January / Febuary 2001

VECTOR

Pointing to Safer Aviation

MICROLIGHT ACCIDENTS AND INJURIES

PILOTS BEHAVING BADLY

MOST COMMON MAINTENANCE ERROR

CAA
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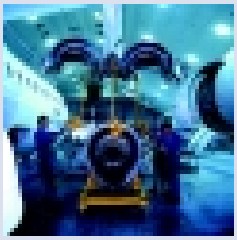
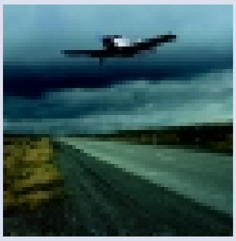


Most aircraft maintenance errors occur when we do not follow procedures properly or are distracted in some way. Jim McMenemy, a Human Factors Specialist for Transport Canada, explains why these slips and lapses sometimes happen and suggests ways to keep them to a minimum.



Why do pilots intentionally break rules? *Pilots Behaving Badly* looks at the most common reasons why and gives examples where pilots knowingly violated 'the rules'.

A dynamic rollover on liftoff is every pilot's worse nightmare. It can happen very quickly and can be fatal. The aerodynamic whys and wherefores of dynamic rollover are discussed.

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Cover Photo:
Evan Gardiner pilots his Pteradactyl Ascender near Waitohi (South Canterbury) as part of the 1983 Richard Pearse Memorial Fly-in. Photograph Jim Barnett, courtesy RAANZ.

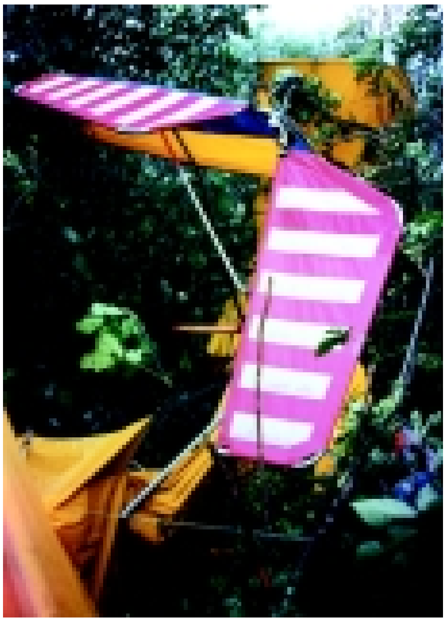
Microlight Accidents and Injuries

This is the final article in a series of *Vector* articles, compiled by Dr David O'Hare, Associate Professor of Psychology at the University of Otago, which looks at the inherent risks and types of injuries associated with the operation of different aircraft types. This article reports on microlight aircraft.

Background

The injury risk potential presented by any vehicle be it aeroplane, car, or horse-drawn carriage is a function of both the inherent characteristics of the vehicle (size, structure, etc) and the way the vehicle is operated. The latter is determined by its design characteristics (for an aeroplane, stall speed etc) and by the decisions of those who operate it.

In the aftermath of an accident it can be difficult to determine the relative contributions of each of these factors to the outcome. Just as the fragile human framework leaves us vulnerable to certain kinds of injuries, so too do the structural characteristics of the different types of aircraft we fly. The levels of risk they pose to our bodily safety can differ markedly.



"…pilots of microlights are more likely to be injured in a crash than are pilots of other categories of aircraft."

In a large passenger aircraft for example, I can make contact with a hard surface (hopefully a runway) at speeds of around 130 knots and barely notice a thing. This is made possible by the structure of the aircraft and the energy-absorbing tyres and hydraulics. The same could not be said of a microlight aircraft. This may sound like stating the obvious because, of course, microlights are designed to touch down at very much lower speeds. Nevertheless, the fact that the pilot of a microlight may be only a few centimetres off the ground with no more in the way of energy absorption than a couple of bungee cords is an important consideration in looking at the types of injuries which are found in microlight accidents.

As explained in previous articles in this series, we conducted a detailed analysis of all the reported aviation crashes in New Zealand between 1988 and 1994. We were particularly interested in the patterns of non-fatal injuries as these have never been investigated in civil aviation accidents before. We were able to do this because of the unique system in this country of recording every single admission to a public hospital. The findings for fixed-wing aircraft, helicopters, and gliders have all been presented in previous articles.

Study Findings

Accident Statistics

According to the latest CAA figures, microlights are the second largest group on the aircraft register after fixed-wing aircraft. There are actually more microlights in New Zealand than the combined total of gliders, motor gliders and amateur-built aircraft.

During the years covered by our study, there were 87 reported microlight crashes. It is important to note the significance of the qualifier 'reported', since we found a number of hospital records of people admitted to hospital as a result of an aircraft accident (this was the case for other categories of aircraft too) yet no corresponding evidence of an accident could be found in the CAA database. Given the number of such cases, we estimated that up to 15 percent of accidents involving injury are not reported. Due to this, the real number of microlight accidents during the study period may have been somewhat larger!

These accidents involved 13 fatalities, with a further 17 people being admitted to hospital with injuries sustained in the accident. Although these figures are not greatly disproportionate from the numbers of microlights on the register, it is a reasonable assumption to make that microlights are flown for fewer hours each year than most helicopters and fixed-wing aircraft are. If this is so, then the rate of fatalities per 100,000 flight hours is probably higher for microlights than for any other

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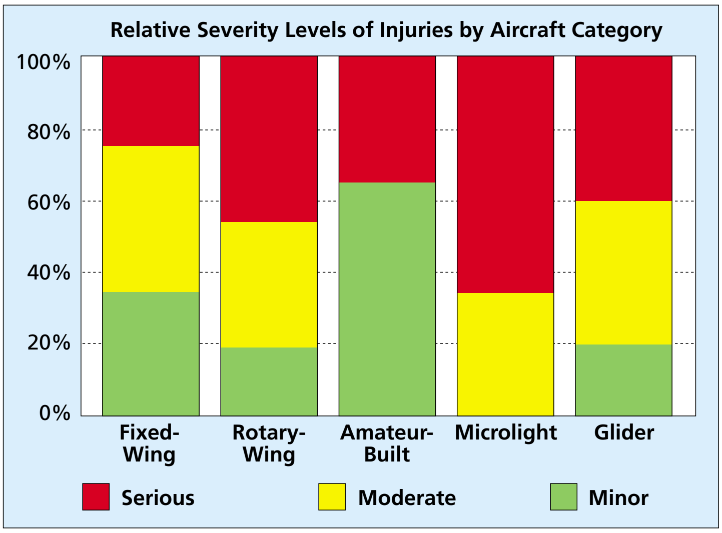
aircraft category. In a follow-up study, in which we looked solely at fatal and non-fatal injuries to pilots, we found that pilots of microlights are more likely to be injured in a crash than are pilots of other categories of aircraft. Compared to fixed-wing aircraft, the risk of being injured in a microlight is about three times higher.

One of the most telling findings was that the seriousness of injuries sustained is typically higher for microlight accidents than for any other aircraft category. None of the hospitalisable injuries were in the minor category, 29 percent were in the moderate category, and over 70 percent were considered serious (see accompanying graph). This comes back to the point made at the beginning of the article about the protective effects of solid aircraft structures and energy-absorbing components.



Analysis

If we look closely at the nature of the injuries sustained then we find that virtually all of the injuries sustained in microlight accidents are fractures. About a quarter of these are fractures of the lower limbs but the majority are fractures of the neck and trunk. Such fractures are by their very nature serious, and this accounts for the high proportion of serious injuries found in microlight accidents. These findings raise the issue of whether there are potential modifications to microlight structures that could reduce the transmission of impact forces through the spine. An important injury reduction mechanism for glider pilots is the use of impact absorbent cushioning (see page 8 of the September/October issue of *Vector*). Given our findings, it should be a high priority to investigate the suitability of this and other similar measures for the occupants of microlight aircraft.

The examination of the nature of injuries sustained also shows a complete absence of burns and only one case of intracranial injury. In contrast, both rotary and fixed-wing accidents show a much higher prevalence of head and skull injuries. In this case, the absence of solid structures for the head to come in contact with may be a positive factor for microlights. Additionally, a high level of safety helmet wearing may be a factor. Similarly, the lack of burns may be due to a lower frequency of post-crash fire in microlights or the greater ease of egress in cases of fire. Unfortunately, we lack any additional data that would clarify these matters.

Summary

As we have seen in this series of articles there are particular patterns of injury risk associated with each category of aircraft. Of course, no pilot sets out to have an accident and it is all too easy to adopt a posture of defence or denial on the subject. The sensible pilot knows that nothing in life is risk-free and is willing to look at the kind of risks involved and think about appropriate corrective and protective actions. Pilots make a large number of choices in terms of what, where, and how they fly. The information in these articles was intended to provide additional knowledge to apply when making these choices. Choose wisely – fly safely! ■

RTF Jamming

There have been several recent instances of approach and area control frequencies being inadvertently jammed for lengthy periods by aircraft radio transmissions, resulting in air traffic controllers being unable to make contact with the aircraft in their sector. This creates a potential for a loss of separation; the safety implications are serious – particularly in the busy approach control environment where unimpeded two-way communication is critical.

Most control frequencies in New Zealand are designed with a backup. Provided that you are aware that the frequency you are trying to transmit on is jammed (something that is not always obvious, although no response to your radio calls is usually a good indication) and know what the secondary frequency is, it is simply a matter of changing to it and notifying ATC of the problem.

In some cases, the pilot of the aircraft that is causing the jamming may not be aware that they are the source of the problem and may keep switching back and forth between the primary and secondary frequency. This could give the impression that both frequencies are being jammed.

If you are operating IFR and suspect that the frequency you are trying to transmit on is jammed, and in-flight workloads do not permit you to refer to the COMs section of the IFG for secondary frequency details, consider trying the following:

- If you have just left approach control, for example, and can't raise area control because the frequency is jammed, go back to the previous frequency and explain what is happening and the controller will advise you of the applicable secondary frequency while ensuring adequate separation is maintained.
- If you are about to enter an approach sector when the frequency you are on becomes jammed, just change to the next frequency and advise the controller of the situation.
- If you are south of a line Timaru to Fox Glacier (or thereabouts) and the control frequency you are on becomes jammed, you are probably better off using Dunedin, Queenstown, or Invercargill tower (depending on which is closest) as a secondary frequency. Christchurch Information on 122.20 MHz also has good coverage in that area.

