July/August 1999, Issue 5

VECTOR

Pointing to Safer Aviation

FLYING LIGHT TWINS SAFELY

SURVIVING AFTER A CRASH

JOINING OVERHEAD

CAA
CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

VECTOR

Managing Editor: Cliff Jenks

Vector Editors: Pam Collings & Barnaby Hill

CAA News Editors: Emma Peel & Francine Beachman

Design: Gusto Design & Print Limited

Published by: Civil Aviation Authority of New Zealand, PO Box 31-441, Lower Hutt, NEW ZEALAND. Telephone +64–4–560 9400, Fax +64–4–569 2024, Managing Editor e-mail: jenksc@caa.govt.nz, CAA News Editor e-mail: peele@cca.govt.nz. Published six times a year, in the last week of every odd month.

Publication Content

The views expressed in ***Vector*** (with the exception of "Occurrence Briefs") are those of the Editor or the named contributor. They are intended to stimulate discussion and do not necessarily reflect the policy of the Civil Aviation Authority. Nothing in ***Vector*** is to be taken as overriding any New Zealand Civil Aviation legislation, or any instructions issued or endorsed by the Civil Aviation Authority of New Zealand.

Reader comments and contributions are welcome and will normally be published, but the Editor reserves the right to edit or abridge them, and not to publish those that are judged not to contribute constructively towards safer aviation. Reader contributions and correspondence regarding the content of ***Vector*** should be addressed to: Vector Editor, PO Box 31-441, Lower Hutt.

Free Distribution

Vector is distributed automatically to New Zealand Flight Crew and Aircraft Maintenance Engineer licence holders, to most organisations holding an Aviation Document, and to certain other persons and organisations interested in promoting safer aviation. ***Vector*** articles also appear on CAA's web site at http://www.caa.govt.nz/

Change of Address

Readers receiving ***Vector*** free of charge should notify the Civil Aviation Authority (Approvals Clerk) of any change of address; quoting your CAA Client Number (or licence number) will assist in administration. Paying subscribers should notify Publishing Solutions Ltd.

Paid Subscriptions

Vector is available on subscription only from Publishing Solutions Ltd, PO Box 983, Wellington, freephone 0800 800 359, phone +64–4–471 0582, fax +64–4–471 0717.

ISSN 1173-9614

July/August 1999, Issue 5

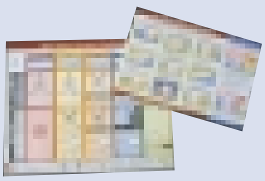
CONTENTS

"The major difference between flying a twin-engine and a single-engine aeroplane is being able to manage the flight if one engine loses power. If everything goes smoothly, there is not much to it – but if something goes wrong it is imperative that the right actions are taken." *Flying Light Twins Safely* is a comprehensive and informative article that offers good practical advice designed to make you a safer light-twin pilot.

You and your passengers have just survived a crash landing – what do you do next? *Surviving After a Crash* steps you through the basics of crash first aid and survival techniques. Having some knowledge of these in such a situation could save lives.

The standard overhead join is a fundamental procedure when joining an unattended aerodrome, but sometimes may not be the safest option when opposite-direction circuits are in use. This article looks at why and suggests some alternatives.

The CAA has just released several new **How To** and **GAP** (Good Aviation Practice) booklets that are now available free-of-charge from the CAA. Details on how to obtain copies of these useful publications are contained within.



The CAA has released two new airspace posters. Further details are contained within.

Also Featuring:

Cover Photo: 'China Doll' (Nanchang CJ-6) foreshadows a beautiful sunset at Omaka aerodrome. Photograph by Neville Dawson.

Safety Seminars

Planning for the 1999 series of Av-Kiwi safety seminars is almost complete, and many seminar venues and dates have now been finalised.

Cross-Country Seminars

This year's topic will focus on the planning and decision-making involved in making a VFR cross-country flight. At North Island seminars pilots will be tasked with flying south to Warbirds Over Wanaka, and at South Island venues pilots will plan a flight north to the America's Cup. Most aspects of planning and executing such a flight will be covered, with particular emphasis on airspace considerations, understanding local weather patterns, avoiding inhospitable terrain, mountain flying considerations where applicable, and interpreting AIP Supplements and NOTAMs.

Experienced instructors will provide you with useful tips about operating in their part of the country, and CAA staff will cover various aspects of the planning and decision-making involved in a cross-country flight.

Whether you have five hours or five thousand hours, these seminars will be of value to you – particularly if you don't fly 'across the ditch' very often.

Over 20 Av-Kiwi seminars are scheduled to run from mid August through to late October. Check the list below for venue and date details, and watch out for advertising posters displayed at your local training organisation or aviation business. These seminars will be enjoyable and informative – so hope to see you at one soon!

Seminar Schedule

Sat 21 August, 9:30 am – 12:30 pm
Whangarei Aerodrome, at Northland Districts Aero Club.

Sun 22 August, 9:30 am – 12:30 pm
North Shore Aerodrome, at North Shore Aero Club.

Mon 23 August, 7:00 pm – 10:00 pm
Ardmore Aerodrome, at Auckland Aero Club.

Wed 25 August, 7:00 pm – 10:00 pm
Gisborne Aerodrome, at Gisborne Pilots Association.

Thurs 26 August, 7:00 pm – 10:00 pm
Napier Aerodrome, at Terminal in HB Airport Authority Boardroom.

Sat 28 August, 9:30 am – 12:30 pm
Masterton Aerodrome, at Wairarapa and Ruahine Aero Club.

Sat 28 August, 9:30 am – 12:30 pm
Christchurch Airport, at Canterbury Aero Club.

Sun 29 August, 9:30 am – 12:30 pm
Timaru Aerodrome, at South Canterbury Aero Club.

Mon 30 August, 7:00 pm – 10:00 pm
Twizel, at Mackenzie Country Inn.

Mon 6 September, 7:00 pm – 10:00 pm
Taieri Aerodrome, at Otago Aero Club.

Tues 7 September, 7:00 pm – 10:00 pm
Invercargill Aerodrome, at Southland Aero Club.

Wed 8 September, 7:00 pm – 10:00 pm
Queenstown, at Sherwood Manor Hotel.

Tues 14 September, 7:00 pm – 10:00 pm
Thames Aerodrome, at Hauraki Aero Club.

Wed 15 September, 7:00 pm – 10:00 pm
Hamilton Aerodrome, at Waikato Aero Club.

Thurs 16 September, 7:00 pm – 10:00 pm
Rotorua Aerodrome, at Rotorua Aero Club.

Sat 18 September, 9:30 am – 12:30 pm
Tauranga Aerodrome, at Tauranga Aero Club.

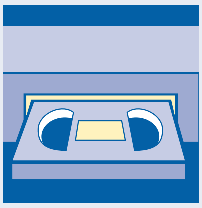
Further seminars are planned at **New Plymouth, Ohakea, Paraparaumu, Nelson, Blenheim, and Greymouth**. Details will be advised in the next issue.

Maintenance Seminars

Two safety seminars on maintenance are planned for Pine Park and Dargaville later this year (October, November). These focus on last year's topic, *Maintenance Matters*, and are particularly pertinent to aircraft owners/operators and pilots.

Achieving a high standard of maintenance is a function of good plant, good planning and good decisions. These seminars look at the ingredients to assist this and highlight the relationships that exist between engineer, owner, operator and pilot to achieve serviceability and safety. The roles and responsibilities of all parties under the relevant CAA rules are also explored in some detail.

The seminars will be presented by Owen Walker, CAA Field Safety Adviser (Maintenance), and he will be assisted by industry engineers. Details on the venues and dates for these additional seminars will be advised in the next issue of *Vector*. ■



New Video

Flying single-pilot IFR, particularly in light twins, is the most demanding of tasks, and yet, so often, it is undertaken by the least experienced. Pilot workload can be high (especially while IMC on an instrument approach), meaning that a comprehensive understanding of the instrument environment combined with thorough preparation is essential. Anything less can be the difference between a routine flight and a dangerous one.

The CAA has just released a new safety video called ***You're On Your Own***. It is designed to assist you to better understand IFR cockpit management and flight planning issues. This 15-minute video emphasises the need for careful pre-flight planning, thinking ahead, and being aware of both the aircraft limitations and your own limitations as pilot. Pilots who regularly fly in this environment also offer some practical advice.

The video can be borrowed from the CAA Library or purchased from Dove Video. See the previous issue of *Vector* for details on how to borrow or buy safety videos.

Flying Light Twins Safely

If everything goes smoothly, there is not much to flying a twin-engine aeroplane – but if one engine loses power, it is imperative that the right actions are taken. Hence, remaining proficient and current is vital, and this means proficient and current in emergency procedures in particular.

A significant aspect of progressing to an aircraft such as a light twin, is that the systems are invariably more complex. On single-engine aircraft, services such as vacuum pump, and hydraulic pump can only be operated by the one engine, and the fact that the service is available on the engine is readily seen. On twin-engine aircraft, such services may be fitted on only one engine or duplicated on both engines. It is therefore important to have a clear understanding of what services are provided by each engine. Fuel systems are usually more complex, with cross-feeding capability a necessity. A comprehensive understanding of the aircraft systems, and the fuel system in particular, is extremely important.

A study by the US National Transportation Safety Board some years ago found that a fatal accident after an engine failure was four times as likely to occur in a twin than in a comparable single. A single-engine aircraft is relatively easy to control and offers no choice of action after power loss. In a twin, you are faced with many options at once. Can you land on the remaining runway? Do you continue the takeoff? Do you land and run off the end of the runway? Can you out-climb the mountains with the load on board? The study found that when pilots of twin-engine aircraft were suddenly faced with an engine failure, especially shortly after takeoff, the element of surprise and the precipitous loss of performance often meant that the pilot lost control of the aircraft. Adequate training and continued practice are imperative.

Engine Failure – Aerodynamic Principles

Safe flight with one engine inoperative requires an understanding of the basic aerodynamics involved – as well as proficiency in engine-out procedures.

Loss of power from one engine affects both climb performance and controllability of any light twin.

Climb Performance

Climb performance depends on an excess of power over that required for level flight. Loss of power from one engine obviously represents a 50 percent loss of power but, in virtually all light twins, climb performance is reduced **by at least 80 percent**. (See Figure 1.)

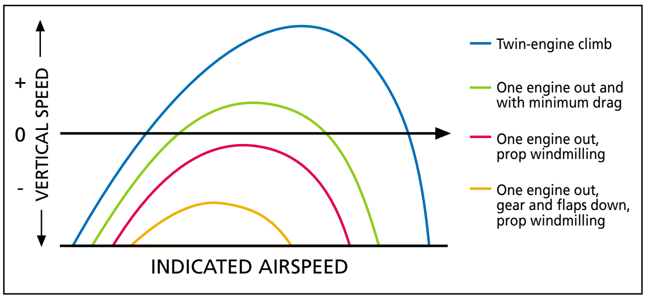


Figure 1: Effect of one engine-out and aircraft configeration on vertical speed.

