1997, Issue 3

VECTOR

Pointing to Safer Aviation

• Wake Turbulence • Tomahawk • Airframe Icing

CIVIL AVIATION AUTHORITY OF NEW ZEALAND

VECTOR

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Our publications are next scheduled to be in your letterbox in early August 1997.

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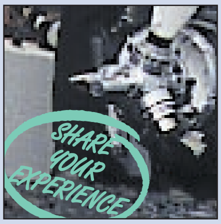
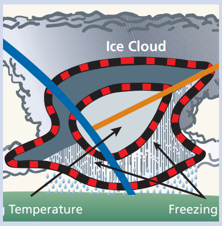
An AFIS ...

A UNICOM service ...





Cover Photographs
R22 and R44 of Helicopter Training College Ltd, over the environs of Auckland. Photographs taken by John King for Helicopter Training, and provided to us by courtesy of the Company CFI, Ray Wilson.

Safety Seminars

We urge you to attend whichever type of seminar is close to or most convenient for you.

This year's series of Safety Seminars is about to begin.

The theme is "Pressures on Pilots", but similar pressures are, of course, experienced by others in the aviation industry, and you don't have to be a pilot to attend. In addition, while each of the fixed-wing and rotary-wing seminars will have a slant towards those particular types of operations, they are open to all. And, not just pilots – you may be an engineer, non-flying manager or connected in some other way to the aviation industry. These seminars will be of benefit to **all** in the aviation industry – we urge you to attend whichever type of seminar is close to or most convenient for you.

The presenters are all experienced and respected pilots from the New Zealand aviation industry who, with the support of CAA, are giving their time, expertise and wisdom to help make a difference to aviation safety. They will be able to give simple and practical advice derived from their many years of experience.

The schedule for July and August is printed on this page. In addition, watch for posters at your local aviation organisation for a seminar near you.

Thursday 10 July, 7.00 pm – 10.00 pm.
Heli-Kiwi Seminar. Presented by Ray Wilson. **Ardmore** Aerodrome, at Auckland Aero Club.

Saturday 12 July, 9.30 am - 12.30 pm
Heli-Kiwi Seminar. Presented by Bernie Lewis. **Whangarei** Aerodrome, at Northland Districts Aero Club.

Saturday 12 July, 9.30 am – 12.30 pm
Heli-Kiwi Seminar. Presented by Ian Wakeling. **Masterton** Aerodrome, at Heli-flight Wairarapa.

Sunday 13 July, 9.30 am – 12.30 pm
Heli-Kiwi Seminar. Presented by Ray Wilson. **Whakatane**, at Whakatane District Council building.

Tuesday 15 July, 7.00 pm – 10.00 pm
Heli-Kiwi Seminar. Presented by Bernie Lewis. **Taupo** Aerodrome, at Taupo Aero Club.

Wednesday 16 July, 7.00 pm – 10.00 pm
Heli-Kiwi Seminar. Presented by Ian Wakeling. **Nelson** Airport, at Air Nelson Training and Administration Centre.

Thursday 17 July, 7.00 pm – 10.00 pm
Heli-Kiwi Seminar. Presented by Ray Wilson. **Taieri** Aerodrome, at Otago Aero Club.

Sunday 20 July, 9.30 am – 12.30 pm
Heli-Kiwi Seminar. Presented by Bernie Lewis. **Hastings** Aerodrome, at Hawkes Bay and East Coast Aero Club.

Sunday 20 July, 9.30 am – 12.30 pm
Heli-Kiwi Seminar. Presented by Neil Scott. **Wanaka** Aerodrome, at the Flightdeck Café.

Monday 21 July, 7.00 pm – 10.00 pm
Heli-Kiwi Seminar. Presented by Neil Scott. **Franz Josef**, at Franz Josef Glacier Hotel.

Saturday 26 July, 9.30 am – 12.30 pm
Heli-Kiwi Seminar. Presented by Ian Wakeling. RNZAF Base **Ohakea**, at Theatrette. Details below*.

