



# Secure Your Aircraft



## CONTENTS

Protection from Storms .....	3
Types of Tiedowns.....	4
<i>Permanent Anchor Points</i> ....	4
<i>Parallel Cables</i> .....	6
<i>Pickets</i> .....	6
<i>Ropes</i> .....	7
Securing the Aircraft .....	9
<i>Position</i> .....	9
<i>Controls</i> .....	10
<i>Doors &amp; Other Openings</i> ....	11
<i>General</i> .....	11
Tying Down .....	12
<i>Wing Spoilers</i> .....	13
<i>Tiedown Knots</i> .....	13
<i>Some Knotting Terms</i> .....	16
Multi-Engine Aircraft .....	16
Helicopters.....	17
Floatplanes and Skiplanes .....	18
After the Storm .....	19
Conclusion .....	19

## Secure Your Aircraft

Aerodromes around New Zealand can experience strong wind conditions, particularly during the spring and early summer months, when gale force westerly winds can persist for days at a time. Stormy conditions from the passage of a vigorous cold front, for example, can be unpredictable and cause havoc to the unwary. MetService try to forewarn us of such weather, but this is not always possible.

High winds can result in damage to unsecured, or inadequately secured, aircraft and cause thousands of dollars of damage. In extreme instances, aircraft can be damaged beyond repair. This can result in claims which cost insurance companies thousands of dollars, which ultimately is transferred to aircraft owners through higher insurance premiums.



A Cessna 180 blown over a fence at Christchurch Airport by nor'west winds.

New Zealand's weather is changeable, therefore, ensure that your aircraft is secured when leaving it parked in the open for any period of time. In addition to setting the park brake and control lock, you should tie the aircraft down. Aircraft owners, operators and pilots should ensure that they know the correct method for securing their particular aircraft.

## Protection from Storms

The best protection against storm damage is to fly the aircraft out of the impending storm area – provided of course there is 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 in a suitable location.

Ideally, this means securing your aircraft to fixed tiedown points. Many aerodromes around New Zealand, however, have only a limited number of places available for securing aircraft to fixed tiedown points, and these are generally reserved for local aircraft.

It is most likely, therefore, that you will have to find a sheltered place in which to picket the aircraft – a natural depression in the ground, 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.



*Before securing your aircraft, check that the tiedown site is not reserved for a local aircraft.*

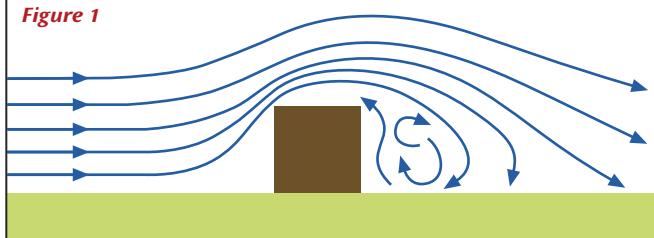
Caution is needed when parking in the lee of buildings. Localised eddies can result in unpredictable airflows around buildings (figure 1). Also, there is the danger of damage to aircraft from flying debris.



*Picket your aircraft in a sheltered place – Seek local knowledge for the best place to secure the aircraft.*

If a relatively sheltered place cannot be found, it may be possible to park a vehicle 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.

**Figure 1**



*Basic flow pattern around a sharp-edged building. In the lee of the building, the velocity of the wind flow is less than on the windward side, but it is more turbulent and unpredictable.*

## Types of Tiedowns

### Permanent Anchor Points

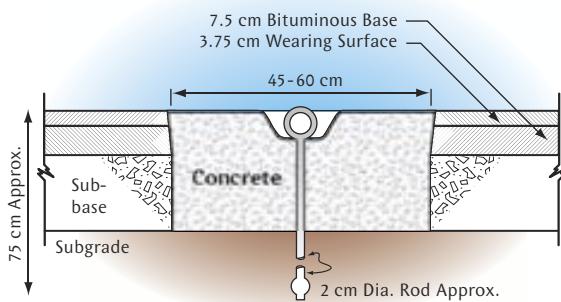
The location of tiedowns is usually indicated by either white or yellow paint, painted tyres, or crushed stone surrounding the anchor point. There are normally three anchor points provided.