The amount of power required for level flight depends on how much drag must be 'overcome' to sustain level flight. It's obvious that, if drag is increased because the gear and flaps are down and a prop windmilling, more power will be required. Not so obvious, however, is the fact that drag also increases as the square of the airspeed, while power required to maintain that speed increases as the cube of the airspeed. (See Figure 2.)

Thus climb performance depends on four factors:

- Airspeed – too little or too much will decrease climb performance.
- Drag – gear, flaps, cowl flaps, prop and speed.

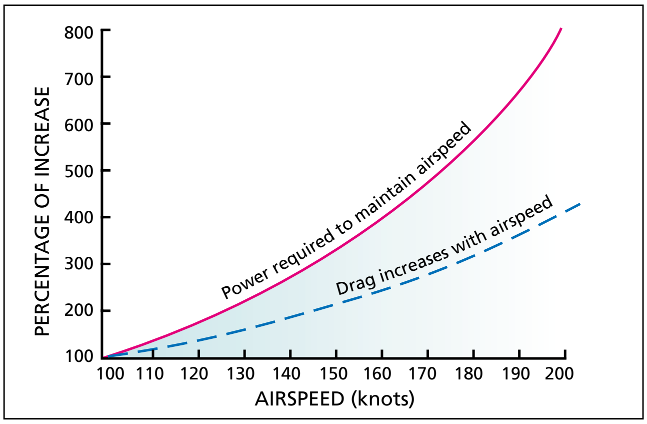


Figure 2: Effect of airspeed on drag and power required to maintain that airspeed while in level flight.

- Power – amount available in excess of that needed for level flight.
- Weight – passengers, baggage and fuel load greatly affect climb performance.

Yaw

Immediately following the failure of one engine, yaw is caused by asymmetric thrust and displacement of the dragline towards the dead engine. Yaw forces must be balanced with the rudder (or by reducing power on the live engine). (See Figure 3.)

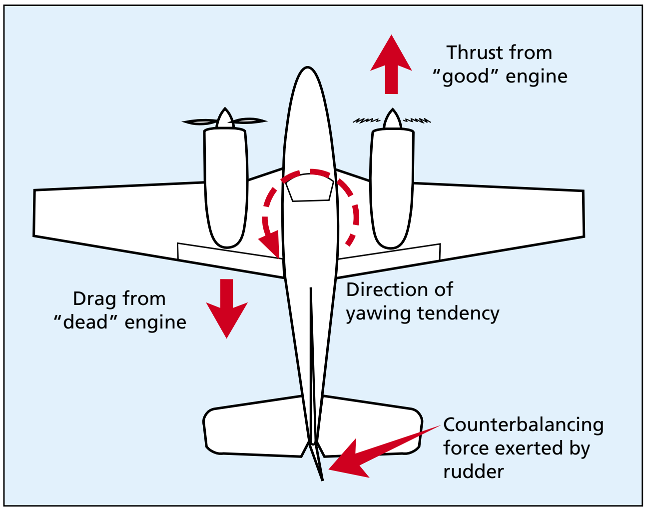


Figure 3: Yaw

Loss of power on one engine reduces slipstream (and induced lift) over the wing. Yaw also affects the lift distribution over the wing, causing a roll towards the 'dead' engine. (See Figure 4.) These roll forces may be balanced by banking into the operating engine.

The Use of Bank

If a small bank angle (about five degrees) is used towards the live engine to help counteract the yaw, a smaller rudder force will be required. Since the displaced rudder increases drag, any reduction in rudder angle will lessen the drag and performance will be improved.

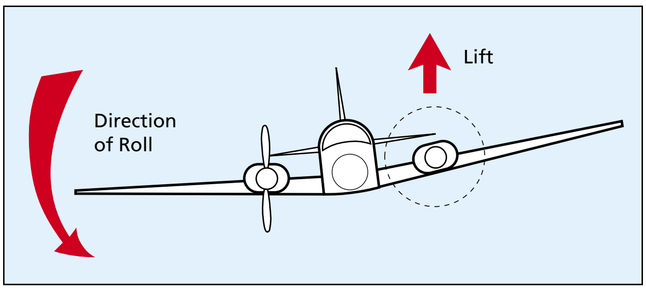


Figure 4: Roll

Critical Engine

The critical engine is that engine whose failure would most adversely affect the performance or handling qualities of the aeroplane. The critical engine on most US manufactured light twins is the left engine, as its failure requires the most rudder force to overcome yaw.

At cruise the thrust line of each engine is through the propeller hub. But, at low airspeeds and at high angles of attack, the effective thrust centre-line shifts to the right on each engine because the descending propeller blades produce more thrust than the ascending blades (called asymmetric blade effect, asymmetric propeller thrust or P-factor, see Figure 6.) Therefore the thrust line of the right engine moves further from the centreline of the aircraft (giving a longer lever arm) resulting in greater yaw and more rudder needed to counterbalance the yaw.

Twins with counter-rotating propellers don't have a critical engine.

Airspeed

Airspeed is the key to safe single-engine operations. For most light twins there is:

- Minimum control speed airborne: Vmca.
- Airspeed below which an intentional engine cut should **never** be made: Vsse.
- Best single-engine rate of climb speed: Vyse.
- Best single-engine angle of climb speed: Vxse.
- Refusal speed: V1.
- Takeoff safety speed: V2.

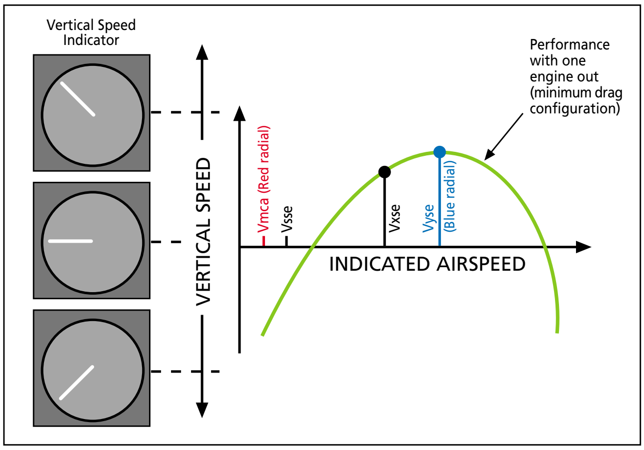


Figure 5: Engine thrust line shifts to the right at low airspeeds and at high angles of attack.

Minimum Control Speed Airborne

Vmca is designated by the red radial on the airspeed indicator and indicates the minimum control speed, airborne at sea level. Vmca is determined by the manufacturer as the minimum airspeed at which it is possible to recover directional control of the aircraft within 20 degrees heading change and, thereafter, maintain straight flight, with no more than five degrees of bank if the critical engine fails **suddenly** with:

- takeoff power on both engines,
- rearmost allowable centre of gravity,
- flaps in takeoff position,
- landing gear retracted, and
- propeller windmilling in takeoff pitch configuration (or feathered if automatically feathered).

However, sudden engine failures rarely occur with all of the factors listed above and, therefore, the actual Vmca under any particular situation may vary.

For instance, Vmca decreases when the propeller is feathered, when power on the operative engine is reduced, or when the C of G is forward of the rear limit.

Other factors affecting this minimum control speed include turbulence, which will effectively increase Vmca because the pilot cannot control the aircraft as precisely as they otherwise might. The strength and skill of the pilot is another variable.

Continued over...

...continued from previous page

Pilot seat position is important so that full and sustained rudder deflection is possible should it be required at any time.

Extreme caution must be used when practising minimum control speed exercises. With some aircraft Vmca occurs below Vs at all altitudes. When this is not the case there is a point where the single-engine power-on stall speed will correspond with the Vmca line. (See Figure 7.) In this situation the instructor may promote the loss of directional control earlier than might be the actual in order to achieve the practice exercise. In turbocharged aircraft there is generally plenty of power available, which means the exercise can be practiced at higher altitudes. With non-turbocharged types, the power availability diminishes quickly with altitude increase. Therefore, in order to achieve Vmca well prior to the stall onset, the exercise may be carried out at a lower level.

Vmca recovery should be applied when the pilot has lost directional control by five degrees but it is imperative that recovery is made at the first sign of any stall onset. If the yaw coincides with the stall or soon after, a spin will be the most likely result. Some light twins have not had spin recovery demonstrated, and the likelihood of you effecting a recovery would be remote. Consequently, it is not advisable to fly at speeds approaching Vmca except in training situations or during flight tests where you have a qualified multi-engine flight instructor with you.

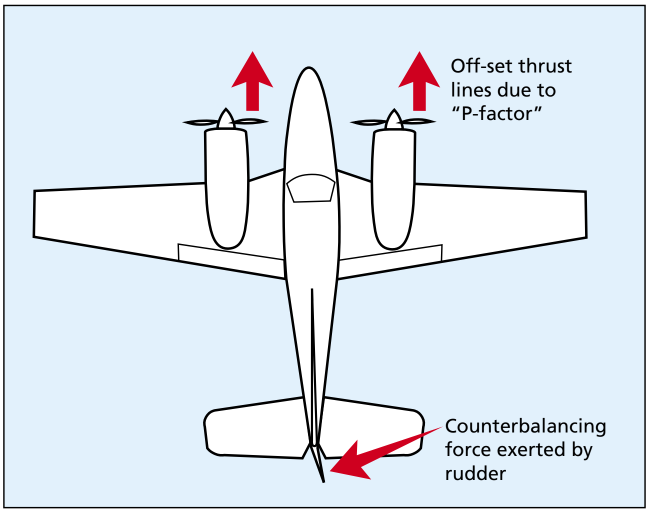


Figure 6: Key single-engine airspeeds

Intentional One-Engine-Inoperative Speed

Vsse is specified by the aeroplane manufacturer in new Handbooks and is the minimum speed at which to perform intentional engine cuts. The use of Vsse is intended to reduce the potential for an accident arising from loss of control after an engine cut has been made at or near minimum control speed. Vsse demonstrations are necessary in training but should only be made at a safe altitude above the terrain and with the power reduction on one engine made at or above Vsse. Power on the operating (good) engine should than be set at the position for maximum continuous operation. Airspeed is reduced slowly (one knot per second) until directional control can no longer be maintained or there is any indication of stall onset. (See Figure 7.)

Recovery from flight at or below Vmca is made by reducing power on the operating (good) engine (to stop further yaw) while decreasing the angle of attack by lowering the nose. Immediately following this initial recovery power is returned to both engines and the aircraft accelerated back to a safe speed.

Best Single-Engine Rate-of-Climb Speed

Vyse is designated by the blue radial on the airspeed indicator. Vyse delivers the greatest gain in altitude in the shortest possible time, and is based on the following criteria:

- Critical engine inoperative, and its propeller in the minimum drag position.
- Operating engine set at not more than maximum continuous power.
- Landing gear retracted.
- Wing flaps in the most favourable (ie, best lift/drag ratio) position.
- Cowl flaps as required for engine cooling.
- Aircraft flown at recommended bank angle.

