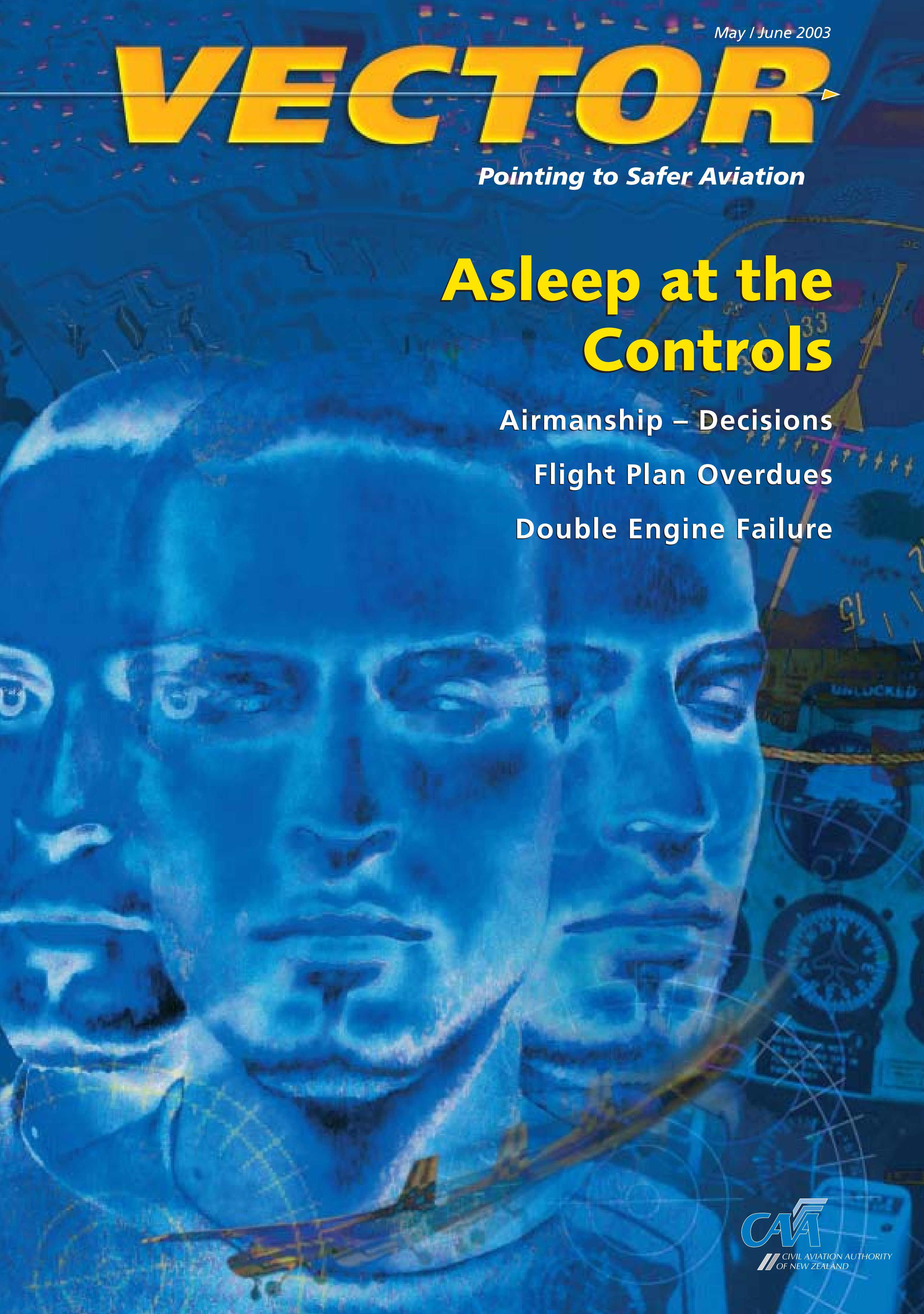
May / June 2003

VECTOR

Pointing to Safer Aviation



Asleep at the Controls

Airmanship – Decisions

Flight Plan Overdues

Double Engine Failure

CIVIL AVIATION AUTHORITY OF NEW ZEALAND

VECTOR

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Design, Gusto Design & Print Ltd.

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

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ISSN 1173-9614

May / June 2003

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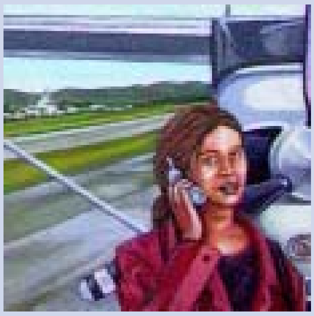
This article continues the series on airmanship and looks at the way in which we make decisions and how they can influence flight safety.



Current statistics show that approximately one in every ten VFR flight plans are going overdue, which is causing National Briefing Office and Search and Rescue staff additional workload and expense. Methods to help pilots remember to amend or terminate their flight plans are discussed.

The effects of sleep inertia and microsleeps on safety in the workplace are generally not well understood by many working in the aviation industry. These are discussed along with other factors.

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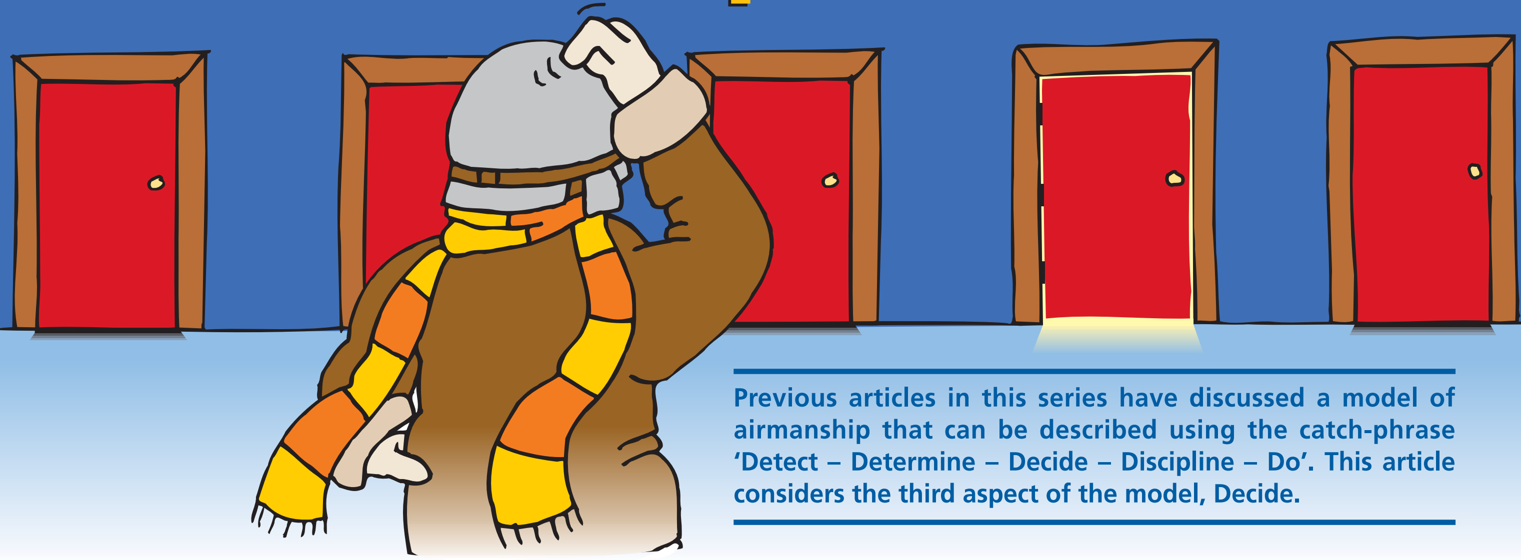
Airmanship – Decisions



Previous articles in this series have discussed a model of airmanship that can be described using the catch-phrase 'Detect – Determine – Decide – Discipline – Do'. This article considers the third aspect of the model, Decide.

Decisions

Decisions are things we are making all the time, in all facets of our life. Some are conscious, after much deliberation –"Do I buy the red car or the white one?" and a surprising number actually occur without any real conscious effort on our part – "Do I put the flap down now, or in a few seconds?" One study into decision making by car drivers indicated that they were often required to make decisions at the rate of up to seven per second! Some of these decisions might have been conscious – "Do I take the motorway or the back road?" – but most would likely be of the involuntary kind, relating to the actual handling of the car – speed up, slow down, change gear and so on.

Aviation and driving have a lot of similarities when it comes to decision making, so it is fair to assume that pilots must be working at least as hard as drivers. That is a lot of decision making!

This article will focus on the conscious decisions that we make relating to the overall conduct of a flight.

In essence, decision making is all about choice. You are presented with a number of options in any given situation, and you have to make a decision about which option you are going to take. A number of factors will determine which choice you make in any given situation, including time pressure, your own degree of risk aversion, your familiarity with the situation, and perhaps most importantly, the way in which you look at the options available to you.

Time Pressure

As a general rule, the more time you have to consider a given decision, the greater the chances are that you will make the correct one. A hasty or impulsive decision-making process may lead you to overlook some crucial information, or you may not have time to think through the consequences of your actions. Taking time to make a good decision is different from procrastinating, or failing to make a decision at all. People are more likely to procrastinate when choices are perceived to have a similar result, with no one choice being clearly better than another. Failure to make a decision at all, when you know you need to make one, is often a sign of a lack of confidence in your decision-making ability. Taking the time to think through major decisions, and ensuring you collect all the relevant information, and think about all the possible consequences, is a sign of a good decision-making process. Procrastination, or failure to make decisions at all, is not.

In aviation, it is often a good idea to have made decisions and contingency plans well before the actual flight or event. One example is the takeoff, where it should normally be possible to determine in advance what the 'go/no-go' criteria would be. For instance, in a light twin, the pilot should decide in advance that if an engine fails before a given speed, height or configuration is obtained, the takeoff must be aborted.