The spacing of tiedown points should allow for ample wingtip clearance between aircraft. This distance is generally equal to the major axis (wingspan or fuselage length) of the largest aircraft plus three metres. The tiedown anchor eye should not protrude more than two and half centimetres above the ground.

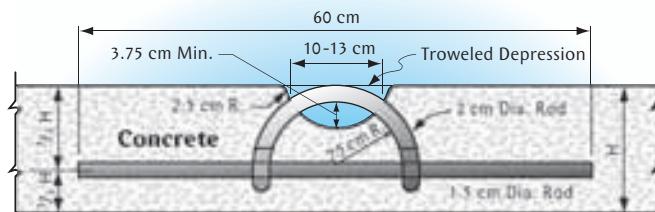
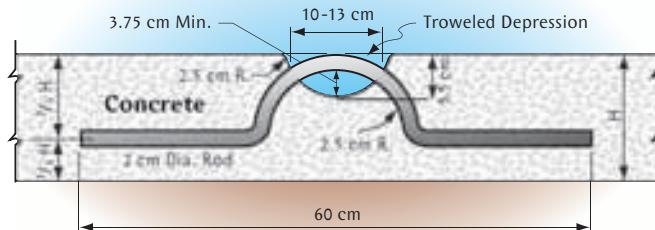
Fixed tiedown anchors for single-engine aircraft should provide a minimum holding power or strength of approximately 1400 kg (3000 pounds) each. The type of anchors in use depend on the type of parking area – for example, a concrete paved surface, a bituminous paved surface, or an unpaved grass area.



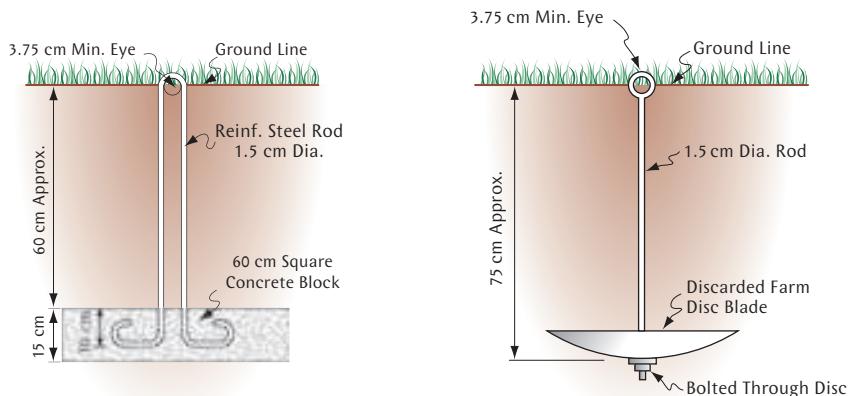
*Fixed tiedown anchor point.*



**Figure 2 – Tiedown Anchors for Bituminous Paved Areas**



**Figure 3 – Tiedown Anchors for Concrete Paved Areas**



**Figure 4 – Tiedown Anchors for Turfed Areas**



*The flex in parallel wire cables can significantly reduce impact loads during gusty wind conditions.*

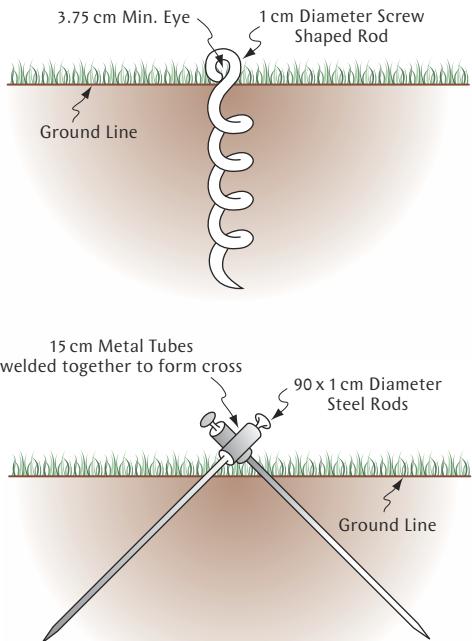
## Parallel Cables

Some aerodromes use 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 small, medium, and large 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 5 shows the two types of pickets most commonly in use for grass areas.