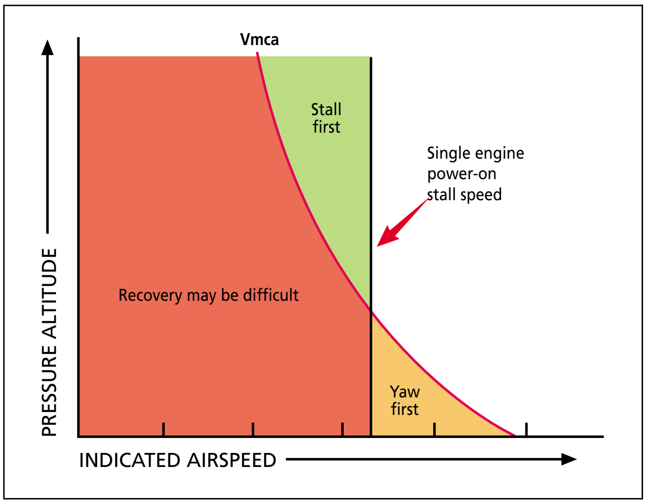


Figure 7: Relationship between stall speed and Vmca for aircraft with normally aspirated.

Drag caused by a windmilling propeller, extended landing gear, or flaps in the landing position will severely degrade or destroy single-engine climb performance. Single-engine climb performance varies widely with type of aeroplane, weight, temperature, altitude and aeroplane configuration. The rate of climb may be marginal – or even negative – under some conditions. Study the *Pilots's Operating Handbook* for your specific aeroplane and know what performance to expect with one engine out.

It is important to remember that the figures in the flight manual can not be guaranteed. These figures were established in a brand-new aeroplane and in the hands of a test pilot — you may well be unable to reproduce the stated performance. In many light-twin aircraft flown in New Zealand, the single-engine climb performance could well be non-existent. Don't bet on the book figures.

Best Single-Engine Angle-of-Climb Speed

Vxse is used only to clear obstructions during initial climb-out, as it gives the greatest altitude gain per unit of horizontal distance (best angle-of-climb speed is further discussed later under "Obstacle Clearance Takeoff"). It provides less engine cooling and requires more rudder than Vyse. Some manufacturers do not quote a Vxse, as performance is marginal (and will normally not be much better than at Vyse anyway).

Decision Speed

Decision (refusal) speed (V1) is the maximum speed for a given length of runway, from which a particular aircraft could be brought to rest in the remaining length of dry runway using maximum braking applied not more than five seconds after one engine has failed.

Takeoff Safety Speed

Takeoff safety speed (V2) is the lowest speed above the stall at which, for an aircraft in the takeoff configuration and following engine failure at takeoff power of the critical engine, a safe margin of control is ensured for the average pilot. The safety speed is therefore always higher than the worst critical speed. Takeoff safety speed is either declared in the flight manual or is the greater of 1.2 Vs and 1.05 Vmca. Note that takeoff safety speed does not provide maximum performance.

Single-Engine Service Ceiling

The single-engine service ceiling is the maximum altitude at which an aeroplane will climb, at a rate of at least 50 feet per minute in smooth air, with one engine feathered. More recent aircraft handbooks show service ceiling as a function of weight, pressure altitude and temperature, while older flight manuals frequently use density altitude.

Single-Engine Enroute

Single-engine enroute performance is of particular importance to flight under IFR. The average non-turbocharged light twin has a single-engine enroute capability of approximately 5000 feet at MAUW on a standard day (ISA), an important consideration when planning a flight. Some IFR routes are not available to many light twins because of their high MSAs.

Basic Single-Engine Procedures

Know and follow the single-engine emergency procedures for your specific make and model of aeroplane. The basic fundamentals of all the procedures are as follows:

- Maintain aircraft control and airspeed at all times. **This is cardinal rule No 1.**
- Usually, apply maximum permissible power to the operating engine.
- Reduce drag to an absolute minimum.
- Secure the failed engine and related sub-systems.

The first three steps should be done promptly and from memory. The checklist should then be consulted to be sure that the inoperative engine is secured properly and that the appropriate switches are placed in the correct position. The aeroplane must be banked into the live engine with the 'slip/skid' ball out of centre towards the live engine to achieve Handbook performance.

"Always plan your takeoff in sufficient detail to know what action you will take if and when a single-engine emergency should occur."

After the initial reaction, in certain situations these steps can be modified. For instance, if the engine failure occurs when you only require a low power setting anyway, you may elect to use only enough power to maintain a safe speed and altitude or descent. If the failure occurs at a low power setting an increase in power will assist identification of the failed engine.

If on final approach, use power and flap as necessary to maintain as normal an approach profile as possible to complete the landing.

Another note of caution – be sure to confirm the dead engine **positively** before feathering it. Many red-faced pilots – both students and veterans alike – have feathered the wrong engine. Don't let it happen to you. Follow this sequence:

- **Identify** the suspected engine (ie, dead leg means dead engine).
- **Verify** with cautious throttle movement of the suspected dead engine: there should be no change in the yaw.
- **Feather**.

Planning the Normal Takeoff

It is imperative to have a plan **before** every takeoff. What type are you flying? What is the load? Where is the centre of gravity? What is the runway length? Are there any obstacles? The list of variables goes on and on, and their importance increases as the runway gets shorter and the load greater.

Always plan your takeoff in sufficient detail to know what action you will take if and when a single-engine emergency should occur. Be aware of what performance to expect in that emergency and the safest flight path to fly. For example, if you have predetermined that the aircraft will not maintain altitude on one engine (considering the gross weight and density altitude) you will then be aware that if an engine should fail shortly after liftoff you will very likely have to land in the most suitable area nearby. Having considered the surrounding terrain features or any nearby landing areas, you will have in mind a definite direction of flight (or circuit) if you 'lose an engine' at a critical point on climb-out.

In other words, plan to be a competent pilot who considers these aspects and is therefore not likely to get into the position where you may run out of altitude, airspeed and ideas all at the same time!

In addition to the pre-flight planning, a competent 'light-twin' pilot knows that it is necessary to fly the aeroplane with precision in order to obtain maximum performance and safety. For example, lift off at a specific airspeed, accelerate to a specific climbing airspeed, and climb with maximum permissible power to a safe single-engine manoeuvring altitude. In the meantime, if an engine fails, you need to immediately attain yet another airspeed – and hold it precisely because you know that only this airspeed will give maximum performance.

First, let us look at liftoff speed. A 'light-twin' can be controlled satisfactorily on the ground in the case of engine failure below Vmca on the takeoff roll. This is possible by proper use of rudder, brakes, power and, with most aeroplanes, by nosewheel steering. If the aeroplane is airborne below Vmca, however, and suddenly loses all power on one engine, it probably **cannot** be satisfactorily controlled. Do not lift off until the takeoff safety speed is attained.

Climb at Vy on initial climb-out until a safe single-engine manoeuvring altitude is reached. This altitude may be dictated by several factors. It should be high enough, for example, to clear any obstacles in the circuit area. If our aircraft will not maintain altitude on one engine, we need to be high enough to see the surrounding terrain and fly to the most suitable landing area. Keep in mind, too, that when a safe single-engine manoeuvring altitude is attained, we can hold that altitude much more easily than we can climb up to it with an engine out.

After reaching a safe single-engine manoeuvring altitude, you can accelerate to your cruise climb airspeed which may be Vy plus 10 to 30 knots. Use of cruise climb airspeed will give you better engine cooling, increased inflight visibility and better fuel economy.

Continued over...

...continued from previous page

However, at the first indication of an engine failure during climb-out, establish Vyse.

Obstacle Clearance Takeoff

Climb speed for obstacle clearance should normally be Vx rather than Vy.

The problem that arises here, however, is that Vx may not be much greater than Vmca in some light twins. So if we climb at Vx and suffer an engine failure, it is possible (through pilot reaction time and poor handling techniques) that the airspeed could decay to below the point where directional control is lost. The best all-engine angle-of-climb speed (Vx) is, therefore, a speed that should be used for obstacle clearance **only** when it is **absolutely necessary**.

Remember that single-engine climb performance can be very poor (sometimes non-existent) especially when operating at, or near, MAUW. The speed difference between Vy, Vyse, and Vxse can often be small and difficult to attain and maintain in rough air. It is therefore good policy to attain a safe height above the terrain as quickly as possible, which is achieved at Vy. If a reduction in rate-of-climb can be afforded, however, it is wise to climb initially at 5 to 10 knots above Vy. For most light twins this still provides good climb performance on two engines and will make achieving Vyse or Vxse easier should it become necessary. Note that if you are climbing at below Vyse or Vxse you will normally have to sacrifice height to achieve the required airspeed – height that you may not have.

> ***"The best all-engine angle-of-climb speed (Vx) … should be used for obstacle clearance only when it is absolutely necessary."***

The decision on what airspeed to use for an obstacle clearance takeoff is up to the pilot. He or she must consider all aspects of the problem before commencing the takeoff and choose the appropriate climb-out speed wisely. If the figures look tight, it is suggested that a takeoff **not** be attempted – or at least delayed until conditions are more favourable. Such parameters would surely beg the question, "What am I doing operating the aircraft into this aerodrome anyway?"

Engine Failure on Takeoff

If an engine fails before attaining liftoff speed, the only proper action is to discontinue the takeoff. If the engine fails after liftoff, the takeoff should still be discontinued if touchdown and rollout on the remaining runway is still possible. The landing gear should be left down until the point where a runway landing straight ahead is no longer possible.

If you are airborne and committed to fly (no more runway), you should attain Vyse. If altitude cannot be maintained at Vyse, continue to hold that speed because it will give the slowest rate of descent. If you find yourself in a position of not being able to climb, your best option may be to pull the power on the good engine and land straight ahead rather than attempt to climb but lose control.

If you are just barely able to hold altitude and airspeed, do not attempt a turn if flight can be made straight ahead. Keep in mind that if a turn is made under these critical conditions, both lift and airspeed will be lost. Fly straight ahead, if possible, until a safe manoeuvring height is reached. At this point you may bank safely in either direction.

Pilot's Operating Handbooks have charts for calculating the runway length required if the engine fails before reaching liftoff speed. They may have charts showing performance after liftoff such as:

- **Accelerate-stop distance.** That's the distance required to accelerate to liftoff speed and, assuming engine failure at that point, to bring the aeroplane to a full stop.
- **Accelerate-go distance.** That's the distance required to accelerate to liftoff speed and, assuming engine failure on the critical engine at that point, to continue the takeoff on the remaining engine to a height of 50 feet.