Wednesday 6 August, 7.00 pm – 10.00 pm
Heli-Kiwi Seminar. Presented by Neil Scott. **Christchurch** Airport, at Canterbury Aero Club.

Thursday 7 August, 7.00 pm – 10.00 pm
Aero-Kiwi Seminar. Presented by Russell Baker. **Twizel**, at Mackenzie Country Inn.

Sunday 10 August, 9.30 am - 12.30 pm
Aero-Kiwi Seminar. Presented by Russell Baker. **Invercargill** Airport, at Southland Aero Club.

Monday 11 August, 7.00 pm - 10.00 pm
Aero-Kiwi Seminar. Presented by Russell Baker. **Queenstown**, at Sherwood Manor Hotel.

Sunday 17 August, 9.30 am - 12.30 pm
Aero-Kiwi Seminar. Presented by Russell Baker. **Greymouth** Aerodrome, at Greymouth Aero Club.

From September to November there will be Aero-Kiwi Seminars at North Shore, Hamilton, Rotorua, New Plymouth, Gisborne, Pine Park, Wellington, Blenheim and Ashburton.

* It is permissible to fly into Ohakea if aircraft type, registration, ETA and advice that you are attending the Heli-Kiwi seminar are notified to Base Operations (Ph 0–6–351 5442, Fax 0–6–351 5448) by midday Friday 25 July. If driving in, visitor passes and directions will be available at the Ohakea main gate. A visit to ATC will be possible immediately following the seminar. The Museum cafeteria will be open for lunch.

Aero-Kiwi and **Heli-Kiwi** – making common sense common practice.

How best to avoid WAKE TURBULENCE

By Grant M.Brophy

Grant Brophy is an expatriate Kiwi living in Daytona beach, Florida and working as an Air Safety Investigator, specialising in air transport operations and aircraft emergency response. He is a member of the International Society of Air Safety Investigators, the American Institute of Aeronautics and Astronautics, and the Human Factors Society. He has recently taken up the appointment of Director of Safety for a new American airline.

*Although written from an American perspective, his story has international relevance. We have, however, added two items which provide a New Zealand focus. The diagrams were created by **Vector**, based mainly on those in New Zealand AIC-GEN A92/86. They make no pretence to scale.*

Many pilots are taught to be aware of wake turbulence. However, incidents and accidents due to wake turbulence continue to occur, causing deaths, injuries, and aircraft losses. In any event, wake turbulence is still out there, and we need to keep in mind how severe wake turbulence can be. The following captain's report typifies the types of upsets being experienced:

"On a visual approach to MSP (flying a BA3100 Jetstream), we were being vectored off the localiser at 4000 feet for spacing on traffic ahead.

"While on a 30-degree heading and level at 4000 feet, we encountered the wake of a B757 ahead.

"Our aircraft rolled violently to the left (approximately 120-degree bank) and entered a rapid descent. The aircraft was completely out of control for several seconds.

"We regained control at approximately 2500 feet amsl (1700 feet agl) and advised ATC of our encounter.

"We climbed and took a few minutes to clean up the cockpit. In the violent nature of this upset, various objects became flying objects. My flight bag (between the seats) flew up, tipped upside down, and landed on the floor. A metal 'can' for maintenance forms hit me in the head, as did a file folder used for the deferral log documentation.