**Figure 5 – Two types of pickets most commonly used for grass areas.**

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.

A mallet or hammer will 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.

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. The coiled type is difficult to get into stony ground and is possibly more likely to pull out in soft ground. Ideally the cross-over type of pickets are the most suitable, as they are more likely to stay in the ground, even if it becomes wet.

The underwing ropes should be led to points outboard and forward of the underwing attachment point. Pickets should be hammered into the ground, 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) are recommended. Nylon or dacron rope is preferable to manila rope. Manila shrinks when wet, is more susceptible to mildew and rot, and has considerably less tensile strength than either nylon or dacron. It is also recommended you check the type of rope. A soft slippery rope can be stronger and easier to splice, but it will not wear as well, and it is more likely to unlay (untwist) than a firm 'locked-up' rope. Multifilament (fine filament) polypropylene looks like

nylon, but don't expect it to be as strong. Spun, or stapled, nylon and dacron are not as strong as ropes made from continuous filaments, but they have the advantage of being less slippery and easier to grasp.

Manufactured tiedowns (webbing with end fittings and a ratchet tightener) can be used. These are manufactured to



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



*The underwing ropes should be led to points outboard and forward of the underwing attachment point. Pickets should be hammered into the ground in front of the wing.*

varying load standards. Be wary, however, as these can 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.

Chains are **not** recommended; they have no elasticity to avoid sudden shock loads being applied to the aircraft structure in gusty wind conditions.



*Check the type and condition of your tiedown rope. Nylon or dacron rope is recommended.*



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

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.

It is advisable to regularly check the condition of your tiedown ropes. Don't just throw them in the back of your aircraft and forget about them; one day you may need them to be in good working condition. If you have concerns about the strength of your tiedown ropes, then 'doubling up' with other ropes when securing your aircraft can be sensible during extreme weather conditions.

## 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 ensure that any adjacent aircraft are also securely tied down – having your own aircraft 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. Ideally, if you are leaving your aircraft for long periods it is a good idea to study the weather forecast for the expected prevailing wind direction. Alternatively, check on the status of your aircraft regularly. This is sensible if your aircraft is secured for periods of time longer than a few days.

There are various 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.

Generally, in winds above 30 knots, it is safer to park the aircraft into wind and dig around the mainwheels. This will lower the aircraft and reduce the angle of attack of the wings. Additionally it will have the effect of chocking the wheels. Another method is to raise the tail to the level flight position. The device which supports the tail must be strong enough to support the aircraft weight and the wing loads. It should be securely tied down, and the tail of the aircraft must be securely tied to it.

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



A tailwheel aircraft secured to fixed tiedown anchors.

## Controls

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

For tricycle undercarriage aircraft, secure the ailerons, rudder and elevator in the neutral position.

If internal gust-locks are not fitted, use external control surface locks, or secure the control column firmly (commonly done with the seatbelts, but it is more effective with bungee cords). When using external surface locks, ensure they have a red

streamer or other means of reminding you to remove them before flight.

