September / October 2001

VECTOR

Pointing to Safer Aviation

Tiedown Techniques

Helicopter Passenger Briefings

More Ways to Hurt Your Aircraft – Engines

CAA
CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

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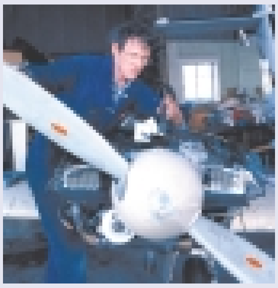

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Cover photo:

A Piper Cub lies badly damaged after having been flipped from its tiedown points by a severe wind gust in the Marlborough Sounds. Photograph courtesy of Aviation Co-operating Underwriters Pacific Ltd and Airclaims New Zealand Ltd.

An apology

The photograph on the cover of the our last issue was wrongly credited to Air New Zealand. The Air Nelson SAAB photograph was taken by aviation photographer Peter Clark. We apologise for our error.

Tiedown Techniques

Each year aircraft are needlessly damaged by wind gusts because of inattention to weather forecasts, negligence or inadequate tiedown measures. With the 'windy season' approaching, it is a good time to brush up on recommended picketing techniques and other precautions against wind damage to parked aircraft. The advice below includes construction details for permanent tiedown anchors.

In New Zealand we do not normally experience the devastating effect of tornadoes and hurricanes so commonly encountered in other parts of the world, but we do have to contend with extremely high winds of almost hurricane intensity in certain areas.

This is particularly so during the early summer months when we experience 'equinoctial gales', which are caused by the high-pressure belts taking up a more southerly transit across the Tasman Sea and South Pacific Ocean. Those living in more exposed areas know full well the potentially damaging effects of gale force westerlies on buildings and property.

There can also be localised strong winds and, because of New Zealand's geographical position and mountainous terrain, some areas can experience sudden changes in weather conditions. MetService try to forewarn us of extreme weather conditions, but this is not always possible.

It is necessary, therefore, to make sure your aircraft is well secured when leaving it parked in the open, even for short periods.

One major insurance company in New Zealand has had seven claims in the last three years where aircraft (all high-wing) have been blown off pickets. The resulting costs ranged from \$3,000 to \$40,000 per aircraft, with a total of \$123,000 worth of damage.

Photograph courtesy of Canterbury Aviation

A Cessna 180 was blown over a fence at Christchurch Airport by nor'west winds damaging another aircraft on the way.

Aircraft owners, operators and pilots should ensure that they know the correct method for securing their particular aircraft type.

Protection from Storms

The best protection against windstorm damage is to fly the aircraft out of the impending storm area – provided of course you have sufficient warning time. The next best measure is to secure the aircraft in a stormproof hangar or other suitable shelter. If hangarage is not available, the remaining option is to ensure that the aircraft is tied down securely.

If fixed tiedown points are not available, then try to find a sheltered place in which to picket the aircraft, eg, a natural depression in the ground, in the lee of a building, or behind a shelterbelt of trees. Seek local knowledge – sometimes the seemingly logical place may in fact be the worst because of localised wind effects.

If a relatively sheltered place cannot be found, it may be possible to park a truck or tractor in front of the aircraft. This will serve as an extra tiedown point, as well as helping to break up the airflow over the aircraft.

Types of Tiedowns

Any aircraft parking area should be equipped for three-point tiedowns. The direction in which the aircraft are to be parked and tied down will be determined by prevailing or forecast wind direction.

Permanent Anchor Points

Aircraft should be headed into the wind, or as nearly as possible, depending upon the locations of the fixed parking area mooring points. The spacing of tiedowns should allow for ample wingtip clearance between aircraft. The distance is generally equal to the major axis (wingspan or fuselage length) of the largest aircraft usually operated, plus three metres.

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The location of tiedowns is usually indicated by some suitable means, either white or yellow paint, painted tyres, or crushed stone surrounding the anchor point. The tiedown anchor eye should not protrude more than two and half centimetres above the ground.

Fixed tiedown anchors for single-engine aircraft should provide a minimum holding power or strength of approximately 1400 kg (3000 pounds) each. The type of anchors in use depend on the type of parking area – a concrete paved surface, a bituminous paved surface, or an unpaved grass area.

Figures 1 to 3 show recommended construction details for tiedown anchors for the different surfaces.

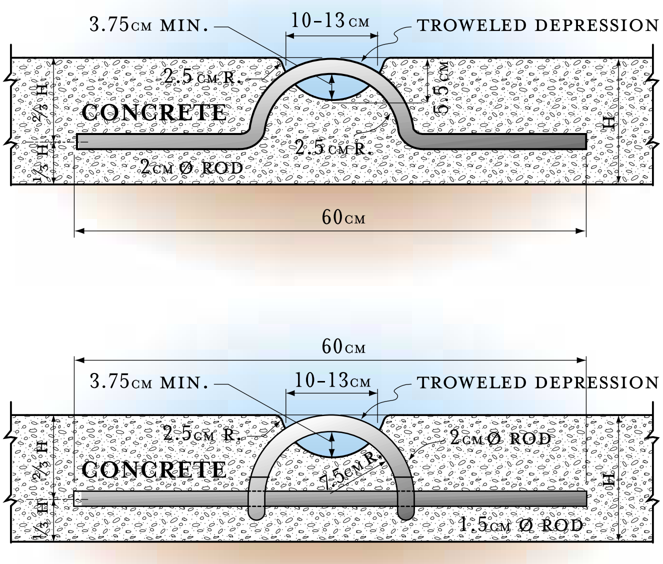


Figure 1. Tiedown Anchors for Concrete Paved Areas

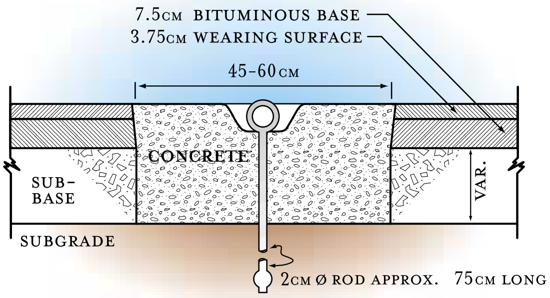


Figure 2. Tiedown Anchors for Bituminous Paved Areas

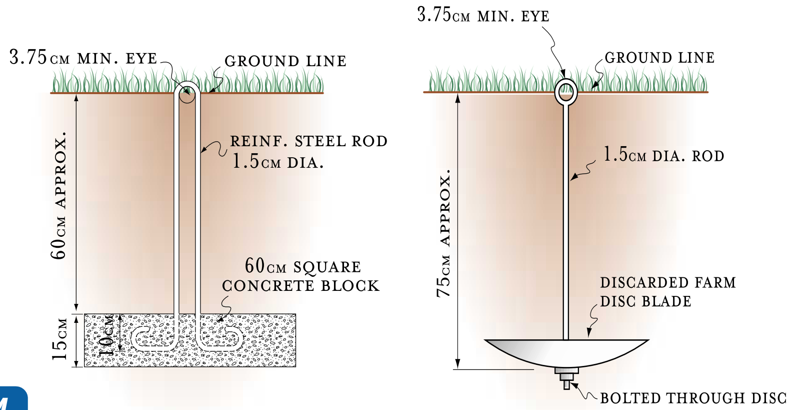


Figure 3. Tiedown Anchors for Turfed Areas

Parallel Cables

Some aerodromes utilise continuous lengths of parallel wire ropes passed through U-bolt anchors and fastened at the ends of the line with wire rope clips. The distance between the wire ropes will depend upon the types of aircraft that will use the tiedown area.

Tiedown chains (or ropes) are attached to the wire rope with roundpin galvanised anchor shackles. This allows the tiedown chains to 'float' along the wire rope and gives a variable distance between anchor points so that a variety of large, medium, and small aircraft can use a vertical tiedown without loss of space. The vertical anchor and the flex in the wire rope significantly reduce impact loads that may occur during gusty wind conditions.

Pickets

If permanent tiedown facilities are not available it will be necessary to use your own set of pickets. Figure 4 shows the two types of pickets most commonly in use for grass areas.

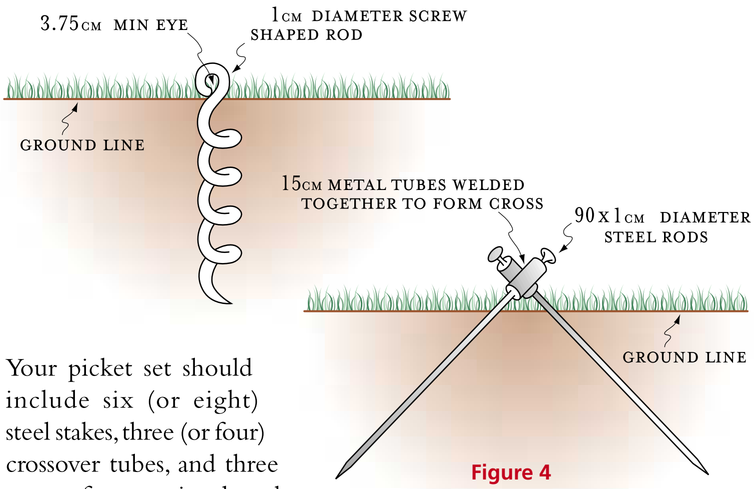


Figure 4

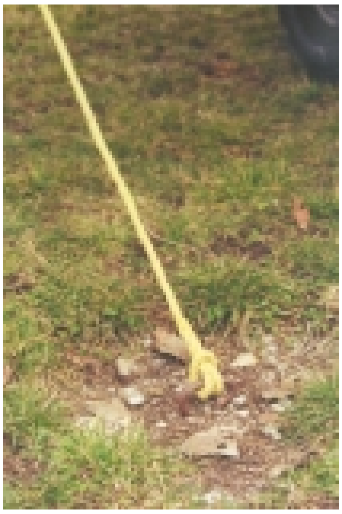
Your picket set should include six (or eight) steel stakes, three (or four) crossover tubes, and three ropes of appropriate length, all stowed in a bag or other suitable container. A mallet of some sort will also be necessary. Be sure to include the pickets in your weight-and-balance calculations, and ensure that they are well secured in the aircraft before flight.

