1999, Issue 4

VECTOR

Pointing to Safer Aviation

Light-Commercial Ops
GPS for the VFR Pilot
Auckland Area Special Events

CAA
CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

VECTOR

Editor: Cliff Jenks

Assistant Editors: Pam Collings, Barnaby Hill, Clare Jeeves

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Telephone +64–4–560 9400,
Fax +64–4–569 2024,
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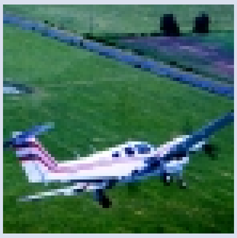

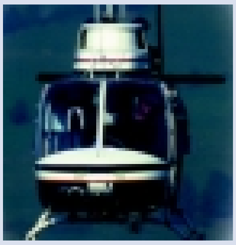

Cover Photo: A Cessna 310 on final approach at Ardmore Aerodrome.

New-look VECTOR – Next Issue

Vector, Review, and *Occurrence Briefs* are getting a new look. The three publications you receive in the mail every six weeks are to be combined into one full-colour glossy magazine starting with the next issue.

It will still be called *Vector* but will include sections containing the information usually found in *Review* and *Occurrence Briefs*.

The new *Vector* will be bigger, more readable and easier to file. It will be published during the last week of every second month (every eight weeks) and will still provide the same amount of safety education each year as it does now.

Other relevant information can be posted out in the same mailing as *Vector* at little extra cost to the CAA. In fact, slim-lining our production means the new *Vector* will cost slightly less than producing the three publications separately.

International Recipients Culled

Free subscriptions to *Vector* will no longer be sent to most overseas recipients, but reciprocal subscriptions with other aviation safety publications and regulatory authorities will not be affected.

About 18 percent of our postage bill is spent on 900 overseas recipients out of a total of 16,000. The CAA believes more can be achieved by focusing resources on aviators who are in New Zealand.

Moreover, the Civil Aviation Act 1990 requires New Zealand Civil Aviation document holders to provide an address for service **in New Zealand**. If you are currently overseas and would like to continue receiving a free subscription to *Vector*, please provide the CAA with a New Zealand address.

If you would like to continue to receive *Vector* at an overseas address, you can subscribe through Publishing Solutions Ltd ($60 annually including overseas postage). For contact details see inside front cover.

Expect your first issue of the new-look *Vector* in late July.

Safety Seminars

Planning is presently underway for the 1999 series of Kiwi safety seminars. In past years we have identified the seminars as Heli-Kiwi or Aero-Kiwi. This year there will be no differentiation – the seminars all come under the banner, Av-Kiwi.

The 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 planned for 1999 running from mid-August through to late October. Check future issues of *Vector* for places and dates. Also watch out for advertising posters displayed at your local training organisation or other aviation business.

Letters to the Editor

Airframe Icing

I feel that a major point was missed in the '*Vector* Comment' section of your recent article on airframe icing, in that aircraft ice protection equipment will not always permit flight in icing conditions. The article alluded; that if the aircraft was fitted with ice protection gear then flight in icing conditions would be possible.

Ice protection equipment will generally only permit flight through icing conditions for the purpose of 'exiting' them either by climbing or descending. However, once ice has accumulated on the airframe, it is generally more difficult to climb to clear it. Quite often a 2000-foot change in altitude will be sufficient to clear any icing.

From my experience in GA flying, when faced with forecast (known) icing conditions I always tried to climb as high as possible, with the objective of clearing cloud and 'cruising on top'. If in the event that I was still in icing conditions during the cruise, a descent was then always an option.

I believe it is always necessary to have an escape route/plan should icing conditions be encountered, to this end an awareness of MSA, DME steps, radar terrain, and VORSEC charts is vital as part of the overall plan.

I hope you find my thoughts useful and constructive.

Peter James
Auckland
April 1999

Vector *Comment*

Thank you for your useful and constructive comments.

Light-Commercial Ops

Attention owners/operators, pilots, engineers, and chief executives!
If you're involved in light-commercial aircraft operations, then this article is for you.

Over the last four years there has been an alarming trend in the accident rate for aircraft in the 2,721 to 5,670 kilograms (revenue passenger and freight) category. In 1994 the CAA and industry set out to significantly reduce the number of accidents in this aircraft group (among others). A target of two accidents per 100,000 flying hours by 2000 was set. Currently the accident rate for this category is nearly five times greater than the target and significantly worse than in the USA and UK. But the problem is not just confined to this particular group, those aircraft which fall just below 2,721 kilograms also have a high accident rate.

Many accidents involved a significant degree of company or pilot error due to the more complex nature of the aircraft concerned and the type of operating environment. More often than not the finger is pointed at the pilot as the 'last line of defence' in the accident prevention chain, but the reality is that company safety culture usually plays a major role in setting the scene for an accident. This article looks at what you can do as CEO, aircraft owner, pilot, or engineer to operate safely – a factor that has a strong bearing on your business survival.

Aircraft between 2,721 and 5,670 kilograms (eg, Britten-Norman Islander and Cessna 421) and those that fall just short of this light-commercial category (eg, Piper Seneca and Cessna 210) operate in a very competitive sector of the aviation market. Many are involved in non-scheduled passenger services, the transportation of overnight freight, scenic operations, and flight training in what can be a challenging environment. Pilots working the light-commercial sector often have to contend with flying different aircraft types to a variety of destinations, handle IFR procedures (more often than not close to the freezing level), night operations, mountainous terrain, and deal with marginal climb performance when close to maximum weight. They may also be required to load the aircraft, refuel it, keep all associated paperwork up-to-date, and handle customer enquiries.

It is often said that this area of the New Zealand aviation industry is one of the most demanding of a pilot's abilities, and in this respect pilots have to be multi-skilled to deal with the wide variety of problems that can confront them on a daily basis. The same is true of aircraft engineers. Keeping to a tight maintenance schedule and fixing aircraft defects at short notice are typical of the pressures that engineers face on a daily basis.

A sound company safety culture, thorough pilot and engineer training, and the adherence to well-documented company procedures are a must if an operation is going to be safe – and survive to be profitable. There is an old saying in aviation about 'making a small fortune in flying'. You have to start with a big one. It is rather a cynical view, but it has an element of truth to it. The theme of this article is, however, about keeping that 'small fortune' intact. The point is that it is the 'safe' organisations that will retain their 'small fortune'. Those that, for one reason or another, have pushed beyond the edge of the safety envelope have not survived.

The remainder of this article looks at common problem areas in light-commercial operations and offers some suggestions that should help improve an organisation's standard of safety.

Safety Culture

You often hear the term 'company safety culture' used with regard to accident prevention. It is now widely accepted that a good safety culture is the key to a safe operation. While it can not be changed overnight, a review of management structure and operating procedures is a good start in the right direction. If you can get the safety culture right then accident prevention becomes far easier.

An integral part of a good safety culture is having a comprehensive safety programme in place. Without it accident prevention is always going to be an uphill battle. Appointing an Aviation Safety Coordinator, who has the full support of the CEO to run the company's safety programme, is a vital step towards a better safety culture and a safer operating environment. If you are concerned about safety standards in your organisation and are in a position to make changes, then take active steps to do so.

Make your safety programme work for your operation. Ensure that staff have a working knowledge of hazard and incident reporting systems that identify the problems – and ensure that they are using them properly. Improve safety awareness through safety notice boards and staff safety meetings, etc.

"…profits must come after – not before – meeting operational costs and investments in safety."

The safety programme and perspective in a company ought also to extend beyond the company. The suppliers of services are part of the company's operational environment. Two key suppliers in this sector are the owners of aircraft you may lease and contracted maintenance organisations. The nature of this arrangement and the expenditure on timely and safety critical maintenance is paramount. The services that an external contractor provides need to be evaluated on a regular basis. If it is suspected that they are deficient, ask them some hard questions and move to resolve the problem quickly. The CEO's role is pivotal here – they are the person that is responsible for the provision of safe equipment for staff to work with.

The CAA runs Aviation Safety Coordinator training courses to help train your organisation in all of these aspects of safety management. Basically, this means the nuts and bolts that make up a safety programme and how to get it up and running. Besides assisting you to achieve a safer operation, it can meet many of the quality assurance aspects of certification under the Civil Aviation Rules and satisfy OSH legislation. These courses assist you to fine-tune your safety programme, which will undoubtedly have long-term benefits for your business. Watch *Vector* for details on when and where these courses will next be held.

Complex Systems

A common theme that emerges from accident investigations involving aircraft in the light-commercial weight range is that of pilot unfamiliarity with aircraft systems and performance characteristics – especially fuel management and weight and balance. Light twins, for example, can have cross-feed fuel systems that differ markedly with aircraft type, the danger being that in an emergency, the pilot will automatically revert back to the system they are most familiar with. In many cases, new pilots have had little experience of these larger and faster aircraft with more complex systems, and the learning curve can be steep. Being promoted to pilot in command of a larger aircraft, especially if single-pilot IFR, is a large step and demands a high level of training, support, and skill. Mentally, and physically, staying ahead of a much faster aircraft is hard enough, let alone dealing with IFR procedures (often in to and out of uncontrolled environments), single-engine performance, more complex fuel selection systems, airframe icing, and takeoff and landing performance. A newly appointed twin-engine pilot normally has to deal with most of these, and sometimes more!

Because of this greater complexity, it is important that pilots know their aircraft systems and performance capabilities inside out – which is the reason why a comprehensive type rating is essential. It's worth taking the extra time to read the aircraft flight manual thoroughly and talk to other pilots that have experience of the machine you are about to be type rated on and to have proper supervision.

Type Ratings

Receiving comprehensive type-rating training is a vital ingredient for a safe operation – the more complex the aircraft the more critical it becomes. Aircraft type-rating requirements are laid down in Part 61 *Pilot Licences and Ratings* of the CAA Rules, but these are minimum requirements only. Additional training will often be required to bring a pilot up to a safe standard, depending on their experience level, and this is especially important when it comes to the amount of 'hands-on time' they receive during the course of the type rating. For an operator, demonstrated competency is the requirement, after all it's your aircraft, business, and reputation that are 'on the line'.

Type ratings can be expensive; some operators may be tempted to keep the number of hours flown to a minimum to save money – especially when twin-engine aircraft are involved. Ironically, light-commercial operations is one of the very areas that comprehensive type-rating training is most needed, and inadequate type-rating training (and on-going training) has been a significant factor in a number of recent New Zealand accidents. Simply because an individual already has experience on twin-engine aircraft does not make it acceptable to do a 'quick conversion' on to a more complex aircraft type (eg, Cessna 421).

Every aircraft is different, and new pilots should insist on spending as much time as it takes to feel totally comfortable and familiar with the machine when completing a type rating. The process must never be rushed, and as much attention must be paid to becoming familiar with the aircraft flight manual and its systems as is paid to flying the aircraft. Pilots, if you are not happy with the amount of time taken over your type rating then let management know – there is no point in taking on the responsibilities as pilot in command if you aren't competent. The advantages are just as likely to be economic ones –

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avoiding shock cooling, use of cowl flaps, and engine leaning for example can all affect the balance sheet!

