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

ADVANCED MANOEUVRES

Terrain & Weather Awareness

This training should expand on the syllabus requirements of low flying, to incorporate an increased level of experience and understanding of flying near terrain and its associated weather, especially wind.

Fundamental to safe flight near terrain is the ability to establish an appropriate horizon reference when the visual horizon is not available, because of terrain or weather.

It is important to develop the student's awareness of space and inertia while they are operating in a confined space using an imaginary horizon.

These exercises do not require high mountains to establish the basic principles.

The introduction exercise could be completed in most low flying areas. Where this is not possible flying at 500 feet agl above an open area with a definable 'confined area' of approximately 500 metres x 500 metres will meet the requirements. This is followed by replicating the exercise within a valley, where a real horizon is not available.

Opportunities for scenario based decision-making should be maximised.

Terrain awareness training should focus on recognising the significance of weather, especially wind, relative to the terrain and its impact on flight conditions and flight path.

Objectives

To establish a useable horizon reference when the actual horizon is not available.

To operate in a confined area.

To develop further awareness of space and inertia when confined by terrain.

To safely cross ridges, saddles, passes or spurs.

Considerations

The student should experience the exercises in a variety of configurations and conditions;

1. In both the clean configuration and poor visibility configuration.
2. In both calm and light wind conditions (less than 15 knots).
3. In clear conditions and with some precipitation.
4. They should complete turns through 180 degrees and 360 degrees both clockwise and anticlockwise.

Superimposed Horizon

Define the horizon as where the sea meets the sky.

Identify the real horizon.

An imaginary horizon can be used when the real horizon is obscured by terrain or weather. The horizon can be imagined by visualising the obstruction (terrain or weather) as transparent, and visualising where the sea would meet the sky.

Operating in a Confined Space

Define a simulated confined area, free of obstacles and with clearly defined boundaries. A flat paddock of approximately 500 metres x 500 metres would suit most light training aircraft.

Define a similar area in a location where a clear horizon is not available.

Discuss how to superimpose the horizon when the real one can't be seen.

Identify a useable imaginary (or real) horizon by visualizing where the sky meets the sea, as if the terrain or obstacle to the visual horizon were transparent.

Use this horizon line to reference the nose attitude, whether in straight and level flight or level turning flight.

Review wind cues and how to estimate drift, as covered in the low flying lessons.

Discuss varying the angle of bank in order to use all available space, and the use of power to maintain a safe speed during all manoeuvres.

Discuss the importance of being aware of the wind direction and speed relative to the terrain. Demonstrate how the wind will behave in varying strengths, and how it will flow around and/or over terrain depending on its strength.

Operating in a Valley

Discuss where to position the aeroplane in a valley, considering;

- right of way rules,
- lift and sink conditions,
- use of space – depending upon weather and airspace conditions,
- positioning right of centre in a large valley,
- positioning on the right side in a narrow valley – so that you can immediately escape by turning 180 degrees, should it be necessary because of weather, sink, turbulence, traffic, or running out of space.

Discuss the need to use the minimum angle of bank necessary to use all the space, this will also minimise the stall speed and improve the potential for anticipation by allowing more time to assess factors such as, space, inertia, rate of closure, radius required, turbulence, etc.

The poor visibility configuration will slow the aeroplane down and reduce turn radius, in addition a reduced flap selection may be required to maintain aeroplane performance.

It is important to remember that this exercise is not a minimum radius turn. If a minimum radius turn is required, a good decision is long overdue.

Discuss the use of check turns to assess the available space well before committing to any area the pilot is unsure of.

Crossing Ridges, Saddles, Passes or Spurs

Students will need to take into account all aspects of the crossing including; the approach to the crossing, the actual crossing, and the flight path after the crossing.

When planning a crossing, the approach angles must take into account the effects of wind and terrain, and allow escape options throughout the crossing, that minimise the period of commitment – a 45-degree angle, or less, is ideal.

The aeroplane must be in level flight, speed under control; not in a climb where visibility and airspeed are compromised; not in a descent where V_A may be compromised in turbulence at the saddle and loss of altitude may compromise return options back over the saddle.

The student should be able to use parallax to help recognise the aeroplane's height in relation to the saddle. If the terrain beyond the saddle is disappearing, the aeroplane is not high enough. If there is increasing terrain beyond the saddle then the aeroplane is higher than the saddle. Discuss how much terrain clearance is needed for a safe crossing.