A lightweight set of pickets utilising stainless steel rods and twisted shackles stored in a plastic (downpipe) tube.

Care should be taken when selecting the area in which to picket the aircraft. Pickets can pull out under strain if the ground is soft or becomes wet. However, they are the best option when permanent tiedown anchors are not available (as is the case on many smaller aerodromes in New Zealand). The coiled type are difficult to get into stony ground and are possibly more likely to pull out in soft ground.

The underwing ropes should be led to points outboard and forward of the underwing attachment point. Pickets should, therefore, be hammered in in front of the wing (not underneath it when – particularly with low-wing aircraft – you run the risk of banging a hole in the wing on the backswing!).

Ropes



Tiedown ropes capable of resisting a pull of approximately 1400 kg (3000 pounds) should be used. Nylon or dacron rope is preferable to manila rope, which shrinks when wet, is subject to mildew and rot, and has considerably less tensile strength than either nylon or dacron.

Figures for synthetic ropes should be available at the dealer. Check them before you buy. Also check the type of rope. In general, a soft slippery rope may be somewhat stronger and easier to splice, but it will not wear as well and is more likely to unlay than a firm well 'locked-up' rope. Blended ropes, part polyolefins and part other fibres, may be found. Multifilament (fine filament) polypropylene looks like nylon – don't expect it to be as strong or do the job of nylon though. (It floats, nylon doesn't.) Spun, or stapled, nylon and dacron are not as strong as ropes made from continuous filaments but are less slippery and easier to grasp.

Manufactured tiedowns (webbing with end fittings and a ratchet tightener) can also be used. These are manufactured to varying load figures. One thing to be wary of is that these generally have a single S-clip fitting at the ends – this could unhook from the aircraft tiedown ring if there is significant rocking of the wings in wind gusts. Make sure you have a closed fitting that cannot come off – this may mean having the tiedowns custom-made. It is not advisable to undo and re-fit the ends yourself, as the stitching can be the weakest link.

Dog-chain type clips should not be used when picketing, as they are not strong enough.

Chains are **not** recommended, as there is no elasticity in them to avoid sudden shock loads being applied to the aircraft structure in gusty wind conditions. A combination of chain and rope can be used, but the rope must always be the part attached to the aircraft. Chains are often used with the parallel wire cable system – in this case the vertical anchor and the flex in the wire rope significantly reduce impact loads. If chains are used, they should be secured without slack and all fittings must be equally as strong – dog-chain type clips are not strong enough, round-pin galvanised anchor shackles should be used.

Securing the Aircraft

After selecting a suitable tiedown site, the aircraft must be secured. Three point tiedowns should be used, allowing adequate wingtip clearance from other parked aircraft. It is important to make sure any adjacent aircraft are also securely tied down – having your own aircraft well tied down will be wasted if the neighbouring aircraft blows over on to it.

Position

Your aircraft should be parked and tied down into wind, or as nearly into wind as possible.

There are varied opinions as to whether a tailwheel aircraft should be tied down tail into wind. Remember that your aircraft was designed to meet the airflow head-on, and that flying control surfaces can be easily damaged if control locks are not in place when the aircraft is parked tail into wind. The aircraft also has a tendency to weathercock when on the ground. Therefore, if parked tail into wind (and not properly secured), it could be blown over as it is rotated into wind by a sudden gust. If the aircraft is parked tail into wind, it must have the park brakes on, control locks in place and the tail securely tied down.

Always check the surrounding area for other items that could be a danger as flying debris – things as large as 44-gallon drums or aircraft stairs and maintenance stands on castors have been known to blow across a tarmac area.

Controls

Flight controls should be locked or tied to prevent them banging against the stops and causing damage to hinges, cable, pulleys, etc.

Secure the ailerons, rudder and elevator in their neutral position.

If integral gust-locks are not fitted, use external control surface locks or secure the control column firmly (commonly done with the seat belts). When using external surface locks, make sure they have a red streamer or other means of reminding the pilot to remove them before flight. The problem with using a seatbelt is that the control column is pulled back with full aileron deflection one way. A better solution is to use bungee cords.

Tailwheel aircraft should have the elevators locked in the **up** position when facing into wind – unless the tail has been raised to the flying position, when they should be secured in the neutral position as for tricycle type aircraft. If the tail is raised, the

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support structure must be strong enough to support the aircraft weight and the wind loads, and it must be securely tied down with the tail of the aircraft securely tied to it. Another method of reducing the angle of attack (and providing a chocking effect) is to lower the wheels by digging holes for them. If a tailwheel aircraft is parked tail into wind, then the elevator should be secured in the **down** position.

After the aircraft is properly located, lock the nosewheel or the tailwheel in the fore-and-aft position, apply the park brake, and chock the main wheels fore and aft.

Doors, etc

All doors, windows and hatches should be closed properly. Engine openings (intake and exhaust) for both reciprocating and gas turbines should be covered to prevent entry of foreign matter. Pitot-static tubes should be covered to prevent ingress of windblown dust, dirt or other foreign matter.

General

Fuel tanks should be topped up to provide mass and added stability in gusts.

Always double-check the security and sealing of fuel tank filler caps to avoid the ingress of any water from heavy rain that may dowse the aircraft in a heavy storm. If the filler cap sealing is in doubt, then duct tape or speed tape should be placed over the cap area.

Tyres could be deflated as an extreme measure for reducing bounce.

Tying Down

Ropes should be tied only to the tiedown rings provided. Never tie to a strut as the rope may slip to a point where even slight pressure may bend the strut.

Ideally, the aircraft should be placed so that underwing ropes can be led to points one metre outboard and two metres forward of the underwing attachment point as pictured below.

On tricycle undercarriage aircraft, secure the middle of a length of rope to the tiedown ring under the tail section, then pull each end of the rope away at an angle of 45 degrees and secure it to ground anchors. If extreme weather is expected, it is advisable to tie down the nosewheel as well.

Particular care should be taken when securing a tailwheel aircraft. Some owner's manuals specify certain steps to be taken for maximum protection, such as tying the tailwheel tiedown rope around the tailwheel gear spring, then securing it to the ground.

When tying ropes, draw them tight (not stretched) and then back them off a few centimetres. Too much slack allows the aircraft to jerk against the ropes, while a rope that is too tight can put inverted-flight stresses on the aircraft, which may not be designed to absorb such loads.

Remember, a tiedown rope holds no better than the knot you tie. Anti-slip knots, such as bowline or square (reef) knot (Figure 5) are quickly tied and easy to undo.

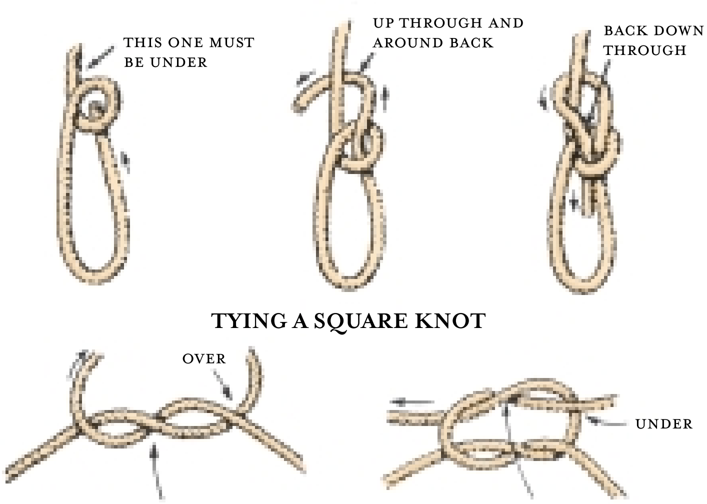


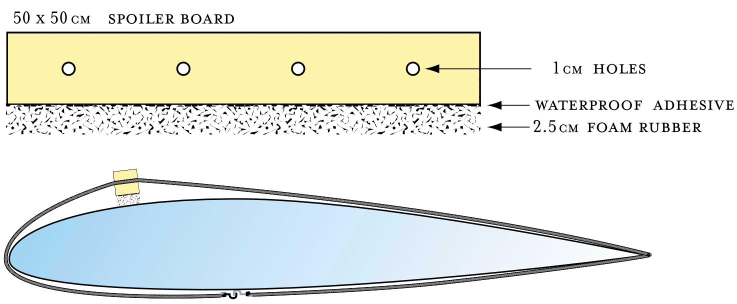
Figure 5. Types of knots

Wing Spoilers

The problem of wing lift from the wind can be overcome to some extent by the use of spoiler boards placed span-wise along the top of the wing. If the anticipated winds will exceed the lift-off speed of the aircraft wings, the makeshift spoilers should run the entire length of the wings.