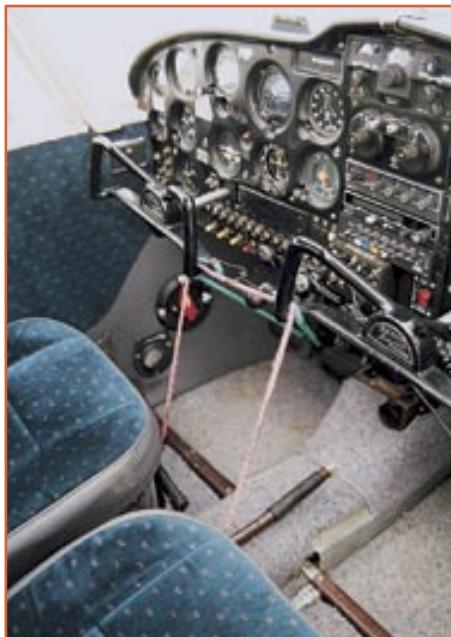
Tailwheel aircraft should have the elevators locked in the **up** position when



*Chock the main wheels fore and aft.*



*If internal gust-locks are not fitted, use external control locks, or secure the control column firmly. When using external surface locks, ensure they have a red streamer or other means of reminding you to remove them before flight.*



facing into wind. Unless the tail has been raised to the flying position, then it should be secured in the neutral position as for tricycle type aircraft. 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 and Other Openings

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.



*Bird bungs*



*Pitot tubes should be covered to prevent the ingress of windblown dust and dirt. Remember to remove the cover before flight!*

## General

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

Always double-check the security and sealing of fuel tank caps to avoid the ingress of any water from heavy rain. If the filler cap sealing is in doubt, then adhesive tape (such as duct tape) should be placed over the cap area.

Tyres could be deflated as an extreme measure to reduce the tendency for the aircraft to bounce in gusty conditions.



*When tying ropes, draw them tight (not stretched) and then back them off a few centimetres.*

## Tying Down

Ropes should be tied only to the aircraft tiedown rings provided. Never tie to a strut, as the rope may slip to a point where even slight pressure may bend the strut. Tiedown rings should be carefully looked after to prevent rust and corrosion weakening them. For aircraft parked for long periods at coastal aerodromes, the salty air will increase the chances of corrosion occurring. It is a good idea to have the tiedown rings checked regularly by your licensed engineer as part of scheduled maintenance inspection on your aircraft. You can assist in looking after the tiedown rings, by regularly washing your aircraft.

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

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. This is to avoid the front of the aircraft lifting in the gusts. Care should be taken on the position of securing the nosewheel.

If fitted, the rope should go through the nosegear tiedown ring.

Particular care should be taken when securing tailwheel aircraft. Some flight 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



*Tiedown ropes should only be tied to the aircraft tiedown rings.*

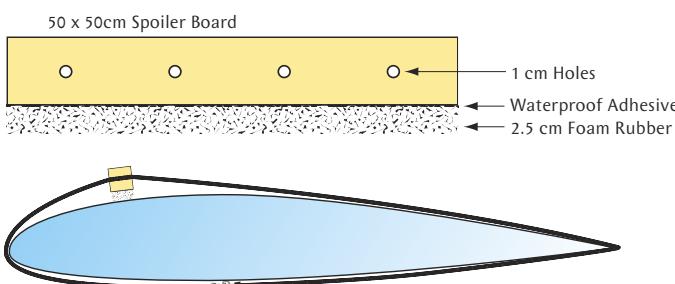
aircraft to jerk against the ropes, while a rope that is too tight can put inverted-flight stresses on the aircraft, which may not be designed to absorb such loads.

## 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 (2 x 2 inch) with a number of 10 mm ( $\frac{7}{8}$  inch) holes drilled at frequent intervals. A strip of 25 mm (1 in) foam rubber is then glued 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 as a buffer to prevent chafing damage.

The position of the spoiler should be located at about the 25 percent chord point (figure 6).



**Figure 6 – Spoiler boards should be positioned at about the 25 % chord point.**

## Tiedown Knots

The weakest link in the tiedown can be the knot that is tied. Ideally, the knot should neither slip nor loosen, and it should be easy to undo.

A knot can fail in three ways: it can come undone through vibration and general movement when there is little load on it, it can pull out when load is initially applied, or it can break under load. Any break usually occurs where the rope enters the knot.