"The decisions we make are often skewed by the amount of risk we are prepared to accept."

Personal minimums are another classic case of decision making in advance – "If the cloud base ahead drops below 1500 feet or visibility below five kilometres, then I will turn back". By making such decisions in advance, your response when things go bad should be automatic, and will be more likely to result in a successful outcome.

Risk Management

In a dynamic environment like aviation, risk is ever present. The decisions we make are often skewed by the amount of risk we are prepared to accept. As an example, suppose a flight from point A to point B can be flown by one of two routes. The first route is quicker, but takes you over inhospitable terrain. The second route has good terrain for a precautionary or forced landing, but will take longer. Which route do you follow? Your answer will depend on your assessment of the relative risk, and your own degree of risk aversion.

Here's another risk assessment to consider. Most pilots of light single-engine aircraft don't really like flying over water that

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much – sometimes it is inevitable, but you do have choices. Suppose you are going to fly from New Plymouth to Hokitika. You can fly down the coast to Paraparaumu, then take the shortest distance across Cook Strait to the Brothers Islands. Alternatively, you could fly to Wanganui then launch off to Nelson, avoiding all that controlled airspace around Wellington. Or, you could take the straight-line route (easy when you've got GPS!) and set off from Cape Egmont for Farewell Spit. Which would you opt for?

Another aspect of risk management is our perception of gain. We know that some 500 people are killed on the roads each year, yet most of us are happy to drive anywhere, anytime. This is mostly because we have decided that the benefits of mobility outweigh the risks inherent in driving. If every second trip by road was likely to result in a crash, you would probably think a bit more about whether a given trip was really worth it!

When it comes to flying, we pilots have decided that the risks in aviation are usually outweighed by the benefits we get from the freedom of flight. If we deem a particular flight or manoeuvre to be too risky, then hopefully we won't do it. This is, however, where the insidious factor of perceived gain or loss comes into play. A common human trait is a general unwillingness to easily give up what we perceive as a gain, or accept a loss, if we think we can avoid it.

Consider a cross-country flight in marginal weather. If you decide to get airborne and 'have a go' and manage to get a long way down track, you are more likely to be reluctant to turn back if the weather turns really bad. This is because you have already started the flight, and by turning back you have lost the gains you made towards your destination. You have also likely had to pay out for the flight, so it is a financial loss as well. In those circumstances, facing a certain loss, people are more likely to take a greater risk than they would normally accept. The fact that they are risking a possible catastrophic loss (a crash in bad weather) tends to get lost in the decision-making process. That is the way human nature works. If you are aware of this, then you can reduce its effect, by avoiding putting yourself in such situations in the first place. If you decide not to get airborne and wait it out, you are likely to be happier with your decision, and have avoided the subtle pressure to continue.

Another potentially hazardous human trait is that when we have made a decision we often tend to stick with it, even when subsequent events show that it was not the right thing to do. This may be another manifestation of the gain and loss phenomenon. We have invested in a decision, so to change it is seen as a loss on our part. That may be fine for our ego, but doesn't look good in an accident report. If you have made a wrong decision, and this becomes obvious, then don't persevere with it out of pig-headedness. Make a new decision.

Familiarity

Our perception of risk is also skewed by our familiarity with what we do. The more often you do something, with a successful outcome, the happier you are with it, and the less risky it seems. It probably is getting less risky, because you now have some experience in coping with whatever you are doing, but the perception of risk reduces even more than that justified by our experience level. This is where complacency can creep in.

Once again, consider the case of a flight in marginal weather. If you have done the same flight before, and got away with it, you are more likely to try it again. The previous flight(s) in bad weather may well have given you more experience to cope with it, but your perception of the risk has been reduced by familiarity. This can be fatal.

Asking the Right Question

Another trait that is nearly universal among pilots is that we tend to be very goal or task-oriented people. Being Kiwis exacerbates this, because we often tend to have a very 'can-do' attitude. This is great for getting things done, but it also has the downside of leading to a mindset of 'How do I do this?' when perhaps a more appropriate question might be 'Should I be doing this?'

Let us once again consider our cross-country flight in bad weather. For many of us, the fact that the weather is making life more difficult is merely compounding the technical problem of how to get the job done. That is fine up to a point, **but** we should never lose sight of the ultimate question – "Should I be trying to do this? Is it a good idea?"

The message is, when faced with a difficult or risky task, don't just ask 'how?' but also ask 'why?'

Summary

- Take the time you need to make decisions – don't be impulsive.
- Make sure you have considered all the relevant factors.
- Don't procrastinate – if you have to make a decision do so. Waiting and hoping is not an option.
- Do as much planning and decision making before commencing a flight as you can.
- Consider all the risks. Don't let familiarity dull your perception of risk.
- Be prepared to cut your losses.
- If you have made a wrong decision, admit it and change it.
- Always remember to ask yourself "Why am I doing this?" as well as "How do I do this?"
- Always take the safest course of action. ■

Flight Plan Overdues

The Problem

Following the change in format and reduction in price, the total number of VFR flight plans filed in 2002 was 22,915, a 17% increase on 2001 numbers. This increase is good news from a safety perspective. The flexibility to nominate a SARTIME that the pilot considers appropriate – a time at which he or she would want some alerting action to be taken – is an additional safety enhancement. It enables the pilot to consider risk management factors in deciding whether to nominate an intermediate SARTIME, for instance, rather than one based on the completion of a long flight.

But – the not-so good news is that pilots went overdue 2,291 times in 2002. That is one in 10 flight plans that are going overdue. This is of extreme concern to Airways and the CAA.

Fortunately the vast majority of flights becoming overdue are not in need of Search and Rescue assistance – they simply go overdue because of an oversight or misunderstanding of the rules. But the same errors keep being repeated. If this rate continues, there is a real risk of the effectiveness of the process being undermined to the extent that, some day, someone in need may not get the service they want as quickly as they expect it.

The 10 percent overdue rate has continued this year. The problem has two elements:

- Failing to amend SARTIME. The plus side of allowing flexibility of SARTIMEs has a down side of there being more potential to forget to amend the SARTIME for the next leg, or if just running later than planned.
- Failing to terminate the flight plan.

In March, the number of plans filed was 2021, with 209 going overdue. Of these, 72 failed to update SARTIME mid-flight, 122 failed to terminate their flight plan (only 4 thought the attended aerodromes would do it for them) and 15 of the overdues were attributed to Airways error.

The problem is not confined to any one sector of the industry. In March, of the 209 cases, 80 were commercial operators, 70 were aero clubs or flying schools, 27 were private operators, 16 were RNZAF, and there were 16 in an unknown category.

In the last issue of *CAA News* the article "Aviate, Navigate, Communicate – TERMINATE" provided a Search and Rescue perspective and an insight into what goes on behind the scenes at the National Rescue Coordination Centre when a flight becomes overdue.

The Solution

We need your help! We want all sectors of the industry to make a concerted and conscious effort to reduce these disturbing figures. Airways personnel and CAA Safety Education staff have been pooling ideas to assist. Over the next few months we intend to keep the need to either amend your SARTIME or terminate your flight plan to the forefront of your consciousness through a variety of means. And we will publish each month's statistics so that we can all see how we are going.

Please make that extra effort and be a part of this campaign. Its success is ultimately up to each individual pilot. Our main aim is the educational approach, but repeat offenders may receive some unwanted attention.

The Basics

Some pilots familiar with the old flight plan system continue to have some misunderstanding about the new. Please make the effort to ensure you fully understand how the new system works. The key points are:

- You must **always** request that your flight plan be terminated – even if landing at an attended aerodrome. Ensure the correct words are used – "terminate flight plan".
- Search and Rescue action commences **at** SARTIME, **not** some time afterwards. Make sure you build in enough time to terminate your flight plan prior to SARTIME (30 minutes after ETA is commonly used).
- Always amend your SARTIME **prior to,** not at SARTIME – at least five minutes notice would prevent inadvertent overdues. (Your watch may be a bit slow, the radio frequency might get busy, so don't run right up to SARTIME before acting).

Some Tips

Never make your SARTIME the same as your ETA – 30 mins after is a good time interval, to allow time for landing and then getting to a phone if necessary.

In many situations, it is best to terminate your flight plan with Christchurch Information before changing frequency to a Tower or unattended frequency for landing. (Flight plans can be terminated with a Tower – but remember you must ask, they will not do so automatically.) At some unattended aerodromes this call will need to be made before descending out of radio coverage, otherwise you must allow extra time to be able to land and make a phone call.

If landing at an aerodrome or airstrip where there is no-one on the ground to see you land safely, you may wish to delay

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terminating until after landing. Allow a suitable buffer in your SARTIME.

If it becomes necessary to amend your ETA to a later time and the 30-minute buffer to SARTIME is reducing, amend your SARTIME to retain the buffer rather than let it become too close to ETA with the risk that you will forget or, for some reason (for example, limited radio coverage when descending to land) be unable to amend or terminate before overdue action is started.

Memory Joggers

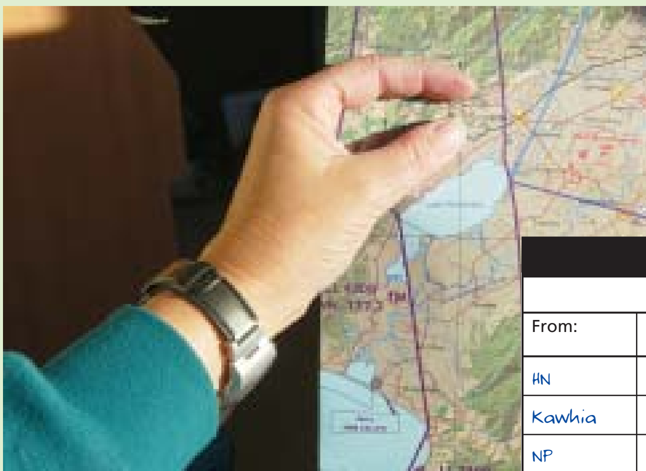
How can we make sure we remember to amend our SARTIMEs and terminate our flight plans.