In light of the fact that jamming does occur from time to time, it is worth considering making a note of all the secondary ATC frequencies applicable to your route on your flight log. That way you will be able to react quickly to a jammed frequency should it occur. ■

Most Common Maintenance Error

Most maintenance errors occur when we are distracted in some way or don't follow standard procedures. Jim McMenemy, a Human Factors Specialist for Transport Canada, explains how these slips and lapses can happen and suggests ways to keep their occurrence to a minimum (article sourced from Issue 2/98 of Transport Canada's aviation safety magazine Maintainer).

We have all heard by now that most accidents are caused by human error. That is interesting, and we should all be careful, but knowing that does not really help us prevent errors and accidents. Many accident reports end with a warning to flight crews and ground crews to be vigilant or not to be complacent. In my years of dealing with pilots and maintainers, I cannot recall seeing much complacency, and I do not think that there is an industry that is more vigilant than aviation. We are all vulnerable to these lapses because we are human. We all want to do the best job that we can and keep things safe up there, so what can we do?

We have to get specific, because we can do things right once we know what 'right' is and what the hazards are. For instance, what do you suppose the most common type of maintenance error is, and how does it happen?

The most common error in maintenance is omission – the result of leaving out a step, not finishing the task, missing one item on an inspection list. Omissions happen when we change procedures; when we are doing repetitive tasks; when we are distracted or interrupted by the phone, the boss, or something going on nearby.

Omissions are not unique to aviation maintenance. One good example of an omission causing an accident was investigated by the Transportation Safety Board Rail investigators. A passenger train derailed because one of the wheels had locked and slid hundreds of kilometres. By the time that it went off the rails, it had developed a 15-inch flat spot – because the mechanics had not serviced the brake actuator. The investigators found that water in the hydraulic actuators was a recurrent problem, and the rail company developed a procedure to prevent it. The procedure involved draining all 16 brake actuators on each coach during regular scheduled maintenance.

Right away, everyone should have been alert to the possible problems.

- A new maintenance requirement was being implemented.
- It was a repetitive task.
- There is no obvious way to tell which actuators have been serviced.
- Mechanics work in teams, and the team that starts the job may not be the one that finishes it.

You can see the possibilities now, but they were not apparent to mechanics or their supervisors at the time. This example illustrates many things:

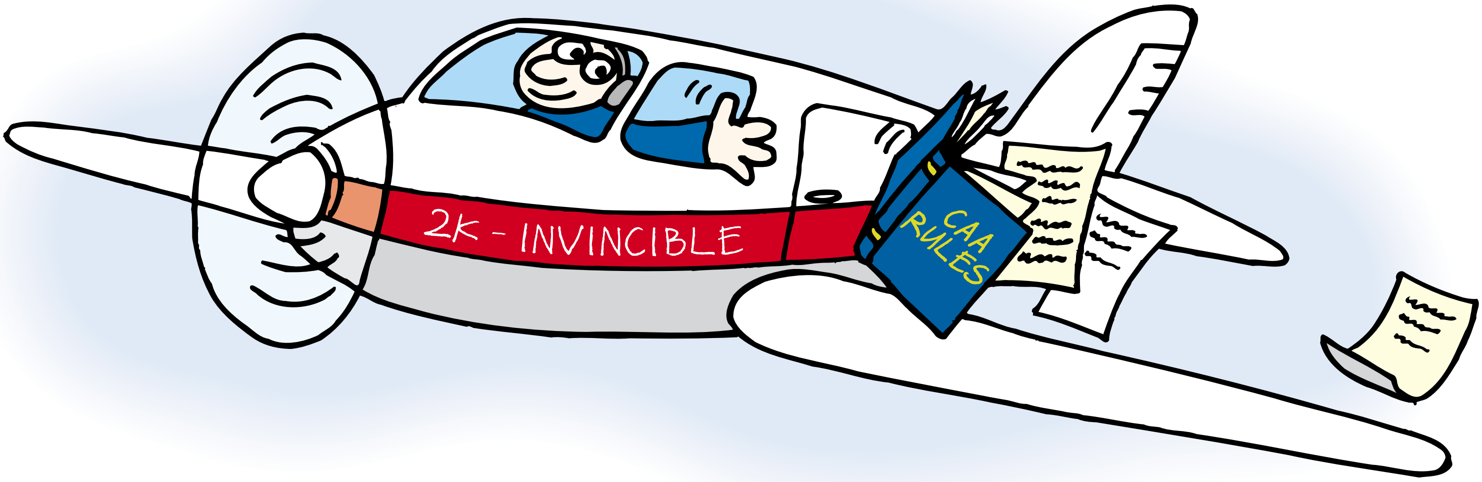
- The error (failure to service the actuator) happened hundreds of miles away from and weeks before the accident. Some mistakes can go unnoticed for a long time, but what we do, or fail to do, today can haunt us for a long time.
- The procedure was new and repetitive, and so it was particularly vulnerable to this type of error.
- Managers and supervisors did not give much thought to the potential problems. Simply putting a chalk mark on each actuator as the final step in the process would have alerted the mechanics as to which units had been serviced, but no one saw the need until it was too late.

How do we make sure that we do not leave things out? You probably use some safeguards already, but here are a few that work:

- Avoid interruptions, if possible. When interruptions or distractions are unavoidable, have a way to deal with them. Finish the part that you are working on, or mark your place so that you re-enter the sequence at the right place. You may find that the best way is to start that task over from the beginning, checking your previous work step by step to ensure that nothing is left out.
- When doing repetitive tasks, mark the work so that you can identify which units have been finished. That way, if you do miss one, it will be obvious and you can correct it.
- If you are working as part of a team, make sure that you communicate. Be clear about what has been completed and what has not. If you are receiving the briefing, make sure that you get the details; "I'm halfway through changing the widget" does not tell you enough to ensure that you will not miss something. ■

Pilots Behaving Badly

Intentional rule-breaking, wilful non-compliance, even recklessness – strong words. What we are talking about is when pilots know the rules and do not follow them – deliberately.



This article comes from the September 1997 issue of Flight Safety Australia and was written by Dave Huntzinger. Dave is a Senior Safety Executive with a major US airline and was formerly Senior Principal Scientist – Safety, for Boeing's aeroplane safety group. There have been fatal accidents in New Zealand directly attributable to pilots knowingly breaking the rules, and there will have been many more lucky escapes. Several accompanying examples, from New Zealand and overseas, illustrate the dangers.

We don't talk about rule-breaking too much in aviation because of the dire consequences of getting caught. If the regulatory agency finds out about it you can lose your licence. And if all this happens on the job, your employer will probably fire you.

This doesn't mean that your company won't benefit from your action. In fact, they may condone a rule-breaking episode, or worse yet, demand that you break the rules.

Commercial jet transport statistics are a good point of departure for studying the effect on wilful non-compliance in aviation. Boeing recently conducted a study of 232 jet transport accidents to identify specific pilot actions that would have prevented those accidents. The leading pilot-related prevention action would have been "adherence to procedures" by either one, or both, of the pilots. This was a factor in 65 percent of those accidents.

"If a person breaks a rule to save time or money, then the protection provided by the rules is lost."

If adherence to the procedures would have prevented the accident, then why did the pilots not follow them? There are only a few possible answers to that question. Ignorance of, or failure to remember the procedures, are possible choices. Pilots, however, especially commercial and air transport types, are required to demonstrate their knowledge of aviation regulations and published procedures on a regular basis.

In addition, many aircraft-related procedures are written down in the form of checklists or a quick reference handbook and carried in the aircraft so they can be referred to when necessary. Multiple non-normal events and confounding situational clues are other possible reasons. Bona fide emergencies or just plain bad rules are another.

Overseas – "Am I Gonna Run into Something?"

A newly licensed private pilot, aged 53 with 110 hours, and his wife were planning a cross-country flight. They were to be met at the destination airport by his wife's sister. From there they were to attend a dinner function.

A pre-departure check of the weather indicated no known problems. A little over half way there the pilot encountered rain and lowering ceilings. He descended to remain clear of the clouds. The ceilings continued to drop and it began to rain harder. To avoid contact with the ground, the pilot was flying at the base of the overcast.

He was too low to receive the VOR so he was following the highway. Unsure of his exact location he knew he was close to a major airport situated near his destination. He contacted the major airport on the radio and they gave him radar vectors to a landmark near his destination.

Unfortunately, the vectors took him through heavy rain and clouds. He found the destination airport and landed uneventfully.

The pilot termed his actions "gotta-get-there-itis". He felt he was committed to keeping a number of appointments and could see no way to cancel or alter them once airborne. He went on to say, in this context, that "it's hard to turn around once you're going".

As for risk, the pilot thought "cripes, am I gonna run into something, a hill, a tall radio tower, another aircraft? Those are the fears. Of course, the ultimate fear is that I'm gonna be a little spot on the side of a hill someplace." When asked if he thought he might get caught violating the rules he replied, "I don't think that was a concern at the time."

Intentional violation of rules and procedures is another possibility. There are few studies that focus on intentional rule-breaking among pilots. One of them comes from the Interstate Aviation Committee, the aircraft accident investigating authority of the former Soviet Union.

Their study indicates that many of their accidents are "due to conscious violations of rules and procedures by flight crews and ground-based personnel". The study revealed that 28 of the 33 accidents involving heavy aircraft resulted from violations of rules and procedures.

Other data show that rule-breaking episodes have undesirable outcomes. A US Airplane Owners and Pilots Association (AOPA) study indicates that 44 percent of all fatalities in general aviation occur when pilots licensed for flight in Visual Meteorological Conditions came upon, and then flew into, Instrument Meteorological Conditions. That 44 percent is the result of a group of pilots violating only one rule.

Why Break the Rules?

Why do people intentionally break the rules? The principal theories of deviancy try to explain why people defy society's norms, values and laws. Most of these theories examine the lives, situations and motivations of the hard-core, long-term criminal.

There is one theory, however, called situational control theory, which describes some rule-breaking behaviour as "episodic, purposive and confined to certain situations". The motives for such behaviour are frequently episodic, oriented to short-term ends and confined to certain situations.