Operational Training

Familiarity with an aircraft, however, is just part of a new pilot's training. Companies need to be careful that a new pilot also receives comprehensive operational training, ie, not specific to type.

Many pilots have not had multi-crew experience or are not familiar with emergency procedures associated with larger aircraft (more passengers) for example.

Thorough training in passenger safety, survival techniques, aircraft flight log usage, other documentation, and aircraft loading procedures are just some examples of the areas that need to be covered in addition to route and aerodrome training. Commercial passenger pressure is different from that when taking friends aloft, or even from local joyride passengers.

Note that most of these requirements are detailed in the applicable Civil Aviation rule Part (eg, Part 135), with further guidance being provided by its associated Advisory Circular.

Pilot Competency Checks

Light-commercial operations often require the pilot to be familiar with a large number of specific routes, IFR procedures, and aerodromes. Competency in mountain flying and short-field takeoff and landing techniques are also other important skills to acquire.

While the Flight Crew Competency Check primarily requires a pilot to prove that they are competent to safely handle the aircraft within their company's particular operating environment, it is also an opportunity to learn more from an experienced pilot. It is important that the competency check debrief is treated as a chance to discuss problems and learn new ways of doing things.

If the flight examiner or flight instructor is not happy with a particular aspect of your performance, then determine what the problems are and ask what further training would be appropriate.

Photograph by Guy Clapshaw of **Pacific Wings**.

Remember that part of your pilot-in-command responsibilities is to remain familiar with your company's operating procedures and the Civil Aviation Rules and Advisory Circulars. Make a point of regularly 'brushing up' on the rules and procedures that apply to your type of operation – the next rainy day is probably a good time to start – and 'aim to impress' at your next competency check.

Pilot Experience Levels

Light-commercial operations are sometimes a stepping stone for pilots wanting to move to the relative security of an airline job. Because of this, some pilots tend not to remain with an operator for very long. Lack of experience in an organisation therefore becomes a problem. This not only becomes apparent in day-to-day operations, but also when training and supervising new pilots. Without this depth of experience within a company, new pilots may not learn all they need to. While many operators set relatively high 'total time' requirements for new positions, such experience has often not been gained on the larger and more complex aircraft for which the position is sought.

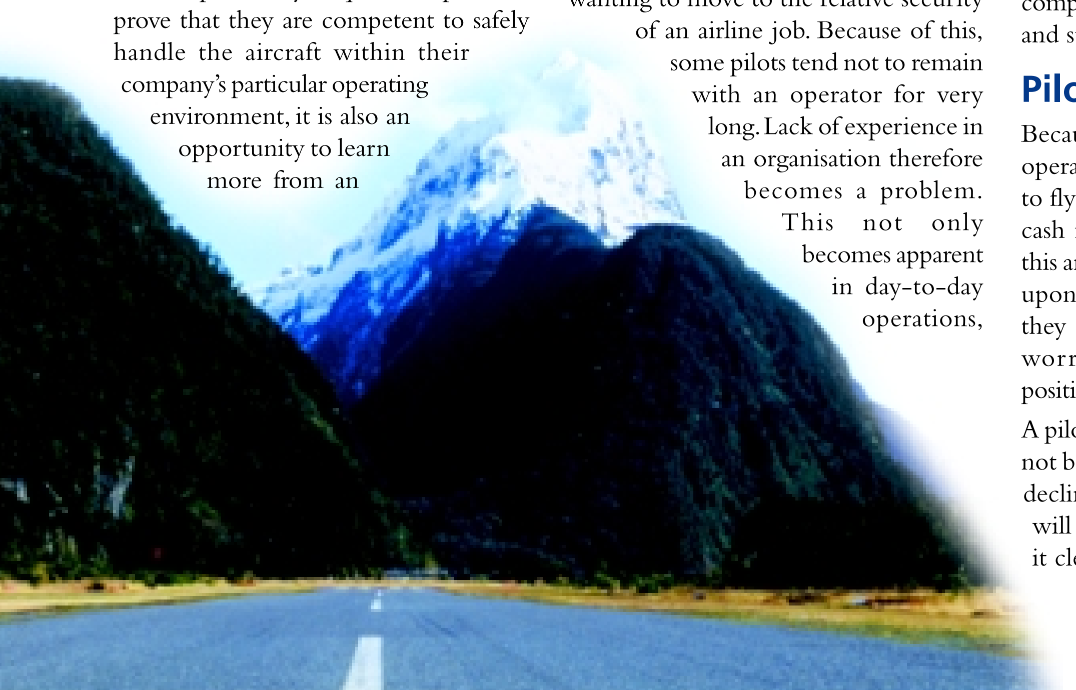
The cycle can be self-perpetuating, meaning that pilot experience levels diminish to the point where safety may be compromised.

The most effective way to break this cycle is for light-commercial flying to be made more attractive as a career option. Unfortunately wage structure and job security have a lot to do with this problem, and until these improve it will be difficult to attract pilots to longer-term positions. This problem can clearly not be solved overnight, so the least we can do is to recognise that it exists and compensate for it with extra pilot training and support.

Pilot Pressure

Because profit margins are often slim, operators are sometimes under pressure to fly as many hours as possible to avoid cash flow problems. Pilots are aware of this and may feel that they will be looked upon unfavourably by management if they don't get the job done, and they worry about the security of their position.

A pilot must feel confident that there will not be any repercussions for them if they decline to do a flight that they consider will be unsafe. Management must make it clear that operational decisions need



to be made free from commercial pressure. The concept that 'we want you to get the job done – but safely' should always be promoted.

It is widely acknowledged that pilots working in this sector of the industry are not well paid for their skill level. Operators that pay by the flying hour are unwittingly placing unnecessary pressure on their pilots. The maintenance equivalent of this is where speed is traded for accuracy. The incentive to complete a flight can become great and result in risks being taken.

"Operators that pay by the flying hour are unwittingly placing unnecessary pressure on their pilots."

Many pilots want to log flying hours towards an airline career as quickly as possible and may place pressure upon themselves to fly as often as they can – this can also lead to taking unnecessary risks. The temptation to look upon a flight as another flying hour must be resisted. Flight and duty time limits can also be compromised. These benchmarks are not only there to protect the pilot's wellbeing, but also the public from fatigued pilots.

Management should also be careful about the way the company's services are advertised to the public – slogans that promise always to get passengers to their destination should be avoided – especially for VFR charters. Staff who handle customer bookings should be trained to emphasise that all flights (VFR in particular) are subject to the weather being suitable on the day. This removes unnecessary pressure on the pilot to complete a flight when conditions are marginal.

Pilot Decision-Making

Learning to assess a situation and make a safe decision about whether or not to complete a particular flight (both prior to or during a flight) is a skill that comes with experience and training in good pilot decision-making. It is important that such training is provided for new pilots and that experienced pilots are always on hand to provide valuable guidance and support when it is needed.

If you are not comfortable with doing a flight, you must assert your authority as

Cutting corners can be costly.

pilot in command and explain to your passengers (or the boss) why you believe the situation to be unsafe. Companies must openly support pilots when it comes to making these operational decisions. Know your company minima (and your personal minima) and stick to them. You should be totally conversant with things like VFR meteorological minima and minimum fuel requirements. Refer to "Pilot Decision-Making" in *Vector* 1999, Issue 1 for further reading on this topic.

Aircraft Maintenance

Correct scheduling of aircraft maintenance with your maintenance organisation, whether it be in-house or external, is important for safety reasons. While routine maintenance can usually be planned, aircraft defects which arise that can not be deferred to the next routine maintenance cycle can be more difficult. If your aircraft develops a defect, you should be careful not to put your maintenance organisation under pressure to get the problem fixed in an unreasonable length of time – maintenance errors can occur when engineers are put under pressure. So in others words, don't always expect to have your aircraft back the same afternoon because it is sometimes just not practicable.

Given that many of the aircraft in the light-commercial sector are older, snags can appear between scheduled maintenance that can be compounded by component supply delays. Operators know that the economics in this sector of the market are tight, but the profits must come after – **not before** – meeting operational costs **and investments in safety**.

If a non-deferrable defect develops that can't be fixed at short notice, **do not** be tempted, or coerced, to operate with it – it's dangerous and illegal. An aircraft that is flown with defects is definitely a sign

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of a poor operation. Most passengers would not be impressed if they knew that the aircraft they are about to fly in is not 100 percent airworthy.

Fatigue

Because of the low wage structure in many light-commercial operations, some pilots are forced to work other part-time jobs to make ends meet. This may involve working at night (or on rostered days off) and flying during the day. Such a combination usually causes fatigue that ultimately affects performance. If you are feeling tired and stressed **you do not** belong in the cockpit. Ask yourself "Am I up to the task today?" If the answer is no, you must be prepared to tell your employer that you do not feel 100 percent. A good employer will not want you to fly feeling 'below par' and will usually have staff replacement contingency plans in place anyway. The same is true of engineers – you can't afford to be fatigued on the job and risk making a mistake.

If the same situation keeps occurring on a regular basis, try discussing the problem with your employer(s) to see what can be sorted out – they may be more accommodating than you imagine.

Summary

Getting the light-commercial aircraft accident rate down requires change. Regardless of whether you're a pilot, an engineer, or the CEO, you should be constantly reviewing the way you do things and trying to make improvements. It is only through having a pro-active and open management structure that a safe operating environment can be created. Everyone should be actively taking part in the company's safety programme and communicating information and new ideas freely.

If you're the CEO, make sure that you are providing a working environment that is conducive to safe operational decision making. Do not try to cut costs in critical areas such as equipment and training for your staff – it is much cheaper in the long run to spend time and money on safety **now** than it is to have an accident later (which could be tomorrow). Give praise to your staff when a job is done well and make them feel part of 'the team'. Ask for their feedback on all aspects of the operation, and involve them in decision making.

If you're a pilot, know your company and personal minima and stick to them religiously. Don't do anything that you are not totally comfortable with, and be prepared to say "No" if you are being pressured. If you observe that some aspect of the operation is unsafe, then bring it to management's attention along with suggested improvements – they may not have noticed the problem yet.

If you're an engineer, don't let an operator pressure you to get a job done quickly. Be firm and make it clear what you expect with regard to the scheduling of maintenance.

Remember that safety is a team effort that requires constant communication between all levels of your organisation. ■

how to... fill the gap

GOOD AVIATION PRACTICE

A new **How To** booklet is now available from the CAA. *How to Own an Aircraft* details the considerations and responsibilities involved in owning an aircraft and is presented in an easy-to-read format. It is recommended for every aircraft owner or potential owner.

The **How To** series aims to help interested people navigate their way through the aviation system to reach their goals. The other **How To** booklet produced to date is *How to be a Pilot*.

A new **GAP** (**G**ood **A**viation **P**ractice) booklet is also now available. *Mountain Flying* covers some of the skills and knowledge that are required to operate safely in the mountains. We suggest it is essential reading before your next flight in to, or over, mountainous terrain.