Some years ago we published the results of a survey of pilots in the United States in which they were asked what tricks they used to remember to terminate their flight plan.

Here are some of the methods they used (accounts modified slightly to fit New Zealand terminology and rules). New Zealand pilots who responded to the request for practical ideas in the last issue of the Airways publication *Planefacts* suggested some similar tips, so we are sure you will find something here that will work for you – or prompt you to adopt some other unique method.

Wrist Watches

Wrist watches – switched and turned or twisted – were by far the favourite memory aid.



A majority of pilots favoured switching wrist watches to the 'wrong' arm, but added a caution – do it before takeoff, or when activating the flight plan!

> "A gimmick I use to remember to terminate a VFR flight plan is to take my watch off my left wrist and put it on my right wrist. Because a flight plan deals with time, and everyone looks at a watch many times in one day, it tends to remind me when I look on my left wrist and my watch is missing."

Another testimonial for switching wrists:

> "It'll drive you crazy and you'll never forget. Great if, like me, you usually fly IFR and would easily forget to terminate."

For those who prefer not to switch wrists, rotating the watch on the 'normal' wrist may work just as well.

> "When I file the VFR flight plan I rotate the watch 180 degrees so that the face is on the inside of my wrist. Because this isn't the customary position ... I am reminded each time that I look at the watch that I have an open VFR flight plan."

Other wrist-y ideas:

> "Get a small (Velcro attachable) wrist band, and keep it with your flight planning gear. When a flight plan is filed, put the band on. When the flight plan is terminated, take the band off."

> "I set my wrist-watch alarm ... for approximately 15 minutes after ETA to remind me to terminate the flight plan. It works for me."

Checklist or Flight Log Reminders

Checklist Reminders

Quite a few pilots believe the pre-approach and before-shutdown checklists are a sure way to remember to terminate VFR flight plans. As one pilot wrote "If a commercial jet pilot uses a checklist, we ordinary mortals with imperfect memories should use them too".

> "Write FLIGHT PLAN ...TERMINATE on your checklist – under descent checklist, and under shutdown checklist. That way, Flight Service can be called either over, or very near, your destination, or just prior to leaving your aircraft."

Another pilot's checklist method is shocking (pink).

> "TERMINATE FLIGHT PLAN is printed in bold, fluorescent pink capital letters at the top of my pre-shutdown checklist. This way, I can make a call while everything is spinning down and the temperature stabilising before shutdown."

Flight Log

AMEND SARTIME OR TERMINATE FLIGHT PLAN

From:	To:	Alt	Track °T	W/V	True Hdg	Mag Hdg	Dist	G/S	Time
HN	Kawhia		242	230/28	240	220	30	84	21
Kawhia	NP		204		214	194	58	85	40
NP	Hawera		173		184	164	32	92	21
Hawera	WU		125		137	115	43	112	23
									1hr:45

Fuel Planning	Time	Litres
Cons. 40 l/hr	Time	Litres
Unusable		8
Taxi & Circuit(s)	15	10
Flight Time	1hr:45	70
Reserve	45	30
Total Required		118
Total Carried		150
Safe Endurance: 3:10	**Land by:** 12:45	

☑ Life-jackets
☑ Survival Kit
☑ Pickets

SARTIME

Local	UTC
1200	0000

Route Frequencies	
Ch Info	129.8
Ch Info	126.8
NP twr	124.7
WU	120.2

Time	Hdg	Observations / Clearances	Fuel 78 LEFT	Fuel 72 RIGHT	ETA
2135	220	↗ HN E: RWY 18 210/20 1014	1:50	1:40	2320
55	194	Taharoa NP 35			
2220		Mokau	1:05	1:40	
56	115	Patea			315
2315		↘ WU	:45	1:00	

Post Flight Checks

☑ Flight Plan terminated ☑ Aircraft left tidy ☑ Check remaining fuel ☑ Secure aircraft

A shutdown memory aid was: "Triple M, Flight Plan", meaning Mixture – Mags – Master – Flight Plan.

In New Zealand, it will not always be possible to establish contact with Flight Information once on the ground. A phone call will be necessary (assuming cellphone coverage or a land-line is available).

Flight Log Notes

One suggestion concerned the use of a flight log.

> "When I file VFR, I write the Flight Service I will terminate with at the bottom of the log. When I activate the flight plan, I add the time I will need to terminate and I place a circle around both. This serves as a reminder during the entire flight. When I terminate the flight plan, I place a large tick in the circle. If I haven't terminated prior to shutdown, I will be reminded to do so when I write down my arrival time. If I cannot terminate then and there by radio, I carry the flight log until I have checked off the "Terminate" circle and recorded my times in my logbook."

In New Zealand, some training organisations now include a box for SARTIME on their standard flight log, which acts as a reminder for amending SARTIME as required, and under Post-Flight Checks at the end of the log is an entry "Flight Plan Terminated" with a box to tick.

Prodding Memory with a Peg

The humble spring-type clothes peg won favour with a surprising number of pilots. Here are some of the clever things you can do with it (before trying these, bear in mind that the peg could be a potential hazard – be careful where you fasten it and ensure it does not become potential FOD if it falls off in flight):

> "I stick it on the ignition key when I activate my flight plan and I take it off when I terminate the flight plan. When I take the key out to go home, the peg reminds me to terminate the flight plan."

> "We keep a spring-type clothes peg clipped inside the flight case. Pre-flight, we clip it on the yoke clip. Activate the flight plan – clip it to the door handle. If the flight plan is not terminated in flight, upon opening the door there's the reminder and then we clip the clothes peg onto the front of our clothing until the phone call is made."

Another pilot follows the method above, but stows the clothes peg in the cockpit by clipping it to the mike cable.

Several pilots favoured painting the wooden clothes peg red, so it would be even more noticeable – today's plastic pegs means you have a choice of bright colours to use.

The red clothes peg was used by some flight schools and instructors for students on solo cross-countries. The student was required to wear a large red clothes peg pinned to the front of their shirt. The intent is that someone will say, "Hey, what are you wearing that silly clothes peg for?" and they will remember to terminate their flight plan. (Today's students may not take kindly to that method?)

Written Notice

A written note or large sign placed in a strategic position was another popular method.

Using Small Stick-on Notes

... on the aircraft key ring. A permanent reminder key ring fob has been made available in the past by CAA but the problem with them is that pilots become used to them and don't really read it any more. A temporary note (or clothes peg) attached to these may rejuvenate their message.

... on the cockpit door post opposite the pilot.

... on the seat of the car if returning to the same car after a flight.

Or take a ball-point pen and, using big letters, write on the palm of your hand, "F P".

Using Larger Notices

... on the exit door of the hangar, flight office, or clubhouse building.

... on the toilet door in the clubhouse or terminal building.

... perhaps beside the fuel pumps.

... anywhere that may act as a reminder to pilots before they leave the airport.

Hitting the Wallet

"I ask my student how much money they have in their bank account. After they tell me, I ask how they would like that to diminish by two decimal places if they get charged for Search and Rescue. It seems to work."

We hope the threat behind that method won't be necessary in New Zealand – try out the simple ones first!

Conclusion

The methods in the US survey were all aimed at remembering to terminate a flight plan. However, some of them can be adapted or will assist in the task (if required) of remembering to amend SARTIME. The March figures above show that failing to amend SARTIME was the reason for about a third of the overdues.

Please try out a method above that you think will work for you. (*Vector* staff have already tried rotating a wrist watch in a non-aviation context and it works).

We will be providing you with information on how the statistics are stacking up in the coming months. We welcome feedback from you on how these ideas may have helped you, and any other practical ideas you may have to improve the problem.

We have some other reminder tools in the pipe-line. Watch for them. Let's all work together on this one. ■

Asleep at the Controls

Pilots and other shift workers, unaware of the effects of sleep inertia and microsleeps, may be putting lives at risk.

*This article by Joanne De Landre, Christine Boag and Adam Fletcher featured in the September/October 2002 edition of **Flight Safety Australia**. Minor modifications have been made for our New Zealand audience.*

Ever had one of those mornings when you wake up, stumble to the kitchen, and the most arduous task you can perform is to make a coffee?

And, if some chirpy little morning person dares talk to you during this time, they are threatened with menacing glares and grimaces?

Do your family and friends tease you about the dangers of talking to you before you've had your first coffee? Do you think that it just takes you a bit longer than most people to wake up, communicate in words rather than grunts, and regain your senses?

> ***"If you are awoken suddenly, the effects of sleep inertia can last up to 30 minutes or more."***

You could be experiencing a very real phenomenon known as 'sleep inertia'.

While on the domestic front this condition might cause a general lack of civility in the morning, in hi-tech transport systems it can be a killer.

Sleep inertia occurs in the period just after waking, and results in a measurable decrease in alertness. Ever nodded off at a performance or lecture? It might be a very highly rated film, and your friend might be really enjoying it, but you just can't stay alert.

After a while, the feeling of tiredness just swallows you up. As your head falls towards your chest, you bounce awake, only to nod off again soon after. What we know as 'nodding off' researchers call microsleeps, and it too is a killer in a complex technical environment.

Sleep inertia and microsleeps are two areas of research that have recently gained prominence after decades of study of fatigue and levels of alertness.

Sleep Inertia

Sleep inertia is a recognised state of transition from sleep to wakefulness.

New research into sleep inertia has revealed a range of effects, including:

- Impairment of performance and reaction time on tasks ranging from arithmetic to simple motor tasks such as grip strength and finger tapping.
- Reduction in memory ability.
- Impairment of the ability to make decisions.

Decision making is a cognitively complex process that involves recognition of the need to make a decision, generation of decision alternatives, and selection of a decision alternative.