Situational control theory has three basic parts. An adequate reward is the first condition that needs to be satisfied. The second is that there must be a high probability of success. That is, you will get away with the act. The third is that there can be no adverse reaction from peers. All of these conditions must be present in order for the rule-breaking episode to occur. If any one condition is not present, or in doubt, the individual will not break the rule.

New Zealand – Unauthorised Flight

The novice pilot was on a local flight in the microlight with his friend on board and was seen circling over a relative's house. The aircraft then made a low, slow, steep turn over an adjacent property. During the turn, the aircraft entered a vertical dive from which it did not recover. The pilot's instructor had not been made aware of his intentions to fly that day and was therefore unable to authorise and supervise the flight as required by the procedures of the Recreational Aircraft Association of New Zealand. The pilot was not certified to act as pilot-in-command of an aircraft carrying passengers. The pilot flew well below the minimum height permitted by the Civil Aviation Rules.

The most likely cause of the accident was poor handling of the aircraft by the pilot while attempting a manoeuvre at low level, which was beyond the capabilities of the pilot and his aircraft.

New Zealand – Needless Low Flying

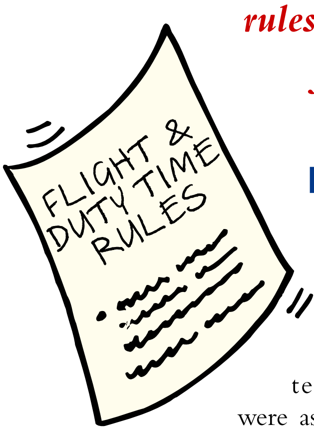
The Cessna 152 departed the aerodrome for a private flight to the north. On board were the pilot and his friend.

Attention was drawn to the aircraft a short time later when it was seen in a persistent bout of low flying, which focused on the passenger's residence. As the aircraft passed over the passenger's house for the last time, a witness believed that she saw it hit a tall tree. Following this low-level pass, the aircraft continued flying for about one nautical mile to the southeast.

Immediately prior to the accident the aircraft was seen to pitch up as if to clear a shelterbelt. At the top of the resultant climb the engine noise reduced and the aircraft's nose dropped. (The aircraft was reported as following a pattern of low flying over the area of orchards where the accident occurred. This pattern involved a pull-up over each shelterbelt, a reduction in engine noise as the aircraft neared the top of the climb, a dive into the sheltered area, and then climbing away over the next shelterbelt.)

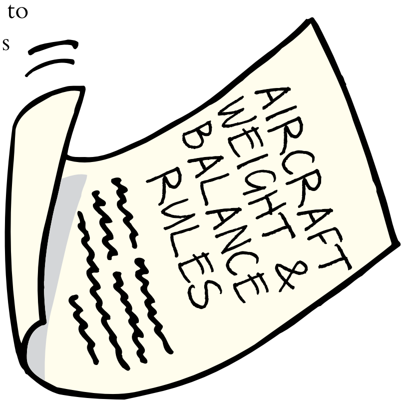
The aircraft then went out of sight and the sound of an impact was heard. The aircraft collided with the ground in a 60-degree left bank at an angle of descent of around 45 degrees. The impact was not survivable.

"Many accidents are due to conscious violations of the rules and procedures by flight crews..."



Pilot Experiences

In 1994 I conducted a research project that examined pilots' experiences. I interviewed 30 pilots: ten private pilots, ten commercial pilots, and ten air transport pilots. They were asked to relate two stories about themselves, one where they intentionally broke a rule (rule-breaking episode) and one where they thought about it but did not ("rule-breaks considered" episode). In both cases they were asked specifically about the motivation for breaking the rule and their perceptions of the risk associated with that decision. The pilots were also queried about adverse reaction from peers.



The motivations were tallied for both the rule-breaking episodes and the "rule-breaks-considered" categories. There were 90 motivations provided.

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Economic concerns (69 out of 90; ie, 77 percent) were the dominant motivating factor. Pilots were willing to break the rules to save time or money for themselves, the company or the customer. The remainder (21 of 90) were attributed to pride, duty or gaining experience.

The perceptions of risk were different between the rule-breaking episodes and the "rule-breaks considered" events. In the rule-breaking situations about half had no concerns about the risk. The remainder felt there was a high probability of success, although 13 thought there was a slight chance of being killed or caught. Six were afraid they might damage the aircraft or that the aircraft's performance would be inadequate for the task.

The distribution of responses changes dramatically in the "rule-break considered" category. The majority of the pilots (24 of 30) were afraid of being killed if they followed the proposed course of action. Seven were afraid of getting caught and three were afraid of damaging the aircraft (the total is greater than 30 because several pilots had more than one concern).

It is interesting to note that none of the pilots was free of concerns when deciding to break the rules; they were clearly worried.

The last category has to do with adverse reaction from peers. A peer in this case is another pilot, a knowledgeable passenger, an observer or even a company official. There was no adverse reaction from peers in any of the 60. This is especially noteworthy for the two groups of professional pilots. In 31 of 40 cases, they were flying with other qualified pilots.

A fairly clear pattern emerges from this study. Within the aviation system there are a wide variety of economic temptations to break the rules. Company management is pushing schedule and cost. Passengers demand to be on time. The pilot and other crewmembers have personal desires and timetables as well. This is the motivation.

The pilots then use whatever information they have about the situation to estimate the probability of success of this action. The estimate will contain some assessment of their ability, the outside environment, and the capability of the aircraft. If the outcome looks positive and they are not challenged, or worse, they are encouraged to proceed, then they will break the rules.

Unfortunately, people are not good at estimating probabilities of possible outcomes. One reason is that people are susceptible to all sorts of biases. These include overconfidence, hindsight, inadequate information and more. Information availability is a special problem in the dynamic world of flying or line maintenance, because people seldom have all the information necessary to make a totally informed decision. As a result, we tend to do what we think will get the job done.

Overseas – Hopelessly Committed

This pilot, aged 48 and with 29 years experience (4100 hours) was flying a charter flight in a VFR-equipped, single-engine float plane. On this particular day the pilot was flying over the water between two parallel shorelines. As he proceeded along this channel, the overcast began to lower so he descended until he was within 50 feet of the water.

He kept thinking that if there was any problem he would reverse course and fly out the way he came in. Shortly afterwards he came upon the bridge that crossed from one shore to the other. He could see the bottom of a bridge but not the top as it was obscured by clouds. A quick glance showed there was no room to turn around. The pilot said he was "hopelessly committed at that point", so he pulled up and into the overcast. He allowed some time to clear the bridge and let down on the other side. He landed after that and refuelled the aeroplane.

Two factors played a role in the motivation to continue. One was the desire to get the passengers and the cargo to their destinations. "I figured that there was a certain urgency about this particular group of people and cargo getting to where it was going so there was a little bit of pressure there." The pilot also said there was "a pride in being able to deliver the mail, so to speak." He tried very hard to "be the one to get through, to get the job done."

The pilot felt the real danger was in trying to turn around inside the narrow passage. He felt he had "no other option" but to go over the bridge. "Actually, I knew that I had pushed real hard that time and been lucky. That's probably not a good way to live a long and prosperous life in flying."

Prevention

This look at intentional rule-breaking is intended to provide a framework for prevention. Armed with this type of data, certain corrective measures become apparent. One of the first is to admit that intentional rule-breaking occurs at all levels of the system.

At the individual level the prescription for change lies in the different components of situational control theory. One course of action is to educate people about the effects of motivation on the decision-making process. The rules, in general, provide a minimum, if not an optimum, level of safety. So if a person breaks a rule to save time or money, then the protection afforded by the rules is lost.

The second element has to do with perceptions of risk – getting caught or being killed. It is clear that the threat of increased surveillance or even punishment is not the answer. With the motivation in place, a potential offender will simply wait for an opportunity that is not monitored.

Awareness is the better path. The more you realise that rule-breaking puts you at tremendous risk, the less likely you will be to attempt it. One course of action, for example, would be to let pilots attempt landings, in simulators after breaking out at 50 feet and off centreline. Having done this myself I can assure you that it changes your perception of your probability of success and the consequences of such an action. The last has to do with adverse reaction from peers. Crew resource management seems to be a natural fit. In this case the other crew members are encouraged, if not required, to point out that a certain course of action may not be in the best interest of the passengers, crew or company.

So far we have been discussing the individual and that person's role in a rule-breaking event. The aviation community determined long ago that there are a number of elements associated with a given event. Decisions like this are very rarely made in a vacuum. Consequently, if a pilot or a mechanic intentionally breaks a rule there is probably a reason why.

Sometimes these are prompted by the employer. (How many pilots have been told "be safe but don't be late?"). So, the same medicine must be administered to the aircraft operating companies. Their policies and actions must put safety above all economic concerns.

On occasion, working norms are at odds with the rules. This might be as simple as pulling a quarter turn on the spanner instead of using the torque wrench. If the norms are good then convert them to standards. If they are not, then corrective action, like training or better tool availability, may be in order. Incentives for safe behaviour are another consideration. Employees are rewarded for following procedures and appreciated for not succumbing to the ever-present economic strains. This takes a concerted effort on the part of management.