GAPs aim to provide the best safety advice possible to pilots. Other **GAP** booklets that are available are:

Winter Operations

Bird Hazards

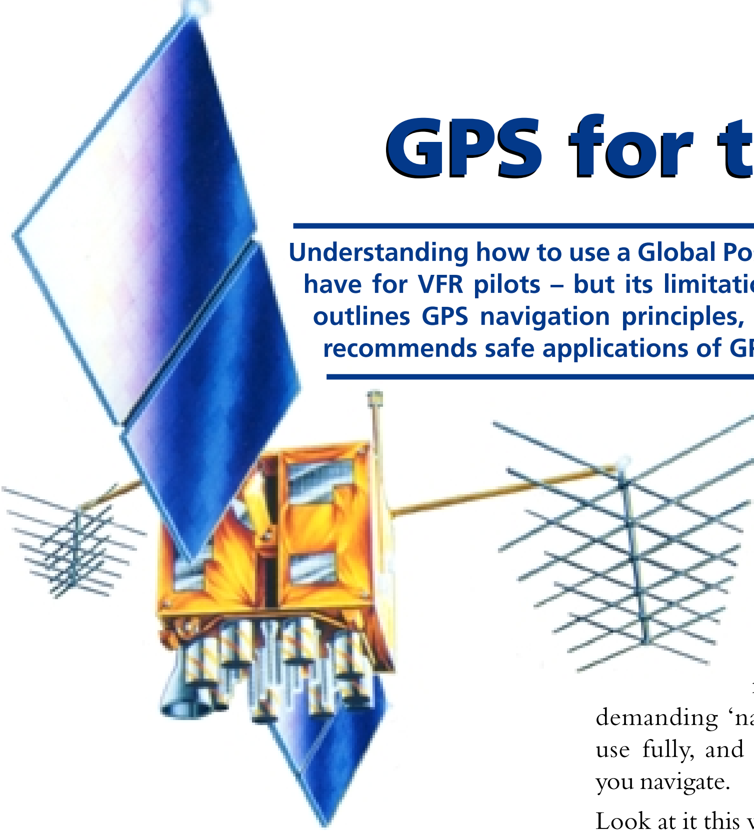
Wake Turbulence

Weight and Balance

How To and **GAP** booklets 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* (the first booklet in the series) is also available from your local high school.

Bulk orders can be obtained from:

The Safety Education and Publishing Unit
Civil Aviation Authority
PO Box 31441, Lower Hutt
Phone 0–4–560 9400



GPS for the VFR Pilot

Understanding how to use a Global Positioning System (GPS) navigation system is a useful skill to have for VFR pilots – but its limitations must be recognised. In this article Dr Ross St. George outlines GPS navigation principles, the training steps to achieve basic GPS competency, and recommends safe applications of GPS navigation.

The use of GPS navigation has become common for the VFR pilot. Since the introduction of GPS satellite navigation technology into the civilian aviation community over a decade ago, the growth of GPS use has been phenomenal, both internationally and locally. The reasons for the appeal of GPS navigation technology to the VFR pilot are obvious. The units are affordable, compact, and offer great flexibility in navigation with a high level of accuracy and reliability.

Some years ago *New Zealand Flight Safety* published articles on ADF and VOR for the VFR pilot. At that time (early 1980s) VFR pilots were likely to find one, or both, of these navigational aids in their cockpit. Although looking out the window, following the track you have drawn on a current map, using a compass and a watch, and maintaining a flight log are the core elements of VFR navigation, the fact that an aircraft may have some navigation aids fitted suggests they might be used on VFR flights to aid navigation – hence the articles. Used on this basis, these instruments add to the navigational information available to a VFR pilot.

About the Author

Dr Ross St George is a CAA Field Safety Adviser. He owns and flies a light aircraft and regularly uses his GPS on VFR flights. As a human factors specialist, he is acutely aware of the potential dangers of over-reliance on GPS technology and has been involved in research relating to GPS use by VFR pilots.

Today, the availability of GPS units presents a situation that, while initially similar (it is just another 'navigation black box'), is one that is operationally much more complex – it is a demanding 'navigation black box' to use fully, and it can change the way you navigate.

Look at it this way – it is fairly simple to turn on, tune and identify an ADF or VOR. The navigation aid's limitations are documented in the VFG, and NOTAMS will tell you if the facility is unserviceable. We really could not take off on a VFR cross-country with a 'plan' to simply track from nav-aid to nav-aid – there are not enough of sufficient strength at most VFR altitudes flown, wind can play havoc with ADF tracking, atmospheric conditions and terrain cause signal fluctuations and so on. So, standard map and track navigation underpinned the flight, and the use of these ground-based radio navigation aids on a VFR flight assisted and confirmed.

GPS navigation is different. The wonderful little units are complex in nature, with menus, databases (which are dated), user-created data, a range of selectable outputs and displays, multiple small controls, and optically demanding displays (much information crammed on to a small screen). There are no aeronautical documents to tell you of signal loss or degradation – the machine has to tell you, and you have to know what to do. And, perhaps most important, the very power of the technology to 'answer' our cross-country VFR navigation questions invites pilots to put aside and neglect fundamental VFR navigation skills and procedures.

How GPS Works

Satellite Systems

GPS is a satellite-based radio navigation system. With a GPS receiver a user can obtain position, time and navigation information of a very high order of accuracy anywhere on Earth, in all weather and 24 hours a day. The US Department of Defence (DoD) developed the satellite system. By agreement with the US Federal Aviation Administration, part of the capability of the system is available to civilian users. There is also a Russian (ex USSR) system, GLONASS (Global Orbiting Navigation Satellite System). Some sophisticated (and more expensive) receivers can utilise both systems, but most if not all receivers in New Zealand will be using the US GPS system.

The GPS system consists of 24 NAVSTAR satellites of which three are operational spares. They orbit at about 11,000 NM above the Earth in approximately 12-hour orbits and are arranged so that at any one time a minimum of four satellites should be in view over most of the Earth. Currently there are 27 GPS satellites, giving an enhanced level of GPS position availability. If, in the future, the number of satellites is reduced, the level of GPS position availability will also reduce.

On Earth there is a master control centre (US DoD facility in Colorado) plus three

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control stations situated at various locations around the Earth which check the integrity and accuracy of the data sent by each satellite and provide system adjustments.

The third element is your receiver and processor – it may be a portable 'handheld' attached by velcro or a clamp in your cockpit, or it may be a dedicated hard-wired unit in the avionics stack.

Those are the system elements, but how does the system work when you press the ON key?

GPS Receivers

Imagining how an ADF, a VOR or DME works is relatively simple. There is a VHF radio signal propagated from a point on the Earth's surface on a specific frequency. You tune the receiver to the frequency, confirm with an auditory identification and navigate by bearing and range to or from the station accordingly. That's the theory, but there are limitations and cautions.

Imagining how a GPS works is a little more demanding. There are no Earth sites and no auditory identifications to say, "I'm here". You are in your aircraft, you have turned on your GPS receiver; it now has to receive the signals from the satellites that are broadly overhead. There is a display 'screen' that you can scroll through to show what satellites are visible, where they are by bearing, elevation and signal quality, and an indication as to whether or not there are sufficient satellites available to use for navigation. To give accurate position information it needs at least four satellites 'in view'.


Photograph courtesy of Airways Corporation of New Zealand.

Ross St. George at the controls of his much loved Piper Warrior.

What is happening then to make GPS work? Your receiver is also a processor. Each satellite transmits continuously on two L-band frequencies. The data going to your processor includes unique satellite position data (where 'I' am – known in your manual as ephemeris parameters), satellite clock time (they have a small atomic clock), satellite signal health data, and UTC (coordinated universal time) synchronisation information. By having this data from three satellites (immediately and constantly) the processor by triangulation can mathematically work out where you are on the surface of the Earth by latitude and longitude. The availability of a fourth satellite enhances the accuracy of the position information by reducing clock error. An error of one 1000th of a second equates to a position error of 120 NM. The availability of a fourth satellite also enables a third dimension calculation, altitude, in reference to world amsl.

"GPS is a powerful tool that can be integrated with, but not substituted for, proper VFR navigation planning and management."

The civilian (or public) signals are downgraded (wobbled) a little in accuracy, but the degree of accuracy is still down to metres. You may have read about the military accuracy levels with Tomahawk missiles – it is true. Civilian GPS accuracy can be enhanced by Differential GPS, where a ground station at the end of a runway can correct for errors and assist IFR approaches, but that is another story.

GPS Tales

These field experiences illustrate the quite serious issues that can arise through blind belief in GPS.

- At Wanganui a pilot arrives with his new R44; a panel mounted GPS has just been fitted. From Wanganui he wishes to fly to Taupo. He asks how does he get 'Taupo' into the unit – he is trying to write T A U P O into the screen and select GO TO.
- An aircraft from Ardmore on a VFR flight plan to Tauranga is queried by a radar area controller about the track. The pilot acknowledges and confirms Tauranga as the flight-planned destination. The pilot arrives overhead Rotorua and has to amend his flight plan and track to Tauranga. The explanation was that the GPS was followed (never mind the view) and that it was borrowed and 'someone must have made a mistake'.
- At Rangiora en route to Queenstown and having lunch under the wing. A pilot from a nice C185 rushes over with his oldish looking map and asks, "Is Omarama in the GPS?"
- On the ground late in the day at Kaikoura with a cloud base of 500 feet amsl, lowering at the Clarence River mouth in mist and sea fog having just retreated from there, and a SPAR at Wellington with sea fog at 200 feet. Time to overnight on a trip north. The offer from pilots refuelling was to "Follow me, I have a GPS". (So did I – the offer was declined).

These examples, which are backed up by both overseas experience and more formal research, show how careful VFR pilots need to be about GPS navigation complementing, but not substituting for, the primary methods that underpin their operations.

For VFR flying in light aircraft, the attraction of GPS is obvious. "It can work out where I am, I can tell it where I want to go, it will tell me how to get there and how long it is going to take." Yes, the processor will do all that – and more. With GPS it is tempting to neglect some of the work of navigation, like planning a track, mastering the nav computer, lines on maps, 10 NM check marks and airborne time-to-run/distance calculations. The GPS will certainly tell you the track, and it will give you groundspeed, distance to go, quick alternates and more. All this is true, but you have to know how to use your GPS properly and skilfully.

It is a seductive technology. You also have to know how to use it with caution and safety in mind. And, you have to remain prepared for a GPS failure.

More GPS Tales

Examples of user reports and comments collected during research by Mike Nendick and Ross St George. They reflect things pilots had to say about units and suspected effects on flying operations.

- Put in the coordinates back to front.
- Forgetting the key sequence to obtain the correct information.
- Inadvertent pressing of a key twice in turbulence resulted in either mode, letter or number changes depending which key was hit.
- The ETA was incorrect because the unit had the wrong latitude for the reporting point.
- Not really understanding fully the functioning of the CDI bar.
- Confusing 'track to' and 'track made good'.
- There are difficulties in reading the screen, with reflections, the size of text and numbers and the very small abbreviations.
- Not noticing warnings that GPS has lost sufficient satellite signals for reliance.
- With the amount of functions in it, you can start to play around with it in flight and spend too much time looking down, not up and around.
- Not getting power always from aircraft therefore running out of battery power.
- Battery failure when I least needed it!
- Failure to receive satellites.
- Faulty aerial connection.
- Pilots are relying on GPS rather than getting a good grounding in nav tracking and map reading – problems of a total reliance on GPS without back-ups.
- Lack of cross-checking of user data entries and use of old databases without cross-checks.
- Loss of situational awareness while VFR due to sole reliance on GPS as navigation resource.
- Encouraging VFR pilots to go on top of cloud – flying the GPS and not the aircraft in marginal conditions – VFR pilots may become complacent or GPS dependent and increase risk taking.
- GPS is so good that you have to remind yourself that it can fail …
- Flying GPS to the 'letter' and busting airspace.