Within the first three minutes of waking, decision-making performance can be as low as 51 percent of the person's best decision-making ability before sleep. Decision-making performance may still be 20 percent below optimum performance 30 minutes after waking.

When woken, most people experience some degree of sleep inertia. The degree of impairment that sleep inertia has on performance is influenced by a number of variables, including:

- The abruptness of awakening. When awakening from sleep normally, the effects of sleep inertia are believed to last for less than five minutes; however, if you are awoken suddenly, these effects can last up to 30 minutes or more.
- The stage of sleep that has been interrupted. If you are woken from deep or slow wave sleep, the effects of sleep inertia are more pronounced. Slow wave sleep is more likely to occur during the early stages of sleep. In a well rested person, slow wave sleep usually occurs within 45-60 minutes, whereas for shift workers or those people already sleep deprived, slow wave sleep may be reached in as little as 20-30 minutes.
- Sleep deprivation, which will increase the effect of sleep inertia.
- The type of task performance – the effects of sleep inertia vary among different types of tasks. For example, performance accuracy is more impaired by sleep inertia than reaction time.
- The time between awakening and time of performance – sleep inertia will cause less impairment as the time between awakening and task performance increases.

Some variables have been shown not to have an impact upon the effects of sleep inertia on task performance.

These include:

- The time of day – the effects of sleep inertia are most apparent when the individual is abruptly woken from sleep, regardless of whether the sleep occurs as a daytime nap or occurs during the night. The exception to this is naps that end during the low point in the alertness cycle. Sleep inertia will generally last longer following naps ending between 0300 and 0700 hours.

- Sleepiness – no evidence of any relationship between sleepiness and sleep inertia has been found.

If you have sleep inertia, you might demonstrate all the outward physical signs of being awake but are not cognitively awake.

It can occur regardless of the duration of sleep – disorientation is experienced after a few seconds of sleep (microsleeps), a nap or a long episode of sleep.

NASA Naps

Dr Mark Rosekind, a scientist who worked for the National Aeronautics and Space Administration (NASA) fatigue counter-measures programme, has studied pilots on trans-Pacific routes where no napping was allowed. He found a consistent decline in performance measures such as vigilance and reaction time.

However, when Rosekind repeated the experiment over the same route allowing a 40-minute nap, the results showed a marked difference, with performance improving by 34 percent and physiological alertness by 100 percent.

Rosekind believes there are many arguments against napping due to the possible effects of sleep inertia upon

waking. However, there are several stages of sleep and the body cycles through each in turn.

An effective nap in operational settings according to Rosekind should be limited to 45 minutes to ensure the nap does not go beyond the second stage of sleep.

Crews allowed to proceed into a deeper sleep stage, will feel the effects of sleep inertia and may perform worse than they did before the scheduled nap.

Preventing Sleep Inertia

Napping to avoid sleep deprivation can significantly improve alertness, communication and performance. However, it is important that the potential effects of sleep inertia following a nap be acknowledged and actions are taken to mitigate effects.

Anecdotal evidence suggests that the use of 'alerting factors' upon awakening, such as washing your face in cold water, bright lights, loud noise and physical exercise may help to minimise the effects of sleep inertia. The effectiveness of these alerting factors, however, has not been empirically validated by research.

There are a range of options that should be considered by operators to guard against the effects of sleep inertia.

You should ensure that anyone likely to suffer from sleep inertia is aware that their performance may be affected for up to 30 minutes or more after waking. For some operators it might be useful to consider using automated facilities, such as auto flight planning and auto fuel calculations.

Involving all crew members in flight planning and decision making can minimise the likelihood of errors going unnoticed.

Operators should consider factoring additional time into the response times to accommodate the effects of sleep inertia. Many emergency medical service operators quote a six-minute response time which would not allow pilots who were deeply asleep to recover from sleep inertia before becoming airborne.

The impact of sleep deprivation on sleep inertia has implications for shift workers who are required to make important decisions shortly after waking, such as crews who are woken to conduct unscheduled emergency flights for medical evacuations, search and rescue, or police work.

Continued over ...

Stages of Sleep

Sleep patterns vary from person to person, however, a well-rested person generally moves through progressive sleep stages, including Rapid Eye Movement (REM) sleep and non-REM sleep.

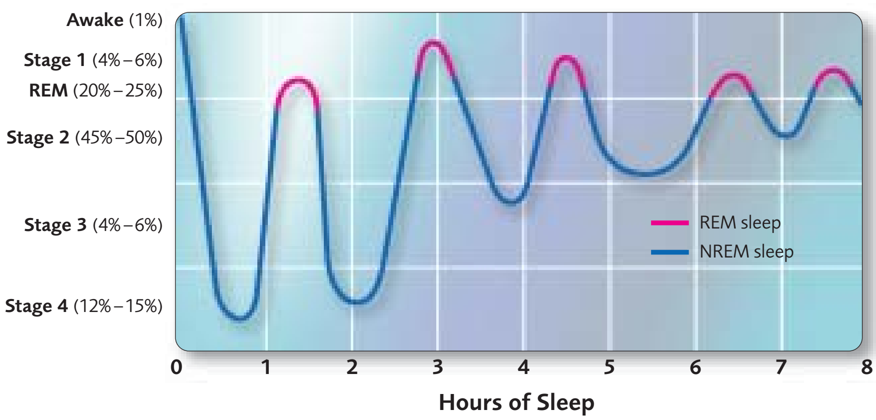
Stage 1 sleep is a transition phase between wakefulness and sleep. Brain waves become smaller and slower. In this stage, a person is still easily awakened and might even deny having slept.

Stage 2 sleep is a deeper, intermediate stage of sleep and occupies about 50 percent of an adult's sleep pattern. In this stage, blood pressure, metabolism and cardiac activity decrease. Brain waves are larger with occasional bursts of activity. A person will not see anything even if the eyes are opened, but can easily be awakened by sound.

Stage 3 sleep is the beginning of deep sleep and is characterised by delta waves – slow brain waves which are about five times the size of brain wave patterns in Stage 2 sleep. A person will be far more difficult to awaken during this stage.

Stage 4 sleep is when the deepest sleep occurs and is characterised by larger delta brain waves. If the person is a sleepwalker or a bed wetter, these activities will begin in this phase.

Waking someone from Stages 3 and 4 sleep is quite difficult. A person awakened from these deep sleep stages will probably be groggy, disorientated and confused and experience sleep inertia.



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These workers are often abruptly woken from deep sleep episodes and need to dress, travel to an aerodrome, and perform flight planning and pre-flight checks before departing within a very short time.

Professor Drew Dawson and Dr Adam Fletcher, two of Australia's leading experts on fatigue and sleep, recommend that emergency service workers should not engage in any critical decision-making or performance tasks, like driving, for a minimum of 20 minutes after waking, to allow any effects of sleep inertia to dissipate.

Several aircraft accidents over the past few years have highlighted performance problems that result when pilots are woken from a deep sleep.

In one recent fatal aircraft accident, the pilot had been woken abruptly to transport medical staff to a patient. Less than 15 minutes elapsed between the time of the pilot waking and the aircraft departing, during which all pre-flight preparation had to be done.

The aircraft subsequently departed from the patient's home with insufficient fuel for the return flight to its base and lost power while attempting to land.

All five people on board died. It is possible that the pilot may have been affected by sleep inertia during pre-departure and the early stages of flight, although the extent to which the pilot actually experienced sleep inertia, if at all, could not be determined (Australian Transport Safety Bureau).

Fatigue Factors

Humans need adequate rest, and if we don't get it our performance suffers markedly. We have a hard-wired, genetically determined biological need for sleep, and a circadian pacemaker that programmes us to sleep at night and be awake during the day.

Nowadays, 24-hour operations challenge these basic physiological principles. Shiftwork, altered and changing work schedules, crossing time zones, long hours of continuous wakefulness, and sleep loss can create disruptions to sleep and circadian rhythms that seriously degrade the waking function.

When someone is deprived of sleep, the physiological response is sleepiness, which is the brain's signal to prompt an individual to obtain sleep. Eventually, when sufficiently deprived of sleep, the human brain can spontaneously shift from wakefulness to sleep in order to meet its physiological need.

The sleepier the person, the more rapid and frequent the intrusions of sleep into wakefulness – these spontaneous sleep episodes can be very short (microsleeps) or last for extended periods of time.

Fatigue has frequently been found to be a major contributing factor in aviation, marine, rail and road accidents with catastrophic consequences.

In 1985, fatigue was cited as a factor in one of the worst aviation disasters in Canadian history when a charter plane carrying US military personnel crashed

A Blink of an Eye

During a microsleep, the brain "shuts off" for just a moment even though the eyes may remain open.

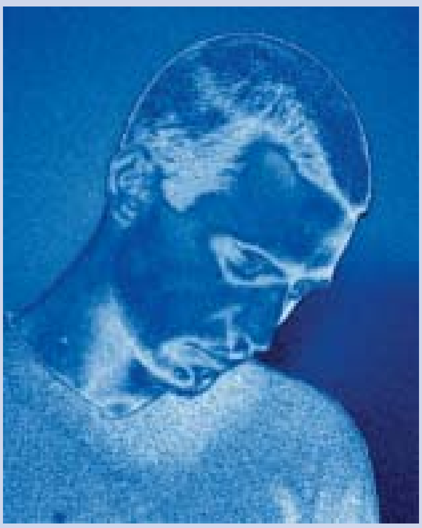
Microsleeps are a very short period of sleep lasting from a fraction of a second to approximately 10 seconds.

Microsleeps may be associated with a blank stare, 'head snapping', momentary dozing or prolonged eye closure that occurs when a person is fatigued but tries to remain awake to perform a task.

Although the existence of microsleeps can be confirmed by electro-encephalography (EEG) recordings, people are generally not aware of them, which makes the phenomenon especially dangerous.

