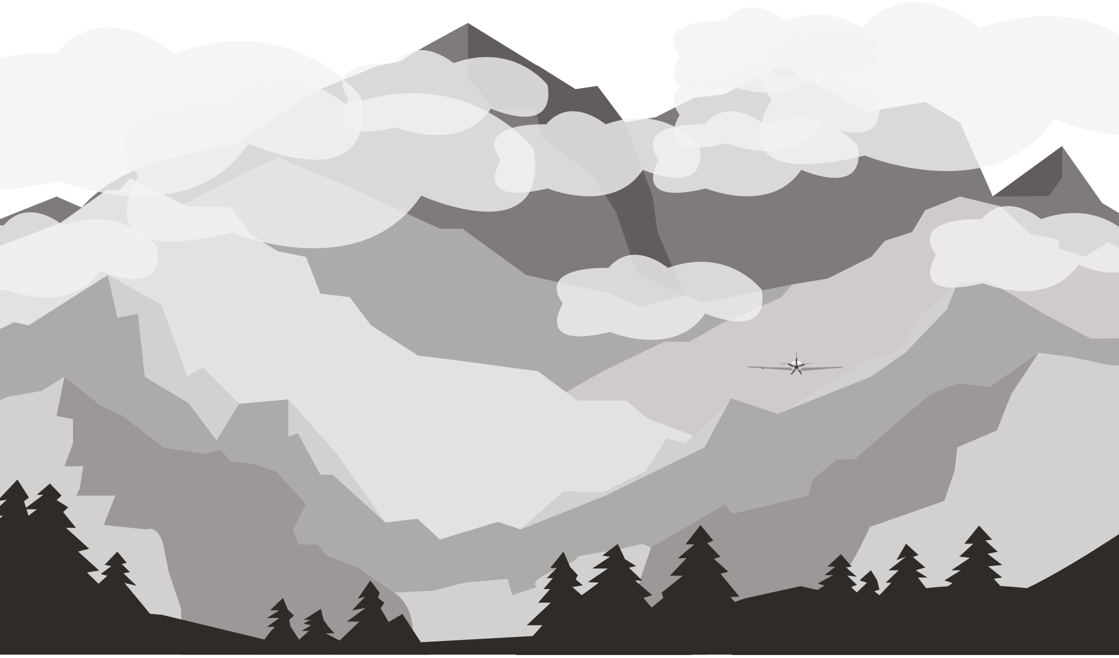
Apply the correct fuel/air mixture leaning procedure for your aircraft. Leaning should not be thought of as being only for high altitude operations – subject to AFM guidance, leaning the mixture should be conducted at any altitude or power setting where it will improve engine performance or allow smoother running. Leaving the mixture fully rich may cause a loss of power at higher altitudes.

Power changes should be smooth and gradual. Long climbs may put additional strain on the engine. Monitor temperatures and pressures to ensure they remain within limits. If oil or water temperatures begin to rise above normal, you may need to lower the nose to increase airflow over the engine or radiator.

Air-cooled engines may be at risk from rapid temperature changes in the descent, particularly if outside air temperatures are low. This can cause excessive engine wear and possible lack of throttle response when levelling off. Subject to RPM limitations, keep the throttle partially open throughout the descent. If descending at idle power, periodically open the throttle to keep engine temperatures up.

Review the risk of carburettor icing and operate the carburettor heat function in accordance with the AFM. For more guidance on piston engine icing, see SSL 14 – Piston Engine Icing.





Meteorology

Mountain flying is best experienced with low wind speeds and minimal cloud, often more likely in the morning. If winds aloft are significant, turbulence and downdrafts will probably exist. Mountain weather is a complex subject, often dependent on location. Always research and understand the local weather patterns. The following pages give an introduction to mountain clouds and wind effects.