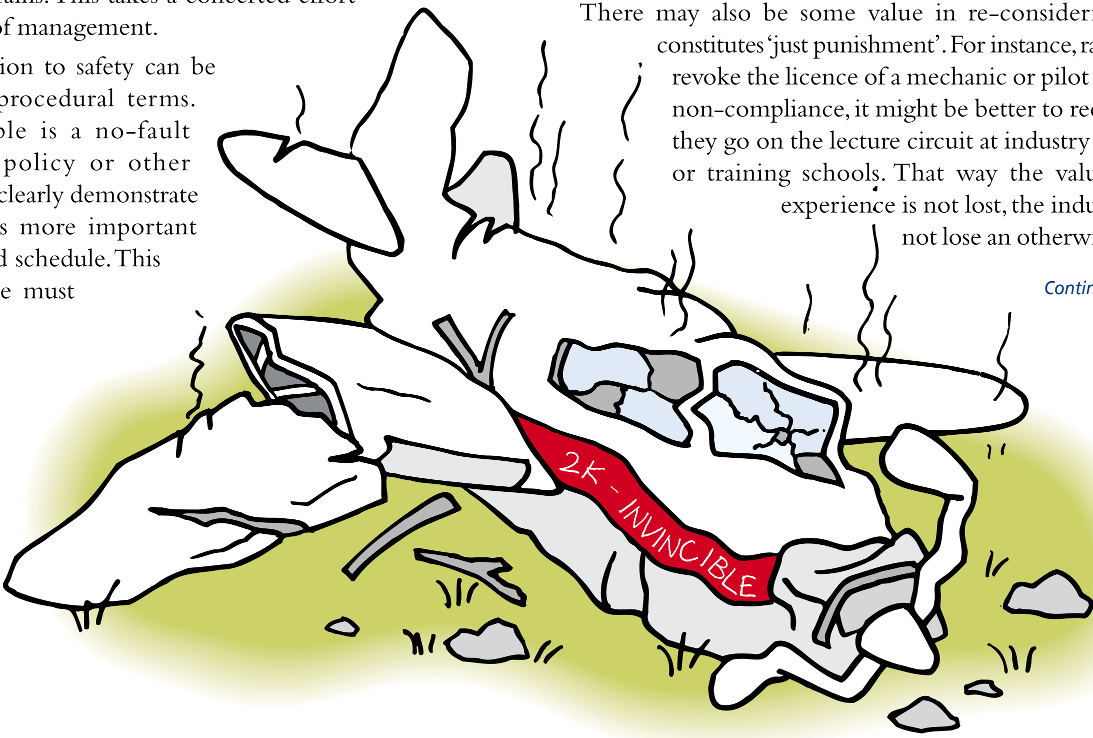
This dedication to safety can be realised in procedural terms. One example is a no-fault go-around policy or other policies that clearly demonstrate that safety is more important than cost and schedule. This same attitude must permeate the entire company. The goal is to have only one motivation – the safe conduct of the flight.

Aircraft rental companies can also modify their rental contracts. It is relatively common for a pilot to fly into deteriorating weather in an effort to get the aircraft back on time rather than pay for an extra day and wait for improving conditions. To remove that temptation some companies have included a clause that permits the pilot to keep the aircraft as long as necessary at no charge, if the weather is beyond the capability of either the aircraft or the pilot.

This might cost the company a few extra dollars on an occasion or two but it is far less expensive than losing an aircraft to an accident.

Regulatory authorities world-wide could also implement progressive measures to counter violations. For example, the investigating or regulatory authorities could move past the violation itself to make sure they understand why the person broke the rule. The lessons could be imparted during initial or recurrent training sessions or in a variety of publications.

There may also be some value in re-considering what constitutes 'just punishment'. For instance, rather than revoke the licence of a mechanic or pilot for wilful non-compliance, it might be better to require that they go on the lecture circuit at industry meetings or training schools. That way the value of the experience is not lost, the industry does not lose an otherwise valued



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New Zealand – Unauthorised Low-Level Aerobatics

The aeroplane was on a private flight in the vicinity of Kaitaia. In the last few seconds of the flight the aeroplane was seen in a vertical climb, which was followed by a manoeuvre resembling a stall turn to the right, and an almost vertical dive toward the ground. The height at which this manoeuvre occurred precluded recovery before the aeroplane struck the ground. The pilot, who was not rated to perform aerobatics below 3000 feet, was killed. The aircraft was destroyed by impact forces and fire.

The accident occurred in close proximity to where a builder was working. The builder was known to the pilot.

This accident highlights the dangers involved when low flying and performing low-level aerobatic manoeuvres without the requisite level of qualification or authorisation.

... continued from previous page

worker, and the individual retains his or her job. What do we want from the aviation system? Is it retribution or system improvement?

Professional Approach

People in the aviation system must recognise that there are temptations to disregard the rules. These may be generated at the personal level or come from external sources such as an employer.

A mature, professional approach is needed to counteract the temptations. The fact that you can't know or predict everything about a given situation should temper any assessment of the risks involved. Abandoning the protection the rules afford can be catastrophic. Remember also that the rules are the minimum acceptable standard.

Organisations can also help prevent rule-breaking episodes. Companies can implement, and support clear operating policies that help to assure safety.

Regulators can recognise that rule-breaking is more than a violation. There are external temptations. These must be uncovered and, if possible, eliminated. ■

New Zealand – Impromptu Display at Airstrip

A school party of seventh formers was camped in the vicinity of the airstrip. The recently qualified (PPL) pilot was one of the group members. He and a friend had left the group during the afternoon to hire an aircraft. When he returned in the PA-38 the pilot made three low passes over the airstrip where his mates were playing cricket. The third pass was reported to be at approximately 50 feet agl. Immediately after this pass, the aircraft was seen to turn into a nearby valley and attempt a 'wing-over' type manoeuvre. The aircraft then nose-dived out of sight. The sound of an impact was heard. Those first on the scene found that the pilot was seriously injured and that the passenger had died.

The valley in which the pilot attempted the manoeuvre was steep-sided and confined, and there would have been no opportunity for him to turn his aircraft around.

Unauthorised low flying, unauthorised carriage of passengers, poor decision-making, and pilot disorientation were all found to be contributing factors in this accident.

Let the Student Do It

This account of a first solo flight comes from the British safety magazine, GASIL No 2 of 1999.

Some months and a few instructors later came the day of my first solo, with the CFI in the righthand seat during a dual circuit before he got out saying the immortal words "Do one circuit, but if you are unhappy with the landing don't hesitate to go round for another try."

I took off and was amazed at how briskly the Cessna 152 leapt into the air this time. The climb-out, crosswind, downwind and base were all perfectly normal. Even final seemed satisfactory with all the checks and procedures completed. However, I suspected that solo the aircraft was very different, bounce-wise, than when there was a 80 kg+ CFI aboard. Anyway, I bounced. The aircraft didn't seem keen to land and I knew all about nosewheel strength limitations so did the sensible thing and went round again.

I suppose I was about ten feet above the runway, but now the Cessna 152 was a very different beast. Sluggish is the best word to describe what now happened, or rather did not happen. I could not climb, the runway was being used up at a rapid pace so I urgently rechecked that the mixture was rich, the throttle fully open, carb heat cold and since it was a fixed landing gear that was about it.

With the hedge between me and the golf course getting awfully close, I scanned all the instruments again for anything odd, this time noticing a white lever which looked a bit out of place. Of course, flaps!, still at full. I had two dramatic effects still to play with – lift and drag – I was about to discover which you lose first when flaps are retracted, which I did with alacrity. The first to go was lift, and I dropped with a thump onto the tarmac. Relieved of the barn doors hanging in the breeze, the aircraft now rocketed, and I mean rocketed, skywards. We missed the hedge, completed an uneventful circuit and managed to land perfectly off the second approach.

I don't remember the debrief comments of the CFI, but I am convinced that the cause of my error was that on every other previous landing the instructors, to a man, had said on rollout "I'll do the flaps". I suppose the idea was to reduce the workload on the student pilot at a very busy time. I'm convinced that it is much better for students to do it themselves because they are much more likely to notice what is wrong, or to do it right first time.

Vector Comment

Indeed, a student should be competently handling all phases of the takeoff and landing without any assistance before being sent solo.

Another danger area is the practice of carrying out multiple touch-and-go landings during circuit training. A student pilot needs a full-stop landing at least every 3rd or 4th landing to (a) be able to practise completing a landing, stopping, clearing the runway and doing the after-landing checks, (b) to have a breather and gather their wits and assess their progress, and (c) to practise the pre-takeoff checks before the next series of touch-and-go landings. ■

Cessna Rudder Jams

The following has been adapted from a Canadian Transport Safety Board report on a Cessna 152 accident in 1998 where the pilot was unable to recover from a spinning training exercise because the aircraft rudder jammed at full deflection. The report highlights the fact that, under certain conditions, it is possible to jam the rudder past its normal travel limits, making it impossible to recover from a spin.

The Accident

A flight instructor and a student were carrying out spin training in a Cessna 152.

The student initiated a spin to the left, his sixth of the day, at an altitude of 3600 feet amsl. The first five spins were to the right. The aircraft entered the spin normally. After one and a half turns, the flight instructor asked the student to recover. The student applied pressure on the right rudder pedal, as taught by the flight instructor, and the rotation did not stop. The flight instructor took over the controls and applied pressure on the right rudder pedal to stop the rotation, but the rotation did not stop.

The aircraft, by then, was established in a stabilised spin to the left. The flight instructor applied full power for a moment, then full flaps, to no avail. Throughout the recovery attempt, the flight instructor continued his efforts to avoid the crash, but the aircraft struck the surface of a lake.

The student pilot sustained serious injuries but managed to evacuate the sinking aircraft through the right rear window. He then tried to pull out the unconscious flight instructor, but without success. The flight instructor died at the accident scene.

The Investigation

It was found that the rudder stop-plate on the righthand half of the rudder horn was firmly jammed behind its stop-bolt on the fuselage. The rudder was deflected 34 degrees measured perpendicular to the hinge line, whereas the maximum allowable deflection for setting the stops is 23 degrees. It required 36 pounds of steady pull on the trailing edge of the rudder to break the rudder out of its jammed position. This steady pull of 36 pounds equated to 180 pounds if the force was applied to the rudder pedal. However, given that the direction of cable pull tended to increase the jamming by closing the horn, it would not have been possible to break the rudder jam with the application of right rudder.

During a 50-hour check engine inspection carried out the day before the accident, the right pedal rudder bar return spring and a spring attachment bracket for this spring, which was welded to the rudder bar assembly, were found to be broken. The return spring supplied a tension force of about 10 pounds per inch of stretch and balanced the force exerted by the matching left rudder bar return spring.

The two return springs maintain tension in the rudder cables that connect to the right and left halves of the rudder horn. Without the right rudder pedal return spring, the right rudder cable slackens. The left rudder pedal return spring will then tend to pull the right pedal toward the pilots, which facilitates deflection of the rudder to the left.

The broken pieces of the rudder control system were removed but were not replaced.