Study your accelerate-go charts carefully. No light-twin aeroplane is capable of climbing out on one engine under all weight, pressure altitude and temperature conditions. Know, before you taxi out, whether you can maintain control and climb out if you lose an engine. It may be necessary to off-load some weight, or wait for more favourable temperature or wind conditions.

Engine Failure En Route

Normally, when an engine failure occurs en route, the situation is not as urgent as on takeoff. Under these circumstances, the pilot should take time to determine the cause of the trouble and to correct the condition, if possible. If the condition cannot be corrected by carrying out the trouble checks, then complete the engine failure drills.

The Single-Engine Approach

Some considerations when planning a single-engine landing are:

- If turns have to be made in setting up an approach, the circuit should be wide enough to avoid the necessity of making steep turns.
- A final approach at Vyse will require the least amount of power. Avoid getting low and slow – keep a minimum of Vyse until landing is assured.
- A good final approach path is one that requires the least amount of power adjustment at a constant airspeed and a constant rate of descent.
- The gear should be lowered in plenty of time to take normal corrective action if 'down and locked' indications are not received.
- When one propeller is feathered, drag is considerably reduced, resulting in a longer flare and landing roll. Make allowance accordingly as you fly the final approach. (Be prepared for the aircraft to yaw towards the live engine as the power is reduced on it.)
- If a go-around is absolutely necessary, the aeroplane must be flown at Vyse. Go-arounds should not be made once committed to the landing, with the gear lowered. If anything gets in your way on the runway you will have to avoid it as best you can.

Summary

Know the key airspeeds for your aeroplane and when to use them.

Recognise the performance limitations of your aeroplane, including its accelerate-stop distances, accelerate-go distances, single-engine enroute limitations, and maximum weight for which single-engine climb is possible.

Know the basic single-engine emergency procedures.

And, finally, **practise**. There is no way to develop skill in single-engine emergencies except by continued practice. The fact that the techniques and procedures of single-engine operation are mastered thoroughly at one time during a pilot's career is no guarantee that you will be able to cope successfully with a single-engine emergency several years hence. Unfortunately, many 'light-twin' pilots never practise single-engine operation after receiving their multi-engine rating. The smart pilot will undertake regular proficiency training with a competent instructor. It should be kept in mind that some single-engine emergencies may be so critical that there may be no margin for lack of skill or knowledge.

Key References: FAA General Aviation Accident Prevention Program. *Flying Light Twins Safely* and *Tips for 'Light-Twin' Operation.*

Some Do's and Don'ts

Do

- Be thoroughly familiar with the aircraft systems.
- Mentally practise emergency drills prior to every flight.
- Have a pre-takeoff brief.
- Keep current and fly the appropriate speeds.
- Ensure the aircraft fits into and out of the airfield at safe speeds and distances.
- Assume you will lose speed if you have an engine failure after takeoff. By the time the brain responds you may well be below Vyse.
- Assume something could go wrong at the most critical time.

Don't

- Be complacent.
- Operate the aircraft outside its parameters.
- Fly the low speeds. (Normally Vyse minimum until a landing is assured).
- Assume the flight can continue if you have an engine failure.
- Practise critical exercises without an appropriately rated instructor beside you.
- Assume you are safer in a twin.
- Push your luck.

■

Military Aerodromes

Recently a civilian aircraft landed at a military aerodrome and offloaded passengers without the prior permission of the Base Commander. The incident occurred over the weekend, when Air Traffic Control was off watch and authorised aerodrome users were employing unattended procedures.

Although an isolated incident, the RNZAF takes such a breach of security very seriously. All pilots are therefore reminded of the following with regard to military aerodromes:

- Military aerodromes are encompassed by Military Operational Areas (MOAs), which are generally active 24-hours a day. An entry clearance is therefore required from the designated controlling authority in the same way that it is for any other restricted area.
- **Ohakea Military Aerodrome**. It is clearly stated on the arrival/departure procedures page of both the IFG and VFG that Ohakea is for **military use only**. Approval for civilian use of Ohakea from the Base Commander is rare.
- **Whenuapai and Hobsonville Military Aerodromes**. Any civilian operation into Whenuapai or Hobsonville requires prior approval from the Base Commander.
- A landing (without prior approval) at any of the above military aerodromes may be made **only** in an emergency situation.

Surviving After a Crash

In many crash landing situations it is likely that some, or all, of the aircraft occupants will receive injuries. These may range from cuts and fractures to serious head and internal injuries. As pilot in command you should know how to identify what type of injuries your passengers have, be able to prioritise their treatment, know what basic first-aid techniques to apply, and have a good knowledge of survival skills. This article covers the basics of crash first aid and looks at surviving a night out in the open. We hope you will never have to put this advice into practice, but if the worst was to happen it might just help you to save someone's life.

Initial Actions

Vacating the Aircraft

Any post-crash situation requires someone to take charge and to be assertive. That person should be you – assuming that you are not badly injured (nominate someone else to take control of the situation if your injuries are going to hinder your mobility). Your first priority should be to get everyone well clear of the aircraft as quickly as possible – this is particularly important because of the risk of fire or explosion. The only exception to this may be if you suspect that a passenger(s) has severe spinal or neck injuries – you then have the difficult task of deciding whether the fire risk is greater than the risk of causing a patient permanent injury. Try to salvage the aircraft first-aid kit (if it is safe to do so), and ensure that the emergency locator beacon has been activated.

Assessing the Situation

Before any consideration is given to the treatment of injuries, it is important that a **very quick** assessment of the accident site is made for potential hazards. Watch out for things like leaking fuel (and any potential ignition source) and broken power lines, because they can be fatal. Consider your own safety first before helping your passengers – you will be of more use to them uninjured.

Having assembled everyone well clear of the aircraft (confirm that everyone is accounted for) you need to make a quick assessment of what injuries your passengers have and to prioritise their treatment. Utilise any able-bodied passengers, and give them clear instructions on how they can help – they may be able to attend to patients who are bleeding badly while you carry out cardiopulmonary resuscitation (CPR) for example.

Calling for Help

Finding an opportunity to call for help when there are seriously injured passengers who need attention can be difficult. But we suggest that you do seek help as quickly as possible (especially if it is nearby), **unless** there are passengers who are gravely injured and in need of urgent attention.

"Making it comfortably through the first night will place you in a better position to decide what your actions should be the next day."

If you have a cellphone (and assuming there is cellular coverage) dial 111 and notify emergency services of the accident (even if you managed to make a MAYDAY call before crashing) so that you can be sure that professional medical help is on its way. Try to include in your call accurate location details (to the best of your knowledge), the number of people injured, and the types of injuries involved. This extra information will not only allow the emergency services to locate you more quickly, but will also enable them to bring sufficient resources to handle the situation.

A crash in a remote and mountainous area is considerably more difficult to deal with, and it may be some time before help arrives – so be prepared to survive several nights out in the open (basic survival techniques are dealt with later in this article). The time taken to receive medical help will depend on how accurate your last position report was, whether your ELT is working correctly, the nature of the terrain, and the weather being suitable for Search and Rescue operations.

Practical First Aid

See the accompanying article for an outline of the basic ABCs of accident first aid.

STOP

After stabilising your passengers as best you can the next thing to do is STOP:

- **S – Stop**. Take a deep breath to calm yourself. Recognise that what has happened is past and can not be undone. Deal with the here and now, that is, survival first and foremost.
- **T – Think**. Your brain is your most important survival asset. Use it. Don't panic. Act with care, and don't do

anything until you have thought it through.

- **O – Observe**. Look around you and assess your supplies, equipment available, and the nature of your surroundings.
- **P – Plan**. Assign priorities to your immediate needs. Develop a plan to survive, and follow it.

If you can STOP, you can survive.

Surviving the First Night

If it is doubtful that you will be found the same day, then you must prepare to spend a night out in the open. Making it comfortably through the first night will place you and your passengers in a better position to evaluate the situation and decide what your actions should be the next day. You can significantly improve everyone's survival chances, particularly those with injuries, by adhering to the five basic principles of survival.

In order of priority, these are:

1. Shelter
2. Location
3. Water
4. Food
5. Will to Survive

Shelter. Protection from the elements takes top priority. The effects of hypothermia (or even sunstroke) must be kept to a minimum. Seek any natural shelter that the surrounding terrain might offer (the aircraft wreckage might be useful too), and erect some kind of windbreak (preferably one that will also afford some protection if it rains) using whatever materials are to hand. Make use of items such as: aircraft parts, pickets, seats, cockpit covers, and thermal survival blankets. Maintenance of body heat is obviously extremely important, so utilise whatever extra clothing you have, huddle together if necessary, and use plant foliage as insulation.

Location. Think how you might be able to attract attention. Has the ELT activated? Can the aircraft radio be used? How can I attract the attention of an aircraft searching overhead (flares, smoke, flashing lights, etc)? Note that if a rescue is not imminent, 'Location' should receive a lower priority (after water and food) and can be dealt with later.

Water. Water is far more important than food in a survival situation. Without it you will only survive a matter of days. It is worth expending energy to locate a supply of water before dehydration becomes a problem, because you will have no way of knowing how long it may take before you are rescued. If water is limited, it should be rationed to less than one litre per person per day.

> ***"Your brain is your most important survival asset. Use it. Don't panic. Act with care, and don't do anything until you have thought it through."***

Food. Any food carried on board the aircraft should also be carefully rationed, as you don't know how long it will be before you are rescued. Utilise natural sources of food that might be near by – but be careful not to expend too much energy gathering it.

Will to Survive. The will to survive has been shown to be a key factor in many successful survival stories. By remaining focused and motivated (which includes keeping your passengers motivated) you will undoubtedly improve everyone's chances of survival.

Suggested Survival Kit Contents

Every aircraft should have a well-equipped survival kit, whose contents need to be checked regularly. The following list is a basic guide only as to what it should contain, and it assumes you already have a first-aid kit on board – you might like to make alterations or include additional items:

- **Shelter –** Lightweight rope, plastic sheeting (also doubles for collecting water), and a knife are all useful for constructing a shelter. Matches (must be waterproof), firelighters are important for starting a fire, and a thermal survival blanket for insulation.
- **Location –** A cellphone, a personal locator beacon (alternatively a mountain radio), compass, whistle, flares, and a torch.
- **Water –** A watertight container and water purification tablets.
- **Food –** Emergency rations (eg, sweets, chocolate, packet soup, dried fruit, and freeze-dried packet meals), a fishing line (plus spare hooks), and a knife.
- **Will to Survive.** A pocket radio, a small survival handbook, and perhaps something like a pack of playing cards.

Summary

As pilot in command, you can never be too well prepared to deal with a crash that involves serious injuries and the possibility of surviving for several days, or more, out in the open. The last thing that you want is to have a passenger(s) die after a survivable accident because you didn't know how to administer accident first aid or know the basic principles of survival. Although each crash situation will be different, following the basics that have been outlined in this article will improve chances of survival for you and your passengers.