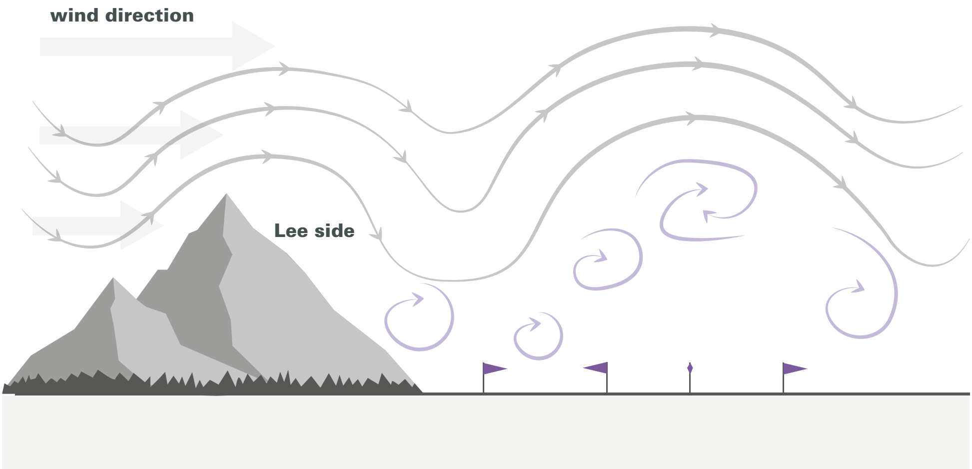
Mountain wave

When there is a stable wind blowing over mountains, a ‘standing wave’ may be produced.

As a rule of thumb, when the wind is 15 kts or more at ridge or mountain top height, particularly with ridge lines perpendicular to the wind direction, you may find mountain wave downwind of the terrain. The presence of a temperature inversion layer at the height of the mountains may facilitate formation of the wave. Long distance pressure gradients may also contribute – for example over the Alps such winds may develop when the pressure to the north in Zurich is significantly higher than in Milan.

As shown in the diagram on the following page, the air flowing over the mountain is displaced upwards. As it descends over the lee side, it tries to return to the original level. The air mass that has been displaced tends to overshoot the terrain as it climbs and descends, giving it the ‘wave’ pattern, while trying to reach equilibrium.

METEOROLOGY



The net lift/sink strength of mountain wave varies depending on different variables:

- How stable the air mass is – higher stability = more powerful mountain wave;
- Strength/direction of wind – usually 15 kts+ at mountain peak height at a perpendicular angle;
- Shape of the mountain – a steep downslope on the lee side will encourage mountain wave;
- Height of inversion relative to the mountain – around mountain top height is optimum; and
- Wind profile – ideal conditions for wave are increasing wind and stable direction with increasing height.

Dangers of mountain wave

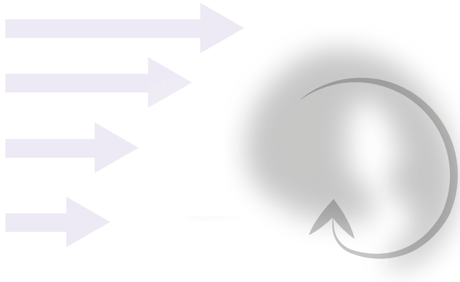
- Typical lift or sink of mountain wave can be around 1000 ft/min. On particularly strong days you may see as much as 3000 ft/min. If you fly through the sinking air, this may result in being unable to climb or even being unable to maintain your altitude. This may prevent you from getting over any terrain, or getting stuck dangerously low in a valley with no landing options.
- Underneath the wave you usually find rough air known as ‘Rotor’. Rotor can cause extreme turbulence and should be avoided where possible.

METEOROLOGY

Rotor

Underneath the stable layer, or temperature inversion, is where you would find the associated rotor. Often the rotor cloud is seen as thin cumulus that rotate in the same place over the ground. The cloud forms and decays in the same place, despite of the wind.

At or below cloud level, unstable and mixing air can be very turbulent. If you encounter these conditions, reduce speed to below Va (manoeuvring speed). Focus on maintaining an appropriate nose attitude – you may have to allow the aircraft altitude to vary.

