



Forced Landing in Difficult Terrain

In the January/February issue of *Vector* we published an article on forced landings without power. That article presumed an engine failure over flat terrain from a height of 2500 feet. As this is not always the case, here are some techniques that can be applied to improve your survival chances if faced with a power loss over inhospitable terrain.

Bush-Covered Areas

Although a landing into trees is not an attractive option, it can be a survivable one. Landing among trees should never be ruled out as an option, because it may be better than landing in other areas of very rough terrain. The following general guidelines should improve the odds of surviving:

- Use the normal approach configuration – full flap and landing gear down.
- Keep your groundspeed as low as possible by heading into wind. Looking at the movement in the tree tops can help you to determine the wind direction.

A prudent pilot will always have a forced landing plan when flying.

- Plan to land in areas of bush that contain as few large trees as possible – this will reduce your chances of hitting a large tree trunk. Low, closely spaced trees, with wide dense branches close to the ground are much better than tall trees with thin tops, because they will reduce your free-fall to the ground afterwards.

- Make contact with the tree foliage at the minimum possible airspeed, taking care not to stall, and aim to ‘hang’ the aircraft in the tree branches in a nose - high attitude. This helps to preserve the cockpit area by allowing the underside of the fuselage and wings to absorb much of the initial impact energy.

Mountainous Terrain

A landing in mountainous terrain is probably the most difficult situation a pilot can be faced with. Flying over large areas of inhospitable mountainous terrain should be avoided where possible to reduce the possibility of ending up in such a situation. Plan alternative routes that take your flight path over terrain where options exist, or fly at a higher altitude to give yourself more time in the event of an engine failure – even if it means adding extra time onto the flight. The following points should help to improve your chances of survival:

- Valleys and riverbeds are often a good option. It will depend on how tortuous the valley or riverbed is. It may be the best option when the valley sides are heavily wooded compared with more open parts on the valley floor. Consider landing

downstream where slope is minimal, as water action settles riverbed stones in a downstream manner.

- Mountain ridges can provide useful landing sites, as they are often reasonably wide, may have fewer rocky outcrops, and are more likely to be of a constant gradient. Ridge top landings may also make it easier to assess wind direction. This can be very difficult to do in the mountains, unless drift is apparent, as opposed to valley landing sites where the wind tends to be multi-directional.
- Landing on a ridge line will mean that ELT transmissions are more likely to be received than they would be from landing sites lower in the valley. Your aircraft will also be more visible to search and rescue teams. A downside, however, is that temperature and wind-chill will be less favourable to survival. Also, if you miss the ridge line, it’s all downhill from there!
- Try to avoid sites that have particularly large rocky outcrops or drop-offs. These may become difficult to manoeuvre around if the approach and landing are misjudged.
- If possible, select a landing site with an uphill slope.



After surviving the forced landing, do you have the provisions to survive the night?

- When landing on a pronounced upslope, care should be taken to ensure that enough speed is maintained to change the aircraft's descending flight-path, just before touchdown, to match the gradient of the slope. It is possible to land an aircraft successfully on relatively steep slopes if enough speed is maintained. However, this requires sophisticated judgement that is gained from extensive training.

Ditching

Assuming that you have a choice, a well executed water landing (ditching) can provide less deceleration than a touchdown on rough terrain or into trees. Many pilots are reluctant to ditch, even though this might be a better option than the land-based alternatives. This is probably because of the fear of becoming trapped in the aircraft and the fact that it will, more than likely, sink. An aircraft that has been set down on the water at minimum speed, and remains intact, may float for several minutes. The buoyancy provided by air trapped inside the fuel tanks, in the wings, and in the fuselage should allow sufficient time to vacate the aircraft.

If you have a choice between a ditching and a forced landing, you should consider the following factors:

- Water is much harder than you expect when impacting at speed.
- Survival times may not be very long in the sea or a cold alpine lake. If you

know the water to be extremely cold, then it may be wise to avoid ditching altogether.

- The proximity of the ditching area to land.
- How well your passengers can swim, and whether they have their life jackets on. Pilots have drowned after textbook ditchings, because there were no life jackets on board.

Whether ditching by choice, or necessity, the following techniques are a guide to increase your chance of carrying out a successful ditching.

- Try to ditch the aircraft as close to help as possible. Ditching close to beaches, boats, or shipping lanes will ensure someone will get to you as soon as possible.
- Retractable landing gear should be kept up to reduce drag in the water. This should prevent the aircraft nosing over.
- Ensure that all occupants have their harnesses tightly fastened – you do not want anyone to be knocked out during the ditching. Life jackets should be worn while flying over any expanse of water, but should be inflated only when clear of the aircraft.
- Avoid using full flap on low-wing aircraft, as this will cause excessive drag under the water line and possibly result in an asymmetric failure of the flaps and slewing of the aircraft.
- In light wind conditions, when the water surface is relatively smooth, an into-wind touchdown can be made.