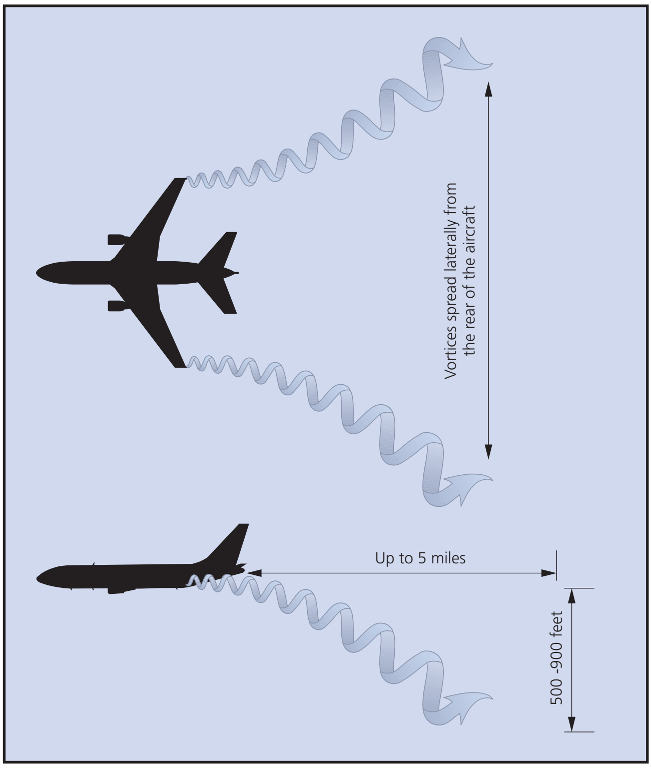
"In the cabin, the wing spar cover came off and hit the rear bulkhead.

"Fortunately, no injuries were sustained by either crew or passengers.

"At the time of our visual approach clearance, we were only 3.5 miles behind the B757 and were 1000 feet below and downwind of the B757's flight path. We were vectored below, downwind, and behind the B-757.

"At the time of encounter, we were almost exactly two minutes (four miles) behind the B757, 1000 feet below his flight path at the same position relative to the runway.

"Our aircraft rolled violently left, so we must have entered his right wingtip vortex."



Viewed from behind the generating aircraft, the left vortex rotates clockwise and the right vortex rotates counter-clockwise. They spread laterally away from the aircraft and descend 500 to 900 feet at distances of up to five miles behind it. Vortices tend to descend 300 to 500 feet per minute in the first 30 seconds.

A recent US National Transportation Safety Board (NTSB) study shows that 51 wake turbulence accidents and incidents were reported in the United States between 1983 and 1993.

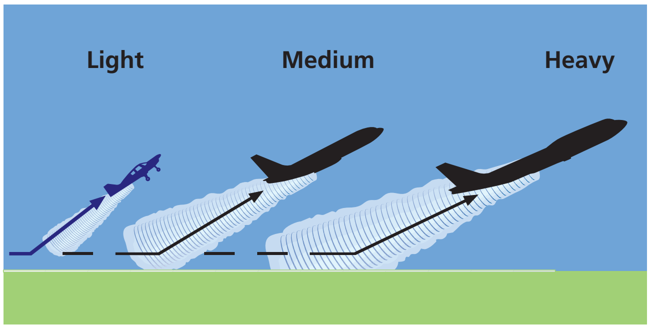
These events caused 27 fatalities and 8 injuries, and 40 aircraft were substantially damaged or destroyed.

"The strongest vortices are produced by 'heavy' aircraft, flying slowly, in a clean configuration."

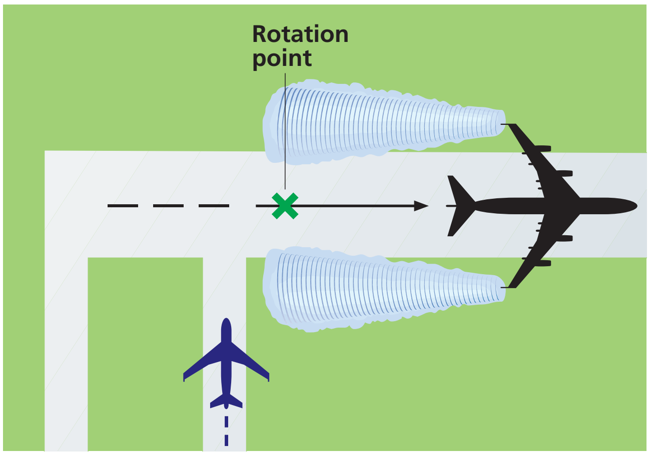
Two of those incidents involved airliners as the trailing aircraft – a DC9 in 1984 and an ATR42 in 1991. The leading aircraft in 31 of the occurrences were jet and turboprop airliners. Only six of the events involved a 'heavy' transport category aircraft in the lead.