Due to the fact that microsleeps are involuntary and no warning is given, they can result in fatal accidents, particularly while driving, due to the speed of the vehicle and the distance travelled while out of control of the driver.

If a person driving at a speed of 100 kilometres per hour has a microsleep lasting just four seconds, the vehicle will travel for 111 metres while completely out of the control of the driver.



During a microsleep people are unable to respond to external stimuli such as other traffic, curves in the road, warning lights or other visual signals.

Microsleeps are uncontrollable by the individual and the perceptual isolation accompanying them can lead to disorientation after the sleep episode and an initial decrease in performance.

According to the NASA fatigue counter-measures group, when microsleeps occur the potential for sleep inertia exists. Pilots could have performance lapses and difficulty in maintaining alertness.

Neurocognitive functioning, such as vigilance, the ability to maintain focus on a specific task, memory lapses and decreased social interactions, can be affected.

In 1994, researchers from NASA travelled with pilots over several trans-Pacific routes and logged their sleep, rest and duty times. The pilots were connected to devices that measured biomedical evidence of microsleeps.

The observations revealed 154 occurrences of microsleeps; of these, almost half lasted 10 seconds or longer.

A worrying finding was that a quarter of the microsleeps were recorded during the critical phases of descent and landing. The findings clearly demonstrated the potential for fatigue and sleep loss to result in unplanned and involuntary occurrences of sleep, particularly in long-haul operations.

and burned in Gander, Newfoundland killing all 256 on board.

More recently, crew fatigue was found to be a contributing factor in the crash of American Airlines Flight 1420 at Little Rock, Arkansas in 1999 (see *Flight Safety Australia*, June-July 2002).

The captain and 10 passengers died when the MD-82 landed in a violent storm and the plane overran the runway, went down an embankment, and slammed into approach light structures.

The last decade has seen extensive research on the risks associated with fatigue. A confidential reporting system administered by NASA found that of the 2,900 aircraft incident reports received per month, approximately 21 percent of pilot errors reported were fatigue related, with most of the errors occurring during critical descent and landing phases.

This year the US National Transportation Safety Board (NTSB) cited crew fatigue as one of the paramount safety issues facing all modes of transportation. The nuclear power plant industry has also recognised the need to manage the effects of fatigue after the events at Three Mile Island and Chernobyl.

Under pressure to travel long distances in monotonous conditions, workers admit they struggle. While the image of a freight train engineer falling asleep somehow seems less threatening than thoughts of pilots dozing in the cockpit or truckers falling asleep at the wheel, the risk of a catastrophic accident remains, as the accompanying case studies reveal.

Case Study 1

In 1994, a Bell 206B helicopter collided with a high tension power line with the pilot sustaining fatal injuries. The profile of the flight path, indicated by breaks in the trees, showed a gradual descent with a steep pull-up at the last group of trees before the power line.

The pilot was very experienced and the autopsy revealed no physical anomalies or impairments that could have contributed to the accident. Examination and disassembly of the helicopter and components by aircraft accident investigators and representatives of Bell Helicopter found no evidence of malfunction.

The investigation found that the pilot's flight duty time during the preceding week was excessive. The investigation report concluded that the flight path was consistent with the pilot falling asleep or having a microsleep episode, and the helicopter beginning a gradual descent into the tree tops.

On impact with the trees, it's likely that the pilot woke suddenly suffering from disorientation due to sleep inertia. Despite his immediate efforts to pull up the helicopter, he misjudged the situation, and did not clear the hydro lines just ahead (Transportation Safety Board of Canada).

Case Study 2

On 26 October 1990, a heavy vehicle truck transporting eight cars entered a highway work zone and struck the rear of a utility trailer being towed. This car and trailer then struck the rear of another vehicle, and the truck and the two automobiles travelled into the closed right lane and collided with three road maintenance vehicles.

Fire ensued, and the eight occupants in the two cars died. All six vehicles involved in the accident were either destroyed or severely damaged. The truck driver and one fire fighter sustained minor injuries.

The investigation by the US National Transportation Board found that the probable cause of this accident was the inattention of the driver of the heavy vehicle truck after a microsleep due to fatigue, exacerbated by an inadequate and unbalanced diet the day of the accident. The investigation also criticised the truck company's failure to ensure that its drivers were qualified and received adequate rest (National Transportation Safety board, USA).

Case Study 3

In December 2000, a northbound express freight train passed through a stop signal and collided head-on with a departing southbound express freight train. The driver told investigators that he "sort of woke up ... to see the headlight of another freight train coming straight at him". He braked and braced himself against a console as the trains hit at a combined speed of 58 kilometres an hour

Three locomotive crew members received minor injuries. The locomotive on each train and a number of wagons were extensively damaged. Safety issues revealed in the subsequent investigation included the control of locomotive engineers' hours of duty, fatigue management, the locomotive engineer losing situational awareness during a microsleep, and the inability of the locomotive vigilance system to overcome short-term attention deficits in time to prevent this type of collision (Transport Accident Investigation Commission, NZ).

Long-range Operations

Fatigue and related issues such as napping, crew alertness and sleep inertia is currently the subject of research co-ordinated by the international safety group, the Flight Safety Foundation.

A team of international specialists including representatives from international airlines, pilots, flight attendants, scientists, civil aviation authorities and manufacturers are working together to recommend regulatory and operational guidelines for ultra-long range (ULR) flights. ULR flights can involve flight-duty periods of 18 to 22 hours.

Around 85 safety specialists from 14 countries recently attended the second workshop in France conducted by the ULR crew alertness steering committee, co-chaired by Flight Safety Foundation and Boeing, and hosted by Airbus Industries.

The aim of the committee and workshops is to develop operational guidelines and strategies for ULR flights, to ensure that crew fatigue is minimised and crew alertness is optimised.

Conclusion

Managing fatigue in transport operations is a complex task that provokes many opinions and lively discussions from a range of personnel including companies, regulatory and investigation agencies, workers and unions.

Education, information dissemination and learning from accidents are a few of the strategies in use to decrease the risks and hazards associated with microsleeps and sleep inertia.

The next time you're woken for work urgently or find yourself tired during a shift, take some time to protect yourself and others from the potentially dangerous effects of sleep inertia and microsleeps.

Individuals and organisations need to become familiar with the high risk precursors to sleep inertia and microsleeps and have a mitigation plan in place. ■

About the Authors: *Joanne De Landre is a human factors research officer with CASA; Christine Boag is a senior transport safety investigator with the ATSB, and Dr Adam Fletcher is a senior research fellow at the Centre for Sleep Research at the University of South Australia.*

Double Engine Failure

Readers are encouraged to share their aviation experiences in order to alert others to the potential pitfalls. We do not accept anonymous contributions. If you tell us who you are, we will not publish your name unless we have your permission.

SHARE YOUR EXPERIENCE

The Incident

We were climbing through 2800 feet amsl after takeoff on a type rating conversion flight when the student pointed out that the landing lights were still on. I asked the student to switch them off, whereupon the left engine suddenly lost power.

I looked over to see that the student had inadvertently turned the left engine's magnetos to the OFF position. The student quickly turned them back on again, but for some reason full power was not restored. The manifold pressure on both engines was now limited to 25 inches of boost even though the throttles were wide open.

My first thought was that the pressure relief valve on the turbos had popped and that the engines were now normally aspirated. A turn was then made back towards the aerodrome at 89 knots (Vyse – best single-engine climb speed). The aircraft was, however, still descending at between 1000 and1500 ft/min, so a suitable forced landing area ahead along the beach was selected in case engine power could not be restored.

The engine trouble-checks were carried out at about 1700 feet amsl, only to find that the student had also inadvertently selected fuel OFF on both engines. The throttles were retarded, fuel ON hastily reselected and both engines slowly brought up to full power, and a climb away commenced from 1500 feet amsl.

The remainder of the flight continued uneventfully.

Post-Flight Analysis

During the post-flight debrief, it was ascertained that the student had carried out the standard after takeoff 'clean-up checks' on climbout, which included turning the landing lights off. Noticing that the landing lights were still on, however, the student elected to start the 'clean-up checks' again. They consist of: brakes OFF, undercarriage UP, cowl flaps OPEN, power SET, and landing lights OFF.

Because the student had previously flown another twin that required the electric fuel pumps (located on the floor between the two front seats) to be turned off after takeoff, an additional check of 'fuel pumps OFF' (to be simulated only) had been included in the 'clean-up checks' to maintain procedural consistency between the different types.

The student, when reaching 'fuel pumps OFF' in the checklist, mentally reverted to flying the other aircraft type and turned both fuel selectors (located between the two front seats) off thinking that they were in fact the fuel pumps, the consequences of which did not become apparent until the loss of manifold pressure was noted. In the meantime, the student had also turned the lefthand engine magneto switches off confusing them with the landing light switches as the last item on the checklist. (The magneto switches are located directly above the landing light switches and have a cover over them to prevent them being inadvertently selected, which the student lifted.)

Lessons Learnt

The root cause of the student selecting fuel OFF was really due to the ergonomic differences between the incident aircraft and the similar type previously flown. Under the high workload of flying the new type, the student reverted back to the old habit of switching the fuel pumps off after takeoff as part of the 'clean-up checks'. In doing so, the fuel selectors were mistaken for fuel pump switches that weren't actually there and, instead, both fuel selectors were turned off.

I had not noticed the student's hand reaching down to turn the fuel selectors off because they are near the elevator trim wheel (if I had, I probably would have interpreted this action as the aircraft being re-trimmed) and are generally obscured from vision by the instructor's leg.

Additionally, poor ergonomic positioning of the magneto and landing light switches led to their mis-selection – something that is easily done under pressure.

When both engines lost power, my initial attention was with resolving a magneto problem, even after the lefthand engine's magnetos were turned on again to no effect. I had developed a mind set that the power loss was associated with a magneto problem. This distracted me from getting on with the remainder of the engine trouble-checks and cost us precious height.