Spoiler boards are constructed from lengths of 50 x 50 mm with a number of 10 mm holes drilled at frequent intervals. A strip of 2.5 cm foam rubber is then glued, not nailed, to the underside. Lengths of nylon or rubberised shock cord threaded through the holes and around the wing leading and trailing edges, tied together underneath the wing, hold the spoiler firmly in place. Before tying, place pieces of foam rubber or other soft material as buffers between the cord and leading and trailing edges to prevent chafing damage.

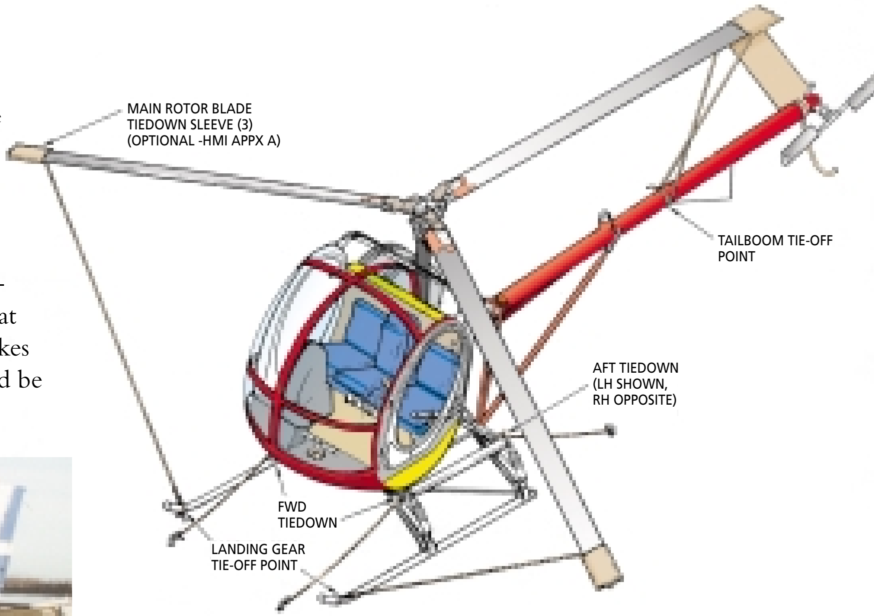
The spoiler should be positioned so that it is at about the 25% chord point.



Multi-Engine Aircraft

Multi-engine aircraft require stronger tiedowns because of their additional weight. The anchors should be capable of a holding power of 1800 kg (4000 pounds) each for the lighter executive twin-engine aircraft. Do not rely on the aircraft's weight to protect it from damage by windstorms. It is quite possible for a sudden, severe windstorm to move, damage, or even overturn such aircraft

Multi-engine aircraft should be tied down and chocked when left unattended for any length of time. Gust-locks should be used to protect control surfaces – these should be well marked to obviate any attempt at takeoff with them still in place. If the landing gear makes use of the down lock safety pins, then these pins should be inserted when the aircraft is being secured.



Helicopters

Helicopters on the ground are particularly susceptible to structural damage from storm force winds. However, they have the advantage of being able to seek shelter more readily, and smaller helicopters can tuck in to places not accessible to fixed-wing aircraft. If helicopters can be hangared, do so. If not, move them to a sheltered position if possible and tie down securely. Helicopters that are tied down properly can usually withstand winds of 55 to 65 knots, but anything above this will likely result in some damage.

When securing a helicopter against wind damage, the following precautions should be taken:

- Face the helicopter in the direction from which the highest forecasted wind or gusts are anticipated.
- Position the helicopter slightly more than rotor-span distance from other aircraft.
- Position the cyclic stick in neutral and the collective lever full down and lock all friction devices.
- Position the main rotor blades and tie them down in accordance with the manufacturer's instructions (check for allowable bend).
- Install rotor blade covers over the main rotor tips. Secure a tiedown rope to each blade cover and the other end to the applicable mooring point on the helicopter. Do not leave too much slack, and use anti-slip knots when tying the ropes.
- Fasten the tiedown ropes to the fuselage mooring points (or the skids) and extend them to the ground mooring anchors. Provide sufficient slack and use anti-slip knots, such as square or bowline knots.
- Place the tailrotor in the position recommended for the particular type (some types have a locking pin) and install a cover over the lower tip. Tie the lower blade cover rope to the tailskid to prevent possible damage from flapping tail rotor blades.
- Close doors, windows, and exterior access panels. Install covers for engine openings and pitot head.

Most helicopter flight manuals have specific instructions for parking and mooring. Ensure you follow the manufacturer's instructions for your make and model of helicopter.

Floatplanes and Skiplanes

Floatplanes and skiplanes should be secured in the same manner as for conventional aeroplanes – to tiedown anchors or 'deadmen' sunk under the water or snow.

In addition to using underwater anchors, some floatplane operators have been known to partially flood the floats of their aircraft to keep the aircraft more stabilised in the water during windstorms. This technique has also been applied when floatplane aircraft are tied down on land, in this case to provide added weight.

If the storm is forecast to be severe, serious consideration should be given to beaching the floatplane and transporting it to a hangar or more sheltered location to be tied down.

Skiplane pilots sometimes pack soft snow around the skis, then pour water on the snow, and allow the skis to freeze to the ice.

Although these techniques are not recommended practices, they have proven effective in preventing aircraft damage from sudden windstorms. Extreme care must be taken to reverse the effects of any such measures prior to operation of the aircraft!

After the Storm

After the aircraft has been standing out in a storm, a very careful pre-flight inspection should be carried out. Look for any structural damage around control hinges, or wing skins at points where high loads collect. Check all hinges and controls for unusual slackness.

Pay particular attention to fuel drains. Drain all sumps and check each sample; shake the wingtips and repeat the draining process.

Don't forget to remove all opening covers and external gust-locks before going flying.

Conclusion

When major storm conditions are forecast, if flying your aircraft out of the area is not an option, and if no stormproof hangarage is available, then the aircraft must be tied down securely.

It doesn't necessarily take storm-force winds to cause aircraft damage – New Zealand is a windy country and suitable precautions should be taken as a matter of routine.

Any aircraft parked outdoors should be properly secured after operations each day, and between operations during the day if it is left unattended for any length of time. This routine will ensure your aircraft is not only safeguarded against any local weather contingencies, but is able to withstand the gale-force winds which can buffet us at times, particularly at this time of year. ■

Helicopter Passenger Briefings

Photograph courtesy of Neville Dawson

This article is taken from Volume 12, Number 2, of* Helliprops Human AD *and outlines why a thorough passenger briefing prior to flight is so important. While specific to helicopters, the principles discussed are just as relevant to fixed-wing operations.

The following account was contributed by a reader:

I was doing spray work in a Bell 47. My crew and I arrived and were ready to do the job. There was one field in which I was to cover only certain sections. I flew out to the field, but it was not obvious what I should and should not spray. To be sure, I decided to talk with the farmer. I flew back, landed and shut down on a slope that was acceptable, but barely so. The farmer tried to describe the work, but it was still not clear to me. I invited him to join me for an over-flight so he could point out exactly what he wanted to have done. Without much of a pre-flight discussion we got in, started up, and took off. (I should point out that I had both lap belt and shoulder straps; the passenger seat had only a lap belt.)

This was not to be a long flight, but it didn't take very long for me to notice that he was nervous. Before we could resolve what I should spray, he said that he was feeling bad and wanted to get back. I didn't waste any time and headed straight back. This time I decided to land on top of our feeder truck. I called the ground crew, told them what was happening, and asked for someone to meet us on the truck. I wanted someone to help the farmer out of the helicopter and off the truck without harm. Two ground crewmen were poised on the side of the feeder truck, ready to help my passenger get out.

Normally we land laterally across the wooden pad on top of the truck. These pads are only about eight feet wide. When the 47 is positioned properly for shutdown and reloading, the tips of the skids, the pedals, and your feet are all past the forward edge of the landing pad. For most landings it is not unusual to keep it light on the skids and to slide it a bit to get it in the right position.

As we were touching down and light on the skids, I was sliding it forward to get the tips of the skids far enough forward. The nauseous and apparently frightened farmer must have thought we were about to slide off the top of the truck. He compensated for what he thought was an accident-about-to-happen by bracing himself. He did so by putting his feet on the right pedal and using it to push his body backwards. Of course we immediately began a right yaw as I was unable to overcome all of his input.

"Now with us in a slightly climbing yaw the farmer lunged over towards me and grabbed me in a tight bear hug."

I was concerned that the spray booms were about to hit the waiting ground crewmen, so I added some power to get some clearance. Now with us in a slightly climbing yaw the farmer lunged over towards me and grabbed me in a tight bear hug. Now I was struggling to maintain control. With him all over me, attitude went into pitch and roll excursions. I had a hard time making the right control inputs. I pushed the farmer off me, but he leaned forward to grab the centre console. His weight shift forward aggravated the forward pitch down angle and forward C of G. I made an abrupt aft cyclic input and the main rotor struck the tail rotor driveshaft.

Now, with the tail rotor driveshaft severed, we began a rapid right yaw. This was a nasty situation. I wanted to get away from the feeder truck and ground crewmen to put this thing down. I managed to make it go away from the truck but there was not a lot of alternatives of where to go. We made a hard landing, spreading the skids, and bending/breaking all sorts of structure, and coming to a stop leaning right just far enough for the rotor blades to barely hit the weeds on the ground. Neither one of us was injured from the impact and rough stop.