The ultimate strength of a knot is a matter of design – some knots are naturally stronger than others. Security, on the other hand, can often be improved by the manner in which the knot is finished off. But making a knot more secure may also make it more difficult to undo when the time comes, so there is little point in making a knot as secure as possible – only as secure as necessary.

The US FAA Advisory Circular on aircraft tiedowns recommends the *bowline knot*. Research suggests that a *reef knot* is not suitable for aircraft tiedowns. It is an excellent general-purpose knot for tying

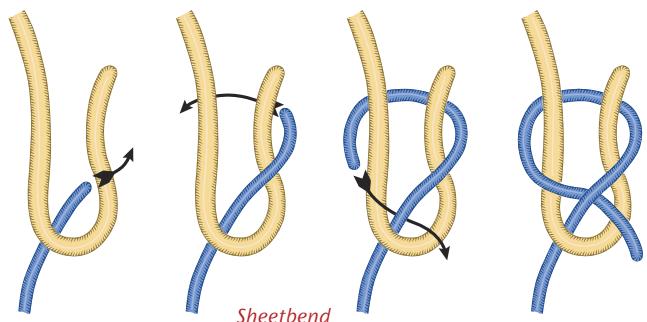
two pieces of string or twine (of equal thickness) together, but it is not a long-term or secure knot.

For a more secure method of joining two ropes together, use a *sheetbend*.

## Sheetbend

The sheetbend is the most commonly accepted knot for joining two ropes together, particularly if the ropes are of different sizes. The thicker rope of the two is used to form a bight, and the thinner rope is passed up through the bight, around the back, and then tucked under itself.

The knot should be tied with the ends of the ropes coming off the same side of the knot. However, it can be accidentally tied with the ends coming off the opposite sides of the bend. This is known as the *lefthanded sheetbend* – which is to be avoided, as it is less secure.

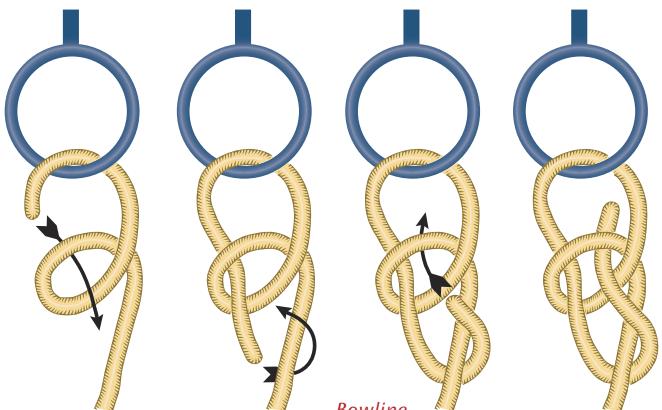


## Bowline

The bowline is one of the simplest ways of putting a fixed loop in the end of a rope. It is easy to tie and untie, it doesn't slip or jam, and it has a high breaking strength.

It is a good way to secure a rope to a tiedown ring. It is also very good for attaching the tiedown rope to the anchors in the ground.

For added security, you can finish the knot with a stop knot such as a figure of eight to remove any possibility of the bowline slipping.



To tie a bowline, form a small loop (the direction is important), and pass the free end of the knot up through the loop, around behind the standing part of the rope, and back down through the loop. The end of the rope should exit the knot on the inside of the loop. If it does not, then it should be re-tied, as the knot will be less secure.

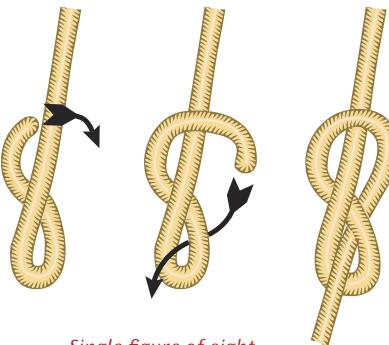
## Single Figure of Eight

The *single figure of eight* is a useful 'stop' knot to temporarily bulk out the end of a