GPS Navigation and the VFR pilot

GPS is not a means of navigation that is 'approved' or sanctioned by the Civil Aviation Rules for VFR flight. Traditional map and track navigation by visual reference remains a core responsibility of the VFR pilot in command. However, like the presence of an ADF, a VOR or a DME, GPS can be a valuable source of navigation information. The challenge for the VFR pilot with GPS is to keep the primary and secondary means of navigation clear in their mind and their operation, and in being competent with the GPS unit.

The reality is that, if a GPS unit is in the aircraft, the VFR pilot is likely to want to use it. What is probably more common is that the typical VFR pilot will buy their own portable unit or be able to borrow one for that long cross-country. GPS units are not expensive; there are units currently available on the New Zealand market for as low as NZD$300. These may not be suitable for aviation, as the processor may not handle the speed calculations, but prospective purchasers may be unaware of the finer points of models. For the private aircraft owner operating VFR, a GPS is likely to be regarded as close to an essential. Furthermore, an aircraft owner, private or organisation, will probably consider replacing a tired Comms box with a Comms/GPS unit or having a GPS replace an unserviceable ADF or VOR.

How many units there are in New Zealand is not known. In the general aviation sector survey information suggests that ownership and access is quite high. Concerns raised recently about the high percentage of light aircraft at the 1998 Warbirds Over Wanaka airshow which did not have current aeronautical charts and documents on board may be a reflection of a 'reliance' on GPS as a substitute.

Since GPS use in the VFR environment is not regulated, and the authorities recognise that it cannot be regulated, the challenge then is to educate for its competent and safe use. The power of GPS to handle the navigation task presents a great temptation in the VFR environment to simply **buy, strap-on** and **fly**. You may not **die**, but you may embarrass yourself.

Education should include the basic knowledge about your GPS, the theory, the skills and the practice required to operate competently. Some of the knowledge can be acquired from the manual (though at times these are not 'operator friendly'), but consolidation of this knowledge and the acquisition of GPS operating skills will only come with frequent practice and revision.

Setting aside GPS unit model differences, what does the VFR pilot need to know about GPS? Here is a GPS beginners' course outline. It could be used as a structure for an individual programme to get to know your GPS and how to use it, or it could be used by an organisation (a Club, a Flight School) to run a course.

GPS – A Course to Competency

Principles, Components, and Performance

This is the GPS theory area, how it works and why it works. Much of this (eg, system structure and control and

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triangulation, range measurement and position fixing) has been covered earlier.

To expand a little on a few points. From a navigational point of view, once your GPS unit has established where it is, it can establish the bearing to another location (a set of coordinates) and monitor its progress. These may be entered by the USER (the pilot) into a unit memory store, or they may exist on a database that the unit has access to. The processor can also record its present position if asked to do so.

The degraded nature of the civilian signal has been mentioned. Other limitations can come about from not 'seeing' enough satellites. Though they are 'overhead', a satellite low to the horizon can be obscured by terrain. It may also pass out of sight before another is 'visible' to provide a sufficient number for reliable navigation. It is also possible that in some form of political/military emergency the civilian satellite signals could be selectively downgraded further or withdrawn. Regrettably, terrorism interference is also a possibility, though hopefully remote.

GPS Errors and Limitations. Convergence and RAIM.

To provide sufficient accuracy, your GPS unit has to 'see' at least four satellites with adequate signal quality. Most hand-held units will have a MESSAGE if insufficient satellites are visible. If you enter the MESSAGE menu, the unit will tell you POOR COVERAGE. It means, "don't rely on my navigation". Higher level (IFR type) units now have RAIM (Remote Autonomous Integrity Monitoring) – that mouthful means that the whole system is being monitored and that additional satellites (a minimum of five) are being concurrently monitored to check the integrity of the navigational data.

Aircraft GPS Equipment: Non-TSO'd and TSO'd GPS Units

GPS units come in all shapes and sizes. One distinction you will hear of is Non-TSO'd and TSO'd units. TSOs are Technical Standard Orders which are FAA manufacturing and performance benchmarks for equipment. Invariably IFR navigation equipment is TSO'd. Most GPSs in VFR use would not be. It means their robustness, durability and performance specifications are not as thoroughly controlled. You get what you pay for.

GPS Installation

Portable or Permanent

Hand-held GPSs are the most common in the VFR environment, though panel mounted permanent units are starting to appear in general aviation aircraft, especially those that cross over into the IFR air transport sector or are used for IFR flight training. Of course, hand-helds are rarely 'hand-held' either. They will go in and out of a plane on a yoke mount (often comes with the unit) or are 'attached' by the pilot/owner to the aircraft in some way. This actually raises a point about the permanency of the arrangement and a Modification Approval. That aside, it is hard to use a 'hand-held' loose in the cockpit.

Photograph courtesy of Airways Corporation of New Zealand.

Power: Sources, Integrity, Back-up

Obviously proper permanent GPSs, in the stack, are powered from the aircraft power system. No problem here. They are fitted by an approved avionics workshop. Hand-helds are a different story. They can be either battery powered or through an external jack point into the aircraft power system, usually the cigarette lighter (commonly fitted in US light aircraft).

GPS unit owners seem to agree that hand-held unit battery life is lower than the manuals suggest. In addition, batteries vary in quality, and it is very easy to forget the time drawn off. There is plenty of reported and anecdotal evidence of GPS screens going blank a few seconds after the LOW BATTERY message, and the pilot having little idea as to where they really were or how to get to their destination by other means – by primary VFR navigation.

Jacking into the aircraft power system is a step forward, but is the connection 'good', is the system fused, and is the additional cable clear of the flight controls?

Aerials, Connections, Mountings

As with most receivers, a permanent, exterior and appropriately mounted aerial gives best reception. Stack mounted GPSs will have such an aerial. Portables come with built-in aerials or connectable aerials. The shielding by aircraft structure has a bearing on performance, and the detachable aerial that is connected by a cable means another cable in the cockpit.

Think about attachment and placement. With a portable aerial you do not want the aerial to dislodge in flight, lose the signal and be a distraction, nor should it obstruct an important part of your visual field.

GPS Operations: Introduction

Set-up Menus

In using your GPS you are working a small and powerful computer. To make these units compact (which has advantages) a lot of features are controlled through the same small keys, and the information is displayed in varying ways on a compact screen (which can have disadvantages). As indicated, compared with operating an ADF, a VOR or DME, there are a lot more options.

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A GPS unit can be set up to tell you all sorts of different navigation information, in different units and working from varying survey datums. As the operator, you have to select these and verify correctness. The manual will take you through the choices and procedures. Are you going to display heading in TRUE or MAGNETIC, are you going to enter the local MAGNETIC VARIATION or the satellite data, do you want range in NM or KM or land miles? What information do you want displayed on ROUTE and NAVIGATION pages? What left or right of track units do you want on the COURSE DIRECTION INDICATOR scale? A large number of GPS units discussed with the author by recent purchasers have simply been in the 'out-of-the box' set-up modes.

If units get swapped around, loaned, played with, then there is also a chance that modes may have been changed or not restored. A 'start-up' or initialisation check is not a bad procedure. It means checking that the navigation data is in the units wanted on the display. The author was nearly caught once when, after loaning a portable unit, modes had been changed – bearing and track did not 'compute' with the paper flight plan data. The difference was 21 degrees – the heading units had been changed by the borrower from magnetic to true!

GPS Modes and Access

GPS units can be operated in quite simple or quite complex ways. The units have a memory and information about locations you may want to navigate to or from can get into the GPS in one of two ways. You can enter it (creating a user waypoint) or it can be an existing location in a database that the unit can interrogate when asked to. You can enter a user location by being at the spot and asking the unit (key stroking a sequence) to store this location and an identifier (neat huh!). If your unit has a database (well, an appropriate aviation database) you can, using the aeronautical identifier codes (eg, NZWN for Wellington), display the relevant navigation information to that location. Simple GO TO navigation can be achieved from this point.

With the location data in your GPS you can do a lot of key pressing to get the information from location to location displayed. Alternatively, you can move on to learn how to set up more complex operations involving ROUTES recorded in the unit memory that take you from point A to B and over intermediary locations stored or created in the memory of the unit. Routes are named (by you) so that you can use them again and again once set up.

None of this sounds too difficult, but the reality is that it takes time to set up, to check and to learn how to fluidly move from display page to display page to activate both simple A to B navigation information or to activate more complex routes. It takes effort and practice to know the codes displayed and to know the keys (with multiple functions) to press to achieve the desired result.

Alerts

GPS units have 'Alerts' you can set. You will get an auditory and/or a visual signal that you have deviated beyond track parameters, or are approaching an airspace boundary or a location. You can set these. You may have to leave the current display, ask (push a key) to see the alert message, and then keystroke to resume the original display.

Study

Ground based study is the key to understanding and competency. Marginal VFR conditions is not the time for initial trial-and-error learning with your head down over the GPS and your fingers making frantic and largely random key strokes to get navigation information. This applies not only to the basics of getting the unit up and running correctly, but even more importantly to using it to assist your VFR navigation.

Simple GPS Operations

Navigation Data Entry and Checks

Think about the GPS as a computer and remember the old saying about "garbage in – garbage out". Study how to enter navigation data accurately into the unit. It has to be keyed in accurately in degrees, minutes and seconds. The location has to be named (usually a four-character code), and it pays to record this somewhere. The author has had to clean up operator GPSs stuffed full of coordinates to unknown and unrecognisable locations. New Zealand coordinates are all South and East. Check that these vital aspects of latitude and longitude are correctly selected.

Check your location entries. Once entered, it is simple to check bearing and distance (range) against map work. This crosscheck will help eliminate embarrassing errors. With a portable unit you can often put the aerial out the window at home in the evening and do this; it is great practice.

Displays

Assuming that the work has been done on the above points, the display mode should be understood and the skill and confidence should be there to amend and change the display to suit your navigation assistance needs for VFR flight.

GO TO Mode Operations

At this stage of learning it is common to use a GPS in the simple GO TO mode. From a departure point a destination point is entered (from the unit's memory – either user created or in the database). With sufficient satellites it will display the navigation data or a symbolic map track according to the set-up options selected.

Be careful when operating in this mode though, the GPS will provide a track direct to the destination from wherever the GO TO button is pushed (not necessarily the departure point). It will also not take account of what might be between you and the selected destination (a large mountain for example) when set in this mode.

NEAREST Operations

Should you wish to change your destination you can, with a few appropriate keystrokes, select an alternative destination from a NEAREST selection in the unit memory. Of course there may be hills in the way, and perhaps weather no better than that ahead. GPS cannot do all your thinking for you.