In retrospect, I should have noticed that the fuel flow gauges were indicating zero suggesting that the fuel had been turned off. I also forgot about using the low-boost fuel pumps in case of vapour lock when restarting the engines – fortunately vapour lock did not occur in this instance. Both of these actions seem obvious in hindsight, but the pressures of dealing with a totally unexpected double engine failure should never be underestimated.

This incident has made me think more about the dangers of converting between different types and the fact that double engine failures can, and do, happen. I now make a point of briefing all my students on the engine trouble-checks and restart procedures in the event of a double engine failure, and periodically ask them what they would do if both engines failed "now" when on training flights.

Student and instructor name withheld
March 2003

Vector Comment

Thank you for submitting this account of an incident that could easily have ended up so differently. Full marks for flying the aircraft first before trying to deal with engine trouble-checks, ie, selecting a suitable forced landing area early on.

This incident reinforces the importance of following the tried-and-tested engine trouble-checking mnemonic **FMIIP** in order, as each action item takes priority over the one before it for very good reason. In the case of a fuel flow problem in an aircraft with a reasonably complex fuel system, if the fuel checks do not rectify the problem, or the pilot fails to recognise that a fuel tank(s) has been mis-selected, then a check of fuel flow/pressure under '**I** for instruments' later in the mnemonic should help the pilot pick up the problem.

Cockpit ergonomics, particularly in a lot of older light twins that are currently being used for flight training in New Zealand, can pose a significant safety issue. Sometimes, the position or sequence of switches and levers in the cockpit are not always intuitive. Consequently, the potential for a mis-selection when under pressure is high – particularly if the pilot is accustomed to flying another type with different systems or cockpit layout. The transition from one type to another, no matter how small the differences are, must be done with care.

This is one of the reasons why students undergoing a type rating conversion should spend time **fully** familiarising themselves with the aircraft systems by **thoroughly** reading the Flight Manual and receiving a full briefing from the instructor concerned. Such a familiarisation should also include spending some time sitting in the aircraft and getting a feel for where everything is – **before** any flying is undertaken.

It is interesting to note that the contents of many multi-engine type rating syllabuses focus on one-engine out emergencies rather than double engine failures. Yet, the reality is that there have been at least four double engine failures over the last ten years in New Zealand, so it makes a lot of sense that such an eventuality is covered in the type rating training. We hope that all multi-engine instructors are doing this. ■

Letters to the Editor

Readers are invited to write to the Editor, commenting on articles appearing in *Vector*, recommending topics of interest for discussion, or drawing attention to any matters in general relating to air safety.

Aircraft Pre-flight

Having just read the "How Thorough is Your Pre-flight" article in the March/April *Vector*, I would like to suggest that there is another causal factor that has not been given enough weight, if any.

I am an RNZAF aircraft engineer and a private pilot and as such can see both sides of this matter. My problem is that someone lost or left a pen in the aircraft without bringing the matter to anyone's attention. As is highlighted in the article, this could have, and probably has had, fatal consequences. I feel that aviation professionals should have enough clues to keep track of the items that they carry onto an aircraft and then be able to ensure that they remove them all afterwards. Instructors should teach their students this and pilots brief their passengers on the dangers of losing such items. As has been highlighted here, a pen is not an inconsequential item in an aircraft, so why treat it as one? FOD in the cockpit has caused more than one bad day in the past.

On another matter, I wish to strongly endorse the publishing of personal experiences and incident reports. Over the years I have learned a lot about flying and airmanship by reading all that I can find and listening to others' experiences. On more than one occasion another's lesson has surfaced to enable me to prevent a recurrence during my own flying.

Murray Shaw
Wanganui
April 2003

Vector Comment

Thank you for your letter on what was an interesting and thought-provoking article.

We would like to reinforce your point that every pilot should always keep a mental inventory of all items introduced into the cockpit, and that each and every one of these must be accounted for at the end of a flight. This advice also applies to all items that passengers bring on board.

Several years ago, a Pitts Special pilot experienced some difficulties trying to recover from an intentional spin while on an aerobatic joy-ride flight due to a restriction in the controls. The cause of the restriction was later traced to a passenger's empty film canister that had found its way aft and fouled the elevator bell crank. This incident is a classic example of how something small and seemingly insignificant can potentially result in a serious accident.

It is always encouraging to receive positive feedback from *Vector* readers on the safety benefits of publishing the experiences of others, whether they be in the form of a "Share Your Experience" article or in the "Occurrence Briefs". We also believe that such forums are an invaluable safety education tool. ■

Wet-Line Instrument Systems

The Incident

Photograph courtesy of TAIC.

The Hughes 369D helicopter was being flown on a scenic passenger flight from Mount Tarawera to the company base near Rotorua when it began to experience engine problems. The helicopter's engine failed completely before the pilot could carry out a precautionary landing, necessitating an auto-rotation on to rough terrain. The helicopter rolled over upon touchdown, but none of its four occupants were injured.

In its accident investigation report, the Transport Accident Investigation Commission (TAIC) identified that the helicopter's engine had failed due to oil starvation following the fracture of a nylon tee fitting in the engine torque gauge oil pressure feed line system.

Background

The accident helicopter's instrument panel, showing the broken torque and oil pressure gauge supply line fittings. Photograph courtesy of TAIC.

The engine torque and oil pressure gauges fitted to this particular model of helicopter utilise a 'wet-line system' (often referred to as a 'direct-reading system') that transmits engine torque-meter and oil pressure readings, via flexible plastic lines, to the instrument panel. The fracture of the tee fittings immediately behind these gauges allows engine oil to escape undetected into the rear of the instrument panel. However, the supply lines are fitted with a snubber device, designed to significantly restrict the oil flow rate should a line failure occur. This provides the pilot with five minutes **only** in which to carry out a precautionary landing before engine oil supplies become critical.

Abnormal engine torque or oil pressure gauge readings are sometimes an indication of a leaking engine instrument system and that oil is being lost. Standard operating procedure in such a situation requires that the pilot carry out a precautionary landing as soon as possible before engine oil quantities become critical.

The pilot of the accident Hughes 369D had not been in the habit of monitoring engine torque gauge readings when making power changes, but instead referencing the TOT (turbine outlet temperature) gauge because it usually reached its limit first. This meant that he had little awareness of the torque gauge readings at any stage during the flight, and that the first warnings of an impending engine failure were lost.

During its investigation, TAIC found that experienced Hughes 369 pilots and instructors generally had a poor understanding of 'wet-line' instrument systems and, in particular, that a torque indication failure might be the first warning of engine oil loss. Because of this, the TAIC report recommended that there was the need for pilots and operators to better understand this type of instrument system and know what the appropriate pilot response should be when erroneous engine instrument indications were observed.

Lessons

Although instrument oil pressure line failures are rare, this accident illustrates that they can, and do, happen. It highlights the importance of being totally familiar with an aircraft's systems and knowing what to do if a suspected failure occurs.

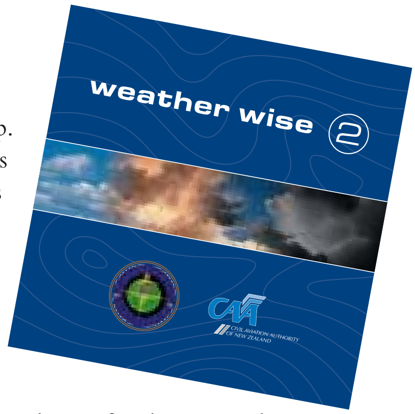
A number of aircraft types (both rotary and fixed-wing) operating in New Zealand have 'wet-line' engine instrument systems fitted. Pilots and operators are therefore reminded to make sure they know what type of pressure sensing system their model of aircraft is fitted with, what the instrument indications would be should a supply line leak develop, and to know the appropriate response action to a suspected failure.

As a result of this accident, the helicopter manufacturer has amended its Flight Manuals for helicopter models fitted with 'wet-line systems' to alert pilots to this potential problem.

It should also be noted that the alternative to the 'wet-line' system is to use a remote sender unit, which transmits oil pressure in the torque-meter or oil pressure system electrically to a gauge or warning light. This has the advantage of keeping the oil contained within the engine. Some aircraft, however, have been modified as an upgrade to this type of system from the 'wet-line' system. The situation can, therefore, occur where a pilot is familiar with the standard model but does not realise that another similar aircraft in the fleet has been modified. Significant differences can also occur between aircraft using the same engine type. The Allison 250 engine, for example, may utilise different engine instrument systems depending on the aircraft type it is installed in. For instance, a Nomad aircraft may have a different system to a Hughes 369D and a Bell Jetranger is different again.

Instructors and company training officers are encouraged to incorporate such instrument-failure scenarios into their training. The military, for example, require that all instrument power sources can be identified by their flight crews and maintenance ground-running personnel. This includes AC and DC power sources, direct reading wet-line instrument sources, and pitot static sources. Otherwise it's an expensive exercise if you're unfortunate enough to get it wrong, as was the case in this accident. ■

Weather Wise 2 – CD ROM



Recently, the CAA distributed *Weather Wise 2* training CDs to all Part 135 operators, Part 141 training organisations and to pilots who attended a 2002 *Weather Wisdom* Av-Kiwi seminar. Produced by the Federal Aviation Administration, *Weather Wise 2* is an interactive CD ROM designed to improve pilots' weather-related decision-making skills. There was an Australasian influence in its development, with Dr David O'Hare of the University of Otago and Dr Mark Wiggins of the University of Western Sydney being closely involved. Feedback so far on the CD has been positive, with many pilots saying that it is an excellent decision-making training tool. However, some users have experienced computer software problems when attempting to run the CD.

The CD contains a number of video clips of weather-related scenarios for pilots to work through, all of which require the installation of the programme QuickTime (version 3 or higher) to view. Normally, the CD would already have this programme encoded on it, which the computer would detect and install when the CD is booted up. Unfortunately, QuickTime was not replicated when the CD was reproduced, which means that disk users who do not already have QuickTime installed on their computers are unable to view the video clips.