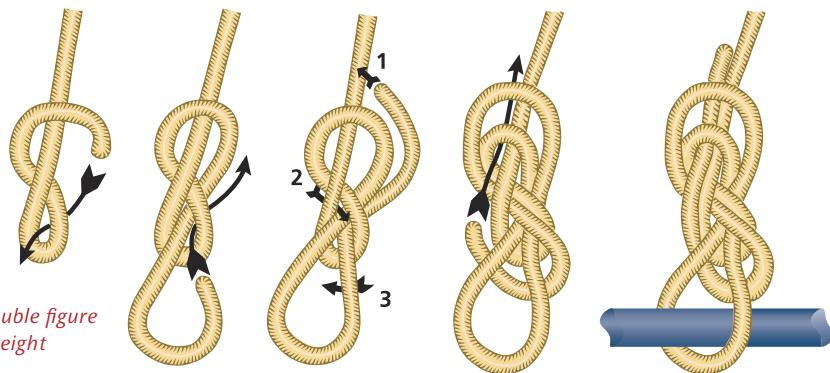
rope. The finished knot looks like its name. It is useful to temporarily stop the ends of a rope fraying before it is whipped.

### **Double Figure of Eight**

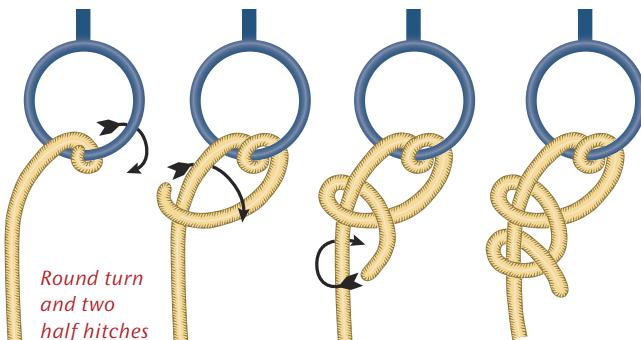
The *double figure of eight* knot builds a non-slip loop at the end of a rope. It is popular with rock climbers (as it is safer than a bowline) who tie their belay rope to their karabiner or harness. To tie, begin with a single figure eight knot near the end of the rope, loop the end of the rope around the karabiner or harness straps, and retrace the figure eight.



*Single figure of eight*



*Double figure of eight*



*Round turn and two half hitches*

### **Round Turn and Two Half Hitches**

A *round turn and two half hitches* is used to secure a rope to a pole or ring, or to start or finish a lashing.

It is a good knot for securing a rope to the tiedown ring, and it is commonly used by many pilots.

While it is easy to tie, it can be more difficult to untie, especially when the rope is wet.

To tie, pass the running end of the rope over the pole or through the ring twice. Then pass the running end over the standing part of the rope, and tuck it back up and under itself, forming a half hitch. Repeat this for a second half hitch.

### Some Knotting Terms

A **bend** is used to join two ropes.

A **hitch** is used to tie to an object.

The **bight** is the curvature of a rope when its direction is changed from that of a straight line, to the maximum of a full circle. Any point within this curvature is said to be in the bight.

The **strength** of a knot is the force required to break a rope containing the knot. The **security** of a knot is related to the force required to make the knot slip or capsize to an unwanted form.

**Whipping** is a series of turns of sail twine or similar, forming a lashing at the end of a rope to prevent fraying.

**Note:** There are a number of web sites which have animated diagrams to assist in learning to tie a range of useful knots.

## Multi-Engine Aircraft

Multi-engine aircraft require stronger tiedowns because of their additional weight. The anchors should provide a minimum holding power, or strength of approximately 1800 kg (4000 pounds) each, for light 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 down lock safety pins, then these pins should be inserted when the aircraft is being secured.