The engine stopped as a result of a ruptured fuel line, but only a small amount of fuel leaked out and caught fire. That was enough to panic the farmer. He released his buckle and began to scramble out his door. The main rotor blades were still turning. I reached after him and was able to restrain him by grabbing his shirt collar. In so doing I inflicted his only injury – a scratch on his neck. I couldn't hold him for long and he amazingly got out of the helicopter and exited between the now slowly rotating rotor blades!

I learned some lessons. Shoulder straps would have helped. A better pre-flight passenger briefing would have helped. Either might have prevented this incident.

This is one of the unfortunate pilots who was unable to escape the clutches of a passenger.

Many helicopter pilots share a common problem – handling passengers in and around the aircraft. This may seem like a minor problem. After all, airlines board and disembark many thousands of passengers every day without a big fuss. What's so special about helicopter passengers?

Well, helicopter passengers have caused many problems big and small. And the problem can be significantly greater for a single pilot than a crew of two

Passengers have done minor things. They have failed to close baggage compartment doors, opened cabin doors in flight, left lap belts dangling out closed doors, reeked with body odour, chased their rotorwash-blown hat back toward the tailrotor, interfered with radio communications, argued, moved around in the cabin, dropped things with a bang on the cabin floor, lied about their weight and the weight of their baggage, smoked when asked not to, complained, asked for special flight manoeuvres and fly-bys, spilled drinks, vomited in the cabin, and have left articles behind.

Each of these do not seem terribly dangerous, but many of them have the potential for something more serious. If nothing else, these minor problems can provide the distraction that requires the pilot's attention to be diverted from the matters of flying, minding, or pre-flighting the aircraft.

Passengers have also done some serious things. They have lifted their skis up into the rotor disk, pulled the collective up when exiting the copilot's seat of a running aircraft, stepped on the pedals when simply shifting to get more comfortable, stood erect on the door step and waved their hand overhead, ignored instructions by opening a door to get out to go back to the baggage compartment immediately after landing, walked under the tailboom, walked into the tailrotor, leaned on the cyclic during flight, brought hazardous materials on board, threatened the pilot, and walked into the main rotor blades.

Some of these actions have cost them their lives, jeopardised the lives of others aboard, and/or scared the wits out of pilots.

Various operators have developed their own procedures to inform and control passengers. If your company has set procedures, follow them. A passenger briefing may be repetitive and insignificant to you, but to a first-time passenger it is not.

Unless you are absolutely certain your passenger is knowledgeable, it is prudent to assume that they know nothing. Passengers may be reluctant to show their ignorance, and simply lie about their experience. Take a conservative approach. It is far better to refresh something they once learned, than to omit something they never knew.

If you do not have a standard passenger briefing, develop one. As a rule, it is far better to invest a little extra time on the ground to conduct a thorough pre-flight briefing, than it is to wrestle with problems in flight.

Your briefing should include everything you expect to happen in a normal situation for your flight, as well as the appropriate abnormal procedures.

Passengers should be informed on procedures such as the use of the seat belts, opening and closing of doors, use of the intercom system, normal external radio communications, when and how to disembark, and avoidance of rotors.

Think about some other things too.

Recognise that some people may simply be afraid of flying in any kind of machine. Their fear may be competing with their commitment to fly. They may be reluctant and, like a sheep, be led onto the aircraft. But once on board and up in the air, fear takes over, and anything may happen.

Try to determine their level of anxiety, and brief them appropriately to set their minds at ease. You may simply describe what the takeoff will be like, the direction and route of travel, how fast and high you will fly, estimated time enroute, the aircraft noise and vibration, and how they might help you spot other traffic.

Try to visualise what the passenger expects to do on this flight. Will they be doing their work as you fly, counting bird nests, photographing some property, or making a report on a natural disaster? Imagine what they might want to do. Will they be in a hurry to disembark after you land? If you take some interest in their motives for the flight, you may be able to anticipate their actions.

Pre-flight briefings are great, but many operations must be conducted when there is the noise and rotorwash of engines and rotors turning on the ground. This can be a hazardous situation with passengers approaching or disembarking. The dynamics can frighten them or diminish their situational awareness, and your ability to communicate with them orally or visually may be non-existent.

There is no one easy answer to solve this.

You must first be aware that passengers can and do take actions that can be harmful. Use ground guides whenever possible. Take advantage of any time that you have to verbally brief passengers. If your only means of communication is to use arm and hand signals, then do it.

You may have to be assertive with your passengers to provide for their safety. Some of your customers may not be accustomed to being told what to do. If you don't tell them, they may not have the knowledge to do it for themselves.

Handling passengers is a serious matter – they are in your hands.

Treat them the way you would your mother. If that does not appeal to you, remember that they are instrumental in paying your salary! ■

Heliprops Human AD is pubished by Bell Helicopter Textron Inc and aims to help reduce human error related accidents through professionalism, safety and sound aeronautical decision-making. **Heliprops** is distributed free to all interested helicopter operators, owners and pilots.

Have you seen our range of passenger safety briefing cards and posters?

Your local CAA Field Safety Adviser can supply you with passenger briefing card templates, which can be customised to your operation though the application of stickers showing safety equipment and other information. They are avialable in five different stylised aircraft types (low and high-wing single-engine aeroplanes, low and high-wing twin-engine aeroplanes, and helicopters) in English, German and Japanese versions.

Your FSA can also supply you with posters on passenger safety around aircraft and helicopters – the latter being available in two options, which are particularly useful for briefing passengers on how to approach and how to disembark from a helicopter. One of these two posters is tailored towards passengers who need to work in and around helicopters as part of their job (see page 19 for a cut-out copy of it), while the other relates more to tourist or similar passenger operations.

More Ways to Hurt Your Aircraft – Engines

In the last issue we discussed ways in which your aircraft's airframe could be damaged in flight through various aerodynamic loads. This article continues that theme by looking at ways in which the unwary pilot can damage aircraft systems, in this case aircraft engine(s).

Most pilots are acutely aware of the performance of their aircraft engine(s). Engines are the animate 'heart' of powered aircraft and so naturally are the aircraft system to which we pay the most attention. While aircraft engines are remarkably robust, there are a number of ways of hurting them. Without looking ahead how many can you think of?

The *Vector* team came up with the following: overspeeding, overboosting, running in forbidden rpm ranges, running outside temperature or pressure limits, thermal shock, inadequate lubrication, inappropriate use of carburettor heat, ring flutter, incorrect use of magnetos, turning engines backwards, and, finally, under-using them.

Overspeeding

Most aircraft engine problems have analogies with car engines, which can also be damaged by drivers. One example is overspeeding, or exceeding engine rpm limits. Aircraft fitted with fixed-pitch propellers have a top speed beyond which the engine rpm will be at red line with full throttle – any faster and rpm limits will be exceeded. This engine red line-speed will, by design, be faster than the straight-and-level top speed of the aircraft, but it can often be easily reached in even a gentle descent with full throttle.

Overspeeding can also be caused by rapid application of throttle, with fixed-pitch or constant-speed propellers, particularly at slow speeds.

In either case, running the engine beyond design rpm can lead to catastrophic component failure at worst, or significantly decreased engine life at best, the same as with your car. Note that any loss of oil pressure in a constant-speed unit can lead to the propeller moving to fine pitch, in effect becoming a fixed-pitch propeller with a very fine pitch. It is very easy to overspeed the engine in such circumstances – a double whammy for the engine because of both the speed and the low oil pressure. Aerobatic aircraft can be particularly susceptible to this.

Overboosting

Overboosting occurs when an aircraft engine fitted with a constant-speed propeller has excessive manifold air pressure (MAP) for the engine rpm, ie, too much throttle for the set rpm. This causes excessive loading on the pistons and, in the worst case, can lead to detonation and subsequent piston failure.

The automotive analogy here is climbing a hill in too high a gear, with the accelerator foot flat to the floor at low rpm. All drivers will be familiar with the way an engine 'bogs down' in these circumstances and normally starts 'pinking'. This is the sound caused by detonation, where the fuel-air mixture 'detonates' or explodes rather than the controlled burning which is supposed to take place. Obviously, an explosion causes more shock loading than a more gradual burning, hence the damage this causes.

A general rule of thumb for most conventional piston engines is that they should not be run with the MAP in inches more than the rpm in hundreds – the so called 'squared' relationship, eg, 25 inches and 2500 rpm – check the aircraft Flight Manual for specific limits though.

Vibration

All engines or engine and propeller combinations have specific rpm ranges where they are prone to vibration. While every effort is made at the design stage to take particularly resonant rpm ranges out of the normal operating range of the aircraft, this cannot always be achieved. In such aircraft the Flight Manual will specify forbidden rpm ranges that must be avoided (these should be marked on the rpm gauge in the aircraft). If they are not avoided, significant vibration can be expected, with prolonged excessive vibration leading to damage to the engine, airframe or engine mounts. It is also a very uncomfortable way to fly, as well as potentially masking any other problems that may be developing.

Temperature and Pressure Limits

All engines have temperature and pressure limits, both high and low. At the high end of the temperature scale, components will start to lose strength, and oil will be losing its lubricating qualities, thus accelerating engine wear. At the low end of the scale, components could be subject to excessive thermal shock as power is applied. Cold oil will not flow freely and may not get to where it is needed to lubricate the engine effectively, again leading to excessive component wear. Seals and bearings can also be damaged by excessive pressures. The message is to keep the aircraft engine operating within limits. This means thoroughly warming the engine before applying significant power, and monitoring engine instruments in flight.