Discuss the types of saddles, and their relative merits. A knife-edge saddle is the most preferable because of the shorter time it takes to cross; it allows for a shallow angle of approach (45 degrees or less) and allows a shallow angle of escape.

It is critical that escape options are always available. The effects of weather, terrain, traffic, turbulence, sink, and confined turning radius can require the use of an escape option at a moment's notice. These escape options should be downstream, downhill and through the minimum possible angle of bank, in order to maintain a margin over the stall in anticipation of potential sink or turbulence.

Airmanship

Thinking ahead of the aeroplane is an important part of this exercise. In the real situation it will ensure that the student does not find themselves forced into reacting to an 'unforeseen' situation.

Good decision making is critical, especially crossing ridges and passes, to maintain escape options and to minimise any commitment period.

The student must remain aware of their situation at all times, in particular remaining aware of the changing weather, nearby terrain, other traffic in the area, and the student's own performance.

It is helpful to make position reports both before and after crossing a saddle or pass to assist with traffic awareness.

As with all low flying, more frequent use of **SADIE** checks is advised.

The minimum descent altitude for this exercise is restated (refer CFI).

Aeroplane Management

Revise the poor visibility configuration – considering when it is necessary to adopt and the effect it has on performance.

Review V_A, V_S, and operating speed range considerations. Review the use of power as necessary to remain safely above stall speed, but in anticipation of potential turbulence, below the maximum manoeuvring speed.

Carburettor heat as required.

Fuel management.

Review leaning the mixture for engine considerations, performance and economy.

Revise control coordination to ensure smooth, balanced handling to reduce unnecessary stress on the aeroplane, passengers and pilot.

Consider the positioning of the aeroplane in relation to the terrain while taking into account wind direction and speed, so as to mitigate the effects of turbulence.

Human Factors

Good planning and situational awareness will reduce disorientation.

Discuss the illusions associated with inaccurate horizon definition, most commonly an insidiously climbing terrain gradient which tricks the pilot into raising the nose.

Potential hazards associated with illusions and poor horizon definition include inadvertently reaching the stall speed with high power and no room, or performance, available to escape.

Motion sickness can be a problem, use the **I'MSAFE** checklist, good planning and training to reduce anxiety levels. Use smooth coordinated control inputs, and provide sick bags as a backup.

Direct the student towards more reading on this subject, there are a number of GAP booklets that deal with flying in mountains, *Mountain Flying*, *Survival*, the *In, Out and Around* series, as well as the *Mountain Flying* DVD.

Air Exercise

In the 'confined area' within a low flying area, fly the boundaries using a minimum angle of bank using all the available space. Control the speed with power.

Use the clean configuration and the poor visibility configuration, calm and light wind conditions, as well as no precipitation and some precipitation. Make turns left and right through 180 degrees and 360 degrees.

Repeat the exercise in an area confined by terrain without a real horizon available.

Use saddle crossing techniques to enter or exit this 'confined by terrain' area.

Refer to the *Mountain Flying Training Standards Guide*.

Airborne Sequence

Operating in a Confined Area

Starting with a larger area, and gradually reducing to the smaller 'confined area' will help students to manage this exercise.

In the clean configuration fly the boundaries using minimum angle of bank, using all available space. Repeat in the poor visibility configuration, noting the differences.

Ensure every opportunity is taken to enhance wind awareness, especially noting wind strength and direction.

Relocate from the obstacle free simulated confined area to a suitable valley or gully to carry out the same exercise but near terrain, and consequently a less defined horizon.
Carry out check turns before entering and during early positioning in the valley to make sure the operation is not beyond personal limitations.

Appropriately position the aircraft to execute level 180 degree and 360 degree turns using all the available space, minimising the bank angle and using only sufficient power to maintain a safe speed between V_A and V_S – appropriate to conditions and aeroplane loading.

Crossing Ridges, Saddles or Passes

Determine the lift or sink sides of the saddle. Assess the approach, crossing and after crossing options.

Approach at 45 degrees to provide the best escape downhill, downstream, and with the minimum angle of bank required.

Fly left to right to allow for the best visibility. However, if the saddle is obstructed or the sink is significant, fly right to left.

Show the student the difference between the 'knife-edge' saddle and the flat saddle, choosing the 'knife-edge' to cross at.

Approach level and below V_A, as discussed.

Show the student how to use parallax to assess sink and their height in relation to the saddle.

Have the student gain experience in making decisions using a variety of approach options.