*Multi-engine aircraft should be tied down and chocked - do not rely on the aircraft's weight to protect it from damage by windstorms.*



*Ensure the windscreens cover is free of dirt to avoid scratching the bubble. The helicopter blade covers should allow moisture to escape. This will reduce the possibility of rotor blade corrosion.*

## Helicopters

On the ground, helicopters are particularly susceptible to structural damage from storm-force winds. They have the advantage, however, of being able to seek shelter more readily and smaller helicopters can tuck in to places not accessible to fixed-wing aircraft. If hangarage is available, then helicopters should be hangared. If hangarage is not available, then they should be moved to a sheltered position and tied down securely. Helicopters that are tied down properly can 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:

- Position the helicopter into wind.
- Position the helicopter further than a rotor-span distance from other aircraft.
- Position the cyclic stick in neutral and the collective lever full down. 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 an anti-slip knot, such as a bowline.
- 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 the 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.

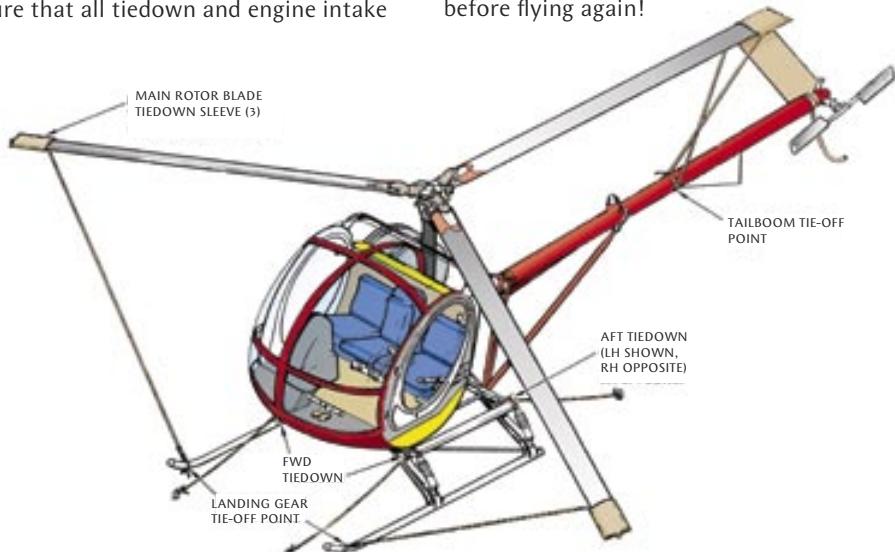
It maybe useful to design a system to ensure that all tiedown and engine intake

covers are removed during the preflight. For example, tie a ribbon between all tiedown sleeves, which makes it impossible to remove the covers if one is still attached.

## 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, you can partially flood the floats of the aircraft for added stability in the water during wind storms. This technique can also be applied when the floatplane aircraft is tied down on land, in this case to provide added weight. Obviously, it is extremely important to empty the floats before flying again!



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

Skiplanes can be secured by packing soft snow around the skis, then pouring water on the snow, allowing the skis to freeze to the ice.

## After the Storm

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

Consideration should be paid to the undercarriage, as the aircraft may have been lifted momentarily and landed heavily. Aircraft can also be skewed on their pickets or chocks in extreme conditions. This can stress the undercarriage; if this is suspected it should be checked by a licensed engineer.

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 flying.**

## Conclusion

Any aircraft parked outdoors should be properly secured after operations each day, and between operations during the day if it is to be left unattended for any length of time. This routine will ensure your aircraft is not only safeguarded against any local weather contingencies, but also is able to withstand gale-force winds, which may sometimes occur without warning.

When storm conditions are forecast and stormproof hangarage is unavailable, then the aircraft must be tied down securely. The integrity of the knot you tie can be the difference in whether your aircraft is protected or not. It is advisable to practise tying knots to ensure the tiedown is effective. It is recommended that the *bowline* knot with a *figure eight* at the end is used. The location of the tiedown area is also crucial. Ideally the aircraft should be tied down behind shelter. Caution should be exercised, however, as loose materials near buildings can become airborne in storms and cause substantial damage if they strike the aircraft.

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





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