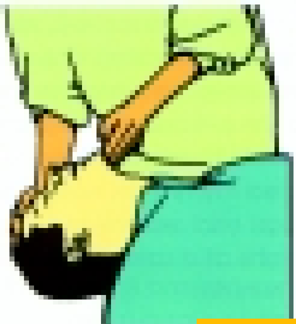
Take the time to read more on first aid and survival techniques, and attend courses in each. Familiarise yourself with the contents of your aircraft's first-aid kit, and ensure the aircraft is also equipped with a survival kit. Always carry extra food, water, and plenty of warm clothing on a cross-country flight – no matter how short it is, or what type of terrain you will be crossing, or what time of year it is.

When you get the opportunity, spend a few moments thinking about how **you** would handle such a situation if it were to happen to you.

Continued over...

...continued from previous page

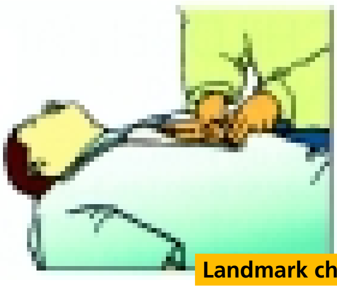
ESSENTIAL FIRST AID



Open airway

Two slow full breaths

Feel for pulse



Landmark check

Chest compressions

Illustrations and photograph courtesy of New Zealand Red Cross.

The information outlined below has been adapted from the New Zealand Red Cross *Essential First Aid* manual. We have covered only the basics, and we strongly recommend that you take a New Zealand Red Cross or Order of St John first-aid course (or a refresher). Knowledge of first-aid techniques is important in any part of our lives and activities. A first-aid manual, provided as part of a course, will allow you to continually refresh your knowledge, and it will be useful to carry in your aircraft first-aid kit for ready reference should the need arise.

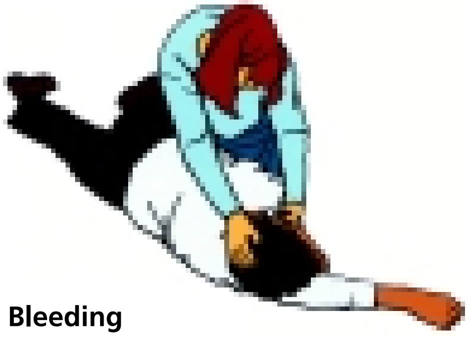
Primary Assessment and Actions

The primary assessment helps to identify any immediately life-threatening conditions and involves checking a patient's response followed by the ABC (airway, breathing, and circulation) checks, then checking for bleeding and shock.

Check for a response – shout and tap.

- **Airway** – If a patient is unconscious they will be unable to maintain an open airway to allow air to enter the lungs. Loosen any clothing that might restrict their breathing, and check that the airway is not obstructed (this may involve using your finger to sweep the patient's tongue forward if they have swallowed it). Remove any foreign material from their mouth (broken teeth, etc) and open the airway by tilting their head back (if spinal injuries are suspected minimise head movement). Insert a Gudel Airway if available.
- **Breathing** – Look, listen, and feel for breathing. If absent, begin rescue-breathing. Continue mouth-to-mouth at a rate of one breath every five seconds until the patient is able to breathe on their own. If a casualty is breathing a pulse will be present.
- **Circulation** – Check for a pulse on their neck. If you can't detect one, then begin CPR (cardiopulmonary resuscitation). Push down (using the heel of your hands) on the centre of their chest with both arms straight (15 compressions followed by two mouth-to-mouth breaths within approximately 15 seconds) to get their heart beating again. Repeat this process, checking after four cycles for a pulse. (It is important to obtain correct training in administering CPR and when to use it.)

An unconscious patient, whose airway is confirmed clear and who is breathing, can be placed in the recovery position if injuries do not indicate otherwise.



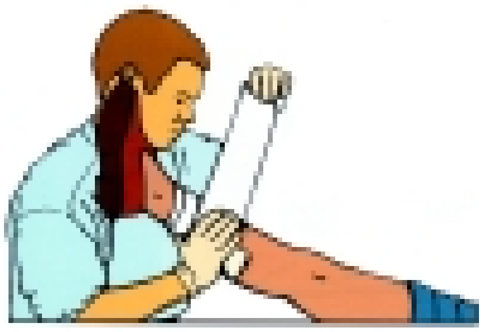
Bleeding

Major bleeding must be managed early to prevent shock developing. With internal bleeding, there may be severe chest or abdominal pain. Watch for the signs and symptoms of shock to alert you to loss of blood. Life threatening arterial bleeding can be easily distinguished from venous bleeding, as arterial blood is bright red in colour and pulses out of the wound – venous blood is much darker and flows steadily.

The steps to manage external bleeding are **RED:**

- **R**est the injured area, and **R**eassure the patient.
- **E**levate the affected limb, and **E**xpose the wound (if under clothing) to determine seriousness of the injury.
- Place a clean non-fluffy **D**ressing over the wound, and apply firm **D**irect Pressure for 10 minutes.

Get the patient to keep applying this pressure (if you think they are able) so that you are free to deal with other injuries. If blood comes through the first dressing, place another pad over the first without disturbing the original one.



Shock

Most serious injuries will be accompanied by shock, which can be fatal. A person suffering from shock usually has pale cold sweaty skin, a weak rapid pulse, and rapid breathing. Minimise shock by lying the casualty down, elevate the legs (if injuries don't prevent this), keep them warm, and reassure them. Monitor vital signs and ABCs.

Hypothermia

Hypothermia occurs if the core body temperature falls below 35 degrees Celsius. Hypothermia can progress quickly, with as little as 30 minutes between the initial symptoms and unconsciousness. Symptoms include: shivering, tiredness, slurred speech, loss of coordination, and changes in behaviour. If not treated, hypothermia will lead to unconsciousness and eventually death.

Move the patient to a sheltered place and try to reduce their heat loss by insulating them with a thermal survival blanket or extra clothing (if possible, place them inside a sleeping bag with a companion to provide extra warmth). If they are conscious, give them a warm sweet drink and provide reassurance. If they are unconscious, place them in the recovery position and insulate them as much as possible.

Secondary Assessment

After action has been taken to treat a patient's immediate life-threatening condition, there is then time to try to identify what other injuries they may have.

Spinal and Neck Injuries

Injuries to the spine or neck are common in high-impact aircraft accidents and can be very serious if not treated correctly. Where possible, casualties with suspected spinal injuries should be left in the position they are found in, whether they are conscious or unconscious. It may be necessary to move them in certain circumstances, if a clear airway cannot be maintained in their current position, for example, or if they are in real and immediate danger (such as the aircraft catching fire).

Any move must be done with **extreme care**, evenly supporting the patient along the full length of their body to keep their spine in line.

Fractures

Fractures to the bones of the arms and legs are also common in light-aircraft accidents. An open fracture is one where the bone protrudes through the skin, while a complicated fracture involves damage to neighbouring organs, nerves or blood vessels. A fracture may be indicated by pain, swelling and tenderness, deformity of the injured area, inability to use the injured area normally, and possibly blood loss resulting in shock.

Fractures are managed with pressure and immobilisation. Treat bleeding with pressure around the wound if possible, and cover bone ends with clean non-fluffy material. Support and immobilise the injured area. Treat for shock.

Broken limbs can be immobilised by using a stable body part as a splint. An uninjured limb, for example, will do as a splint. Place some padding between the injured and uninjured limb (or an injured arm against the chest wall) and bind firmly with a bandage – this will stiffen the limb and help avoid any unnatural flexing of the bone. Ensure that the bandage is not too tight by checking the warmth and colour of the surrounding extremities. Note that if you are in any doubt as to how to make a splint, avoid trying, as you may cause further damage to the patient. The patient should then be told to keep the affected limb as still as possible to avoid further injury from splintered bone ends.

Burns

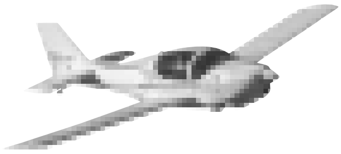
Run plenty of cool water over a burn-affected area (you may have to use an item of water-soaked clothing if water is in short supply) for a least 10 minutes. With serious burns there may be no pain, because nerve endings have been damaged, but the casualty will be in shock, and this should be managed.

Note that burns should be bandaged with a non-fluffy dressing to reduce fluid loss and the chance of infection.

Suggested First-aid Kit Contents

A well stocked first-aid kit, the contents of which should be regularly checked (at least once every 12 months), is a must in any aircraft. First-aid kits should contain, at the very least, the following:

- Several large absorbent gauze pads suitable for stopping arterial bleeding
- Sterile dressings and wound dressings
- Large bandages suitable for making splints, slings, or dressing wounds (should also include safety pins and adhesive tape)
- Pain killers and antiseptic solution
- Gauze dressings and bandaids
- Razor blades and scissors
- A basic first-aid instructional booklet
- Thermal survival blankets
- Water purification tablets ■



Joining Overhead?

The standard overhead join is a fundamental procedure that should ensure the safe and orderly sequencing of traffic around an aerodrome circuit, particularly if it is unattended. But with the use of opposite-direction circuits at some unattended aerodromes, the standard overhead join may sometimes not be the safest option.

Why Join Overhead?

While it is still good aviation practice to carry out a standard overhead join at the majority of unattended aerodromes most of the time (especially if they are not familiar to you), it may not always be appropriate at those which have simultaneous opposite-direction circuits in use.