On completion of the check, the aircraft was signed out as being airworthy and released to service with no reference to the outstanding defect being recorded in the aircraft logbook. The aircraft maintenance engineer (AME) judged that the absence of the spring and bracket would not affect the flight characteristics of the aircraft and decided to release it for service until replacement parts could be installed.

After conducting tests on the accident aircraft and another C 152, investigators determined that, under certain conditions, the design and condition of the stop-bolt and rudder horn stop-plate allowed the stop-plate to over-travel the stop-bolt and jam.

The tests showed that the absence of the return spring, in combination with other factors such as incorrect rudder rigging, condition of the rudder, and rudder horn or stop-plate condition and alignment, set the stage for irreversible jamming of the rudder during application of controls for spin entry.

Vector Comment

This accident highlights the danger of improper maintenance procedures leading to the release of an aircraft for flight in an unsafe condition. With a rudder cable return spring missing, the aircraft did not meet the airworthiness requirements for flight.

As a result of this accident, Cessna is reviewing the design of Cessna 150 and 152 rudder stop-bolts, and expects to issue a Service Bulletin offering a new configuration for all Cessna 152s and 150s built after 1966.

The FAA, as the regulatory body in the state of design and manufacture, has primary responsibilities with regard to continuing airworthiness of both aircraft and will be determining if any mandatory action (such as an airworthiness directive) is required.

The CAA will monitor the results of both the Cessna and FAA reviews and take appropriate action as necessary to ensure the continuing airworthiness of Cessna 150 and 152 aircraft operating in New Zealand. ■

Standing Out on the Tarmac

Airports can be busy and dangerous places for ramp workers, pilots and passengers alike. Apart from the dangers posed by rotating propellers and jet engine blast, there are often a multitude of service vehicles whizzing around to watch out for. While you do your best to stay out of their way, they may not always see you – especially if you are not particularly conspicuous.

It is for this reason that the majority of people working on the apron are now required by their employers to wear high visibility garments (normally a jerkin or vest) to minimise the chances of an accident. The practice is actively encouraged by OSH to help cut down such accidents in the workplace.

Pilots of club or private aircraft may occasionally need to pick up or drop off passengers at an aerodrome terminal (or possibly another busy part of the aerodrome apron area). Pilots of light-commercial and scenic flight aircraft may frequently have passengers traversing busy apron environments. Wearing a hi-vis jerkin when escorting your passengers across the tarmac would ensure you are conspicuous – you will possibly be unfamiliar with the area and from the point of view of the normal airport traffic your aircraft may be parked in a position not regularly traversed by passengers. (The jerkin would also identify you as the pilot although you will still need to display your ID badge or have your pilot licence handy!)

A hi-vis safety jerkin is a recommended part of every aircraft's survival or emergency equipment and should be used every time the pilot needs to cross the apron, especially when escorting passengers. (It would, of course, also have significant value to catch the attention of rescuers in an accident or forced landing situation). Aircraft owners and operators should consider investing in a hi-vis garment for each aircraft in their fleet.

They are available from most safety equipment outlets and range in price from about $18 to $40. We recommend the vests that have reflective tape. Money well spent when you consider that many apron accidents are fatal! ■

QNH Settings

The aircraft was on an IFR approach into an aerodrome, where the cloud base was 3000 feet agl and the visibility fair. A VOR approach was required, and it was continued in VMC below the cloud base for training purposes.

During the approach, the pilot not flying (PNF) noticed that visually they looked too high, even though all instrument indications were normal. The PNF called "decide" two DME before the missed approach point, because he was concerned that they were becoming too high to land straight-in safely. On looking outside, the pilot flying also commented that they looked too high and that there was something wrong with the QNH.

A safe landing was carried out due to the PNF having terminated the instrument approach early.

During the roll-out, the altimeter read 300 feet below aerodrome elevation. The tower confirmed the QNH as being 1036 hPa, but the aircraft altimeter was in fact set to 1026 hPa.

The PNF could recall having difficulty determining if the ATIS was indicating 1026 hPa or 1036 hPa. On initial contact with Area and Terminal radar controllers the PNF read the QNH back as 1026 hPa. Neither controller detected this error.

The PNF, at the beginning of each duty period, was in the habit of transferring all applicable terminal aerodrome forecast QNH ranges to his data sheet. When checking the incorrect aerodrome QNH involved in this incident, the PNF checked it against the wrong line on his data sheet and ticked it off as being within range.

During the approach brief the pilot flying simply checked that the appropriate boxes on the data sheet had been ticked off and proceeded with the rest of the approach.

In these circumstances no harm was caused, but both pilots were alarmed at how close they got to minimums on the approach with the QNH 10 hPa out before realising that something was wrong.

They had made the comment that a radio altimeter setting of 300 feet agl would save you in such a situation – until they remembered that an aircraft can be dispatched for service without a radar altimeter.

The pilots felt their incident should be submitted for publication in order that other pilots and air traffic controllers could learn from it. The main lessons were seen to be:

- The need for QNH to be checked against the actual terminal aerodrome forecast.
- For controllers to verify that the pilot has correctly read back the QNH. This is critical – it can affect vertical separation, or cause gross height errors during an instrument approach.
- Finally, if you are having trouble determining the QNH off the ATIS, make sure you confirm its value with ATC. ■

DYNAMIC ROLLOVER

This article comes from issue 1/2000 of Transport Canada's aviation safety magazine Vortex. It neatly summarises the whys and wherefores of dynamic rollover in helicopters.

We've all heard the term, and most of us have read about dynamic rollover and the hazards associated with it. Some believe that the condition can only be encountered if one skid or wheel is stopped from moving sideways or up, but the truth of the matter is that you can run into the problem under a diversity of circumstances. The main upsetting moments are due to a tilted thrust vector with respect to the C of G and, for multi-bladed helicopters, a hub moment. Factors that can accentuate the onset of dynamic rollover are:

- crosswind
- slope
- lateral C of G displacement
- tail-rotor thrust
- skid or wheel obstruction
- main-rotor thrust

There are two issues with rollover – the static and the dynamic.

Statically, the moment that keeps the helicopter upright comes from the lateral position of the C of G staying between the skids or wheels. The closer the lateral position of the C of G comes to a skid or wheel, the smaller the restoring moment becomes. If the lateral position of the C of G goes outside the skid or wheel because of a slope, or excessive bank angle on liftoff, the helicopter will fall over.

Dynamically, lateral movement of the cyclic combined with thrust can introduce a rolling moment that could also be sufficient to put the machine on its side. Restricting items below the C of G, such as a stuck skid or wheel, will generate a similar moment and further compound the problem. Crosswinds can either help or make things worse, depending on the direction relative to the slope.

Obviously, a combination of an offset C of G, excessive lateral cyclic movement, an unfavourable crosswind and a skid that is hung up on a snow crust can make this a very complicated and dangerous situation.

The moment that keeps the helicopter upright and stable comes from keeping the weight between the skids or wheels, and the more you roll the helicopter, the more you diminish the stability. The stability goes to zero if one skid or wheel rises far enough to place the C of G directly over that skid or wheel. Narrow landing gear, slope, and shifting C of G (perhaps from fuel movement or loose cargo) can also compound the problem.

A rollover can take place in calm air if the cyclic is displaced far enough from centre during takeoff. A crosswind can make this event more likely.

If your corrective action to a pending rollover is a reduction in collective to get back on the ground, remember to be firm but gentle. If you are too aggressive in reacquiring the ground, you may bounce on the gear that was in the air and start a rollover in the opposite direction.

The most effective methods of preventing dynamic rollover are:

- Make sure that the helicopter is properly loaded and that all cargo is well secured.
- Check around the area prior to start-up, looking for deadfalls, wires, ropes, stumps, rocks, grounding cables, hard snow crusts, and anything else that may impede a clean liftoff.
- Conduct a slow, smooth, vertical liftoff to a height sufficient to confirm that the C of G is OK. If any resistance is felt during liftoff, get back on the ground quickly but smoothly, and remember that if you left from a slope you're probably going to land back on a slope, so be ready.
- When the low-hover C of G check is completed, continue the vertical takeoff to a height that will ensure clearance and continue with a normal takeoff.

If you follow these basic guidelines on every takeoff, you'll greatly reduce the chance of falling prey to the dreaded *dynamic rollover.*

A New Zealand example

Bell 206

A monsoon bucket was being used to spread the contents of a cowshed-settling pond.

For the first three loads the bucket was filled by lowering it into the pond with the door open. For the fourth load the pilot dropped the bucket into the pond and dragged it along sideways to enable it to fill more rapidly from the top.

When full, the pilot executed a hovering left turn into wind but when he raised the collective the helicopter rolled to the right and came to rest inverted in the pond.

During the hovering turn one of the two lifting strops had become hooked over the rear of the right skid. As the pilot attempted to climb away dynamic rollover occurred.

The operator has since designed a system of removable struts, which prevent the lifting strops from fouling the skids. ■

Bits that Fall off Things

The accompanying photograph is a collection of FOD sent to us by an airline ground safety officer. These bits and pieces were uplifted from the runways and taxiways of a few provincial aerodromes around the country.

FOD is Foreign Object Damage, an acronym used in the aviation industry to categorise damage to aircraft from objects that are left where they can create a hazard. It can also mean Foreign Object Debris – the objects themselves.

It is relatively common to find the sort of debris illustrated (eg, bits off cargo or baggage containers, service vehicles, and aircraft) at many aerodromes. Windblown plastic and paper is becoming more and more of a problem at many larger aerodromes, where the main danger is from their ingestion by aircraft engines and auxiliary power units.

Aircraft operators suffer FOD damage to engines, tyres and other aircraft components on a fairly regular basis, which, apart from being potentially dangerous, can cost them a considerable amount of money. The consequences of a blown tyre late in the takeoff roll or an engine failure just after takeoff do not need to be elaborated on from a safety point of view, other than to say that they could be catastrophic.

With FOD on the runway being suggested as the probable cause of the Concorde accident, everyone should be mindful of the possible consequences of such debris that finds its way onto the movement areas of our aerodromes.

Only a dedicated effort by **all** members of the aviation community (especially airport ground staff) will help lift FOD awareness levels and reduce the risks. Aerodrome operators can only do so much in terms of FOD awareness programmes – in the end it ultimately comes down to a concerted effort by everyone to pick up FOD and place it in the FOD disposal bin.