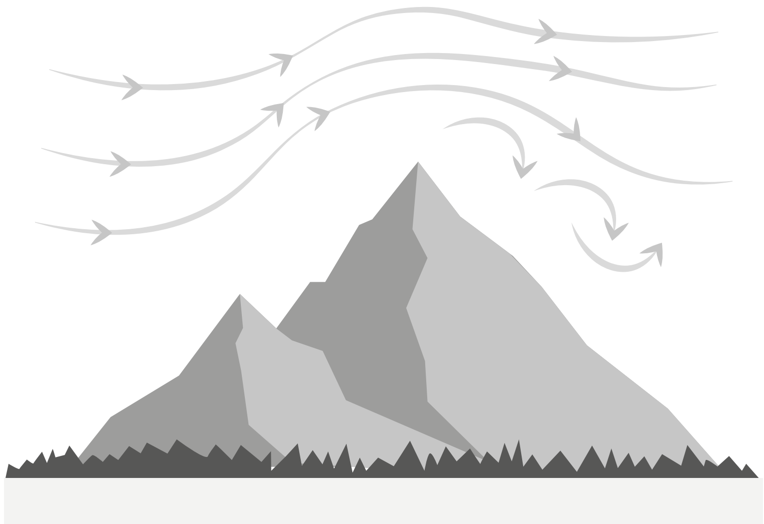


Above the rotor cloud is usually smooth laminar flow air, with rising air on the upwind side of the cloud and sinking air on the downwind.

Ridge lift and sink

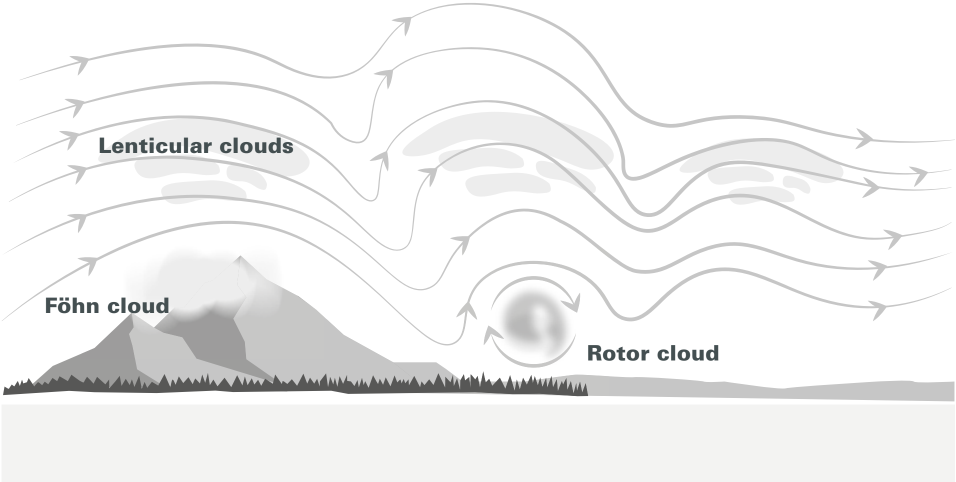
Ridge lift (or hill lift) and sink occurs when the wind meets a hill head on, flowing up the face (rising air/lift) and then following the terrain down the other side (sinking air).

Flying close to the lee side of hills or mountains can be dangerous due to strong sinking air and potential for severe turbulence, it should be avoided where possible. In extreme cases this can lead to loss of control.



METEOROLOGY

Mountain clouds



Lenticular clouds

Lenticular clouds form at higher altitudes where air ascends in the wave flow above and on the lee side of the mountain. These clouds are typically stationary above the ground, even though the wind is normally blowing through them at high speed.

The leading edge appears where the ascending air reaches the dew point in the atmosphere. After the airflow has peaked, the air begins to descend again, and cloud formation stops. Lenticular clouds (sometimes called a 'Föhn wall') appear to be smooth, but this is deceptive – mountain wave and turbulence is usually present. You may also see multiple layers of cloud, depending on the moisture content of the air flow.