Engine temperature is a balance between the heat being produced and the heat being lost to the airflow. Heat production is a function of power produced and mixture setting. More power means more heat. A leaner mixture means a hotter running engine. Heat loss is a function of engine temperature, air temperature, airspeed and, where fitted, cowl flap position. To keep temperature within limits, the balance between heat production and loss must be maintained. Always ensure adequate cooling for the power you have set, but not too much! Avoid excessive leaning, particularly in the climb. Better to use a bit more fuel and keep the engine cool than to cause engine damage by running too lean.

If your engine is not achieving the manufacturer's recommended operating temperature range, have it checked out by your engineer. There may be a specific reason for it, such as a faulty vernatherm valve in the oil cooler (if fitted). Continuous engine operations at low temperatures may mean that internal engine moisture will not 'boil off' to the atmosphere, which can lead to premature internal corrosion of engine components.

A worst-case condition of heating and cooling that can lead to damage through thermal shock is applying too much power to a cold engine (eg, the overshoot from a practice forced landing) or sudden cooling of a hot engine (eg, throttle closure after a climb). The sudden temperature change caused by such power changes leads to uneven temperature distribution through the engine and rapid temperature changes for some components – particularly cylinder heads. This in turn can propagate cracking. Engines must be suitably warm before high power is applied and conversely should be allowed to stabilise and cool gently before significant power reductions. Examples include periodic engine warming during glide descents such as practice forced landings, or flying level at cruise power after a sustained climb, before commencing low-power or high-speed descents. Parachute drop pilots and glider tow pilots must be particularly aware of the susceptibility of their aircraft engines to this problem.

Incorrect cowl flap settings can catch the unwary pilot not used to using these useful temperature controllers. By changing cooling airflow through the engine, they can keep the engine cool in the climb (cowl flaps open) or keep it warm in descent (cowl flaps closed) while keeping cooling drag to a minimum in the cruise (open just enough to keep the engine at the optimum temperature). Unfortunately, leaving cowls closed in the climb will quickly cook the engine. Pilots must ensure their checklist actions are correctly carried out, particularly CUP checks or equivalent on finals, to ensure cowl flaps are open prior to a climb (CUP stands for Cowls, Undercarriage, Propellers, and is a common 'finals' check in more advanced aircraft).

When conducting the aircraft pre-flight, ensure that you check for any obstructions to cooling airflow, particularly around cylinder heads. Also ensure that your engine is regularly cleaned to remove the inevitable build-up of dirt and the like from between the cylinder head cooling fins.

On the subject of pre-flights, a useful addition to your pre-flight routine is to turn the engine over by hand during the walk around, **after** first ensuring that the magnetos are OFF and mixture is at

A CAA Accident Investigator inspects a crankshaft bearing from a failed engine

IDLE CUT-OFF. Normally, the engine should be turned over twice; that is, 'pulling through' eight propeller blades for most four-cylinder light aircraft. This engine turnover does four things:

- Starts some oil flow around the engine, reducing engine wear on start.
- Allows the pilot to check cylinder compressions (each blade should have about the same force to turn it over).
- Enables a check of the magneto impulse coupling if fitted (a 'çlunking' sound that indicates that the retarding mechanism is working properly).
- Allows you to pick up audible abnormalities like 'chuffing' which can indicate a blown exhaust gasket or even a cracked cylinder.

The author has personal experience of finding a major crack in a Cherokee cylinder by pulling through. There had been no indication of any engine problems but, on pull-through, one cylinder was found to have virtually no compression. If you are not sure about what you are seeing, feeling or hearing, ask your engineer to confirm any symptoms.

Remember to **always** treat propellers as live. Stay out of the propeller arc when turning them over and only **ever** pull propellers by the trailing edge. If you do move a propeller by hand, **do not pull it backwards** – this will cause significant damage to the vanes of any vacuum pump fitted.

The Good Oil

Run out of oil – and your engine won't run too well or for too long. As well as lubrication, oil functions as a heat transfer

Continued over...

... continued from previous page

medium, taking heat away from hotter parts of the engine. Low oil level, or old contaminated oil, reduces the ability to transfer this heat, potentially leading to damage. Keep oil levels at those recommended by the manufacturer, and keep the oil clean – regular oil changes are a cheap form of preventive maintenance. (Note that it is possible to overfill the engine with oil. The excess will just be blown out through the engine breather and dirty the aeroplane.)

Photograph courtesy of *Flight Safety Australia*

Carburettor Heat

Application of carburettor heat applies warm air (heated by the exhaust) to the carburettor in order to prevent or remove icing in the carburettor venturi.

Pilots must be cautious about carb heat application to an engine that has already been leaned. Problems most commonly occur following the descent from a cruise at altitude with a lean mixture set. Increased induction charge temperatures can result in abnormally high combustion temperatures, which may in turn cause exhaust valve seat damage and thermal shock to cylinder heads. It is therefore prudent to advance the mixture control prior to adding carb heat and reducing power in such situations.

Similarly, the application of full power with carb heat selected (such as during a go-round with the carb heat inadvertently left out) can cause problems too. Increased combustion temperatures can result in detonation and engine bearing damage due to extreme fluctuations in cylinder pressure.

In a number of engines, application of carb heat also allows air to by-pass filters and go straight to the carburettor. Consequently, conducting a carb heat check during run-up in dusty, dirty areas will allow abrasive grit into the engine. Even fresh grass clippings can be a problem. A few minutes of this treatment can cause more wear than many hours of running. If you do have an open-venting carb heat system, ensure you are in a suitable area prior to run-up, and, in any case, limit the time with carb heat selected ON to that which you need to confirm its proper operation.

During the pre-flight walk around, watch out for birds' nests clogging the carb heat air duct (depending on the engine type), as birds love to place all sorts of debris in such cavities.

Magnetos

Another system checked on run-up are the magnetos. A really easy way of causing potentially catastrophic damage to the engine is to turn the magnetos inadvertently to OFF while checking them, then turning them on again, with the engine at a high power setting. This can cause a massive backfire or uncontrolled burning, caused by the sudden ignition of a whole lot of unburnt fuel-air mixture in the cylinders and manifolds. In older radial engines it was not unheard of for cylinder heads to be blown right off the engine!

If you do inadvertently select magnetos OFF, let the engine completely stop and then restart it. The instinctive reaction is to turn the magnetos on again. **Don't do it!** The problem is not so apparent at low power setting, so a quick 'live magneto' check prior to engine shutdown is okay. This will help to ensure the magnetos really are dead when selected OFF.

Ring Flutter

A phenomenon that many pilots may be unaware of is something called ring flutter. Quite literally it is when the piston rings move or flutter, potentially damaging the rings, cylinder walls and pistons. It is caused when the engine is operating at significant rpm but is not producing a lot of power. This normally happens only when the engine is being driven by the propeller, such as during a glide. Operating at normal glide speeds is not usually a problem, unless sustained for long periods. Of more concern would be a prolonged high-speed dive with the throttle closed, and engine rpm increased by the windmilling propeller. These conditions should be avoided.

Lack of Use

Like anything mechanical, engines need continual care and maintenance. One way of slowly damaging them is failing to use them. In particular, internal components need the regular lubrication that running provides. Some engines with camshafts at the top of the engine are particularly prone to camshaft corrosion if not regularly run. (Once again, the author has personal and expensive experience of this!). Most engine manufacturers recommend that their engines be regularly run – every week or so. This means getting the engine up to normal operating temperatures, to ensure that normal combustion residues, including water, are removed from the engine by 'boiling off'. Check your Flight Manual or engine operating handbook for specific manufacturer recommendations.

If you ever intend to store your aircraft for any significant length of time, refer to the manufacturer's instructions for the correct inhibiting and blanking procedures.

Summary

Modern aircraft engines are very reliable, but they can still be damaged by the unwary pilot. Most engine handling is common sense. If you wouldn't do it in your car you certainly shouldn't do it to your aircraft! Some damage mechanisms are, however, peculiar to aircraft. The aim of this article has been to make you aware of some of these.

There are other potential hazards, such as incorrect or contaminated fuel, and problems peculiar to engines being run in. Talk to your friendly instructor or maintenance engineer if you need further information or clarification of the points discussed here. ■

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. The following titles have been published so far:

Title	*Latest Version*
How to be a Good IA	*2000*
How to be a Pilot	*2000*
How to be an Aircraft Maintenance Engineer	*2000*
How to be an Aircraft Owner	*1999*
How to Charter an Aircraft	*1999*
How to Deal With an Aircraft Accident Scene	*2001*
How to Get Your Licence Recognised in New Zealand	*2000*
How to Navigate the CAA Web site	*2000*
How to Navigate the Rules	*2000*
How to Report Your Accidents and Incidents	*2000*

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

Title	*Latest Version*
Aircraft Icing Handbook	*2000*
Bird Hazards	*1998*
Chief Pilot	*2000*
Flight Instructor's Guide	*1999*
In, Out and Around Milford	*2001*
In, Out and Around Queenstown	*2001*
Mountain Flying	*1999*
New Zealand Airspace	*2000*
Takeoff and Landing Performance	*2000*
Wake Turbulence	*1998*
Weight and Balance	*1999*
Winter Flying	*2001*

How To and **GAP** booklets (but not *Flight Instructor's Guide* or *Aircraft Icing Handbook*) are available free 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
Tel: 0–4–560 9400

*The *Flight Instructor's Guide* and *Aircraft Icing Handbook*) can be purchased 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

In, Out and Around Queenstown GAP

Queenstown and its surrounding areas boast some magnificent scenery and recreational activities for both the summer and winter traveller. But for the aviator the mountainous terrain, changeable weather, and high density and variety of traffic make it a challenging destination.