REVERSAL Operations

The REVERSAL operation is the GPS equivalent of the 180-degree turn that the VFR pilot should be prepared to use. It too is a useful tool but also requires some practised keystrokes. Don't rely on doing it right first time in a valley with reducing visibility and a lowering cloud base and the DI not calibrated with the compass and the heading not noted. And, while the pilot may be aware of the terrain over which they have just flown, the GPS does not indicate what has happened to the weather behind. Good VFR aviation principles still apply.

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Complex GPS Operations

Aviation Databases and Updates

Many GPS units have a database. These contain information of aerodromes and navigation aids (VOR, NDB sites) drawn from aeronautical publications. It is not a requirement that a particular GPS unit have the most recent database as it is **not** the primary means of navigation. However, be aware that information on locations can become dated. Should your GPS be a TSO'd, IFR-approved model and the aircraft used for IFR operations as well as VFR, then the requirement is for the current database applicable to the unit. The database date is shown when the GPS is turned on. Updates are by chip replacement (a service centre task) or by disk or computer download.

Route Creation

Routes can be created (with waypoints from the GPS database and the user created location information) to assist with cross-country VFR navigation. These can be extensive with multiple legs. Setting up routes takes time, effort and verification (that all-important crosscheck with the maps and flight log that you will have with you!).

Route Selection and Operation

Once set up and identified in the unit (keep a written record) you then operate through the ROUTE menu, selecting the chosen route and activating. Routes are built and stored in the machine in 'one direction' as it were, to 'go home' you have to INVERT, another little keystroke procedure. When in the ROUTE structure of the GPS you can also reverse and/or consider alternative destinations – if you have mastered the displays and keypad! Again, it is hard to do this and fly the aircraft if GPS knowledge and skill are low and the situation is becoming rather scary.

Practice, Practice

Study and practice will see many VFR users of GPS operating the units confidently and competently. Comfort in using the complex operations is an achievable goal. If you are having difficulties, then seek assistance on the ground. Clubs, flight schools and fellow pilots can assist. Some organisations have started formal short courses. And, it is practice that as much as anything will lead to competence with both simple and complex GPS operations. Use it alongside your VFR flight planning and management as much as you can.

Integrating GPS with VFR Flying – Safely

VFR Flight Planning and Navigation

As stressed at the outset, VFR flying requires the use of VFR flight planning and management methods. The presence of an ADF, a VOR or a DME in an aircraft on a VFR flight did not mean a lessening of basic flight planning and management requirements. A sound knowledge of how to use these aids is a bonus for the VFR pilot. They are 'angels in the ether' if you like. The same applies to GPS in this context. The difference is that ground based navigation aids never appeared to solve the paper work and planning work (the calculations) – GPS appears to do this, and this is its seductive nature. It can quickly be seen as a substitute, and in the perception of the pilot on a typical VFR flight, become the primary means of navigation. After all, you only have to get in the aircraft and turn it on.

But, the flight rules have not changed. GPS is a powerful tool that can be integrated with, but not substituted for, proper VFR navigation planning and management.

Aviation safety is built on redundancy and duplication of critical systems. The basic competencies and skills of VFR navigation must underpin the addition of affordable and powerful GPS navigation technology in general aviation. That relationship has not changed, and, for your safety and those who fly with you, work towards GPS competency, since the technology is superb – but also work to avoid GPS dependency. It will either embarrass or possibly kill. ■

Further Reading

The Global Positioning System and Australian Aviation Navigation. Civil Aviation Safety Authority, Australia, 1995.

O'Hare, D and St.George, R. GPS – (Pre) Cautionary Tales. *Airways*, Vol 7, Issue 1, May 1994, pp 12-15.

Nendick, M. and St.George, R. General aviation pilots and GPS: Some results from a New Zealand study. *Airways*, Vol 9, Issue 1, Feb 1996, pp 12-16.

St. George, R, and Nendick, M. GPS training for general aviation VFR pilots: to regulate or educate? Paper presented at the Fourth Australian Aviation Psychology Symposium, March, 1998, Manly, Australia (available on the CAA web-site).

Dawn Patrol

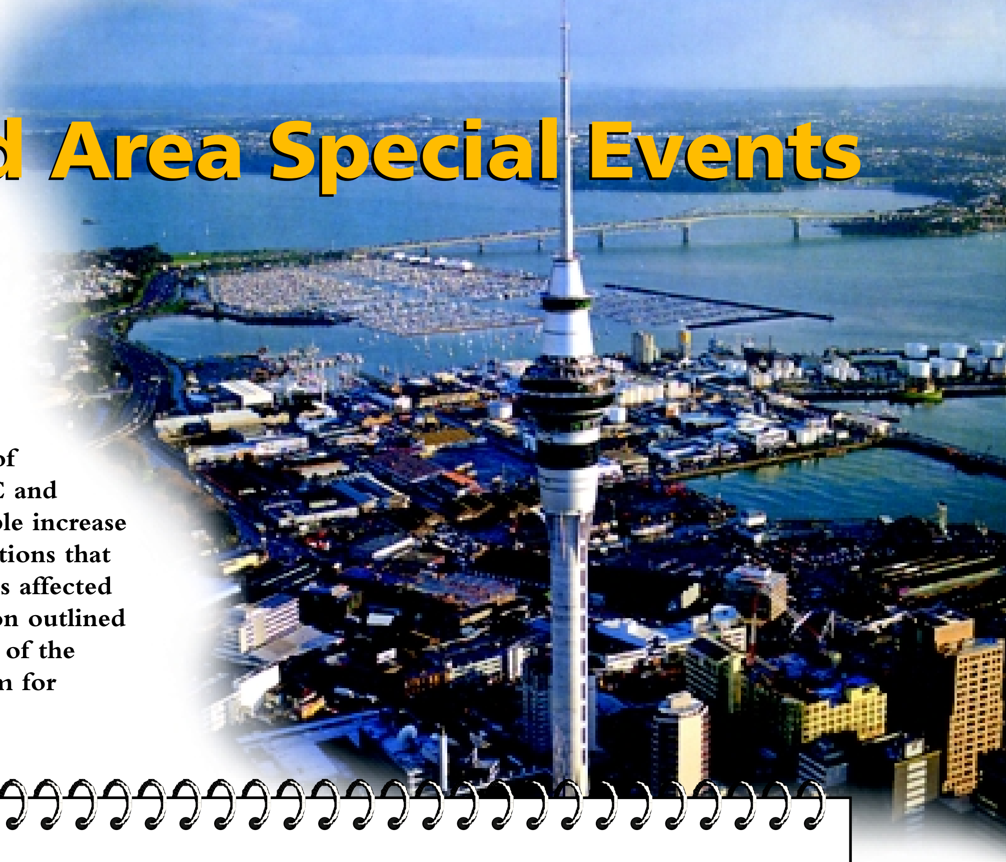
*The following excerpt is from an issue of **Callback**, NASA's aviation safety reporting system newsletter.*

Fast-moving fog – and the well-known "sucker hole" that often accompanies it – surprised another reporter, a helicopter pilot en route to an early morning construction job. Fuel was not a critical issue in this incident, but this is certainly the sort of situation that can lead to fuel exhaustion.

"Takeoff was to be at [dawn]. Although I saw there was fog immediately around the airport, it was clear with unrestricted visibility along the route of the flight. Knowing my route was clear, I elected a Special VFR departure. As soon as I took off and climbed through a large hole in the clouds, I saw that the weather had changed dramatically and that I was on top of an overcast layer which went for miles in all directions. I also realised that I could no longer return to my departure airport – my hole had disappeared. I had to ask Tower for a radar fix to be certain I didn't violate the nearby Class B airspace and because I had lost contact with the ground. After deviating several miles out of my way, I found the earth again approximately 10 minutes later.

"I knew better. The marine layer around here has dramatic changes at dawn and dusk. I had seen this before, but never this dramatically. I have made a personal promise to myself... to think twice on "dawn patrol" takeoffs."

Auckland Area Special Events



Flying around the Auckland area over the next 12 months? If so, read on because you're likely to encounter plenty of aviation activity.

The down side to being the centre of attention for the forthcoming APEC and America's Cup events is the inevitable increase in air traffic and the airspace restrictions that go with it. It is imperative that pilots affected by these events study the information outlined in this article, because with the eyes of the world upon us there will be no room for complacency.

CALENDAR OF EVENTS

APEC

The first period to note on your calendar is 10 to 14 September 1999, when the Asia Pacific Economic Cooperation (APEC) conference will be held in Auckland. Having said that, there is a strong likelihood that several Heads of State will visit other parts of New Zealand after the conference. Pilots are urged to obtain NOTAM information on any restrictions up to one week after 14 September.

America's Cup Challenger Series

The next date of significance is the start of the America's Cup Challenger Series (Louis Vuitton Cup), which commences 1 October 1999 and continues through to January 2000.

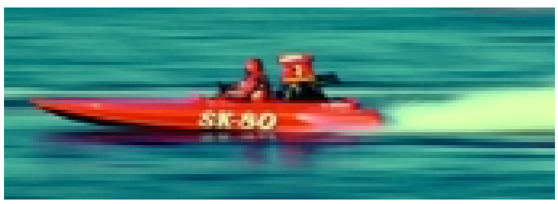
Year 2000 Celebrations

Restricted airspace, or special procedures, to deal with the expected increase in tourist traffic (in particular over the East Coast) associated with Year 2000 celebrations may be required. These will be advised by AIP Supplement.

Year 2000 Changeover

Restricted airspace, or special procedures, to accommodate possible Y2K issues may also be required. These will also be advised by AIP Supplement.

World Offshore Powerboat Championships



The World Offshore Powerboat Championships will be held in the Hauraki Gulf from 7 February to 16 February 2000. There may be a need for special procedures or restrictions during this period to manage aircraft traffic near this event. These will be advised by AIP Supplement.

America's Cup

Finally, the America's Cup proper will occur during the period 19 February to 4 March 2000, assuming Team NZ requires all nine races to defend the Cup!