Föhn wind and cloud

A Föhn wind is a dry wind that occurs on the lee side of a ridge or line of mountains, often after an airmass has deposited precipitation on the windward side. The moist air may create a cloud wall along the high terrain, shrouding the ridges and peaks. The cloud then dissolves on the lee side as it descends and warms.

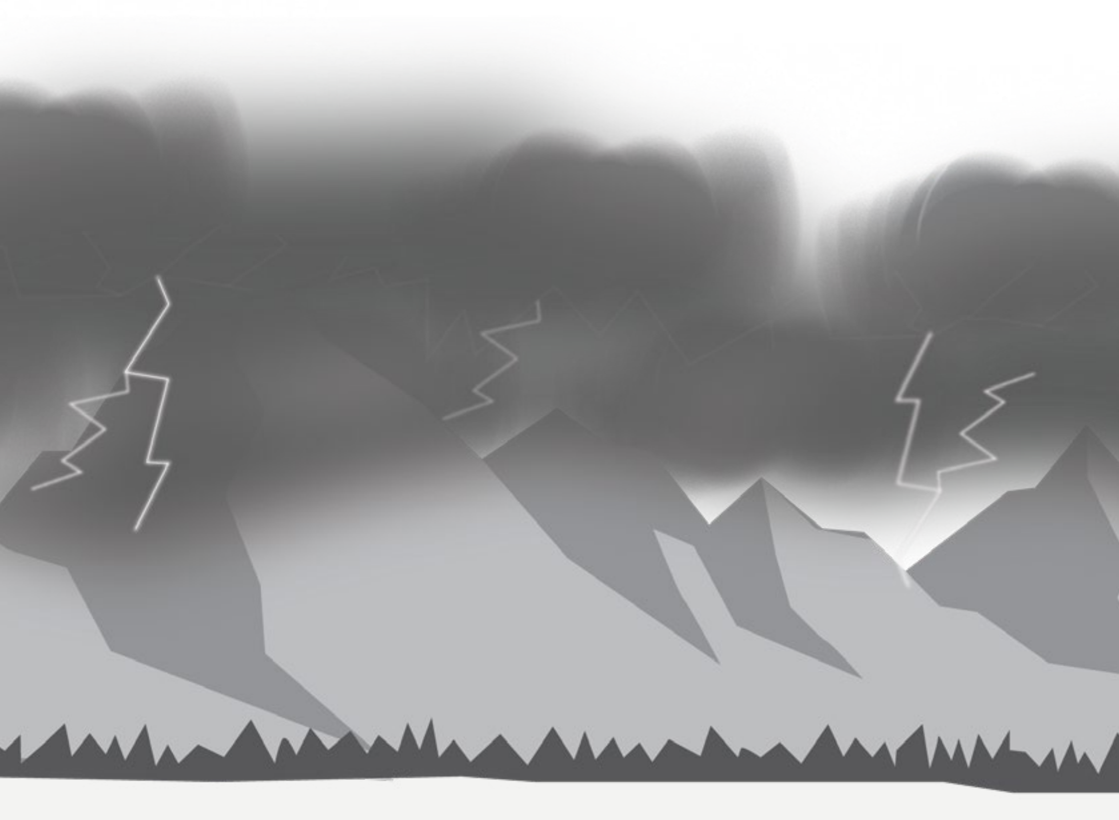
METEOROLOGY

Valley fog

Valley fog may form due to cold air draining into the lower areas around mountains. This is more common during the winter but can occur at any time of the year. Sometimes a significant temperature inversion will exist, creating an abrupt ceiling to the fog or flat layer of stratus cloud, with the peaks in sunshine. Fog formation can vary considerably over a short distance, one valley may be clear but around the next corner lurks heavy IMC.

Thunderstorms

During the summer, mountain ranges will experience increased thunderstorm activity. Warm, humid air masses may be forced to climb rapidly into cooler air, creating updrafts and downdrafts. Check the weather forecast carefully and understand the local conditions that may be conducive to storm formation. Look out for cumulonimbus clouds that may be forming amongst and above the mountain peaks, they will likely bring heavy rain showers or hail.