Before flying into the Queenstown area, a pilot should have a thorough understanding of its airspace and local procedures, and have a sound knowledge of basic mountain flying techniques (refer to the *Mountain Flying* GAP). Carefully studying the Queenstown/Milford VTC and VFG, in addition to talking to other pilots with experience of the area (local operators for instance), well in advance of the flight are the keys to achieving this.

In, Out and Around…Queenstown steps you through the structure and function of Queenstown's airspace and its associated arrival/departure procedures, which are well illustrated with aerial photographs of many of the visual reporting points. The booklet is designed to be studied in conjunction with the Queenstown/Milford VTC. Aerodrome circuit procedures, aircraft performance considerations, and general RTF procedures are also discussed.

This booklet will be a useful reference, whether you are a first-time pilot to the area or a regular visitor. We suggest that you obtain a copy to keep in your flight satchel in preparation for your next visit to Queenstown.

This GAP will be distributed shortly – watch for it in the rack at your local flight training organisation. ■

AIP Supplement Cut-off Dates

Do you have a significant event or airshow coming up soon? If so, you should have the details published in an *AIP Supplement* – relying on a NOTAM is not as effective, and the information may not reach all affected users. In order that such information can be promulgated in a timely manner, you need to submit it to the CAA with adequate notice (at least 90 days before the event). Please send the relevant details to the CAA (ATS Approvals Officer or AIS Coordinator) at least one week before the cut-off date(s) indicated below.

Supplement Cycle	*Supplement* Cut-off Date	*Supplement* Effective Date
01/12	4 October 01	29 November 01
01/13	1 November 01	27 December 01

Oshkosh and Wanaka

Many of you will be aware of the Experimental Aircraft Association gathering held at Oshkosh, Wisconsin in early August each year. During that week, particularly at the beginning and end of the event when hundreds of aircraft fly in and depart Wittman Field, Oshkosh becomes the busiest airport in the world.

Although the event is on a much larger scale, there are parallels with Warbirds Over Wanaka in New Zealand. Both are events that pilots make a special effort to get to, with many flying there in their own or hired aircraft. Because of this, special arrival and departure procedures are put in place to assist with a safe and orderly flow of traffic. It is imperative that pilots are aware of and comply with these procedures. It is equally important that they apply a high degree of airmanship and basic flying skills while en route – and particularly during their arrival and departure.

There were several accidents, some fatal, associated with the Oshkosh event this year and Rick Durden, a columnist for AVweb, lost a friend in one of them. He has written a heartfelt plea to all pilots in an article entitled "Yes, Pogo, the Enemy is Us" in AVweb's *The Pilot's Lounge* series, No 38. Here is an extract from the summary, but we recommend that you read the whole article, and then read it again (and put it on the club noticeboard) before heading off to Wanaka next Easter. You will find it at www.avweb.com under **Articles**, then **Columns** (direct link http://www.avweb.com/articles/lounge/tpl0038.html.).

Here's the extract: "This is Oshkosh. It is a special, almost sacred place to aviators. On top of that it is extremely visible to the public (far more people drive in than fly in). Each and every one of us has an extra duty and responsibility when we fly in to OSH to do so with our skill levels high enough to meet the demands, and having read the stuff one has to read to arrive and depart. Our errors are magnified. Our accidents at OSH are discussed endlessly. Our stupid pilot tricks are in front of everyone in aviation. At Oshkosh we are not just responsible for the safety of ourselves and our passengers, we have a duty to aviation and every single person who cares deeply for it. Right now, we are letting aviation down, and we are at risk of having to pay a serious price."

"Ben, I miss you. The sight of that funeral pyre of smoke over your airplane is going to be with me until I die. … right now, your death has caused me to finally express some of the deep anger I feel over pilots who continue to screw things up for the rest of us. If that means that just one more pilot next year reads the NOTAM, or takes some dual before coming to OSH or does an honest self-assessment and decides to drive in, and saves one life, then your death is going to make a difference to people you never knew, just as your life made a difference to a lot of people who knew you."

This extract originally appeared in AVweb, the Internet's aviation magazine and news service at http://www.avweb.com/, and is reprinted here by permission. ■

The Perils of Unapproved GPS

From Issue 2/2001 of Transport Canada's Aviation Safety Letter.

Recently, one of our readers sent a letter outlining problems with a hand-held global positioning system (GPS). Basically the problems were with the map display. It appears this particular model showed highways in the incorrect location, and the Toronto Island airport was shown far out into the lake. The manufacturer of the equipment blamed the database (which they obtain from another supplier), but other hand-held GPSs that use the same database were correct.

What lessons are to be learned from this? For those who supplement their IFR navigation with hand-held GPS units, remember they are very different from IFR-approved GPS receivers. Hand-held GPSs are not subject to any certification process, and while they are useful, they are not a substitute for standard IFR navigation instruments or proper VFR map reading. Hand-held GPSs have no self-monitoring to tell you that the satellite geometry may be less than optimum. There have been reports of errors of up to 80 NM with hand-held GPSs. GPS is a very useful tool, but it is not without its pitfalls! ■

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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 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-DXZ, Cessna U206F, 4 Jul 96 at 1337, 20 NM N Invercargill. 1 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot details unknown.

The pilot of the aircraft declared an emergency and his intention to make a forced landing. Another aircraft overhead advised that the forced landing was accomplished safely, and reported that there were no injuries and that no SAR action was required.

Subsequent enquiries revealed that the engine lost power on climb-out from Invercargill and that the pilot had force-landed in a valley, breaking the aircraft nosegear off in the process. Further inspection revealed that one of the No 1 connecting rod bolts had failed, causing a catastrophic internal failure.

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

CAA Occurrence Ref 96/1736

ZK-KVL, Beech 58, 11 Jun 97 at 0135, 11 NM E Paraparaumu. 1 POB, injuries 1 fatal, aircraft destroyed. Nature of flight, freight only. Pilot CAA licence CPL (Aeroplane), age 27 yrs, flying hours 1024 total, 150 on type, 165 in last 90 days.

At about 0130 hours, the aircraft, on a night freight flight, disappeared from the ATC radar-monitoring screen. The aircraft wreckage was subsequently located in the Tararua Ranges. The aircraft had struck a wooded slope at high speed in a steep spiral dive, and fragmented. The pilot was killed on impact. The aircraft probably encountered severe in-flight icing at 10,000 feet, in the area of a convective cell, resulting in loss of control. Ingress of carbon monoxide to the cabin of the aircraft probably impaired the pilot's mental functioning and induced a loss of situational awareness.

Main sources of information: Abstract from TAIC Report 97-012.

CAA Occurrence Ref 97/1758

ZK-GLS, Schleicher Ka 6CR, 13 Jul 97 at 1500, Thames. 1 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age unknown, flying hours 421 total, 1 on type, 2 in last 90 days.

The glider was on aero tow with its air brakes open. The tow-plane pilot attempted to communicate that the air brakes were open and gave a signal (rocking the wings) to the glider pilot. In fact the tow pilot should have waggled the rudder. The rocking of wings signalled to the glider pilot that he should release from the tow. He complied with the signal and released when he estimated he could make the airfield. Strictly speaking, the glider pilot should have released immediately. A forced landing followed in a nearby paddock, rather than at the airfield, due to the increased sink rate caused by the air brakes being open. On the landing roll the right wing struck a fence post.

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

CAA Occurrence Ref 97/2128

ZK-GNO, Grob G102 Club Astir IIIB, 26 Apr 98 at 1431, Drury. 1 POB, injuries nil, damage minor. Nature of flight, training. Pilot CAA licence nil, age unknown, flying hours 75 total, 24 on type, 5 in last 90 days.

After launch, the glider's airspeed dropped to about 45 knots at a height of around 350 feet agl, at which point the student elected to release the winch tow cable and lower the nose to increase flying speed. A straight-ahead landing was attempted but, due to the confined space available for landing and the steep descent required to achieve it, the glider impacted the ground tail first during the flare.

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

CAA Occurrence Ref 98/1098

ZK-JGY, Ultravia Pelican Club VS, 26 Apr 98 at 1700, Pollok. 1 POB, injuries 1 minor, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age unknown, flying hours 480 total, 144 on type, 33 in last 90 days.

During cruise the engine lost power, surged, and stopped. Due to the nature of the surrounding terrain, landing sites were limited. In attempting to land on a hilltop, the aircraft stalled and impacted the side of the hill.

Significant investigation by the pilot revealed that an after-market fuel filter had been incorrectly machined. The two-piece housing is intended to allow fuel to pass through the entire surface area of the top hat filter. Due to a ridge remaining in the bottom half of the housing, only the very end of the filter was exposed to the fuel flow. A small circular mass of lint was removed from the filter end and it is likely that this restricted the fuel flow. The filter housing was machined and flows checked against original pre-survey figures and another filter. An open 8-mm tube (a fuel supply line) flowed at 220 litres/hour, the faulty filter with lint removed flowed at 37.5 litres/hour, the other filter flowed at 150 litres/hour, and the faulty filter (after machining) flowed at 167 litres/hour. The original pre-survey flow was 40 litres/hour.