Some may consider this a small plane driver's dilemma. Not exactly ...

Taking off behind a larger aircraft



Start takeoff from a point where your aircraft can be safely rotated before the rotation point of the preceding larger aircraft, and establish a climb above its fligh path until such time as a turn can safely be made clear of its wake. If this is not possible, delay your takeoff.



If planning to take off from an intermediate point on the runway, when the preceding aircraft has used full length, delay your takeoff. (Alternatively, using full runway length may enable you to remain clear of the wake.)

The NTSB study also documented three accidents and two incidents involving medium sized aircraft trailing B757s as the leading aircraft in the period between December 1992 and December 1993.

A Cessna Citation, a Westwind, and a Cessna 182 crashed. The pilots of an MD88 and a B737 experienced significant but recoverable loss of control and were able to land safely and file reports.

Four of the aircraft descended below the glide path of the leading B757s. The other aircraft entered the vortex at about 75 feet in ground effect. Two of the events happened while the trailing aircraft were attempting to land on a parallel or converging runway less than 2500 feet from the lead aircraft's runway.

"Light crosswinds may cause vortices to drift …"

Recommendations from the NTSB included providing training for pilots that specifically related to the movement and avoidance of wake vortices and techniques to determine relative flight paths and separation distances.

The NTSB also recommended that air traffic controllers receive annual refresher training regarding wake turbulence separation and advisory criteria.

Recently, a co-operative effort involving the FAA, the Boeing Company, and a joint industry group developed training materials to meet that need.

The training kit consists of a comprehensive, well-illustrated manual titled: "Wake Turbulence Training Aid" in printed and CD-ROM formats, and an accompanying videotape.

The FAA plans to distribute the materials to military, general aviation, and some participating foreign operators.

The programme is designed to educate pilots and air traffic controllers in how to avoid the wake turbulence phenomenon and increase situational awareness, especially when operating VMC.

This article was prepared as a reminder to pilots, to make them aware of wake turbulence and how best to avoid it.

What is Wake Turbulence?

All aircraft produce wake turbulence. Wake vortices are formed any time an aerofoil is producing lift. Lift is generated by the creation of a pressure differential over the wing surfaces. The lowest pressure occurs over the upper surface and the highest pressure under the wing. This pressure differential triggers the roll-up of the airflow aft of the wing, resulting in swirling air masses trailing downstream of the wing tips. Viewed from behind the generating aircraft, the left vortex rotates clockwise and the right vortex rotates counter-clockwise. They spread laterally away from the aircraft and descend 500 to 900 feet at distances of up to five miles behind it. Vortices tend to descend 300 to 500 feet per minute in the first 30 seconds.

Light crosswinds may cause vortices to drift, and crosswinds in excess of 5 knots tend to cause them to break up behind the aircraft. Atmospheric turbulence and several other conditions generally cause them to break up more rapidly.

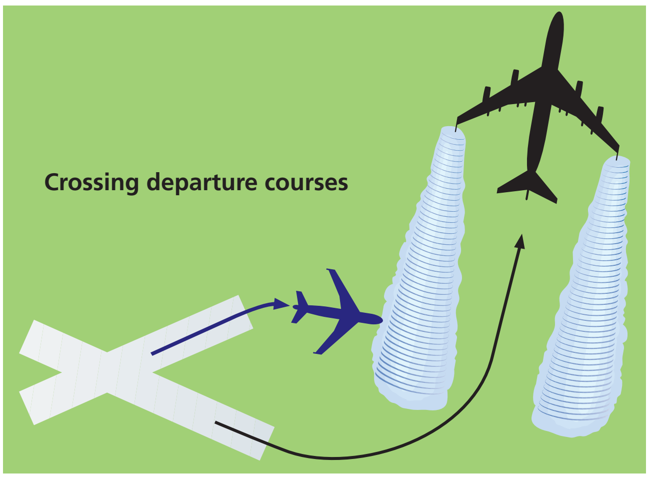
The intensity or strength of the vortex is primarily a function of aircraft weight, wingspan, and configuration (flap setting, etc). The strongest vortices are produced by 'heavy' aircraft, flying slowly, in a clean configuration. For example, a 'large' or

"Helicopters also produce wake turbulence."