Flight planning

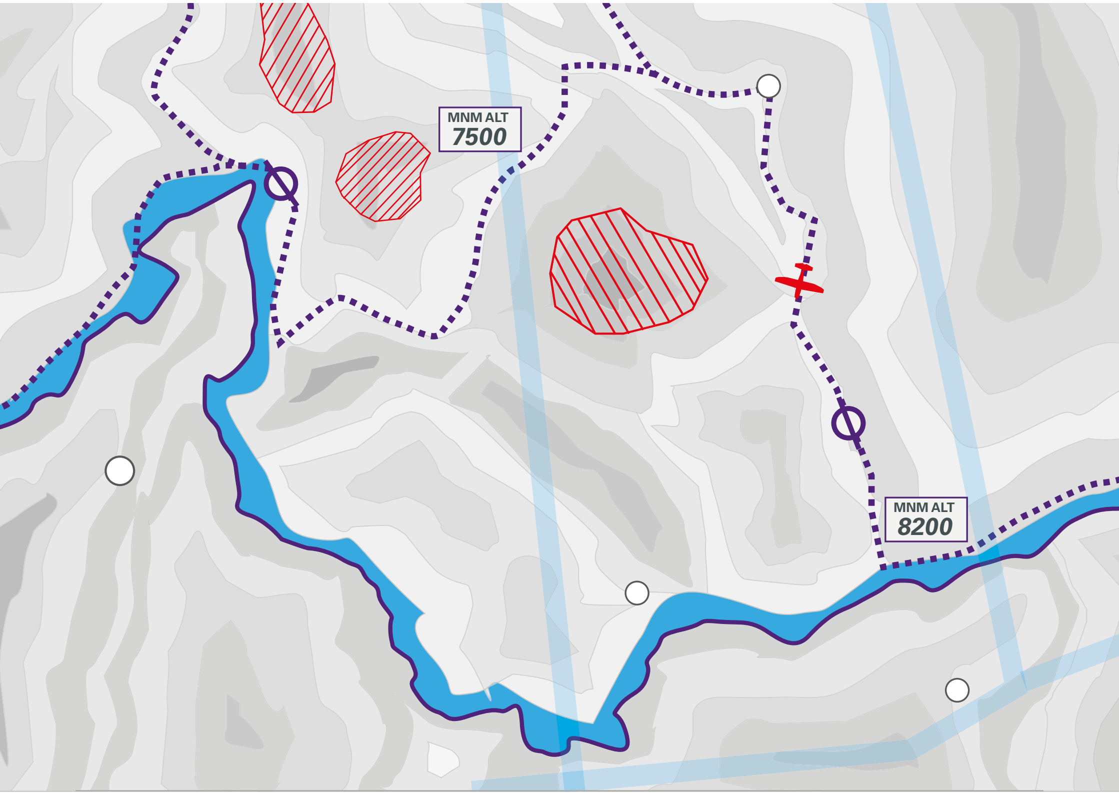
Finding a route

Review and understand local guidance in the relevant Aeronautical Information Publication (AIP) and VFR flight guides – these will contain important information to aid planning. For general guidance on planning and flying a VFR flight, see SSL 5 – Flight under VFR.

Study the VFR chart for your flight, identifying terrain elevations and clear landmarks that will help you remain on track. Mountains and valleys will look remarkably similar from the cockpit, and it is easy to make navigational errors that may put you on a collision course with terrain. Note the required headings for each route of the leg and during the flight, and cross check them after starting a new leg

Select a minimum safe altitude for each leg of the route, noting any points at which a climb may be required. Some states publish recommended VFR routes through mountainous areas – these will normally have a minimum crossing altitude.

Mountain flying is a good opportunity to practice good aeronautical decision making and threat and error management (TEM). For more information, see Chapter 7 of the Skyway Code.