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

CAA Occurrence Ref 98/1099

ZK-HQG, Revolution Mini 500K, 6 Feb 99 at 1600, nr Temuka. 1 POB, injuries nil, aircraft destroyed. Nature of flight, private other. Pilot CAA licence PPL (Helicopter), age 31 yrs, flying hours 75 total, 10 on type, 10 in last 90 days.

The pilot reported that he was climbing out after landing, and commenced a turn at 100 feet. The helicopter sank back on to the ground, collided with a fence and rolled over. The pilot stated that he thought that he had made the turn downwind.

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

CAA Occurrence Ref 99/233

ZK-HKV, Aerospatiale AS 350D, 10 Feb 00 at 1845, Tapora. 1 POB, injuries 1 fatal, aircraft destroyed. Nature of flight, agricultural. Pilot CAA licence CPL (Helicopter), age 30 yrs, flying hours 3939 total, 1500 on type, 103 in last 90 days.

The helicopter was on an agricultural spraying flight, and was returning to the loading site after applying a load of chemical. Part of the spray equipment became detached from the helicopter in flight and was struck by the main rotor, resulting in the separation of the main rotor transmission from the airframe. A full report is available on CAA web site.

Main sources of information: CAA field investigation.

CAA Occurrence Ref 00/315

ZK-OIL, Cessna 310Q, 11 Mar 00 at 1440, Ardmore. 3 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence CPL (Aeroplane), age 28 yrs, flying hours 2880 total, 150 on type, 30 in last 90 days.

The nosewheel would not retract after takeoff; subsequently it would not fully extend and lock for landing. The aircraft landed on a non-duty runway and the nosewheel leg collapsed. Investigation revealed that the nose landing gear packing support ring had jammed the nose oleo in the on-ground position as the result of a build-up of corrosion deposits. During the subsequent retraction/extension cycle, the oleo yoke impinged on nosewheel well hardware and became jammed causing an overload failure of one of the torque tube rod ends in the retract/extend mechanism. The nose leg was then effectively disconnected from the extend retract system.

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

CAA Occurrence Ref 00/616

ZK-RCA, Fairchild SA227-AC, 15 Jun 00 at 1600, Hamilton. 2 POB, injuries nil, damage substantial. Nature of flight, training dual. Pilot CAA licence ATPL (Aeroplane), age 35 yrs, flying hours 5287 total, 2841 on type, 122 in last 90 days.

The aircraft was landing on Runway 14 at Gisborne, when the left main undercarriage drag braces failed, causing the leg to fold rearwards. A go-around was performed and the aeroplane was flown to Hamilton for a wheels-up landing. The undercarriage failure resulted from a fatigue crack that had developed and grown to a critical length in the outboard lower drag brace. The fatigue crack originated in a recess machined to accommodate a grease fitting, near the attachment point to the undercarriage leg. The crack was not detectable during normal maintenance. The inboard drag brace failed in overload when the outboard brace failed.

Safety issues included the need for improved design and inspection requirements for Metroliner aircraft undercarriage drag braces. The Manufacturer, the FAA and the New Zealand CAA addressed the safety issues. No safety recommendations were required.

Main sources of information: Abstract from TAIC Accident Report 00-006.

CAA Occurrence Ref 00/2014

ZK-GPH, Glaser-Dirks DG-400, 5 Aug 00 at 1645, Taupo. 1 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age 36 yrs, flying hours 136 total, 14 on type, 16 in last 90 days.

Wind conditions were such that the gliding club strip was in the lee of Mount Tauhara. The pilot made an angled approach to Vector 22 to minimise the crosswind component, but landed fast and groundlooped.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/2619

ZK-HSC, Sikorsky S-55B, 29 Aug 00 at 1030, nr Wanganui. 1 POB, injuries 1 fatal, aircraft destroyed. Nature of flight, agricultural. Pilot CAA licence CPL (Helicopter), age 33 yrs, flying hours 513 total, 247 on type, 127 in last 90 days.

The helicopter was spraying liquid fertiliser on a farm property near Wanganui. When it did not return from its fifth sortie, the loader driver and farmer began a search. A column of smoke was seen leading them to the accident site, where they found the helicopter burnt out. The investigation disclosed no specific cause for the accident. A full report is available on the CAA web site.

Main sources of information: CAA field investigation.

CAA Occurrence Ref 00/2821

GA Defect Incidents

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

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

Key to abbreviations:

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

Aerospatiale AS 350BA – Mast bearing locking plate fractures

Non-ferrous metal was found in the transmission oil filter. The lower mast bearing retaining/locking plate had fractured and displaced shavings of material from the upper housing. TSO 2861 hrs; TSI 336 hrs.

ATA 6310 CAA Occurrence Ref 99/2319

Cessna 172M – Aileron hinge pins missing

During the pre-flight check the aircraft owner noticed that the righthand outboard aileron hinge pin was missing. He effected a temporary repair and flew the aircraft to its maintenance base where rectification action was carried out during scheduled maintenance.

The owner was not authorised to carry out the repair work prior to the flight, he was not supervised by a licensed engineer, no duplicate inspection was carried out, and unapproved and non-standard parts were used to complete the temporary repair. This effectively rendered the aircraft airworthiness certificate invalid for the flight.

Engineers reported that the retaining split pin appears to have fallen out of the aileron hinge pin, allowing the pin to come adrift, and that the inboard hinge security split pin was also missing. The remaining split pins were not corrosion resistant and were in a poor state. The missing split pins had most likely corroded and fallen out, or perhaps had not been reinstalled when last removed.

CAA Comment

The safest and most appropriate action would have been to get a licensed maintenance engineer to repair the aircraft at its home base.

ATA 2710 CAA Occurrence Ref 00/4119

NZ Aerospace FU24-950M – Rudder cable breaks

The pilot called to advise he was joining and had a broken rudder cable. He was anticipating handling and control problems on finals and after landing. A local standby was declared, but the aircraft landed safely.

The bolted joint at the rudder quadrant fork fitting had become stiff, preventing the fork fitting moving freely on the quadrant. This probably resulted in fatigue of the stainless steel rudder cable, leading to its eventual failure at the fork fitting.

ATA 5540 CAA Occurrence Ref 99/3510

Piper PA-23-250 – Drag link centre pivot bolt shears, P/N AN 177-27

Once the aircraft touched down on the runway it began to sink. The undercarriage folded and the aircraft suffered a propeller strike.

Further investigation revealed that the lefthand main landing gear drag link centre pivot bolt had sheared. The failure was attributed to fatigue cracking, possibly from overstressing due to loose bushings.

ATA 3210 CAA Occurrence Ref 99/367

Piper PA-23-250 – Landing gear select lever lock spring breaks

The aircraft rolled and yawed to the right as it rotated during the takeoff roll. The pilot suspected a tyre puncture. The undercarriage was observed by ATC to have no obvious abnormalities. A local standby was declared and the aircraft landed safely. During the rollout after landing, the right engine stopped and propeller damage was observed. Slight damage to the right undercarriage doors was also found after shutdown.

It appears that the right main gear commenced retraction before the weight was off the oleo, and this caused minor damage to one of the gear doors. It also allowed the righthand propeller to contact the ground. The cockpit gear selection lever lock was found to have a broken spring. The spring stopped the lever being moved to the UP position unless the lock was physically moved aside. During checks, after starting the left engine, the gear lever was pushed DOWN, and if the left engine hydraulic pump was providing operating pressure the lever would move back to neutral. A broken spring may have allowed the lever to inadvertently move slightly into the UP range. The selection would put a system valve on the left main oleo into the retract cycle. When that valve detected the weight come off the wheel during takeoff, it allowed hydraulic pressure to retract the gear.

The takeoff was made with a moderate crosswind from the right. This took the weight off the left wheel before the right wheel and, because of the broken spring in the gear select lever, may have resulted in the select valve porting hydraulic pressure to the retract side before the right gear was off the ground.

The spring was repaired, the propeller replaced, and the engine bulk stripped. The aircraft operator has since included guidelines relating to this issue in its training syllabus.

ATA 3230 CAA Occurrence Ref 99/275

Piper PA-32-260 – Forward fin attach ring frame corroded

During inspection of the forward fin attach point, the ring frame was found to be severely corroded, with a large portion of the parent material affected. The submitter indicates that, left undetected, this defect may have resulted in separation of the fin within a year or two. TTIS 8600 hrs.

ATA 5340 CAA Occurrence Ref 99/3276

International Occurrences

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

Australia

Occurrences

The following occurrences come from the December 1998 edition of *Asia-Pacific Air Safety* published by the Bureau of Air Safety Investigation (BASI), Australia.

Robinson R22 Beta – Engine loses power

The pilot reported that while conducting an aerial inspection of cattle, he flew the helicopter through a descending right turn into wind. As he commenced to flare the helicopter at about 100 feet agl, the engine rpm dropped rapidly. He lowered the collective control and wound on more throttle. There was no response from the engine.

The helicopter rapidly developed a high sink rate, which the pilot was not able to arrest completely before impact with the ground. The helicopter bounced twice and rolled onto its left side. Neither of the two occupants were injured.

The licensed aircraft maintenance engineer who recovered the helicopter from the accident site reported that he could not find a mechanical reason for the power loss. He said that the helicopter was being operated on Mogas, which is a more volatile fuel than Avgas and in the higher temperatures tends to vaporise in the fuel lines, causing an interruption of fuel to the engine.