Opposite-direction circuit patterns are usually prescribed to provide a greater degree of separation between powered fixed-wing aircraft and other aircraft types (such as gliders or helicopters) and to ensure a safe and streamlined flow. This means that such an aerodrome can have two active traffic sides at any one time – a situation that can be confusing to pilots. Letting down on to the active side of another circuit may create a risk of a head-on collision with an aircraft already established in the opposite-direction circuit, and it could be contrary to rule 91.223 (a)(2) *Operating on and in the vicinity of an aerodrome* which requires you to "…conform with or avoid the aerodrome traffic circuit formed by other aircraft…"

There are currently a number of aerodromes with opposite-direction circuits promulgated in the VFG:

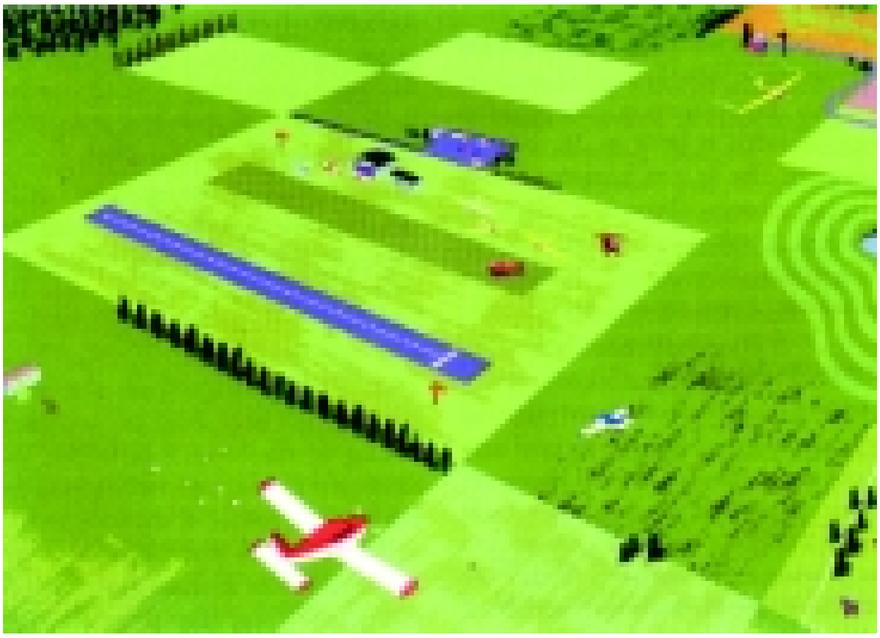
- Paraparaumu has intensive gliding operations throughout the year. This can mean that gliders, tugs, and tailskid aircraft are all operating in the opposite-direction grass circuit. Joining overhead at Paraparaumu may therefore be undesirable – especially over busy fine-weather weekend periods and public holidays, when there is likely to be a large volume of recreational traffic in both circuits. As gliders present a very small frontal profile, it is important to ascertain if they are operating, to keep a good lookout, and to avoid their circuit pattern. Alexandra, Hastings, and Omaka are examples of other aerodromes where there are similar opposite-direction operations and caution is required.
- Masterton has a grass vector with an opposite-direction circuit that is restricted to local operators. Visiting aircraft need to be aware of this and watch for conflicting traffic.
- Ardmore, Dannevirke, North Shore, and Wanganui are examples of aerodromes where helicopters can operate in an opposite-direction circuit to fixed-wing aircraft. Although the helicopter circuit height is usually several hundred feet lower (normally an adequate vertical separation), it is still important that all parties maintain awareness of each other's whereabouts so as to reduce the likelihood of conflict.

Note that microlights operating from unattended aerodromes generally use a lower-level circuit pattern rather than an opposite-direction one. This is something else to watch out for – particularly since some microlights do not have radios.

Unfamiliar Aerodromes

If you are visiting a less familiar aerodrome, study the aerodrome notes in the VFG thoroughly as part of your pre-flight planning. If opposite-direction circuits are promulgated, you will need to approach the aerodrome with caution and ascertain early what level of activity is present, in order to decide whether it is wise to carry out an overhead join.

If an opposite-direction circuit is in use, it may be preferable to join directly via the downwind, base leg, or final approach. Most of the time it should be easy to ascertain the runway in use (thus the circuit direction) and the whereabouts of other traffic by maintaining a careful



lookout and a listening watch. Obtain the ATIS/AWIB early (if available) and start listening out for other circuit traffic while you are still some distance from the aerodrome. Obtaining this information early will allow you to confirm (with cross-reference to the VFG) the orientation of the runway in use and the circuit direction (something that can sometimes be difficult if the aerodrome has a number of vectors).

It should then be relatively straightforward to sequence yourself safely into the traffic circuit directly without joining overhead. Remember to keep a good lookout for Nordo aircraft – do not assume that the traffic for which you have heard radio calls is all there is.

Ensure your radio calls are clear and concise. Advise other traffic of your position, altitude and joining intentions. You should not, however, advise what you think your sequence in the circuit might

So How Should You Join?

Familiar Aerodromes

If you are operating locally, or in an area with which you are familiar, you should already have a good idea of what types of operations take place at each aerodrome and, therefore, whether joining overhead is appropriate. If it is clearly not local practice to join overhead, you should have no problem in joining the circuit directly (ie, via the downwind, base leg, or final approach) by observing the movement of other traffic. Make use of your local knowledge and maintain a careful lookout and listening watch for other traffic to help you determine your position in the circuit sequence. If there is no other traffic (or ATIS/AWIB broadcasts) to help you determine the runway in use, or you know there is no traffic in the opposite-direction circuit, then it is wise to join overhead in the normal way.

be, because it is likely to change by the time you get there. This should be done only when you are close enough to the circuit pattern to be certain of it.

"If you are in any doubt as to the runway in use or the position of other aircraft, then remain clear until you can form a picture of what is happening."

Entering the Active Circuit

When approaching to join the circuit pattern directly onto the downwind leg, it is particularly important to watch out for traffic that is established in the crosswind leg of the circuit. Also, watch out for outbound traffic climbing through your altitude on the extended runway centreline. The potential for a mid-air collision between you and traffic already established in the circuit is there, so an active scan must be maintained at all times. The same degree of vigilance is required when joining on a base leg or a final approach. Remember to scan both inside and outside the circuit pattern for traffic before entering it, and give way to aircraft already established in the circuit.

Keep your radio calls concise and to the minimum appropriate – frequent long-winded calls can jam up the frequency (which may be in use for more than one airfield) and prevent other aircraft from reporting their position.

If you are in any doubt as to the runway in use or the position of other aircraft, then remain clear until you can form a picture of what is happening. It is better to take a little extra time to confirm what is happening and clearly advise your joining intentions to other traffic, than it is to go blundering into the circuit and disrupt the traffic flow.

Summary

The overhead join will always be a vital ingredient in maintaining safety at unattended aerodromes, and it will on most occasions be the best way to join. But, as we have pointed out in this article, it may sometimes be unwise at aerodromes where opposite-direction circuit patterns are in operation. If you are familiar with the traffic patterns and conditions at a particular aerodrome, then it should be no problem to join the circuit pattern directly.

If you are venturing further from home, make sure that you know what types of traffic you are likely to encounter at each aerodrome you visit, and therefore whether joining overhead is appropriate. Maintain a listening watch, and brief yourself on the circuit in use from the VFG well before reaching the aerodrome. Be especially vigilant when joining directly onto the downwind, base leg, or final approach. Know the right-of-way rules, be prepared to give way (even if you are in the right), and if in doubt stay away until the picture becomes clearer. ■

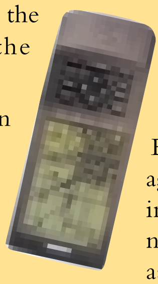
GPS Roll-over

The Problem

All owners and users of GPS units need to check them for a system reset known as "End of Week Roll-over" (EOW) – some manufacturers referred to it as "Week Number Roll-over" (WNRO).

EOW is a result of a system design feature of GPS. The system calculates time by counting the number of weeks since 6 January 1980 (the time of system inception) up to a maximum of 1023 weeks. Time has obviously rolled on since then, and week 1023 will occur at midnight between 21 and 22 August 1999. At this time the week counter will roll back to zero weeks. The GPS system controllers, the US Department of Defence (DOD), say that this will not create problems for the GPS satellites, nor the DOD ground control centre, but it could present problems for users of older GPS units. The problem is that some GPS units were not designed to accommodate this phenomenon, and they could process satellite data incorrectly and display inaccurate navigation information. One of the following GPS receiver problems could be experienced:

- It will be unable to locate the satellites, resulting in the receiver not working.
- It will take more time than usual to locate the satellites.
- It will appear to be working but will display inaccurate positions, times or dates.



The EOW problem is distinct from Y2K compliance issues, which relate to GPS units recognising the year 2000. It is therefore important that all operators and owners of GPS units check them for EOW as well as Y2K.

The Solution

Fortunately, GPS manufacturers have been proactive in this field and have information on the ability of each GPS unit to handle these issues. Modifications or 'fixes' have been developed to cope with the problems. It is possible in some cases to make the changes yourself. These include repetitive clock resetting for a specified period on starting your unit and downloading correctional information that can be passed to the GPS unit via a personal computer. Some units, however, may require 'bench-work' to be done on them by the manufacturer or agent.

The type of 'fix' involved will vary with unit age, type, and from manufacturer to manufacturer.

Check the status of your GPS unit for EOW with the manufacturer or local agent. If it can not handle EOW it is imperative that you arrange for the necessary corrections to be made as soon as possible before first use after 21 August 1999. If you are borrowing a GPS (portables do get moved around), or the aircraft you hire has a GPS, it is important that you ascertain that it has been checked for EOW before you go flying after 21 August 1999.

EOW will be upon owners and users of GPS units in a few weeks. Do not delay. It is suggested that you contact the manufacturer and/or agent soon as you can. Relevant information can also be obtained direct from the manufacturer at the following web site addresses:

Garmin : www.garmin.com

Trimble: www.trimble.com

AlliedSignal: www.alliedsignal.com

Morrow(Apollo): www.iimorrow.com

See the CAA web site:
www.caa.govt.nz
under **Public Information** for further information on this topic.

How To – Fill the gap

The CAA publishes two series of information booklets.

The **How To** series aims to help interested people navigate their way through the aviation system to reach their goals. The following titles have been published so far:

How to be a Pilot	*Published 1998*
How to Own an Aircraft	*Published 1999*
How to Charter an Aircraft	*Published 1999*
How to Navigate the CAA Web Site	*Published 1999*

The **GAP** (**G**ood **A**viation **P**ractice) series aim to provide the best safety advice possible to pilots. The following titles have been published so far:

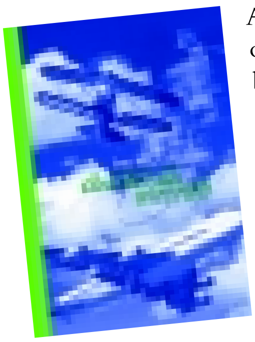
Winter Operations	*Published 1998*
Bird Hazards	*Published 1998*
Wake Turbulence	*Published 1998*
Weight and Balance	*Published 1998*
Mountain Flying	*Published 1999*
Flight Instructor's Guide	*Published 1999*

How To and **GAP** booklets (except the *Flight Instructor's Guide*) are available from most aero clubs, training schools or from Field Safety Advisers (FSA contact details are usually printed in each issue of *Vector*). Note that *How to be a Pilot* is also available from your local high school.

Bulk orders (except the *Flight Instructor's Guide)* can be obtained from:

The Safety Education and Publishing Unit
Civil Aviation Authority
PO Box 31-441, Lower Hutt
Phone 0–4–560 9400

How to Charter an Aircraft

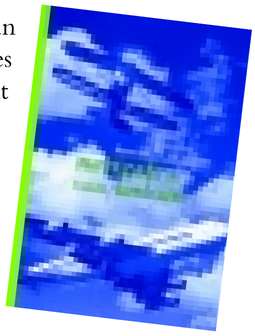


A company that charters an aircraft from an operator who is not correctly certified could be putting their business on the line. Such a flight will not only be illegal (thereby possibly invalidating the company's insurance) but could also be unsafe.

Knowing what documentation an aircraft operator should have in order to conduct a particular type of flight can be difficult to determine – particularly if you are a non-aviator. To assist in this regard, the CAA has produced a new booklet called *How to Charter an Aircraft*. This eight-page booklet outlines what documentation one might wish to see before deciding to charter an aircraft.