Weather forecasts

Conduct a thorough review of the available weather information. You will normally have to register for access to individual national weather services – details can be found in the relevant AIP.. Flight planning software may integrate weather information from multiple states, but you should check this for completeness. Build as comprehensive of a picture as possible- examine surface pressure and significant weather charts, as well as relevant TAFs and METARs.

Check for low cloud or high winds aloft – winds above 20 kts over mountains may cause turbulence and downdrafts. Mountain wave is often found in stable atmospheric conditions when the weather might seem otherwise benign. Mountain wave warnings may be found in SIGMET and AIRMET forecasts.

GAFOR

Several European states publish a GAFOR (General Aviation Forecast) to help pilots establish whether conditions on a route or area of high terrain are suitable for transit. Review the relevant AIP for further details.

Some GAFOR correspond to recommended VFR routes. The relevant forecaster considers cloud ceiling and visibility to determine whether conditions would allow safe VFR flight. Note this may not take account of winds and turbulence. Different time periods are indicated to aid planning.

Categorisation for route GAFORs, for example as used by Switzerland:

- **X = Closed**
- **M = Marginal**
- **D = Difficult**
- **O = Open**

The categorisation is primarily based on the height of cloud above the higher terrain along the route. Note that the ‘reference altitude’ used in some GAFOR presentations is not the same as the minimum recommended transit altitude for the route.

Some VFR navigation software integrates the GAFOR in flight planning mode, including the time windows for which the forecast is valid. If you are flying through a mountainous area without an associated GAFOR, you must examine the local forecasts throughout the time of your flight and check the cloud base and visibility.

Diversions

Consider options in case you have to divert due to weather or other unforeseen circumstances. As you progress along your route, you may pass aerodromes suitable for landing, should the need arise, In a diversion scenario the route to the geographically closest aerodrome may be blocked by high terrain, so you may have to carefully reverse course and route to an aerodrome further away.

Fuel

For VFR flights, you should carry enough fuel to reach your intended destination, plus a 30 minute reserve. A diversion while flying in mountainous areas may involve a longer flight than anticipated, so account for this when uploading fuel. Also ensure you calculate the fuel burn for any long periods of climbing.

Moving maps

Moving map displays are a valuable aid to mountain flying, but they should not be the sole means of flight planning and navigation. If available, enable any terrain depiction or warning features. Ensure configuration is optimised before departure, to minimise unnecessary adjustment to settings during the flight.

It is important to keep your eyes outside the aircraft as much as possible – only periodic reference to the moving map should be made to verify position and orientation. Separation from terrain should be maintained by visual reference, with terrain warning features acting as safety mitigation.

In the event of having to change route, verify that the flight path is safe from terrain, before interacting with the moving map device. GNSS signal may be less reliable in mountainous areas, so be prepared to revert to dead reckoning. Strong sunlight may cause overheating of devices or make them hard to read. For more guidance on Moving Map devices, see SSL 29 – VFR Moving Map Devices.

You are strongly recommended to review and carry the relevant ICAO VFR chart for the area, alongside using flight planning software – sometimes key information will be more obvious on the chart, and it will give you an enhanced understanding of terrain and airspace.

Human factors

Fit to fly

Mountain flying will place increased demands on the mind and body. Follow the **IAM SAFE** checklist before the flight. Also recognise any hazardous attitudes that may develop as a result of external pressures. For full details, see Chapter 7 of the *Skyway Code*.

Workload

If you are inexperienced in mountain flying, the environment may feel unfamiliar and uncomfortable. The need to be constantly terrain aware will be an additional mental demand, leaving less capacity for decision making.

Minimise distractions, such as unnecessary interactions with your moving map device. If carrying passengers, explain to them that there may be times that you need to focus your entire attention on flying the aircraft, even during the cruise.

The scenery may be spectacular, but flying the aircraft and remaining a safe distance from terrain is the priority. For more guidance on distraction in GA flying, see SSL 31 – Distraction in GA Operations.