United Kingdom

Occurrences

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

Thruster TST – Lean mixture causes engine failure

While on a cross-country flight at 1500 feet QNH, the engine failed completely without warning. The pilot kept his airspeed at 42–45 knots and started a left turn into wind to look for a landing site. The terrain was very hilly with tiny fields and lots of woodland. One possible field had cables across the approach. Another was downwind. According to the pilot, the gliding qualities of a Thruster resemble those of a housebrick, so at 400 feet agl the pilot was faced with a downwind landing. The aircraft impacted the far hedge. The pilot suffered a spinal fracture, a broken ankle and multiple cuts and bruises.

Inspection of the failed engine revealed a hole in the aft piston which caused the engine seizure. This engine has dual carburettors and a PFA inspector says it is important to check that throttle cables are of the correct length so that one cylinder is not running leaner than the other.

Pegasus AX2000 – Turbulence results in hard landing

There was low-level turbulence and a gusty wind of 7–15 kts with a 30-degree crosswind for the landing. A gust of wind caught the aircraft at roundout, lifing it and dropping it back onto the runway. The aircraft landed on the nosewheel, causing damage to the front forks, the pod and the propeller. The pilot concluded that more airspeed would have been appropriate for the conditions.

PPL with 220 hrs P1 and 120 hrs on type.

Piper PA-38-112 – Hard landing damages nosewheel

The instructor was teaching circuit training, when he told the student to delay the landing flare slightly. On the next approach, the student allowed the airspeed to decrease and did not flare before the aircraft contacted the ground; the instructor was too late to prevent a hard landing. He applied full power on the bounce and went around. On the final landing the instructor demonstrated the correct flare with the student following through on the controls. The landing was normal but the ground attitude indicated that the nose gear was damaged.

CPL/IR/Inst with 1000 hrs total, 400 hrs on type with 100 hrs in the last 90 days and 13 hrs in the last 28 days.

Piper PA-28-180 – Pilot fails to recognise go-around situation

The aircraft was being landed on the 650-metre grass runway in calm conditions. The first approach was too high and the pilot went around. The second approach resulted in a touchdown at 60 kts slightly beyond the normal point. The brakes locked the wheels and were released and reapplied. This caused a significant yaw requiring firm rudder input to correct. The pilot decided that there was insufficient runway remaining to stop so he commenced a go-around by applying full power and raising two stages of flap. He then realised that the aircraft was going to hit the perimeter hedge and reduced power. The aircraft passed through the hedge, crossed a roadway and came to rest in a field and sustaining substantial damage. The pilot was unhurt.

The pilot's full and frank report stated that he did not judge the aircraft or its systems to have been faulty or under-performing.

PPL with 145 hrs total, 37 hrs on type with 8 hrs in the last 90 days and 3 hrs in the last 28 days.

Gulfstream AA-5B – Instructor responds quickly to power loss

The private pilot took off from Runway 24 for a check flight under the supervision of a flying instructor. There were four people on board. The surface wind was 180/15 kts.

While turning right at about 700 feet agl, the engine began to run roughly. The instructor took control and, climbing slowly, turned to position downwind for an immediate landing on Runway 24. He made a Pan call and switched off each magneto in turn and selected carb heat, without effect. The instructor positioned so a glide landing was possible. He selected full flap on final and landed slightly long. The aircraft ran slowly into a fence beyond the runway end, causing minor damage to the aircraft.

One spark plug in the left magneto was breaking down and another in the right bank had a cracked ceramic insulator. Both were replaced and the engine performed normally.

BCPL/FI with 1585 hrs total, 75 hrs on type with 101 hrs in the last 90 days and 36 hrs in the last 28 days.

SAFETY AROUND HELICOPTERS

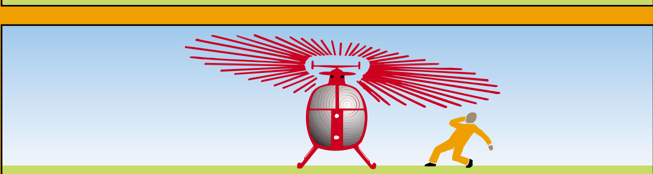
APPROACHING OR LEAVING A HELICOPTER

Do not approach or leave without the pilot's knowledge and clearance. Keep in pilot's field of vision. **Observe Helicopter Safety Zones** *(see diagram right)*

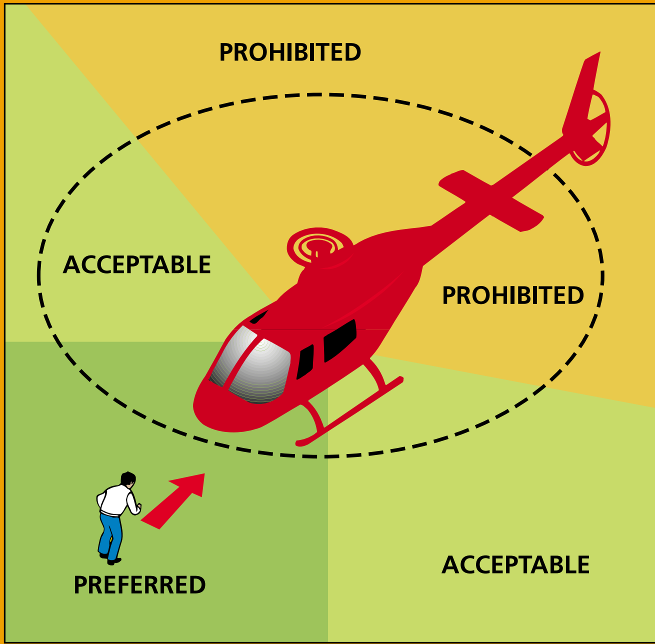
On sloping ground always approach or leave on the downslope side for maximum rotor clearance.

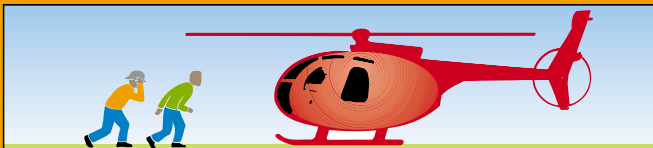
If blinded by swirling dust or grit, STOP – crouch lower, or sit down and await assistance.

If disembarking while helicopter is at the hover, get out and off in a smooth unhurried manner.

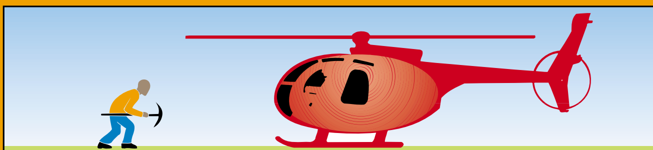


Do not approach or leave a helicopter when the engine and rotors are running down or starting up.



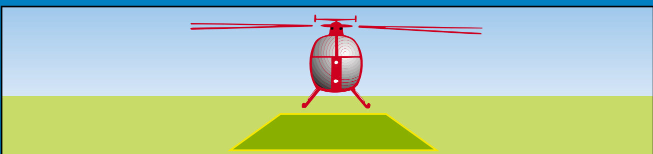


Proceed in a crouching manner for extra rotor clearance. Hold onto hat unless chin straps are used. Never, never, reach up or chase after a hat or other articles that blow away.

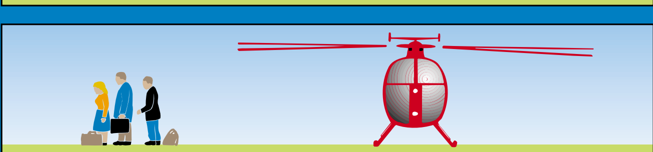


Carry tools, etc, horizontally below waist level – never upright or on the shoulder.

LANDING, TAKE-OFF AND LOADING OPERATIONS

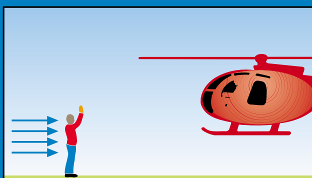


Keep helipad clear of loose articles – water-bags, ground-sheets, tins, etc. Secure other gear from effects of rotor wash.

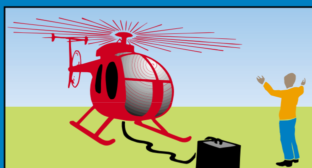


When transporting personnel, loading staff should ensure that:

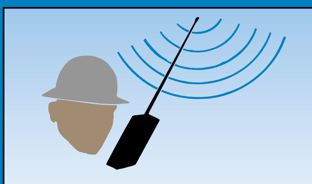
- Passengers are briefed as above
- They are grouped together and well back at side of landing zone
- They face away from helicopter during take-off and landing
- Each person looks after their own gear
- They are paired off and ready to board in turn as soon as the pilot gives the signal



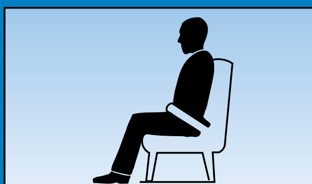
When directing pilot for landing, stand with back to wind and arms upraised.



After hooking up cargo sling, move forward and to the side to signal pilot. Ensure sling is not across skid. Never ride on sling.



When directing pilot by radio, remember that he or she may be too busy to give an acknowledgment.



Fasten and adjust seat belt on entering helicopter and leave it fastened until pilot signals to get out.

Safety Education & Publishing Unit, Civil Aviation Authority of New Zealand.