The Safety Education and Publishing Unit would like to apologise for this oversight and hopes that not too many CD recipients have been frustrated by this technical problem. The good news is that QuickTime (version 3 or higher) can be downloaded free of charge from the Apple Computer Inc web site (www.apple.co/quicktime/download/). Simply select the operating system that is applicable to your computer, enter your user details, hit the download button and follow the set-up menu dialog boxes. Your computer should now be set up to run the CD. ■

New Video – Airframe Icing

A new CAA safety video entitled *Airframe Icing* has just been released. This video looks at the fundamentals of airframe icing, including the conditions that cause it, types of icing, its effect on aerodynamic performance, and what to do if icing is encountered.

The latter part of the video contains an IFR flight scenario, illustrating such factors as weather forecast interpretation and the enroute decision making necessary when dealing with icing conditions.

IFR pilots of single-engine, through to commuter turboprop aircraft will find *Airframe Icing* relevant to their operation, regardless of their experience level.

Airframe Icing can be borrowed from the CAA Library free of charge or purchased directly from Dove Video. See the January/February 2003 issue of *Vector* for contact details or visit our web site (**www.caa.govt.nz**) and look under **Safety Information/Videos**.

AIP Supplement Cut-off Dates

Do you have a significant event or airshow coming up soon? If so, you need to have the details published in an AIP *Supplement* rather than relying on a NOTAM. (Refer to AC 91–1 *Aviation Events* for operational requirements.) The information must be promulgated in a timely manner, and should be submitted to the CAA with adequate notice. Please send the relevant details to the CAA (ATS Approvals Officer or AIS Coordinator) at least one week before the appropriate cut-off date indicated below.

Supplement Cycle	*Supplement* Cut-off Date (with graphic)	*Supplement* Cut-off Date (text only)	*Supplement* Effective Date
03/08	5 Jun 03	12 Jun 03	7 Aug 03
03/09	3 Jul 03	10 Jul 03	4 Sep 03
03/10	31 Jul 03	7 Aug 03	2 Oct 03

Accident Notification

24-hour 7-day toll-free telephone

0508 ACCIDENT

(0508 222 433)

CA Act requires notification "as soon as practicable".

Aviation Safety Concerns

A monitored toll-free telephone system during normal office hours. A voice mail message service outside office hours.

0508 4 SAFETY

(0508 472 338)

For all aviation-related safety concerns

OCCURRENCE BRIEFS

Lessons For Safer Aviation

The content of *Occurrence Briefs* comprises notified aircraft accidents, GA defect incidents (submitted by the aviation industry to the CAA), and selected foreign occurrences that we believe will most benefit engineers and operators. Statistical analyses of occurrences will normally be published in *CAA News*.

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

Accidents

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

Some accidents are investigated by the Transport Accident Investigation Commission, and it is the CAA's responsibility to notify TAIC of all accidents. The reports which follow are the results of either CAA or TAIC investigations. Full TAIC accident reports are available on the TAIC web site **www.taic.org.nz**.

ZK-TMO, Pacific Aerospace Cresco 08-600, 14 Jun 01 at 11:30, 14NM W Gisborne. 1 POB, injuries 1 fatal, damage destroyed. Nature of flight, agricultural. Pilot CAA licence CPL (Aeroplane), age 49 yrs, flying hours 7300 total, 261 on type, 261 in last 90 days.

The pilot was engaged in topdressing operations from Te Aroha Station, a property near Gisborne. Shortly after takeoff, the aircraft began dumping fertiliser during a steep turn in order to remain clear of the surrounding terrain. However, the aircraft continued to lose altitude while in the turn until there was insufficient height remaining to complete the manoeuvre. It subsequently struck a fence post, cart-wheeled and caught fire.

A full accident report is available on the CAA web site.

Main sources of information: CAA field invesigation.

CAA Occurrence Ref 01/2053

ZK-JBE, Pegasus XL, 29 Jul 01 at 10:00, Fox Glacier. 1 POB, injuries nil, damage substantial. Nature of flight, training solo. Pilot CAA licence nil, age unknown, flying hours 12 total, 12 on type, 12 in last 90 days.

While landing on a private airstrip the right wheel touched down first on the soft ground. This spun the aircraft sideways, damaging its left wing.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 01/2664

ZK-FVE, Micro Aviation B22 Bantam, 16 Feb 02 at 16:00, Pikes Point. 1 POB, injuries nil, damage minor. Nature of flight, private other. Pilot CAA licence nil, age 59 yrs, flying hours unknown.

After completing a precautionary landing during a test flight, the aircraft hit a concealed tree stump and over-turned.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/403

ZK-SWK, Seawind 3000, 10 Aug 02 at 13:00, Lake Wairarapa. 2 POB, injuries nil, damage minor. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 44 yrs, flying hours 177 total, 61 on type, 4 in last 90 days.

The pilot reported that during a water landing, a high rate descent combined with rounding out too high caused the aircraft to bounce, damaging its starboard float.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/2400

N30DM, Vans RV-4, 18 Aug 02 at 11:50, Okarito. 2 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 32 yrs, flying hours 700 total, 120 on type, 30 in last 90 days.

The pilot reported that there was limited braking action on the wet grass and that the aircraft had overrun the airstrip. Damage was limited to a broken propeller, a slightly bent landing gear leg, and a cracked engine cowl.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/2469

ZK-JCR, Cessna A188B, 1 Sep 02 at 13:00, Clinton. 1 POB, injuries nil, damage destroyed. Nature of flight, agricultural. Pilot CAA licence CPL (Aeroplane), age 41 yrs, flying hours 900 total, 530 on type, 20 in last 90 days.

The aircraft failed to climb away after becoming airborne from a topdressing airstrip. The pilot began to jettison the load, but this did not significantly improve the aircraft's performance. As a result, it overran the airstrip before coming to rest on the slope below and catching fire.

The pilot suspected that some of the previous load may have been damp and remained in the hopper, which could have resulted in the takeoff being inadvertently attempted in an overloaded condition. There was also a light fluctuating wind present at the time, which may have contributed to the poor climb performance.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/2572

ZK-IMG, Robinson R22 Alpha, 9 Sep 02 at 15:45, Parawaihipi Station. 1 POB, injuries nil, damage minor. Nature of flight, private agricultural. Pilot CAA licence PPL (Helicopter), age 46 yrs, flying hours 700 total, 600 on type, 83 in last 90 days.

The helicopter was engaged in a private farm work operation, when it encountered power settling due to a stronger-than-expected tailwind while on approach to land. This resulted in a heavy landing, which caused damage to the engine frames, tail cone skin, and cabin door frames.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/3113

ZK-SPC, Murphy Maverick, 25 Sep 02 at 10:34, Te Kowhai. 2 POB, injuries nil, damage substantial. Nature of flight, training dual. Pilot CAA licence PPL (Aeroplane), age 40 yrs, flying hours 3380 total, 178 on type, 88 in last 90 days.

The pilot had taxied the microlight to the end of the runway to do his pre-takeoff checks when he noticed a large dark cloud approaching the airfield. He decided to taxi back to the hangar, but as he did so a gust of wind lifted the aircraft onto its nose and then over onto its back.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/2822

ZK-RAM, Robert Koch Tandem Special, 27 Oct 02 at 12:00, Timaru. 1 POB, nil, damage substantial. Nature of flight, private other. Pilot CAA licence CPL (Helicopter), age 59 yrs, flying hours 28370 total, 310 on type, 17 in last 90 days.

Inadvertently, the pilot attempted to take off on a mown strip of grass that is only used to position gliders for the main grass runway. During the takeoff run, the rough ground caused the rotor blades to flap and the gyrocopter to launch itself into the air. The pilot shut down the engine due to the ensuing vibration, which caused the gyrocopter to pitch down and to the left, and impact the ground.

The pilot identified that fatigue, and a failure to correctly identify the grass runway, were contributing factors to the accident.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/3140

ZK-SBK, Cessna 172P, 31 Oct 02 at 16:00, West Melton. 1 POB, injuries nil, damage minor. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 46 yrs, flying hours 204 total, 38 on type, 13 in last 90 days.

The pilot had been practising for bombing competitions, flying 500-foot circuits on runway 29 at West Melton. On completion, he attempted to land on runway 04 with a quartering tailwind, which had increased in strength during the sortie. The aeroplane overran the runway, struck a fence and came to rest in an adjacent paddock. The aircraft sustained minor damage to the nosewheel spat and one wingtip.

Main sources of information: Accident details submitted by operator.

CAA Occurrence Ref 02/3583

ZK-GVS, PZL-Bielsko SZD-48-1 Jantar Standard 2, 20 Nov 02 at 16:00, Mt Benmore. 1 POB, injuries 1 serious, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age unknown, flying hours 2133 total, 1000 on type, 25 in last 90 days.

The glider crashed onto the top of Mt Benmore at 5000 feet amsl while the pilot was searching for better lift. Unfortunately, he was rendered unconscious during the accident and cannot recall any details just prior to the impact. However, another pilot, who was flying just ahead of him, stated that he had tried to warn the pilot on his radio of the severe turbulence that he had just experienced. The glider had been flying at 65 knots at the time.

It was felt that the accident glider may have been caught in the same turbulence, and because it was flying at a lower airspeed (the pilot remembers the airspeed being below 65 knots), it may have clipped a rock outcrop before control could be regained.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 02/3375

ZK-DZC, NZ Aerospace FU24A-950, 19 Dec 02 at 13:00, Nelson. 1 POB, injuries nil, damage substantial. Nature of flight, aerial application/dropping. Pilot CAA licence CPL (Aeroplane), age 62 yrs, flying hours 22000 total, 10000 on type, 150 in last 90 days.

The aircraft was engaged in topdressing from a rough airstrip when, just after takeoff, the pilot realised that the left main landing gear was missing. The pilot flew the aircraft to Nelson Airport, where a successful landing on the remaining undercarriage was made.