Undertaking appropriate instruction will allow you to become more comfortable in a mountain environment and expand your mental capacity, without having to take sole responsibility for the safety of the flight.

Hypoxia

Hypoxia is a state of oxygen deficiency in the body which is sufficient to impair functions of the brain and other organs.

This can become a factor at higher altitudes – physical and mental function is normally adequate below 10,000 ft, although health conditions or smoking may affect this. Above 5,000 ft you may experience some loss of mental capacity and degradation of eyesight.

Symptoms include:

- Euphoria
- Tunnel Vision
- Light headedness
- Headache
- Dizziness
- Increased breathing rate
- Confusion

Hypoxia can impair judgement, so you may not realise that you are hypoxic and potentially getting into a dangerous situation.

If you are flying with passengers or another pilot, discuss the symptoms and be alert for them being displayed by other occupants of the aircraft.

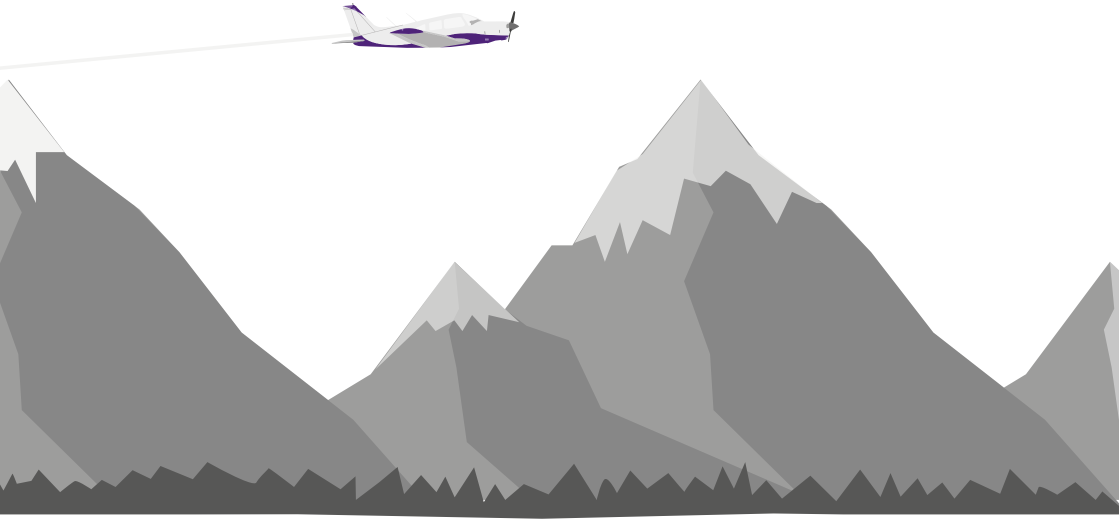
To mitigate against hypoxia:

- Consider using supplemental oxygen; and
- Use a finger mounted pulse oximeter to monitor blood oxygen levels.

Between 95% and 100% is a normal blood oxygen saturation level. Hypoxia symptoms may start at saturation levels of 90%. If symptoms do occur, you must descend as soon as possible.

When flying above 10,000 ft you should use supplementary oxygen in compliance with NCO.OP.190.

HUMAN FACTORS



Other factors

Fatigue and dehydration are other factors to consider when flying in mountainous regions. Glare is greater due to clouds and snow-covered terrain as there are less atmospheric pollutants.

The use of cabin heating is more likely at higher altitudes. Cabin heat in piston aircraft is normally provided by an exhaust heat exchanger, which can leak exhaust fumes into the cabin. For this reason, it is strongly recommended to carry an active carbon monoxide (CO) detector.

From January 2025, it will be a requirement for UK registered piston engine aircraft to carry an active CO detector when passengers (who are not qualified pilots) are onboard. For more information, see SSL 34: Carbon Monoxide Safety.

Further information

Links to further information, including guidance published by other states, may be found on the CAA mountain flying webpage.

Any queries regarding this publication should be addressed to **GA@caa.co.uk**