- In moderate wind conditions, it is best to land with a crosswind. Aim for the crest of the swell and land along it. The danger of nosing into a swell is generally greater than that involved in ditching with a crosswind.
- In strong wind conditions, over 35 knots, plan your approach to land back into wind, as this will probably outweigh the danger posed by the swell system.
- **Depth perception can be difficult to judge when landing on smooth water.** There is a risk of either flying into the water, or of stalling at some height above the water and nosing in. To minimise this hazard, set up the approach at the minimum rate of descent and fly the aircraft onto the water.

Landing on Snow

While landing on snow can provide a cushioning effect, dangerous obstructions can also be hidden under a light covering of snow. Snow covering will also make it more difficult to judge the surface gradient and general topography of the landing area. Try to avoid areas where there might be patches of ice, as these will cause the aircraft to slide for much greater distances, increasing your chance of colliding with a solid object.

A landing on snow should be executed like a ditching, with the same aircraft configuration (except that low-wing aircraft should use full flap). Depth perception can also be difficult to judge when landing on snow.

Built-Up Areas

An engine failure while flying over a built-up area is somewhat more complicated, as it generally involves the safety of the people below. Rule 91.311 *Minimum heights for VFR flights*, stipulates that you must not fly over a built-up area at less than 1000 feet above the highest obstacle present (when operating within a 600 metre horizontal radius of it), and that you must always remain within gliding distance of a suitable emergency landing site.

With this in mind, you should not fly over built-up areas that do not have favourable emergency landing options, and resist the temptation to operate at heights

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where you are unable to glide clear. Get to know the forced-landing possibilities around your city before going flying. If you do find yourself facing an engine failure while operating over a large built-up area, turn immediately towards a known emergency landing area, eg, a park, a golf course or school playing field.

It is your responsibility as pilot in command to consider the safety of people on the ground when making this selection. If none of the above mentioned options are favourable, then a motorway which has double-lane traffic will allow you to touch down moving in the same direction as the traffic. It will also help you to pick a space between moving traffic more easily.

Decision Making

When faced with a forced landing in the 'real world', the decisions that you make will have a direct outcome on the success of the situation. There will always be elements of compromise in any emergency situation and you need to ask yourself, "What is the best compromise?".

Summary

The FLWOP has always been an important part of pilot licence training. For many of us, these forced-landing skills may have diminished somewhat over the years. It is therefore important that we remain familiar with them. Being totally familiar with the FLWOP drills not only allows you to make the most appropriate landing site selection, but also enables you to concentrate on the task of successfully flying the aircraft to that site. This sort of familiarity allows you to focus your attention outside the cockpit, where it should be, and reduces the tendency to become distracted inside the cockpit.

Minimise the time you spend flying over extensive areas of inhospitable mountainous terrain, large expanses of water, large areas of bush, and substantial urban areas. It is not worth taking the risk when an alternative route is available. The extra time and cost involved in selecting a safer alternative route, or higher altitude, is often not as great as you might expect.

A prudent pilot will always have a forced-landing plan when flying.

This involves being aware of the wind direction, ground elevation, and possible landing sites below. It also involves knowing – as you are flying along – how you would execute an approach to these sites. "Would I fly a 'straight-in', approach given that I am only 700 feet agl?" The rougher the terrain, the more frequently you need to carry out this assessment. The more you ask yourself the question, "What would I do if the engine failed now?", the more prepared you will be to respond quickly if it ever happens to you. ■

A forced landing into difficult terrain requires good decision making while dealing with issues of compromise. Knowing your engine failure checks, and having a disciplined approach to your flying, will greatly improve your chances of a successful forced landing.

Airstrip Safety Guideline Published

The Safety Guideline – Farm Airstrips and Associated Fertiliser Cartage, Storage and Application has now been published.

This safety guideline is the result of three years of joint effort between a number of government and industry bodies, and it was developed under the auspices of the Health and Safety in Employment Act 1992.

It covers all aspects of aerial top-dressing, from fertiliser manufacture and transport, to storage and spreading, and brings together a set of agreed minimum standards to help the industry achieve safer levels of performance.

You can download a copy from the CAA web site, or for a bound copy, email the CAA Health and Safety Unit, hse@caa.govt.nz.