The lower portion of the landing gear could not be found during the subsequent investigation. The left main scissor link top bolt on the remaining portion of the undercarriage leg, however, appeared to have failed in a similar fashion to others in the past due to rough airstrip operations.

Main sources of information: CAA field invesigation.

CAA Occurrence Ref 02/3689

ZK-HSX, Bell (US Helicopter) UH-1H, 19 Dec 02 at 18:30, Kopaki. 1 POB, injuries 1 minor, damage substantial. Nature of flight, agricultural. Pilot CAA licence CPL (Helicopter), age 52 yrs, flying hours 16654 total, 1162 on type, 145 in last 90 days.

The helicopter was engaged in aerial spraying operations when it struck a wire and then landed heavily. The pilot vacated the machine, which was then substantially damaged by a fire that broke out.

Main sources of information: Accident details submitted by pilot and operator

CAA Occurrence Ref 02/3688

GA Defect Incidents

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

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

Key to abbreviations:

AD	= Airworthiness Directive	**TIS**	= time in service
NDT	= non-destructive testing	**TSI**	= time since installation
P/N	= part number	**TSO**	= time since overhaul
SB	= Service Bulletin	**TTIS**	= total time in service

Hughes 369D – Collective support bracket fails, P/N 369A7339

At about 20 feet the pilot heard a loud bang, whereupon the helicopter dropped approximately three feet. He immediately disembarked the passengers onto a nearby ridge and then flew to a suitable landing site and shut down.

Engineering investigation found that the bracket holding the collective bungee installation together had broken off and fallen to the floor. A new part was fitted.

TTIS 11592 hrs.

ATA 2700 CAA Occurrence Ref 01/1437

Hughes 500D – Engine oil return line ruptures

The helicopter was being ferried following maintenance work being carried out, when the pilot noticed that the oil pressure was fluctuating. He had just initiated a descent when the oil chip light illuminated. The helicopter was landed immediately. On shutdown he noticed oil was present throughout the engine bay, but there was none visible in the oil sight glass.

Engineering investigation revealed that the oil loss was caused by a broken oil return line, which passes through the engine firewall. The oil line had deteriorated due to age.

ATA 7900 CAA Occurrence Ref 02/2721

NZ Aerospace FU24-950 – Lycoming IO-720-AIB main bearing fails, P/N LW 13683

The number five main bearing shells suffered a catastrophic failure resulting in the cracking of the crankshaft.

Discussions with Lycoming indicated that they acknowledged there were problems with this type of bearing, and they advised overhaul organisations to use only P/N LW-14830 bearings in the future.

TTIS 5987 hrs; TSO 1603 hrs.

ATA 8520 CAA Occurrence Ref 01/1625

NZ Aerospace FU24-954 (Walter Turbine Conversion) – Fuel control unit problems

The pilot reported that, during takeoff at approximately 10 feet agl, the engine torque gauge reading dropped below 20% and the power turbine (NG) reading also declined. Cycling the power lever to idle and then back to full power did not improve the situation. A safe landing was made.

Engineering staff checked the fuel control unit for air in the fuel. Some air was found in the bottom drain point. It is reported that this type of aircraft has a history of air in the fuel system. It is suggested that at engine run-up during pre-takeoff checks the electric fuel pumps are momentarily turned off. If a drop in NG or engine torque readings is observed, it may indicate the presence of air in the fuel system.

ATA 7300 CAA Occurrence Ref 02/3867

Piper PA-28-140 – Elevator trim cables breaks

The pilot had just started an enroute climb and was trimming the controls when the elevator trim wheel went slack. The flight continued uneventfully, and the pilot landed the aircraft without the aid of the elevator trim control.

Engineering reported that the trim cable was found to have broken completely at a point where a pulley had split in half. The cable had jammed in the broken pulley, which had caused it to chafe through. The reason for the failure of the pulley could not be determined, but it is thought that it may have degraded due to age.

This incident highlights the need for extra vigilance when inspecting flight control cables at scheduled maintenance.

ATA 2731 CAA Occurrence Ref 03/496

Piper PA-28-161 – Landing gear bolt shears, P/N AN4-11A

Pre-flight inspection revealed that a righthand main landing gear bolt had sheared under its head. History has shown that these bolts have frequently been found loose on training aircraft.

New bolts and nyloc nuts have since been fitted to the undercarriage assembly and the area closely monitored at each inspection.

TTIS 8650 hrs; TSI 94 hrs.

ATA 3210 CAA Occurrence Ref 01/1639

Westland Scout AH/1 – Main rotor blade cracks, P/N H12-2-297

The helicopter exhibited a heavy vertical bounce at approximately 100 feet above the ridgeline. The pilot could see that one blade was below the disk line of the other blades. Lowering the collective or applying power increased the bounce. A precautionary landing was made. It was discovered that a main rotor blade had cracked from its trailing edge through the skin to the leading-edge spar. The crack originated from a previous blending repair in the trailing edge. Deep file and gouge marks were present in a chord-wise direction in the trailing-edge spar at the point where the repair had been performed.

TIS 312 hrs.

ATA 6210 CAA Occurrence Ref 00/4053

International Occurrences

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

Australia

Occurrences

The following are a selection of occurrences that come from the ATSB's (Australian Transport Safety Bureau) *Aviation Accident/Incident Database* contained on their web site.

Beech Baron 95-B55 – Aft C of G likely to have precluded recovery

The aircraft disappeared from Air Traffic Control radar display, without prior indication of difficulty. Its wreckage was located the following morning on a moderately timbered slope, 700 metres above mean sea level and 45 kilometres north-east of Canberra. The pilot and all five passengers were killed and the aircraft was destroyed by impact forces.

The investigation determined that the aircraft departed Bankstown Airport loaded in excess of the maximum allowable takeoff weight, and that the pilot did not comply with either Instrument Flight Rules or Night Visual Flight Rules rating recency standards required for the conduct of the flight. While cruising at 8,000 feet, the aircraft entered a rapid descent, during which it reversed direction in a left turn. The descent was briefly arrested at a low altitude; however, the aircraft again turned left and descended rapidly.

The aircraft exhibited flight characteristics consistent with those of an aircraft loaded to an aft centre of gravity position. There are indications that the centre of gravity moved further aft during the flight, until reaching a point at which the pilot was unable to prevent significant diversions in both climb and descent from the reference altitude, culminating in the rapid descent.

Saab 340A – Airframe icing causes in-flight upset

The aircraft was enroute between Albury and Melbourne on a scheduled public transport service. It was operating in instrument meteorological conditions and had accumulated a deposit of ice on the wings and windscreen wipers. The crew interpreted this ice deposit as being less than that required for them to activate the de-ice systems on the wing leading edges, in accordance with the aircraft Flight Manual procedures. As the aircraft approached Melbourne the crew were instructed to enter a holding pattern at Eildon Weir. The crew acknowledged this instruction and reduced power in order to slow the aircraft to the holding pattern airspeed. The crew subsequently allowed the airspeed to fall below the target speed of 154 knots, and despite remedial action, did not regain the target speed.

Shortly after the aircraft entered the holding pattern it suffered an aerodynamic stall and rolled approximately 126 degrees to the left and pitched nose down to approximately 35 degrees. The crew regained control after approximately 10 seconds. The aircraft lost 2,300 feet. The crew was not provided with a stall warning prior to the stall.

The investigation found that despite being certified to all required certification standards at the time, the Saab 340 aircraft can suffer from an aerodynamic stall whilst operating in icing conditions without the required warnings being provided to flight crew. This problem had been highlighted when the aircraft was introduced to operations in Canada and as a result a modified stall warning system was mandated for aircraft operated in Canada. This modification was not fitted to other Saab 340 aircraft worldwide.

United Kingdom

Occurrences

The following occurrences come from the Autumn 2000 edition of *Flight Safety Bulletin*, which is published by the General Aviation Safety Council, United Kingdom.

Jabiru UL – Airsick passenger distracts pilot

The pilot took a young passenger for a flight, but the passenger was airsick and felt unwell throughout the flight. The pilot landed on the grass runway in calm conditions. The aircraft bounced several times before coming to rest with a broken nosewheel. The pilot said his concentration had suffered as a result of his anxiety to land as soon as possible.

PPL with 81 hrs total, 15 hrs on type with 8 hrs in the last 90 days and 6 hrs in the last 28 days.

Mainair Flash – Reduced headwind component increases landing roll

The surface wind was reported as 23 kts when the pilot approached the short landing site sheltered by a basin of hills. As soon as the aircraft descended below the hills, the wind dropped to zero. The pilot says this led to a greatly lengthened landing ground run towards a barbed wire fence. The aircraft was turned to avoid the fence and tipped onto its side, damaging the leading edge hang strap and cracking the pod.

PPL with 231 hrs P1 and 300 hrs on type.

Raven – Wake turbulence prevents aircraft climbing

While taking off behind another aircraft in nil wind conditions, the aircraft encountered wake turbulence and was unable to climb. The aircraft was only just airborne at the end of the runway and the pilot saw an earth bank ahead. The aircraft stalled while the pilot attempted to clear this bank. Still under full power, the aircraft struck the ground and suffered damage probably sufficient to write off the aircraft. The pilot was unhurt.

PPL with 60 hrs P1 and 60 hrs on type.

Robinson R22 B – Pilot becomes distracted during hover taxi

The aircraft had just refuelled and lifted into a rearwards hover taxi from the fuel pump. It lost height and the skids struck the ground. The nose pitched up and the tail rotor hit the ground. The helicopter spun round several times before coming to rest on its right side, damaged beyond economic repair. The pilot escaped uninjured. He said he was distracted by people on the ground near the helicopter.

PPL(H) with 1700 hrs total, 1200 hrs on type with 67 hrs in the last 90 days and 23 hrs in the last 28 days.