APEC Procedures

Whether you are on the ground or in the air near Auckland, the best advice during APEC will be to stay well clear of the activities surrounding this event. Pilots will not be permitted to enter APEC restricted areas under any circumstances unless approved by the restricted area Controlling Authority. Approval will only be given for flights:

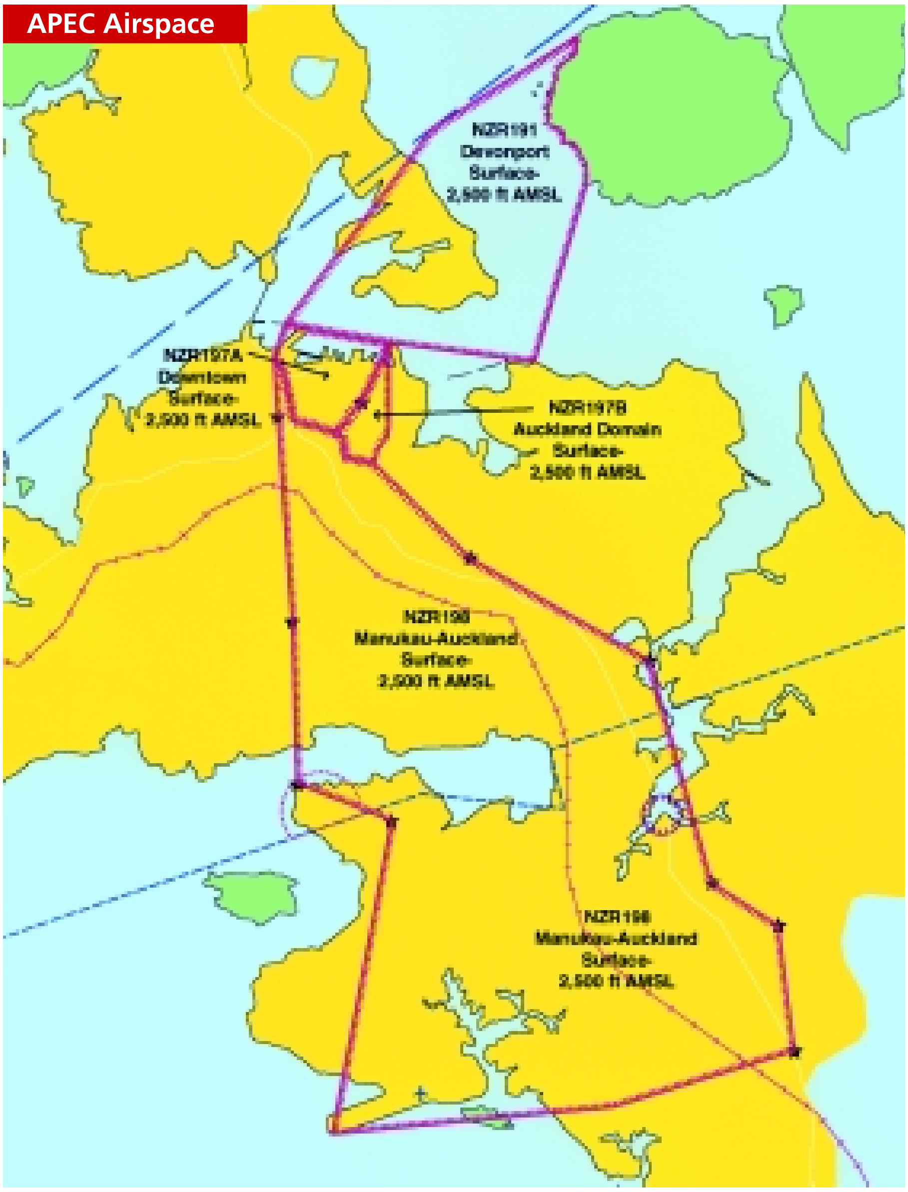
- Involved in an APEC activity,
- Operating as an emergency flight, or
- Operating as instructed in portions of controlled airspace that are coincident with APEC restricted areas.

The security measures for APEC will be very strict, both on the ground and in the air, and it would be unwise to wander anywhere near activated restricted airspace if you are not approved to do so. Extreme vigilance will therefore be necessary in determining airspace boundaries in order to remain clear of their respective restricted areas. Any breach of a restricted area may result in a major security response and enforcement action.

APEC Airspace

APEC airspace is comprised of the following restricted areas:

- **NZR 191, Devonport.** Activation is via NOTAM but is expected to be rare and infrequent.
- **NZR 197A, Downtown.** Active 24 hours a day during APEC.



Ivan Stade (left) and Len Wicks of the CAA discuss Auckland airspace.

- **NZR 197B, Auckland Domain.** Active during daylight hours on 13 September 1999 only.
- **NZR 198, Manukau/Auckland.** Activated via NOTAM, this restricted area will remain active for relatively short periods only.

It should be noted that the imposition of this restricted area is not intended to unduly disrupt air traffic operating to and from Auckland International Airport. An ATC clearance to operate within the Auckland CTR/C constitutes an automatic entry clearance to operate within that portion of NZR 198 (not the portion outside controlled airspace, north of Mangere Bridge). If necessary, ATC will pass instructions to such aircraft from the restricted area Controlling Authority.

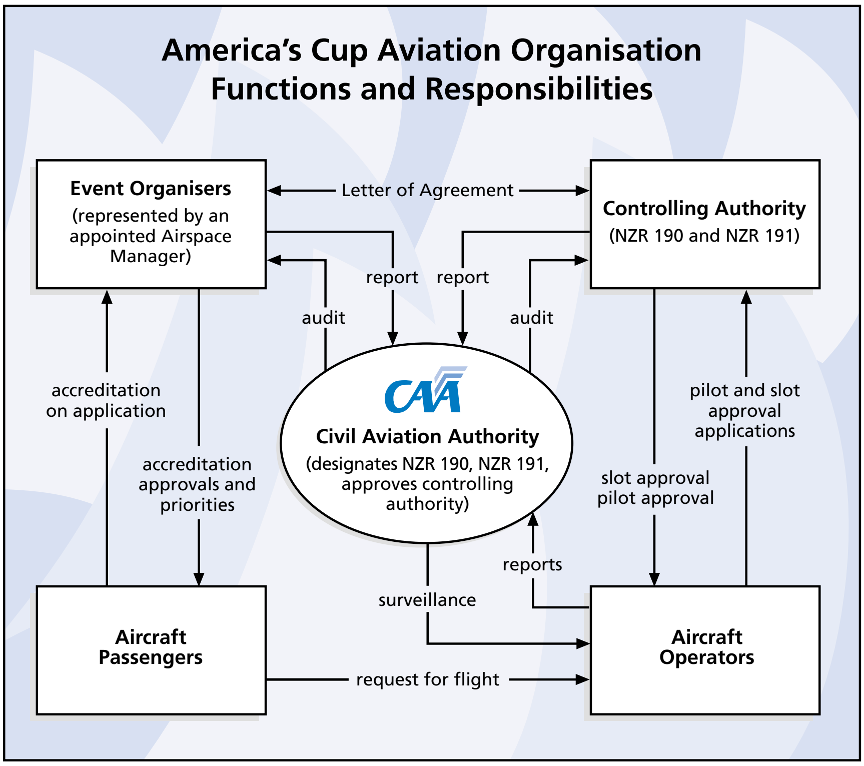
America's Cup Procedures

America's Cup procedures have been developed through over three years of consultation with industry. Drafts of these procedures have been available on the CAA web site for much of this consultative period.

Pilot Approval

Pilots will not be permitted to enter America's Cup restricted areas unless they are 'approved'. The approval process requires each pilot to request the America's Cup briefing package compiled by the Controlling Authority, and to sign and return the confirmation document. This document confirms that the pilot has received, understood, and will comply with the requirements outlined in the package.

It is important that any pilot who wishes to enter America's Cup airspace contacts the Controlling Authority at the earliest opportunity to receive their briefing package. Briefing packages may



- **NZR 191, Devonport.** This is the same restricted area as designated for APEC. It is activated in the same manner as NZR 190, but for shorter periods to cover competing yachts that are transiting between the Viaduct Basin and the race course.
- **NZR 192, Viaduct Basin.** Active 24 hours a day throughout the entire America's Cup event this restricted area has a different Controlling Authority from NZR 190 and NZR 191. Only aircraft involved in emergency operations will be permitted to enter this airspace.

VFR Transit Lane

Temporary restricted area requirements, and in particular entry approval, take precedence over the requirements for coincident portions of controlled airspace, victor lanes, and the Auckland MBZ (NZC 118). For that reason,

Continued over...

be obtained by contacting the Controlling Authority after 1 July 1999 at the following address:

America's Cup airspace Controlling Authority
Whenuapai Tower
RNZAF Base Auckland
Private Bag
Whenuapai 1250

Procedures are being developed for pilots who wish to operate within America's Cup airspace at short notice. These will be detailed in the America's Cup AIP Supplement effective on 12 August 1999.

Accreditation

'Accreditation' is a separate process of approval carried out by the Event Organisers (the Defender and Challengers for the Cup) which will be required by all passengers or organisations wishing to enter America's Cup airspace. Details on accreditation will be contained in the America's Cup briefing package.

Restricted Areas

America's Cup airspace is comprised of the following restricted areas:

- **NZR 190, East Coast Bays.** This is the main restricted area over the race course itself and is activated by NOTAM (will usually be active for a couple of hours during races only). Activation will also be notified by special America's Cup ATIS, frequency 124.6 MHz.

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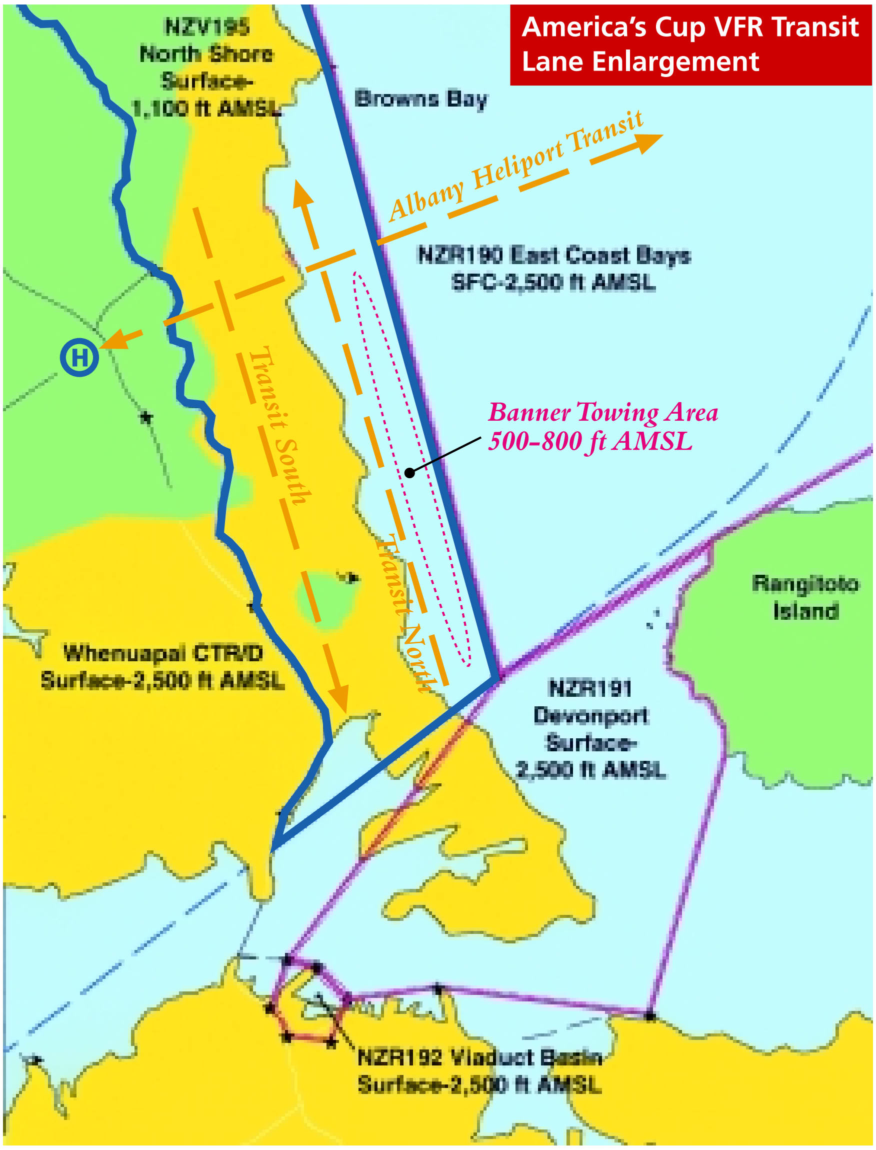

America's Cup VFR Transit Lane Enlargement

temporary victor lane **NZV 195 (North Shore)** is necessary to afford transit access when NZR 190 is active. This victor lane is sandwiched between the Whenuapai control zone (CTR) and East Coast Bays Road.