How to Charter an Aircraft has been sent to all Part 119-Certificate holders, flight training organisations, and other businesses (such as the Department of Conservation, Television New Zealand, and the New Zealand Police) that charter aircraft on a regular basis. Copies may also be obtained through your local CAA Field Safety Adviser (see the previous issue of *Vector* for contact details) or by contacting the **Safety Education and Publishing Unit** at the above address.

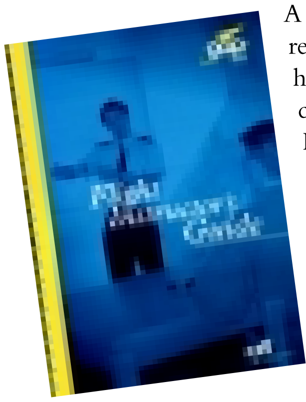
How to Navigate the CAA Web Site



The CAA's web site is a quick and cost-effective way to access important, and sometimes vital, aviation information. Regardless of whether you need the information to run your business or are just browsing, chances are the CAA's web site will contain what you are looking for.

To assist you in navigating your way around the site, the CAA has produced a new **How To** booklet called *How to Navigate the CAA Web site*. The 20-page booklet has been mailed to all flight training organisations and Part 119-Certificate holders, but may also be obtained through your local CAA Field Safety Adviser or by contacting the **Safety Education and Publishing Unit**.

Flight Instructor's Guide



A major new **GAP** has just been released. The *Flight Instructor's Guide* has been compiled by the CAA in consultation with the RNZAC Instructor Council, the Aviation Industry Association, and Aviation Services Ltd, as a comprehensive reference text for aspiring C-Category instructors, and indeed for instructors of all levels. This guide covers 34 lessons ranging from taxiing to map-reading skills. Each lesson plan contains associated background information, a pre-flight briefing, and outlines how the air exercise should be taught. The guide also devotes a number of chapters to the theory of learning and recommended teaching techniques. It is useful both for budding instructors and for those with more experience who wish to improve the way they teach.

We would like to think that this guide would become part of every instructor's essential reference texts. This could, over time, help to standardise the way in which the PPL and CPL syllabuses are taught in New Zealand and allow an even better standard in flight training to be achieved.

The *Flight Instructor's Guide* can be purchased directly from the printer for $37.00 (plus postage and packaging) by contacting them at the following address:

Design and Copy Centre

36 Railway Ave	Phone 0–4–939 0030
PO Box 30-185	Fax 0–4–576 4513
Lower Hutt	E-mail sally@designcopy.co.nz ■

0508 ACCIDENT

The CAA is still receiving a considerable number of accident notification calls on the old 0800 number. We would like to remind readers that the correct toll-free accident notification number is 0508 ACCIDENT (0508 222433), which is normally published in every issue of *Vector*. You should call this number as soon as practicable if you are involved in, or witness, an aircraft accident. The number is staffed 24-hours seven days a week (via the CAA's National Rescue Coordination Centre).

Aviation Safety Coordinator Courses

Attention all aviation companies!

Three Aviation Safety Coordinator training courses are planned for September and October 1999. These two-day courses will be held in Queenstown on 16–17 September, Palmerston North on 30 September – 1 October, and Hamilton on 7–8 October.

An Aviation Safety Coordinator runs the safety programme in an organisation. Does your organisation have a properly administered and active safety programme?

If you are involved in commuter services, general aviation scenic operations, flight training, or sport aviation, this course is relevant for your organisation.

For further information and enrolment forms contact: Rose Wood, AIS Liaison and SEPU Administration Officer, Civil Aviation Authority, PO Box 31-441, Lower Hutt, e-mail: **woodr@caa.govt.nz**

What Is an Aviation Safety Programme?

An aviation safety programme is a formalised and documented plan that focuses on creating safety awareness and reducing accidents. It achieves this through two primary functions, risk management and safety awareness.

The safety programme includes all activities carried out within an organisation in order to maintain and promote safe practices. Such activities will usually include a hazard identification system, an occurrence reporting system, and safety surveys. Awareness will be raised by seminars, videos, magazines, meetings, posters, etc. A good safety programme will stimulate good communication.

A safety programme is a very important part of sound professional work practices. Safety should be very much a part of all aspects of your organisation's activities.

A Safety Coordinator can advise and make recommendations – the authority and instructions for implementation must come from a management level. The success or failure of any aviation safety programme rests at that level.

The first step must be commitment by the top management to a safety programme.

The CAA can provide formal training for your Aviation Safety Coordinator.

Why Have a Safety Programme?

The short answer is, "If you think safety is expensive, try having an accident!"

You may be insured for direct costs, but the indirect costs of an accident are many times greater (latest figures suggest 4:1). A safe operation could be critical to staying in business.

The benefits are many and include a safer operating environment for employees and passengers, a more cost-efficient operation, and a positive image leading to public confidence and business opportunities.

New Airspace Posters

The CAA has produced two new posters that should help you better understand the structure and operational requirements of New Zealand airspace.

The largest poster (slightly bigger than A2) summarises New Zealand Airspace Classifications by using symbols and colour codes. These have been combined with a comprehensive key system in an effort to simplify what is a relatively complex topic. The poster will invite close study, but we hope that the combination of colour and symbols will help you recall the knowledge when you most need it – in the cockpit.

The other poster (slightly smaller than A2) uses computer-generated diagrams (originally used in *Vector* 1997, Issue 7) to illustrate the physical characteristics of each type of Special Use Airspace, and bullet points below each diagram briefly spell out the applicable operational requirements. The poster also has a panel depicting day VFR airspace (Victors, etc) also in pictures and words.

These posters will be a useful asset to have on the wall of your organisation as both a training aid for student pilots and a refresher for more experienced pilots. Your local CAA Field Safety Adviser will distribute them free-of-charge to your organisation over the next few months. If for some reason you have not received them, then please contact the following address:

The Safety Education and Publishing Unit
Civil Aviation Authority
PO Box 31-441,
Lower Hutt
Phone 0–4–560 9400

Publications

0800 800 359 — Publishing Solutions, *for CA Rules and ACs, Part 39 Airworthiness Directives, CAA (saleable) Forms, and CAA Logbooks. Limited stocks of still-current AIC-AIRs, and AIC-GENs are also available. Also, paid subscriptions to Vector and Civil Aircraft Register.*

CAA Web Site, http://www.caa.govt.nz *for CA Rules, ACs and Airworthiness Directives.*

0800 500 045 — Aviation Publishing, *for AIP documents, including Planning Manual, IFG, VFG, SPFG, VTCs, and other maps and charts.*

Accident Notification

24-hour 7-day toll-free telephone

0508 ACCIDENT

(0508 222 433)

CAA Act requires notification "as soon as practicable".

Occurrence BRIEFS

CAA Occurrence Briefs is published up to eight times a year, and is mailed on our normal six-weekly cycle to our industry-wide audience. The content of *CAA Occurrence Briefs* comprises all notified aircraft accidents, GA defect incidents (submitted by the aviation industry to the CAA), and selected foreign occurrences that we believe will most benefit engineers and operators. Statistical analyses of occurrences will normally be published in *CAA Review*.

Individual Accident Reports (but not GA Defect Incidents) – as reported in *CAA Occurrence Briefs* – are now accessible on the Internet at CAA's web site (http://www.caa.govt.nz/). These include all those that have been published in *CAA Occurrence Briefs*, and some that have been released but not yet published. (Note that *CAA Occurrence Briefs* and the web site are limited only to those accidents which have occurred since 1 January 1996.)

Accidents

The pilot in command of an aircraft involved in an accident is required by the Civil Aviation Act to notify the Civil Aviation Authority "as soon as practicable", unless prevented by injury, in which case responsibility falls on the aircraft operator. The CAA has a dedicated telephone number 0508 ACCIDENT (0508 222 433) for this purpose. Follow-up details of accidents should normally be submitted on Form CAA 005 to the CAA Safety Investigation and Analysis Group.

Some accidents are investigated by the Transport Accident Investigation Commission, and it is the CAA's responsibility to notify TAIC of all accidents. The reports which follow are the results of either CAA or TAIC investigations.

ZK-HPG, Schweizer 269C, 5 May 98 at 1330, 4 NE Waikanae. 2 POB, injuries 2 fatal, aircraft destroyed. Nature of flight, other aerial work. Pilot CAA licence CPL (Helicopter), age 37 yrs, flying hours 1172 total, 885 on type, 20 in last 90 days.

The helicopter was engaged on a sling-loading operation and was in transit to the next pickup site. The sling, consisting of a chain attached to a length of rope, was still attached to the helicopter. The chain flicked up into the main rotor, causing major damage. Out of control, the helicopter descended steeply and struck the ground heavily, killing both occupants.

The most likely cause for the chain striking the main rotor was a momentary snagging on a tree or other obstruction, the elasticity in the rope then catapulting the chain forward and up.

Main sources of information: CAA field investigation

CAA Occurrence Ref 98/1250

ZK-HUQ, Hughes 369HS, 10 Jul 98 at 1330, Whitcombe Pass. 1 POB, injuries nil, damage substantial. Nature of flight, ferry/positioning. Pilot CAA licence CPL (Helicopter), age 44 yrs, flying hours 756 total, 598 on type, 35 in last 90 days.

The helicopter was approaching the top of Whitcombe Pass from the west, when the pilot decided to turn back towards Hokitika because of fog. While in the turn, engine power and rotor rpm suddenly decreased and the pilot attempted an emergency landing in a creek bed. There was insufficient height to establish an autorotation and the landing, although controlled, was firm. The aircraft rolled shortly after touchdown at the same time as the engine evidently regained operating rpm.

After confirming that the ELT was operating, the pilot sought shelter in a mountain hut. A SARSAT detected the ELTs transmissions allowing a search aircraft to home in on them. The pilot was rescued the next day.

The pilot reported that a problem with decaying engine rpm had been experienced in the proceeding months but no cause had been found for it. Examination of the engine, and relevant components, revealed some deficiencies but none were considered to have caused the reported run-down – the cause of which still remains unknown.

Main sources of information: Accident details submitted by pilot plus further enquiries by CAA.

CAA Occurrence Ref 98/1865

ZK-DXD, Cessna U206F, 3 Aug 98 at 1430, Parakai. 5 POB, injuries nil, damage minor. Nature of flight, parachuting. Pilot CAA licence CPL (Aeroplane), age 45 yrs, flying hours 900 total, 300 on type, 90 in last 90 days.

During the climb for a parachute drop run the engine started to lose oil pressure at about 1500 feet. The pilot made a forced landing without power into mangroves. The pilot's Mayday call was overheard by an aircraft overhead and was relayed to air traffic control.