FOD can be expensive
FOD can be lethal
FOD can be avoided

Airport and aircraft operators should already have FOD disposal bins in place as part of their safety programme, with staff being actively encouraged to use them. Their contents need to be examined from time to time to ascertain where the FOD is coming from so that appropriate steps can be taken to minimise its source. Such inspections also allow immediate engineering action to be taken should the FOD contain any aircraft components.

Any organisation whose staff have a need to enter the manoeuvring area carrying tool kits or loose tools should consider having such articles made more conspicuous either by attaching reflective tape, or by dipping the items in luminous paint. This can aid the search for any mislaid items. ■

AIS Funding Update

A consultation document, *The provision and funding of the Aeronautical Information Service – Industry consultation document,* was released to the aviation industry on 3 April 2000. In addition to this, and because the consultation process was out of phase with the *Vector/CAA News* publication cycle, a circular entitled *Who should pay for the AIS?* was distributed to *Vector* readers in early April 2000.

While responses to the consultation paper were sought by 8 May 2000, the consultation process was extended to allow further discussions with the Airports Division of the Aviation Industry Association (AIA).

The consultation process has now been completed. A paper titled *Provision and funding of the Aeronautical Information Service – Responses to consultation* was presented to the December meeting of the CAA Board. The paper included a recommendation that a levy be imposed on specific document holders to enable the Board to carry out its function under the Civil Aviation Act to ensure that AIS is provided.

The Board responded by:

- Approving the release of the paper to the aviation industry.
- Agreeing to adopt the funding model outlined in the paper, which assigned AIS production costs directly to information originators and delivery costs to AIS subscribers.
- Agreeing that a case be prepared for submission to the Ministry of Transport to commence the legislative process.

The paper has been sent to all individuals and organisations that made submissions during the consultation period. A copy is also available on the CAA web site (www.caa.govt.nz).

When implemented, the price of the AIP *Planning Manual,* IFG, VFG and all aeronautical charts will reduce by 44%.

The CAA would like to thank all who participated in the consultation process, and say that we look forward to the implementation of a new-generation aeronautical information service that will be of benefit to all of the aviation industry. We will keep you informed of progress in future issues of this magazine. ■

New Videos

Mountain Survival

The CAA, in conjunction with Tourism Holdings Ltd (THL), has just produced a video on alpine survival.

Mountain Survival is a 24-minute training video based on a THL alpine survival training course for pilots should they and their passengers be forced to spend time out in such a potentially inhospitable environment.

The video covers the basic principles of survival, suggested survival kit contents, how to maximise the insulative values of different clothing types, ways to utilise the aircraft fuselage as a primary means of shelter, using a Zdarsky sack, building a snow mound, using a cooking stove, and finally the importance of positive leadership.

Although primarily intended for pilots involved in commercial high-country operations, the information covered in this training video is also relevant to the recreational flyer who might occasionally operate in and around mountainous terrain.

It is suggested that this video be viewed in conjunction with another CAA safety video, *Survival*, which deals with being able to prioritise your actions after a crash, and the basics of surviving out in the open.

Both titles can be borrowed free of charge from the CAA Library or purchased directly from Dove Video. (See the previous issue of *Vector* for details on borrowing CAA videos.)

Mountain Flying

A recent industry initiative has resulted in the production of a video on mountain flying. A group of pilots, who wished to pass on their knowledge and experience of flying in the mountains, were responsible for the initiative.

High Country Productions sought and received sponsorship from Shell Aviation, Aviation Co-operating Underwriters Pacific Limited, and the CAA to help cover the cost.

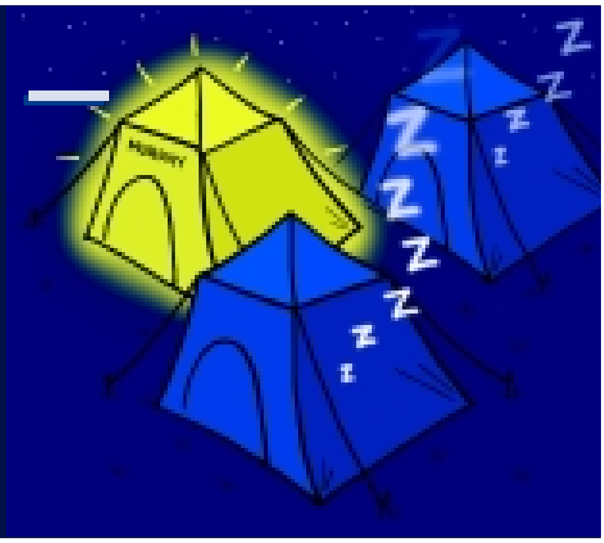
Mountain Flying is intended to encourage interest and stimulate discussion on safe mountain-flying techniques rather than to be used as a formal training video.

The 66-minute video covers the importance of pilot proficiency and knowing your aircraft, details a precautionary landing exercise, and discusses valley-flying and ridge-crossing techniques. A great deal of practical advice and experience is included. The latter half of the video takes the viewer on a scenic flight from the headwaters of the Rakaia River through the Southern Alps to Fox Glacier, Makarora, Wanaka, Milford Sound and then on to Queenstown.

This video has a lot to offer any pilot who intends to venture into mountainous country. Pilots might consider viewing it in conjunction with the CAA mountain flying video *It's Alright if you Know What You're Doing – Mountain Flying*.

Mountain Flying can be borrowed from the CAA Library free of charge. Purchase, however, must be directly from the makers: **High Country Productions, C/o John Richards, RD2 Darfield, Canterbury. Tel: 0–3–318 6838.** Price is $39.95 plus $5 postage. ■

Assume Nothing — Murphy Never Sleeps



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.

Vector Content

As a PPL VFR pilot I find the content of *Vector* deals me a new disappointment every couple of months.

The magazine often chooses to highlight oddball subjects of low general applicability. Wirestrike is a good example. Messy and spectacular and as far as I can tell it seems to happen very occasionally to helicopter and ag pilots. The vast majority of pilots never fly remotely close to wires – especially back country wires. The helicopter accident at Manapouri was tragic, but no more so than a five-death car crash.

Then there is the problem of low journalistic/editorial standards. Consider the article on VFR incursions to M300/301. Much of it is a lengthy harangue on the range and blast radius of various weapons. Then we get most of the whiz bang pictures twice – on the cover and inside. A classic example of the lazy technique where you take an outsider's work, edit it lightly then spread it as thinly as possible to fill the maximum space. The article would have been meaningful with highlighted maps. I don't expect to need a VTC in my hand to understand a *Vector* article. Sloppy and slack. Produced to meet a schedule not a standard. This in the same publication that promotes quality assurance (in the same issue even!).

I would also like to put in a plug for modern technology. I routinely plan cross-country flights using Champagne flight planner – this software knows all the NZ waypoints and can produce (in no time flat) a detailed flight plan with simplified map, ETEs, fuel burn, sector headings/tracks, etc. I don't understand why anyone would want to use pencil lines on maps, rulers, protractors, prehistoric 'computers', etc, when the late 20th century has a better way. The software costs about $250 and will run just fine on a $400 second-hand PC. It's not hard to learn. Every flying club or school should have something like this available and train pilots in its use. Champagne is only one of the products available.

I am surprised that CAA does not promote/endorse the use of these tools for flight planning. Better flight plans are safer flight plans. After collecting the weather info I can produce a detailed printed flight plan in about five minutes. Then I check that off on a map so I can fold it right, etc. We won't get into the argument of whether I'd rather have a folding book of maps like I use for road travel ...

From what I have seen of VFR PPL pilots heading up-country from where I fly (the Manawatu) a flight to (say) New Plymouth is – "that's an hour and a bit up the coast and through the Stratford gap – the plane holds four hours of fuel so what's the biggie about a flight plan?" With Champagne I put together a flight that tracks me from Palmerston to Marton to Wanganui, Hawera, Stratford and New Plymouth. I get this all printed out plus an en-route information sheet that gives me a summary of the VFG page for each airfield waypoint. I have **never** seen anyone (other than a student) do a flight plan with this much detail for this sort of trip.

Then there is the question of GPS use. Anyone who has used one for more than one flight is a convert. I understand the regulatory issues problems that make GPS certification difficult and restrict GPS use for IFR flight. However, GPS receivers are not dear relative to the cost of an aircraft and as a safety measure it has to be a plus to know where you are.

I am not suggesting that CAA should become evangelists for computer flight planning and GPS navigation, although I imagine it's been a while since an Air NZ flight was planned with a ruler, protractor and slide rule "computer". But when I look at a glossy magazine that I – one way or another – have to help pay for – I just can't believe half a page with pictures of someone in assorted poses poring over a map at a desk! I am also amazed by the number of instructors I have encountered who have never used flight planning software or flown with a GPS.

You could usefully read the Australian *Vector* equivalent. It has a very good section along the lines of "silly things I have done and survived" which makes gripping reading. Simple things like flying into cloud, arriving just after dark, dealing with engine failures and the like. Written by real people – it was experience-based stuff I could identify with. You could do worse than just ask them if you could reprint it.

Ian Boag
Palmerston North
December 2000

Vector Comment

Thank you for your letter. We appreciate feedback, both positive and negative.

The bulk of *Vector* content is pertinent to general aviation pilots, and we are surprised and concerned that you are disappointed with it.

The magazine is mailed out to the whole of the New Zealand aviation industry, and we need to cover a wide spectrum of topics to meet the needs of all sectors. We do not cater only for the majority (and majority in numbers does not necessarily mean majority in hours flown). The incidence of wirestrike accidents (and fatalities) is sufficient to cause concern and, although the article in the January/February issue was aimed primarily at those who need to fly regularly at low level, there were lessons there for all pilots.

The article on military operational areas highlighted the potential dangers for VFR pilots, and we set out to illustrate these dangers clearly. *Vector* articles don't get updated, so we seldom reproduce charts, as it is important that readers refer to the current chart version. Finally, the article was prepared not by an 'outsider' but by CAA staff, with input from those acknowledged.