Northbound transiting aircraft are expected to generally fly east of the coastline, and southbound west of the coastline. Pilots of southbound aircraft are reminded that Civil Aviation Rule 91.311 *Minimum Safe Heights* requires them to be at least 1,000 feet amsl over a built-up area. Pilots of northbound aircraft should note that there will be a strong likelihood of banner-towing aircraft operating between 500–800 feet amsl on their side of the victor lane. To avoid conflict, it is strongly recommended that northbound aircraft fly at no less than 1,000 feet amsl. Pilots should transmit their position, altitude, and intentions at entry and exit on frequency 130.3 MHz while operating within NZV 195.

Controlling Authority

The Controlling Authority (callsign "Cup Base") for NZR 190 and NZR 191 will not be providing an air traffic service (such as traffic information) throughout the America's Cup except in an emergency. Cup Base will monitor 130.1 MHz and its secondary frequency 130.3 MHz to provide the following:

- Restricted area activation and deactivation,
- Whenuapai QNH,
- Instructions on circuit patterns, entry/exit requirements, and slot availability as necessary,
- Monitoring to ensure the maximum number of aircraft is not exceeded,
- Co-ordination with Whenuapai and Auckland ATC units, and
- Emergency assistance to aircraft when practicable.

Slot Allocation

Aircraft wishing to operate within NZR 190 and NZR 191 require slot allocations, which are issued by the Controlling Authority. Slot allocation will be either by request to the Controlling Authority prior to flight, or by in-flight request to "Cup Base". In-flight requests on the secondary frequency 130.3 MHz will have a lower priority than prior approvals, and in all cases slots will only be allocated to approved pilots.

Slot Allocation Example *Figure 1*

2,500 ft	1003-1023,	1007-1027,	1011-1031,	1015-1035,	1019-1039,	1023-1043
2,000 ft	1002-1022,	1006-1026,	1010-1030,	1014-1034,	1018-1038,	1022-1042
1,500 ft	1001-1021,	1005-1025,	1009-1029,	1013-1033,	1017-1037,	1021-1041
1,000 ft	1000-1020,	1004-1024,	1008-1028,	1012-1032,	1016-1036,	1020-1040

Restricted Area Patterns

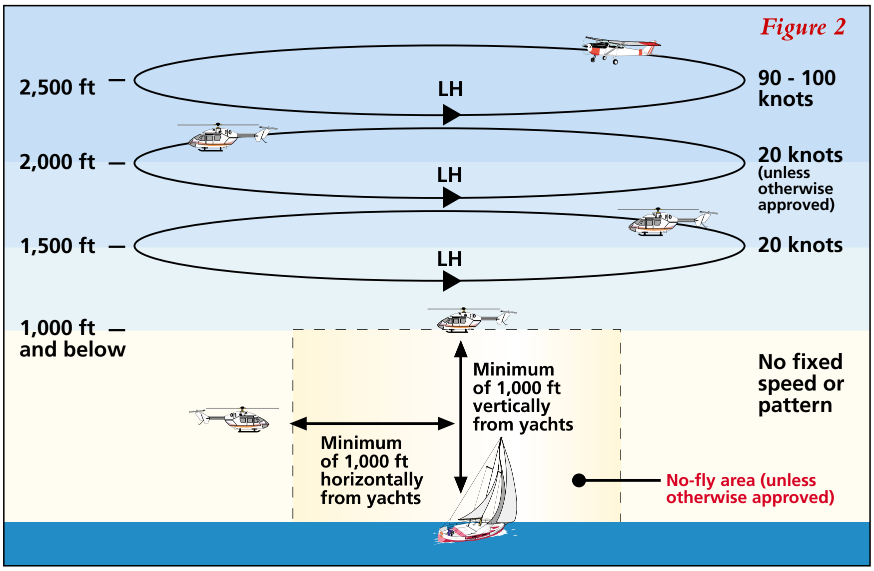

Figure 2

Successive slot allocation at each level will be four minutes apart, with a maximum of three aircraft entering at each slot-commencement time. Slot allocations will be for a duration of 20 minutes or multiples thereof. In the example given on the previous page (see figure 1), an aircraft occupies two slots from 1000 to 1040.

Restricted Area Patterns

There will be up to four circuit patterns (dependent on demand and the cloud base) within NZR 190 to accommodate VFR traffic overhead the race course. The same levels and slot allocation system will be used for NZR 191, except aircraft will not be required to fly a circuit or at a particular speed. There will be a maximum of 18 aircraft allowed to operate at each level within NZR 190 and six within NZR 191 (see Figure 2 for further details).

Aircraft Restrictions

A complete list of requirements, including use of radios, transponders, altimeters, circuit procedures, and reporting requirements will be available in the America's Cup briefing package, or may be viewed on the CAA web site. General aircraft requirements for entry into NZR 190 and NZR 191 will be as follows:

- No banner towing aircraft, paragliders, hang-gliders, balloons, gliders or kites,
- Aircraft shall be operated with landing lights and/or anti-collision lights switched on,
- Aircraft shall be operated with two serviceable radios, and
- Aircraft shall be operated by two pilots, or a pilot and an observer (someone who has no other technical duties such as a professional camera operation for example), while within the restricted area.

Emergency Procedures

Any aircraft within the NZR190/NZR191 with a radio failure, or suffering an emergency situation, is required to immediately vacate the area as soon as practicable.

In the event of an aircraft blocking primary frequency 130.1 MHz, aircraft should change to frequency secondary 130.3 MHz while the interference continues.

Further Information

Further information regarding APEC and America's Cup airspace is available on the CAA web site at **http://www.caa.govt.nz under Aeronautical Services.** There is also an automatic notification service available from this web site under **Notification Service**, which will keep you up to date on pertinent information and will even notify you when the restricted areas are activated. If you are going to be affected by these events, then you are strongly urged to subscribe to this free service. ■

The Fuel Goes Into the Helicopter

*This item is taken from Transport Canada's Aviation Safety **Vortex**, Issue 5/97*

I'm a 47-year-old helicopter pilot with nineteen and a half years in this business and I have accumulated over 8500 hours of accident-free flying in Bell helicopters. I have flown over, and worked in, most parts of Canada and some parts of the United States.

Just when I was getting comfortable and starting to think I knew something, a funny thing happened on the way to work. No, let me rephrase that: I took a shortcut and it almost cost me my life. Here's hoping that you won't have to try this. Remember, the fuel goes into the helicopter, not the pilot!

While I was getting ready for a routine flight in a Bell Jet Ranger, the customer called to inform me that he had shortened the trip and wanted to add more people. In order to be within legal weight limits for takeoff, I determined that some fuel had to be removed from the aircraft. I didn't have the proper hose and fittings for the electric pump, and so I decided to use a rubber hose and siphon the fuel into a barrel. I exhaled and took a fairly hefty suck on the hose and, sure

Photography by Neville Dawson.

enough, the jet B started flowing. However, I inadvertently took in a considerable amount. I spit out the awful-tasting liquid and rinsed my mouth with coffee, stuck in some chewing gum and went flying.

As it turned out, the customer changed his mind again. New destination, two landings above 4000 feet and a reconnaissance flight for some roads and cutblocks. I then had to go to the nearest airport for more fuel. I questioned the customer again about how much flying was involved.

> ***"It felt as if all my joints had hot, wet sand in them and it hurt to move or to lie still."***

He said enough to do the originally planned trip, and so I added adequate fuel. Returning to pick up the other passengers, we carried on. We had just gotten airborne when they decided that they were hungry and wanted to return to Grande Prairie, Alberta. About five hours had passed since I had ingested the jet fuel and the only effects so far were horrible burps, which brought up that horrible taste again. However, my right wrist and shoulder were starting to ache and I had mild chest pains. The flight was

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scenic with fall colours and went very well.

After the deplaning and paperwork, my left shoulder started aching and I started feeling nauseous with flu-like conditions. I decided to go home and lie down. Conditions got worse. It felt as if all my joints had hot, wet sand in them and it hurt to move or to lie still. My chest pains got worse to the point that breathing became difficult. Severe headache and nausea. I phoned my doctor and he was kind enough to see me right away. He sent me to the hospital for chest X-rays, blood work and an electrocardiogram. After more poking and prodding, I was left in an emergency room with my peek-a-boo nightgown and hooked up to a monitor. I lay there in pain for about three or four hours, not knowing what was going on with my body or my career. My doctor came in and informed me that I had pneumonia, brought on by chemical burns to my lungs. They wanted to keep me in the hospital, but, with cuts to our health-care system, no beds were available.

I was discharged at about 7:30 p.m. and told to return in the morning for more tests. The doctor gave me a prescription for an antibiotic and told me to take Tylenol for the pain. Needless to say, I didn't sleep very much and returned at 8:00 a.m. for more tests. I had asked the local refueller for a material safety data sheet (MSDS) after I got home and asked that it be at emergency for me if I needed it during the night. Apparently he didn't have time or something, but, in any case, the information wasn't there. Fortunately, my friend Bruce brought a copy over to me.

In the hospital, the chest X-ray showed slight improvement to my lungs, but, with the MSDS, we discovered that there is also some diethylene glycol monomethyl ether (which is a fancy name for antifreeze) in with the kerosene and naphtha in jet B.

The data sheet says, "Small amounts of jet B drawn into the lungs through swallowing or vomiting may cause **severe** health problems such as bronchopneumonia or pulmonary edema." Bingo!

We had no way of knowing how much fuel I had taken in, and so more tests were performed: a urinalysis, more blood work, a liver-function test and a really neat oxygen test (for this one they poke a needle right into an artery in the wrist). The MSDS stated that the toxicity level for a rat ingesting jet B is 2500 mg/m^3. The relationship of these studies to humans has not been established, but my doctor calculated that less than four spoonfuls in the lungs would be fatal.

With all this wonderful information, I was again discharged and told to wait for test results and not to fly until more was known. All of this started on Thursday, September 25, 1997, and so I spent the weekend at home sick, in pain and grounded. On Monday, September 29, I again went to my doctor and he said that the test results were good, but I still had pneumonia and had to wait another week before having my next X rays and checkup.

I have noticed some vision loss and some memory loss. I don't know what the future will bring and, God willing, I want to keep flying, but, even if I don't, I hope this will help someone else not to do this.