Investigation revealed that the power loss was due to the failure of the No. 5 big end bearing. The bearing failure led to an excessive heat build-up (approximately 1000°C) in one of the connecting rods. This resulted in a reduction of strength in the connecting rod bolts, which eventually suffered an overload failure causing a catastrophic engine failure. Metallurgical analysis of the bearing metal could not reveal the cause of the bearing failure.

Main sources of information: Accident details submitted by pilot plus CAA engineering investigation

CAA Occurrence Ref 98/2102

ZK-VAC, Cessna 402C, 19 Aug 98 at 1643, nr Bluff. 9 POB, injuries 5 fatal, aircraft destroyed. Nature of flight, transport passenger A to B. Pilot CAA licence CPL (Aeroplane), age 51 yrs, flying hours 14564 total, 27 on type, 77 in last 90 days.

Surviving passengers reported that en route from Stewart Island to Invercargill there were symptoms of a righthand engine failure, which was corrected by the pilot's manipulation of floor-mounted fuel tank selectors. Shortly afterwards, both engines stopped. The pilot broadcast a Mayday and advised the passengers that they would be ditching. A successful ditching was carried out approximately 12 NM south of Invercargill. All occupants escaped from the aircraft, however, four persons exited without life jackets. The pilot entered the cabin but was unable to locate more before the aircraft sank. Rescuers reached the scene about an hour after the ditching only to find that all those without life jackets had perished, as had a young boy who was wearing one.

A TAIC investigation found that there was no evidence of any component malfunction that could cause a double engine failure, although due to seawater damage the pre-impact condition of most fuel quantity system components could not be verified. Both fuel tank selectors were positioned to the lefthand tank, and it is probable that fuel starvation was the cause of the double engine failure.

Company procedures for the Cessna 402 lacked a fuel quantity monitoring system to supplement fuel gauge indications. Dipping of the tanks was not a feasible option. Company pilots believed that the aircraft was fitted with low-fuel quantity warning lights, which was not the case. As three pilots believed the gauges indicated sufficient fuel was on board before the preceding round trip to the island, exhaustion may have followed an undetermined fuel indicating system malfunction.

The failure of the company to require the use of operational flight logs, and other deficiencies in record keeping, were identified in the TAIC report. The much-publicised misunderstanding about the ditching location was not considered by the TAIC report to have affected the outcome of the rescue, but provides an example of the continued importance of using the phonetic alphabet in radiotelephony.

A safety recommendation that operators use a fuel-quantity monitoring system to supplement fuel gauge indications was also made by the TAIC report.

Main sources of information: Abstract from TAIC Accident Report 98-008

CAA Occurrence Ref 98/2274

GA Defect Incidents

The reports and recommendations which follow are based on details submitted mainly by Licensed Aircraft Maintenance Engineers on behalf of operators, in accordance with Civil Aviation Rule, Part 12 *Accidents, Incidents, and Statistics.* They relate only to aircraft of maximum certificated takeoff weight of 5700 kg or less. Details of defects should normally be submitted on Form CAA 005 to the CAA Safety Investigation and Analysis Group.

The CAA Occurrence Number at the end of each report should be quoted in any enquiries.

Gippsland GA200

Cylinder studs fail

Just after takeoff, there was a loud bang and an engine power loss. The pilot elected to jettison a load of water and return for a safe landing.

Further investigation revealed that the engine failure was due to the loss of one cylinder. A cylinder hold-down stud had broken, which was possibly due to the effects of localised heating during an engine-case rework. This allowed the remaining studs to be overstressed resulting in the eventual failure of all but two of the studs.

ATA 8530 CAA Occurrence Ref 98/1840

Hughes 269C

Tailrotor drive spline teeth fail

The pilot carried out a precautionary landing on a ridge-top due to an uncommanded right yaw and increase in rpm. Inspection revealed that the tailrotor drive spline teeth had been stripped. The component had 200 hours left to run.

ATA 6420 CAA Occurrence Ref 98/2123

Hughes 369D

369D rotor blade cracks, P/N 369A 21613-61

During a pre-flight inspection the pilot discovered that the tailrotor was cracked inboard of the leading-edge cap. It seemed to be starting from under the protecting tape.

Further investigation revealed that the rotor blade had been modified 600 hours previously, and the leading edge abrasion strip replaced. The manufacturer had issued Service Bulletin 369-193 to inspect for cracking in the suspect area. TTIS 2672 hrs; TSI 39 hrs.

ATA 6410 CAA Occurrence Ref 98/3077

Hughes 369D

Allison C20B compressor fails, P/N 6890550

About five minutes after takeoff a muffled 'bang' was heard from the rear of the aircraft. A rise in turbine outlet temperature (TOT) was noted and an immediate emergency landing made.

Further investigation revealed that the engine had suffered a catastrophic failure from FOD ingestion. It became clear that the bolt (P/N NAS 1004-28) that holds the particle separator in position had entered the compressor intake causing extensive damage to the compressor wheels. The anchor nut was found to be serviceable, indicating that the bolt had not been fitted correctly. It was interesting to note that this bolt had not been disturbed since the aircraft arrived in New Zealand. TTIS 11106 hrs; TSO 2573 hrs; TSI 17 hrs.

ATA 7230 CAA Occurrence Ref 98/63

Hughes 369HS

Compressor sprag shaft fails

The pilot had just taken off when the engine failed. A safe autorotation was carried out.

Upon external inspection there appeared to be no visual damage to the engine, but engineers determined that the compressor sprag shaft had failed. This shaft can be subjected to excessive fatigue if the compressor is not correctly shimmed to its mounts. Previous incorrect shimming of the compressor could have contributed to this failure.

ATA 7230 CAA Occurrence Ref 98/545

Kawasaki BK117 A-4

Kawasaki BK117 blade cracks, P/N 117-150041

During unscheduled maintenance a 57mm crack was noticed in the lower-surface steel leading-edge cap of a main rotor blade.

The crack could be detected only after very close inspection as the droop of the blades acted to close it. There was considerable discussion amongst experienced staff as to whether the indication seen was a crack. It was not until the blade was flexed that it became evident that the mark was in fact a crack, highlighting the need for close inspections.

The manufacturer advised that it is only the third such blade to crack in the leading-edge cap and that it had completed a relatively small number of hours for such a defect to occur. TTIS 745 hrs.

ATA 6210 CAA Occurrence Ref 98/2911

NZ Aerospace FU24-950

Textron Lycoming engine casing cracks

During cruise the engine developed an oil leak and oil began to cover the windscreen. The pilot was able to complete the flight safely.

Further investigation revealed that the crankshaft thrust face had insufficient lubrication, which caused a crack in the engine crankcase. The lack of lubrication was caused by inadequate oilways machined into the new engine casings at the thrust face. Lycoming have developed a local modification, which can be incorporated at overhaul. All engine cases in New Zealand stock have since been re-inspected.

ATA 7900 CAA Occurrence Ref 98/1842

International Occurrences

Lessons from aviation experience cross international boundaries. In this section, we bring to your attention items from abroad which we believe could be relevant to New Zealand operations.

United States of America

GA Fatal Accidents

The following are a selection of occurrences that come from the NTSB's *Aviation Accident/Incident Database* contained on the FAA web site.

Cessna 402 – Pilot fails to ensure adequate climb profile on takeoff

During the initial climb after takeoff, while executing a dark-night departure, the pilot failed to maintain clearance from rising terrain about one mile from the end of the runway. Operator records indicated that the pilot had flown out of this airport in the past, and that the aircraft was approximately 270 kilograms below maximum certificated gross weight at the time of departure.

A teardown inspection of both engines revealed no pre-impact anomalies, and visual and teardown inspections of the propellers showed damage signatures consistent with ground contact in a flat-pitch position under significant power.

FAA Occurrence No SEA97LA125

Piper PA-38-112 – Aircraft performance insufficient to out-climb terrain

During the return leg of a cross-country flight through mountainous terrain, the pilot attempted to fly through a mountain pass which was more than 8500 feet high. At the time of the accident, the density altitude in the area was greater than 10,000 feet amsl, and according to the pilot's operating handbook the aircraft's expected climb rate would be less than 100 feet per minute. While attempting to get through the pass, the aircraft encountered downdraughts that were sinking at a greater rate than the aircraft could climb. Although the pilot attempted to out-climb the sinking air, he could not keep the aircraft from descending into the terrain.

FAA Occurrence No SEA97LA123

Occurrences

Cessna 402 – Windshear causes aircraft to undershoot runway

The pilot encountered unforecast winds on final approach and touched down short of the runway, shearing one of the main landing gear legs. The other main landing gear leg collapsed during the landing roll. The aircraft skidded 2600 feet on its belly before coming to rest on the right side of the runway.

Published aeronautical information associated with the region warns pilots that they may encounter abrupt changes in wind direction and wind velocity, and that severe updaughts and downdrafts are common – particularly near or above abrupt changes of terrain such as cliffs or rugged areas.

FAA Occurrence No LAX96LA252

Piper PA-38-112 – Pilot loses directional control during ground-effect demonstration

The chief flying instructor (CFI) had the student fly the aircraft down the runway in ground-effect with full flap. The CFI then raised the flaps to the first notch, at which time he became distracted. He reported that by the time his attention returned to the aircraft, it had veered to the left side of the runway. According to the CFI, they were too slow to fly out of ground-effect, so full power was added in an attempt to recover. The right wing then contacted a runway light on the left side of the runway.

FAA Occurrence No CHI98LA030

Piper PA-38-112 – Pilot stalls aircraft during crosswind go-around

The wind was coming from the right side of the runway. The student pilot said he planned to make a crosswind landing, using the crab-to-slip method. As the aircraft approached the runway threshold, the pilot applied left rudder but neglected to apply right aileron. The aircraft drifted to the left side of the runway. The pilot said he applied full power to go around. The pilot stated that, after applying full power, he felt the aircraft begin to sink. Shortly after the aircraft was pitched up, it stalled. The main landing gear contacted the ground first, followed shortly by the nosegear. The pilot said the nosegear collapsed and the aircraft continued its landing roll. The aircraft nosed over a short time later. The pilot recalled having received training in go-arounds. He said he recalled doing only two while receiving dual about six months before the accident. He said he had made two go-arounds during solo flight sessions, but he could not recall when.

FAA Occurrence No CHI97LA264

THIS IS THE END!

LANDING OVER-RUN ACCIDENTS CAN BE AVOIDED BY:

1. **Recognising** the existence of these main contributing factors, any one of which will increase landing distance considerably:
   - Approach speed too fast
   - Height at threshold too high
   - Obstacles on the approach
   - Tail wind component
   - Wet and greasy surface
   - Poor breaking action
2. **Deciding** early whether to continue or abort the approach or landing.
3. **Executing** immediate and correct go-around action when necessary (obstacles and terrain permitting).
4. **Avoiding** airstrips that are beyond the capabilities of you and your aircraft type.

CAA
CIVIL AVIATION AUTHORITY
OF NEW ZEALAND