You are obviously enthusiastic about utilising current technology to assist you in flight planning and navigation. These modern aids can be a great asset, but student pilots must first learn the basics and remain competent in their execution. Although you may not utilise a protractor and nav computer, I trust you still draw in your track lines and study the terrain and airspace en route – so poring over the map can not be dispensed with. The article in question covers many aspects of flight planning – and however great and detailed a flight plan may be, the decision-making in the air is what ultimately makes a successful flight. Two thoughts about GPS: One, it doesn't always work. Two, while it is "a plus to know where you are", it is an even bigger plus to know whether you should be there.

We agree that sharing of lessons gained from personal experiences can be a useful safety tool. We have had for many years, a 'Share Your Experience' series – unfortunately we do not receive as many contributions as we would like. ■

How To – Fill the gap

The CAA publishes two series of information booklets.

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

Title	***Published***
How to be a Pilot	*1998*
How to Own an Aircraft	*1999*
How to Charter an Aircraft	*1999*
How to be an Aircraft Maintenance Engineer	*1999*
How to be a Good IA	*2000*
How to Navigate the Rules	*2000*
How to Get Your Licence Recognised in New Zealand (web site only)	*2000*
How to Report Your Accidents and Incidents	*2000*
How to Navigate the CAA Web Site	*2000*

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

Title	***Published***
Winter Operations	*1998*
Bird Hazards	*1998*
Wake Turbulence	*1998*
Weight and Balance	*1998*
Mountain Flying	*1999*
* *Flight Instructor's Guide*	*1999*
Chief Pilot	*2000*
New Zealand Airspace	*2000*
Takeoff and Landing Performance	*2000*
* *Aircraft Icing Handbook*	*2000*

How To and **GAP** booklets (but not *Flight Instructor's Guide* or *Aircraft Icing Handbook*) are available from most aero clubs, training schools or from Field Safety Advisers (FSA contact details are usually printed in each issue of *Vector*). Note that *How to be a Pilot* is also available from your local high school.

Bulk orders (but not *Flight Instructor's Guide* or *Aircraft Icing Handbook*) can be obtained from:

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

*The *Flight Instructor's Guide* and *Aircraft Icing Handbook* can be obtained from either:

- **Expo Digital Document Centre**, P O Box 30–716, Lower Hutt. Tel: 0–4–569 7788, Fax: 0–4–569 2424, Email: expolhutt@expo.co.nz
- **The Colour Guy**, P O Box 30–464, Lower Hutt. Tel: 0800 438 785, Fax 0–4–570 1299, Email: orders@colourguy.co.nz

How to Navigate the CAA Web Site

The CAA's web site is the fastest, simplest and most cost-effective way for you to access vital aviation information. If you have never used the Internet before, the CAA web site is a good place to start.

You can get all Civil Aviation Rules, Advisory Circulars and other legislation free, and you can arrange to be notified by email whenever there are changes. You can find an aviation doctor or a flying school near you, and you can find out who owns any aircraft in New Zealand.

Our aim is to provide information to assist your business, improve your safety, or excite your interest.

The CAA web site **www.caa.govt.nz** has recently been overhauled, which meant the *How to Navigate the CAA Web Site* booklet also required updating. Under the same name, the new booklet gives you a guided tour through the CAA's new-look web site.

If you would like an updated booklet, call the CAA Safety Education & Publishing Unit Tel: 0–4–560 9400, or contact your local Field Safety Adviser.

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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

24-hour 7-day toll-free telephone

0508 4 SAFETY
(0508 472 338)

For all aviation-related safety concerns

OCCURRENCE BRIEFS

Lessons For Safer Aviation

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

Individual Accident Reports (but not GA Defect Incidents) – as reported in *Occurrence Briefs* – are now accessible on the Internet at CAA's web site (http://www.caa.govt.nz/). These include all those that have been published in *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.

ZK-HPK, Hughes 269C, 10 Dec 99 at 0630, Te Awamutu. 1 POB, injuries 1 minor, damage destroyed. Nature of flight, agricultural. Pilot CAA licence CPL (Helicopter), age 30 yrs, flying hours 880 total, 350 on type, 80 in last 90 days.

The helicopter had been fully loaded for the second spray run of the day. The pilot reported that the helicopter suffered a mechanical failure of its drive belt system. The attempt to land was unsuccessful and the aircraft was destroyed. Subsequent investigation revealed that the spline at the engine end of the drive shaft, which mates with the lower drive shaft, had failed due to overloading of the splines.

Main sources of information: CAA field investigation.

CAA Occurrence Ref 99/3505

ZK-AKC, De Havilland DH 82A Tiger Moth, 7 Jan 00 at 1200, Dunedin. 1 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 60 yrs, flying hours 216 total, 33 on type, 0 in last 90 days.

The pilot of the aircraft noted a change in the sound of the engine, followed by some power loss. A suitable place to land was selected and an emergency landing carried out. A fence was struck on landing.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/42

ZK-AUX, Auster J1, 16 Jan 00 at 1440, Mangatawhiri. 3 POB, injuries 3 serious, damage destroyed. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 31 yrs, flying hours 222 total, 13 on type, 8 in last 90 days.

The overloaded 90-hp Auster landed at an airstrip still under construction. During the subsequent takeoff the pilot endeavoured to turn away from rising terrain but collided with a hill at the end of the airstrip. The overloaded aircraft, combined with the lack of takeoff distance from the partially completed airstrip, were contributory factors in this accident.

Main sources of information: CAA field investigation

CAA Occurrence Ref 00/40

ZK-HFF, Robinson R22 Beta, 18 Jan 00 at 0700, Big Bay. 0 POB, injuries nil, damage substantial. Nature of flight, hunting. Pilot CAA licence CPL (Helicopter), age 42 yrs, flying hours 712 total, 240 on type, 116 in last 90 days.

The helicopter was left idling while the pilot assisted his shooter to gut a number of deer. The pilot had applied carburettor heat, collective and cyclic frictions, and reduced rpm to a low idle. After about four minutes, the pilot heard the rpm increasing and when he looked round, saw the helicopter lift off and turn through 360 degrees. He attempted to catch it but was unable to do so before the main rotor struck a log and the machine came to rest on the heels of the skids and the tail section. The pilot then shut the engine down, noting that the collective friction had backed off to between half and three-quarters and that the lever had ridden fully up. He was of the opinion that the idling vibration level had been exacerbated by the nature of the surface (stony sand) on which the helicopter was parked, causing the friction to back off. He said later that he had a collective clip available, and in hindsight he should have applied it.

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

CAA Occurrence Ref 00/93

ZK-JEI, Piper PA-23-250, 25 Jan 00 at 2055, Mercer. 2 POB, injuries nil, damage substantial. Nature of flight, training dual. Pilot CAA licence CPL (Aeroplane), age 39 yrs, flying hours 877 total, 128 on type, 53 in last 90 days.

The student was landing the aircraft. Following touchdown, poor braking action was experienced due to the wet grass surface and the aircraft over-ran the runway into a ditch. A slight tailwind was noted after the landing.

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

CAA Occurrence Ref 00/150

ZK-JGR, Maranda AMF-514 DIXW, 30 Jan 00 at 1255, Hastings. 2 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 46 yrs, flying hours 379 total, 184 on type, 28 in last 90 days.

The aircraft was landing at Runway 29 at Hastings in strong westerly wind conditions. During the landing flare, at approximately 15 to 20 feet agl, the aircraft encountered windshear. Full power could not arrest the high rate of sink, and the aircraft made a heavy landing, collapsing the undercarriage, causing the aircraft to slide on its belly.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/255

ZK-RAD, Tim McClure Eagle Rotorcraft, 8 Feb 00 at 1630, Timaru. 1 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age 53 yrs, flying hours 367 total, 343 on type, 47 in last 90 days.

The pilot reported that localised mechanical turbulence caused an abnormal landing, which resulted in the righthand undercarriage axle breaking. As the machine tipped over, the rotor and propeller struck the ground, causing further damage to the horizontal stabiliser.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/483

ZK-DUP, Piper PA-28-140, 22 Feb 00 at 1651, Christchurch. 1 POB, injuries nil, damage substantial. Nature of flight, training solo. Pilot CAA licence PPL (Aeroplane), age 57 yrs, flying hours 118 total, 107 on type, 13 in last 90 days.

The pilot was returning to Christchurch after a cross-country flight. He was given a runway change (Runway 11) after initially joining for the western grass. The approach onto Runway 11was made with excessive speed, and the aeroplane porpoised on landing. The nosewheel strut folded back during the porpoising sequence.

Main sources of information: Accident details submitted by operator.

CAA Occurrence Ref 00/412

ZK-MCN, Pilatus PC-6/B2-H4, 23 Feb 00 at 1030, Tasman Glacier. 9 POB, injuries 2 minor, damage nil. Nature of flight, transport passenger A to B. Pilot CAA licence CPL (Aeroplane), age 49 yrs, flying hours 2950 total, 470 on type, 60 in last 90 days.

The aircraft had landed on the Tasman Glacier and was shut down in preparation for passenger disembarkation. It began to slide backwards, and despite the efforts of the pilot and other pilots present at the landing area the aircraft could not be stopped. The pilot ordered an emergency evacuation of the aircraft, in which two passengers received minor injuries. The aircraft came to rest further down the glacier without sustaining any damage.

Main sources of information: Accident details submitted by operator.

CAA Occurrence Ref 00/402

ZK-HSQ, Robinson R22 Beta, 24 Feb 00 at 1000, North Esk R. 1 POB, injuries nil, damage substantial. Nature of flight, hunting. Pilot CAA licence CPL (Helicopter), age 63 yrs, flying hours 6744 total, 505 on type, 70 in last 90 days.

The helicopter had come to a hover to pick-up the shooter. As the shooter was boarding, the helicopter lurched and the main rotor struck a rock. The pilot was able to maintain control and landed the helicopter about 200 metres away from the intended pick up point. The ELT was activated manually. The main rotor and transmission required replacement as a result of the rotor strike.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/426

ZK-AZT, Auster J1B, 28 Feb 00 at 1400, Clevedon. 2 POB, injuries 2 minor, damage substantial. Nature of flight, private other. Pilot CAA licence ATPL (Aeroplane), age 54 yrs, flying hours 16332 total, 290 on type, 150 in last 90 days.