A footnote to the original item stated that the pilot returned to flying status but, tragically, was killed, along with his two passengers, in the crash of a Bell 206 less than a month later. The Transportation Safety Board of Canada was investigating but, at the time of publication, had not determined the cause of the accident. ■

A Primer on Primers

by Patrick Benton

This article was published in the September 1998 issue of ***FAA Aviation News****. The author, an Assistant Professor, School of Aviation Sciences, teaches aircraft systems courses at Western Michigan University. Pilots should check the flight manual of their aircraft type and follow any specific recommended priming techniques.*

Anatomy of a Primer System

The engine priming system seems to be one of the most misunderstood systems on light aircraft. What exactly does the primer do, and how does it do it? Should you use the primer for every start or just when it's cold? Is it okay to prime the engine by pumping the throttle a few times? These are some of the questions frequently asked by new and experienced pilots, including flight instructors.

To develop safe and efficient priming techniques, it is necessary to understand the system and how it works. A primer system is used on aircraft engines to introduce a small amount of atomised fuel into the engine to improve cold starting. The priming system is a stand-alone system and is not part of the carburettor.

"Even if you've had success "priming" with the throttle, it's only a matter of time until an induction system fire occurs..."

The system consists of a fuel pump, discharge nozzles, and interconnecting plumbing. There are two types of systems in use. One type uses a small, manually operated fuel pump located in the cockpit. The other type uses the aircraft electric boost pump to provide fuel pressure to the discharge nozzles. The electric primer system also incorporates an electrically operated valve to control the fuel flow to the nozzles. The discharge nozzles and plumbing (normally one-eighth-inch tubing) are the same for both systems. Most small aircraft use a manual primer system, while large or multi-engine aircraft may have electric primer systems.

The discharge nozzles are very important to the proper operation of the system. They have a small discharge orifice, which causes the fuel to atomise much like the nozzle on a spray bottle of window cleaner. The nozzles are usually located in the cylinder head, in front of the intake valve. Some engines have a nozzle in all the cylinders, while others have nozzles in only some of the cylinders. Sometimes there is only one nozzle for the entire engine. When a single nozzle is used, it is normally located in a central location in the induction manifold, rather than in the cylinder head.

Primer System Operation

The manual primer system uses a single-acting or one-way piston type pump located in the cockpit. When the pump is pulled out, fuel from the main fuel line is drawn into the pump through a check valve. When the pump is pushed in, the fuel exits through a second check valve into the primer lines and out to the discharge nozzles. When operating the manual type of primer, you should wait a few seconds after pulling the pump out before pushing it back in. This allows time for the fuel to fill the pump chamber. If the pump is hard to operate, the seals may be bad or the nozzles could be plugged. Have your mechanic check the system if the pump does not operate easily or if priming does not seem to be effective.

Manual primer pumps are equipped with a locking feature on the pump. This allows the primer pump to be locked in the closed position, which prevents the pump from accidentally opening in flight. If the pump does open with the engine running, fuel will be drawn through the pump and into the engine. This will cause an over rich fuel-air mixture, which will result in power loss or engine stoppage.

An electric primer system uses the boost or auxiliary fuel pump to provide fuel pressure for priming. An electric solenoid valve controls the fuel flow to the nozzles and is operated by a switch in the cockpit labelled PRIME. With the boost pump on, the prime switch can be turned on to send fuel to the cylinders. This is a spring-loaded-off type switch; therefore, you must hold it in the primer position. Keep in mind that when you hold the prime switch in the primer position with the fuel boost pump on, fuel is flowing through the primer system and into the engine. It is very easy to over-prime an engine with an electric primer, so engage the prime switch briefly.

Priming Techniques

Priming techniques vary among aircraft; therefore, it is important to determine the best method for the aircraft that you fly regularly. The engine may not necessarily require priming on every start, depending on the ambient temperature and the engine temperature. Try starting the engine without priming on a warm day or with a warm engine. You may find that the engine starts just fine. There is no set rule, such as "always give it two shots of prime". Experiment with different techniques to see what works best for your aircraft. [Editor's Note: But always check your aircraft's operating handbook or flight manual first.] Remember that the less fuel you have to introduce to get the engine started, the better.

One technique that often works well with both manual and electric systems is to engage the starter and allow the engine to rotate a few times before priming. This allows air to flow into the engine so that, when primer fuel is introduced, it will mix with the incoming air. With a manual primer, pull the primer out, engage the starter, and slowly push the primer in while the engine is cranking. With an electric primer, turn the boost pump on, engage the starter, and then turn on the electric primer for a few seconds. Introducing the fuel into an air stream, rather than into a static engine, greatly improves the effect of priming. It also reduces the possibility of over-priming, which can flood the engine and lead to an induction fire.

Priming with the Throttle

Some pilots – even CFIs – say that they pump the throttle a few times when starting a stubborn, cold engine. This is not a recommended practice, because aircraft engines generally have up-draft or horizontal-draft induction systems. This means that air and fuel must flow upward or horizontally through the carburettor and the induction tubes on their way to the cylinders. If the fuel is not completely picked up by the air and taken into the cylinders, it will drain away from the cylinders and back into the induction system, where the fuel may then form puddles of raw fuel.

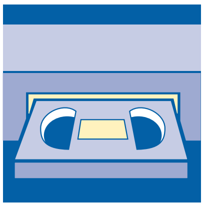
The fuel is especially likely to "drop out" or fail to mix with the air stream if the fuel is introduced in a coarse, heavy spray rather than a fine, atomised mist. To illustrate this concept, change the nozzle setting on a spray window cleaner bottle from "spray" to "stream". Squirt some on a window. Notice that when it hits the glass it promptly runs down the window. But with the nozzle set in the "spray" setting, the cleaner is dispersed in a fine mist and does not run off as easily.

The fuel that is discharged from the acceleration system of the carburettor

when the throttle is pumped is a coarse, heavy stream – not a fine mist. It is very likely to run down the inside of the induction tubes and form puddles. The primer nozzles are so important because they atomise the fuel. It is possible to form puddles even when using the primer system, so do not over-prime. If you do create puddles of fuel in the induction system and the engine backfires during starting, the fuel can ignite or even explode. This is called an induction system fire and can result in serious injury or damage. Even if you've had success "priming" with the throttle, it's only a matter of time until an induction system fire occurs and spoils your whole day.

Don't be afraid to try different priming techniques to discover what works best for your aircraft. Just remember that there are only two universal rules for priming:

- Less is best, and,
- Do not attempt to prime the engine with the throttle. ■



Videos

Here is a consolidated list of safety videos made available by CAA. Note the instructions on how to borrow or purchase (ie, don't ring the editors.)

Civil Aviation Authority of New Zealand

No	*Title*	*Length*	*Year released*
1	Weight and Balance	15 min	1987
2	ELBA	15 min	1987
3	Wirestrike	15 min	1987
6	Single-pilot IFR	15 min	1989
7	Radar and the Pilot	20 min	1990
8	Fuel in Focus	35 min	1991
9	Fuel Management	35 min	1991
10	Passenger Briefing	20 min	1992
11	Apron Safety	15 min	1992
12	Airspace and the VFR Pilot	45 min	1992
13	Mark 1 Eyeball	24 min	1993
14	Collision Avoidance	21 min	1993
15	On the Ground	21 min	1994
16	Mind that Prop/Rotor!	11 min	1994
17	Fit to Fly?	23 min	1995
18	Drugs and Flying	14 min	1995
19	Fatal Impressions	5 min	1995
20	Decisions, Decisions	30 min	1996
21	To the Rescue	24 min	1996
22	It's Alright if You Know What You Are Doing – Mountain Flying	32 min	1997
23	Momentum and Drag	21 min	1998
24	The Final Filter	16 min	1998
25	We're Only Human	21 min	1998

Miscellaneous individual titles

Working With Helicopters	8 min	1996*

*re-release date

Civil Aviation Authority, Australia

The Gentle Touch (Making a safe approach and landing)	27 min
Keep it Going (Airworthiness & maintenance)	24 min
Going Too Far (VFR weather decisions)	26 min
Going Ag – Grow (Agricultural operations)	19 min
Going Down (Handling emergencies)	30 min

The videos are VHS format and may be freely copied, but for best quality obtain professional copies from the master tapes — see "To Purchase" below.

The New Zealand tapes are produced on a limited budget, the first 11 titles using Low-band equipment. Quality improves in later titles. While the technical quality of the videos may not be up to the standard of commercial programmes, the value lies in the safety messages.

To Borrow: The New Zealand tapes may be borrowed, free of charge, as single copies or in multi-title volumes (Vol A contains titles 1 to 8, Vol B titles 9 to 14, Vol D titles 15 onwards. The Australian programmes are on a multi-title volume (Vol C). Contact CAA Librarian by fax (0–4–569 2024), phone (0–4–560 9400) or letter (Civil Aviation Authority, PO Box 31–441, Lower Hutt, Attention Librarian). **There is a high demand for the videos, so please return a borrowed video no later than one week after receiving it.**

To Purchase: Obtain direct from Dove Video, PO Box 7413, Sydenham, Christchurch. Enclose: **$10 for each title** ordered; plus **$10 for each tape** and box (maximum of 3 hours per tape); plus a **$5 handling fee** for each order. All prices include GST, packaging and domestic postage. Make cheques payable to "Dove Video".

Foot to the Floor

This recent landing accident was passed to Vector by the CAA's Safety Investigation Unit because it involved an aircraft design feature that has the potential to be fatal.

Landing on a sealed runway, the Cessna 185 developed a severe tailwheel shimmy. The pilot was flying from the righthand seat, when the left rudder pedal, which was of the stowable type, became unlocked. Deprived of full directional control, the aircraft weathercocked to the right, forcing the left undercarriage wheel assembly to break away. The left leg dug into the ground, tipping the aircraft on to its side.

Engineering investigation found that one element of the dual cable, which unlocks the stowable pedals, had failed. Also, one of the associated locking plates was bent, allowing the locking pin to disengage under load.

No Airworthiness Directive was issued as a result of this apparently isolated occurrence, but as the stowable pedal system is not confined to the 185 series, this serves as a reminder to those operators flying Cessna aircraft with this system fitted. Prior to flights where the aircraft is to be flown from the righthand seat, the pilot should make a positive check that the stowable pedals are locked in the operational position, and that the release knob is fully in. Also, on periodic maintenance, the serviceability of the system should be verified, if it is not already a check item.

Field Safety Advisers

John Fogden
(North Island, north of line, and including, New Plymouth-Taupo-East Cape)
Ph: 0-9-424 7911 Fax: 0-9-424 7945
Mobile: 025-852 096 e-mail: fogdenj@caa.govt.nz

Ross St George
(North Island, south of line, and including, New Plymouth-Taupo-East Cape)
Ph: 0-6-353 7443 Fax: 0-6-353 3374
Mobile: 025-852 097 e-mail: stgeorger@caa.govt.nz

Murray Fowler
(South Island)
Ph: 0-3- 349 8687 Fax: 0-3-349 5851
Mobile: 025-852 098 e-mail: fowlerm@caa.govt.nz

Owen Walker
(Maintenance, New Zealand-wide)
Ph: 0-7-866 0236 Fax: 0-7-866 0235
Mobile: 025-244 1425 e-mail: walkero@caa.govt.nz

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Publications

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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".

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