'heavy' aircraft that must reduce its speed to 250 knots below 10,000 feet, and is flying in a clean configuration while descending, produces very strong wake.

Helicopters also produce wake turbulence. Helicopter wakes may be of significantly greater strength than those from fixed-wing aircraft of the same weight.

Departure



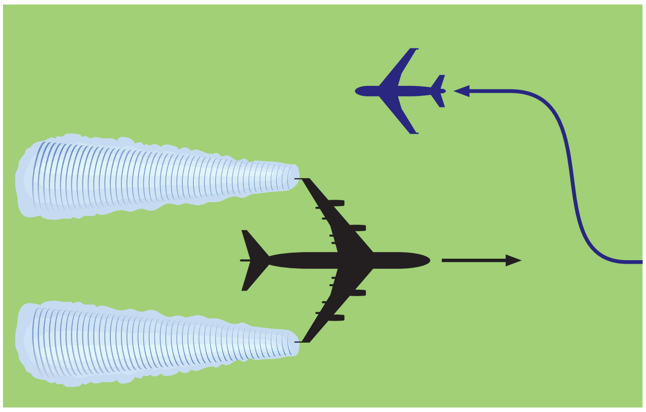
After takeoff, avoid subsequent headings which cross below and behind the path of a larger aircraft.

The strongest wake can occur when the helicopter is operating at lower speeds (20 to 50 knots). Some mid-size or executive class helicopters produce wake as strong as that of heavier helicopters. This occurs because two-blade main rotor systems, typical of light helicopters, produce stronger wake turbulence than rotor systems with a greater number of blades.

Stay Heads-Up for Wake During the Takeoff and Landing Phases

While there have been rare instances where wake turbulence caused structural damage, the greatest hazard is induced roll and yaw. This is especially dangerous during takeoff and landing when there is little height for recovery.

En route



Avoid flight below and behind a larger aircraft's flight path. If a larger aircraft is observed less than 1000 feet above you on the same track (same or opposite direction) adjust your position laterally, preferably upwind.

Wake turbulence-induced roll rates can be extreme. Countering roll rates may be difficult or impossible, even in high performance aircraft with excellent roll control authority.

In fixed-wing aircraft, wake vortices begin as the nose is rotated for takeoff and continue throughout flight until the nosewheel touches down on the runway once again. The vortices can cause problems for crossing or lower airborne traffic on departure. Low approaches, touch-and-goes, and go-arounds can also cause problems for taxiing or departing aircraft.

During takeoff and landing, the vortices sink toward the ground and move laterally away from the runway when the wind is calm. A crosswind of 3 to 5 knots will tend to keep the upwind vortex in the runway area and may cause the downwind vortex to drift toward another runway. We also know that wake vortices sometimes bounce, diverge, and dissipate more rapidly in ground effect.

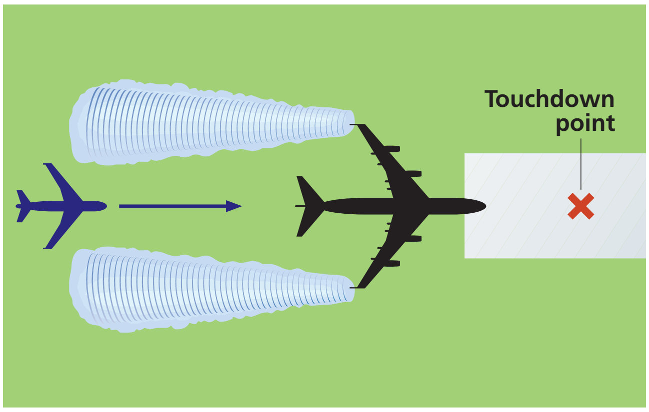
"The onset of wake turbulence can be insidious and even surprisingly gentle."