The aircraft was returning to its base airstrip where Runway 15 was in use. A south to southwesterly wind of five to eight knots was blowing at the time, with the occasional gust. At about 200 feet agl the pilot encountered a loss of directional control due to windshear or turbulence associated with a row of trees to the left of the airstrip and to either side of its threshold. This resulted in the aircraft rolling rapidly to the left and contacting trees to the left of the threshold.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/454

ZK-PGH, Gippsland GA200C, 22 Mar 00 at 1330, nr L Brunner. 1 POB, injuries nil, damage substantial. Nature of flight, agricultural. Pilot CAA licence ATPL (Aeroplane), age 63 yrs, flying hours 21015 total, 113 on type, 53 in last 90 days.

The pilot was conducting supervised spraying operations from a sealed strip with a grass extension at either end. The supervising pilot had been taking 600-litre loads throughout the morning, and it was the intention of the pilot under supervision to start with 500 litres. However, 600 litres was loaded inadvertently on the first flight of the afternoon, and the pilot decided to continue with that load. The takeoff run started from the grass short of the sealed strip, but when the aircraft ran on to the seal, a slight tailwheel shimmy developed. The pilot applied light braking to assist in raising the tail, but then encountered directional control problems on the cambered strip, exacerbated by a quartering crosswind. The aircraft failed to become properly airborne, over-ran the departure end of the strip and collided with a fence.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/655

ZK-LJA, Maule M-5-235C, 9 Apr 00 at 1600, Mt Somers. 1 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 23 yrs, flying hours 300 total, 30 on type, 20 in last 90 days.

The pilot was landing into a light easterly on a farm strip, when he encountered a high rate of sink on short final. He checked back to arrest the rate of descent, and the aeroplane landed tailwheel first before landing firmly on its mains. After a short landing roll, the right main gear leg collapsed, and the aeroplane slid to a halt. The pilot considered that he had encountered windshear in the lee of some trees to the left of the landing path; there was a slight crosswind component from the left at the time of landing.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/1078

ZK-RES, British Aerospace Jetstream Series 3200 Model 3201, 18 May 00 at 0905, Wellington. 11 POB, injuries 1 minor, damage nil. Nature of flight, transport passenger A to B. Pilot details not relevant.

A boarding passenger bumped his head on the aircraft doorway, sustaining a large gash on his forehead. Rescue Fire personnel attended, administered first aid, and the passenger continued on to Nelson. The problem was found to be the steps in use, originally built for Bandeirante aircraft. The top step was slightly higher than the aircraft door threshold, requiring passengers to stoop on entry. A proposed interim fix was to install an arch over the stairs, near the top, so that passengers would need to duck before reaching the doorway. The ultimate solution was to have another two sets of stairs built for Jetstream use.

Main sources of information: Accident details submitted by operator.

CAA Occurrence Ref 00/1988

GA Defect Incidents

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

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

Aerospatiale AS 350B – Fatigue failure of tail rotor gearbox

The pilot noticed an unusual noise from the tail of the aircraft.

On removal of the electrical chip plug from the tail rotor, oil ran out of the self-sealing plug. However, no metal was found on the chip plug. The helicopter was made unserviceable. A metallurgical report showed fatigue failure of teeth after high time usage, with no abnormal indications prior to the failure. TSO 2409 hrs; TSI 77 hrs.

ATA 6400 CAA Occurrence Ref 99/1640

Bell 206B – Cabin roof structure badly cracked

The operator noticed that the aircraft was exhibiting some unusual vibration. The engineer inspected the aircraft and found that there were fatigue cracks in the cabin roof structure at the lefthand rear and righthand forward main rotor transmission mount points. The support assembly was cracked longitudinally and the lefthand rear mount foot had completely broken off.

The engineer who performed the 600-hour inspection just prior to the detection of the problem had not noticed the cracking. Further disassembly revealed the presence of an unapproved repair to the rear cabin bulkhead assembly frame underneath the rear lefthand transmission mount.

It could not be determined if this repair contributed to, or was related to, the fatigue cracking. All cracked and broken items were repaired and a transmission alignment check carried out.

ATA 5300 CAA Occurrence Ref 99/3042

Cessna – Propeller blade ferrules found cracked, P/N C4451

The propeller hub and blades were received for scheduled overhaul. Two blade ferrules were found to be cracked at approximately 80 percent of their circumference. The propeller had a history of oil leaks between 1994 and 1995, but had no further leaks up to the present time. The aircraft was extremely close to losing a propeller blade. It was noted that the ferrules appear brittle, with pieces splintering out. TSO 1199 hrs.

ATA 6100 CAA Occurrence Ref 99/2336

Cessna 172P – Nosegear retaining collar broke, P/N 0543018

The pilot reported that he felt a significant nosewheel shimmy at the end of the landing roll.

Further investigation revealed that the securing bolt (P/N AN5-10A) on the left side of the noseleg lower attachment fitting assembly had failed. One half of the assembly (P/N 0543018) had broken away and departed the aircraft. The nosewheel assembly was retained by the upper attachment fitting only.

ATA 3220 CAA Occurrence Ref 99/1768

Cessna 207 – Rear carry-through spar severely corroded, P/N 1212866-4

During scheduled maintenance, a 12,000-hour inspection revealed that the rear carry-through spar was cracked on the starboard side. Considerable corrosion was found under the wing attachment fittings upon being removed. No corrosion protection was carried out at manufacture. TTIS 10618 hrs.

ATA 5700 CAA Occurrence Ref 99/1807

Hughes 369D – Manufacture of rotor blades defect, P/N 500 P2100-101

There have been two reports of defects found 'in service' with PMA main rotor blades manufactured overseas by Helicopter Technologies Co. The nature of the defects were de-bonding of the skin at the trailing edge and blade grip. The blades had 258 and 107 hours time-in-service respectively. The blades have been returned to the manufacturer and the FAA advised of the problem.

ATA 6210 CAA Occurrence Ref 99/2382

International Occurrences

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

United States of America

Occurrences

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

Cessna 185 – Engine suffers catastrophic failure while IMC

On 3 January 2000, a Cessna A185F was substantially damaged during a forced landing following a loss of engine power after departing from Clover Field Airport. The commercial pilot, who was the owner of the aeroplane, and his three passengers were not injured.

The cross-country flight departed the Clover Field Airport at 1215 and was destined for the Gregg County Airport near Longview, Texas. The pilot stated that he departed to the north from Runway 32 and was climbing in instrument meteorological conditions through 3500 feet, when he heard a sequence of "loud bangs". The pilot stated that he looked at the digital engine monitor and noted that the cylinder head temperature for the No 3 cylinder was indicating an "excessively high temperature". The pilot also noted that the oil pressure and oil temperature gauges were indicating, "lower than normal". He added that the aeroplane was "vibrating violently" and therefore elected to pull the throttle to idle and initiate a descent.

The pilot declared an emergency to air traffic control (ATC) and they cleared him direct to the Clover Field Airport. The pilot stated that the aeroplane broke out of the clouds at 1500 feet, and he reported to ATC that he had the airport in sight. The pilot determined that he would not be able to fly the aeroplane to Runway 32 with the available power, and elected to land on Runway 22 (a 730-metre-long grass runway) instead.

On final approach, the pilot fully extended the flaps while maintaining a 90-knot glide speed. He added that the aeroplane landed halfway down the length of the runway at about 70 knots. The pilot applied heavy brake pressure in an attempt to stop the aeroplane before it contacted a ditch located at the end of the runway. When the aeroplane slowed to about 40 knots, it nosed over, coming to rest inverted.

Further investigation showed that the No 3 cylinder head had separated from the barrel.

NTSB Occurrence Ref FTW00LA058

Robinson R-22 – Student fails to respond to instructor's control inputs

On 22 January 2000, a Robinson R-22B sustained substantial damage during an in-flight collision with terrain following a loss of control during takeoff from Runway 18 at East Troy Municipal Airport. The CFI received minor injuries. The student was not injured.

According to the CFI's written statement, they were practising a running takeoff on Runway 18 and after traversing approximately 10 feet of the takeoff run the student applied right pedal input. The CFI stated that he tried to overcome the student's right pedal input by depressing the left pedal input and verbally commanding the student to do the same. The CFI reported that he was unable to counteract the students control input and the aircraft yawed to the right. The helicopter's left skid impacted the terrain, the aircraft rolled onto its left side, and it slid for 15 feet before coming to rest.

NTSB Occurrence Ref CHI00LA060

United Kingdom

Occurrences

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

Rans S6-116 – Soft surface causes nosegear to collapse

The pilot reported a normal approach and landing on the 350-metre grass strip, although the touchdown was slightly fast. During the landing roll the nosewheel collapsed and the aircraft inverted, causing substantial damage to the airframe and minor injury to the pilot and passenger. The pilot described the landing surface as soft. The recovery team described it as "like a bog".

PPL with 206 hrs total, 8 hrs on type, with 3 hrs in the last 90 days.

Cessna FRA150M – Pilot lands on nosegear

The pilot was doing a series of touch-and-go landings on the grass runway with a crosswind component of 5 to 8 knots. On the application of power after the third landing, the nosewheel struck the ground and collapsed, destroying the propeller and nose oleo, shock-loading the engine, and distorting the firewall. The pilot observed that he was not very familiar with the Cessna 150 flap operating system and may have applied power before retracting the flap. (All of the pilot's flying experience was on the Cessna 150.)

PPL with 109 hrs total, all on type, with 4 hrs in the last 90 days.

Cessna 177B – Pilot mishandles aircraft during crosswind landing

The pilot was landing on a 520-metre grass strip, which has a 3-degree upslope. The runway is 20 metres wide and the surface wind was 120 degrees from the left at 8 knots. The pilot flew a normal 'crabbed' approach to the flare where he applied rudder to align the aircraft heading with the runway. The touchdown was close to the right edge of the runway, so the pilot applied left rudder, but the right main wheel ran into soft ground off the runway edge. The nosewheel struck a runway edge light, and the aircraft entered soft soil, decelerating rapidly. The propeller struck the ground before the aircraft stopped. The pilot attributed the accident to 'kicking off drift' too early and then drifting across the runway during the flare.

PPL with 218 hrs total, 141 hrs on type, with 24 hrs in the last 90 days.