The term 'heavy' serves as a clue to ATC to keep all trailing aircraft the following distances behind a 'heavy':

- other 'heavy' (more than 300,000 lb), at least 4 miles,
- 'large' (12,500–300,000 lb), 5 miles, and
- 'small' (under 12,500 lb), 6 miles.

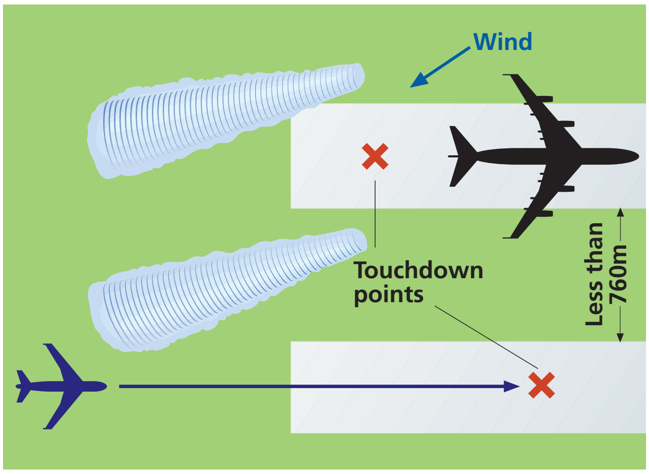
In the United States, when a 'heavy' aircraft is not in the lead, standard separation is 3 miles between all aircraft, and as little as 2.5 miles in some high-density traffic situations. From 1 July 1994, the FAA implemented a measure that requires 4 miles separation for all "small, large, and heavy" aircraft following a B757.

Landing behind a larger aircraft: (1) same runway



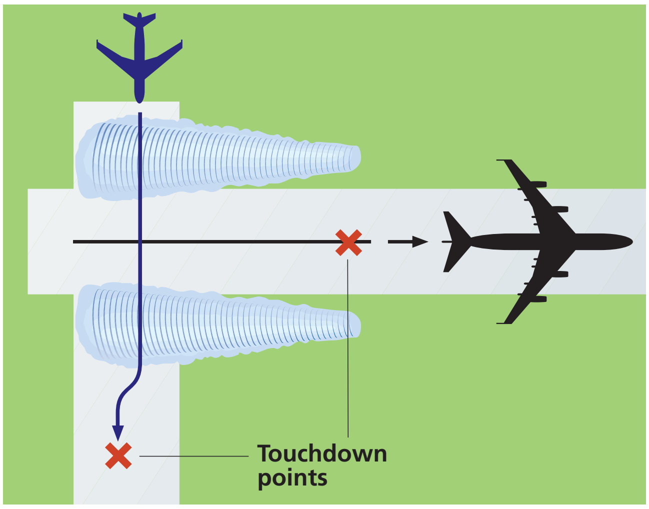
Stay at or above the larger aircraft's final approach flight path. Note its touchdown and land beyond it.

(2) parallel runway or vector



Note wind for possible vortex drift to the landing vector if practicable. Stay at or above the larger aircraft's final approach flight path. Note its touchdown point and land beyond a point abeam it.

(3) crossing runway



Cross above the larger aircraft's flight path.

New Zealand pilots should refer to the NZAIP for details of required separation standards.

Tower controllers typically provide wake turbulence separation for departing aircraft by applying time intervals. The most common of these intervals is 2 minutes for all aircraft behind a 'heavy' on the same or parallel runway within 2,500 feet.

A similar restriction applies if the departing/trailing aircraft will fly through the airborne lead aeroplane's path. Controllers are supposed to impose a 3 minute delay for all aircraft making an intersection or opposite direction takeoff behind a 'heavy'.

Tower controllers are responsible for runway separation for all aircraft arriving or departing airports. Tower controllers do not provide visual wake turbulence separation to arriving aircraft; that is the pilot's responsibility. Only under IMC, or when pilots are unable to fly visually, are controllers responsible for applying the wake turbulence longitudinal separation distances.

Issues Impacting Visual Separation

Air traffic controllers may separate departing aircraft by visual means after considering aircraft performance, wake turbulence, closure rate, routes of flight, and known weather conditions. Controller visual separation of aircraft should not be applied between successive departures when departure routes and/or aircraft performance would not allow the pilots to maintain adequate separation.

In the terminal area, the air traffic controller must have both aircraft in sight and must be in radio contact with at least one of them. The flight crew of the trailing aircraft must see the lead aircraft and be informed of the lead aircraft's position, its direction of flight, and its crew's intentions. The pilots of the trailing aircraft must acknowledge sighting the lead aircraft and be instructed to maintain visual separation. The tower controller shall not provide visual separation between aircraft when wake turbulence separation is required.

"Wake turbulence-induced roll rates can be extreme."

In controlled airspace with ATC radar coverage, the controller must inform the pilot of converging traffic and about VFR traffic.

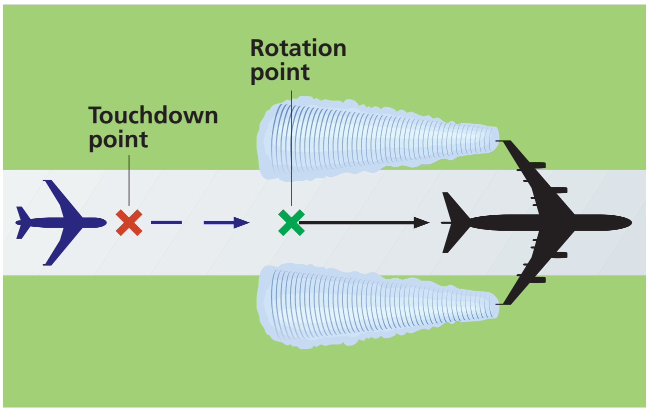
In cruise, when IFR and VFR aircraft are sometimes separated by as little as 500 feet, pilots must use proper avoidance procedures. Because wake turbulence is nearly always invisible, pilots need to anticipate where it might be, based on experience and through knowledge of current wind conditions. Air traffic controllers issue "Caution – wake turbulence" warnings only and are not responsible for anticipating the existence or effect of the condition.

The Warning Signs

Any uncommanded aircraft movements such as wing rocking, may be caused by wake vortices. This is why maintaining situational awareness is so critical. Atmospheric turbulence is not unusual, particularly in the approach phase. Pilots who suspect wake turbulence is affecting their aircraft should immediately get away from the wake, execute a missed approach, or go-around, and be prepared for an even stronger wake vortex encounter.

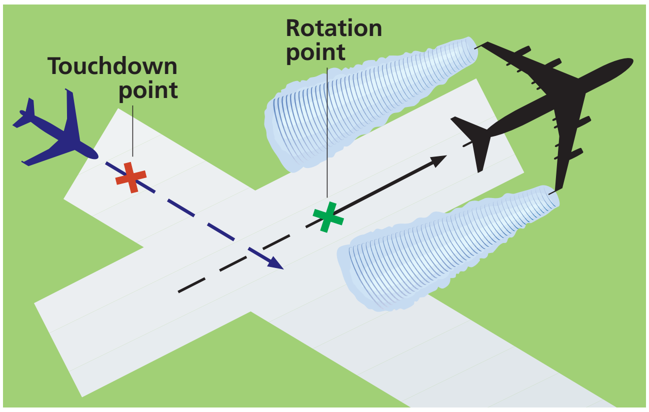
The onset of wake turbulence can be insidious and even surprisingly gentle. There have been serious accidents where pilots have attempted to salvage a landing after encountering moderate wake only to encounter severe wake turbulence. Pilots should not depend on any aerodynamic warning, but if the onset of wake turbulence is occurring, immediate evasive action is a **must**!

Landing behind a departing larger aircraft:
(1) same runway



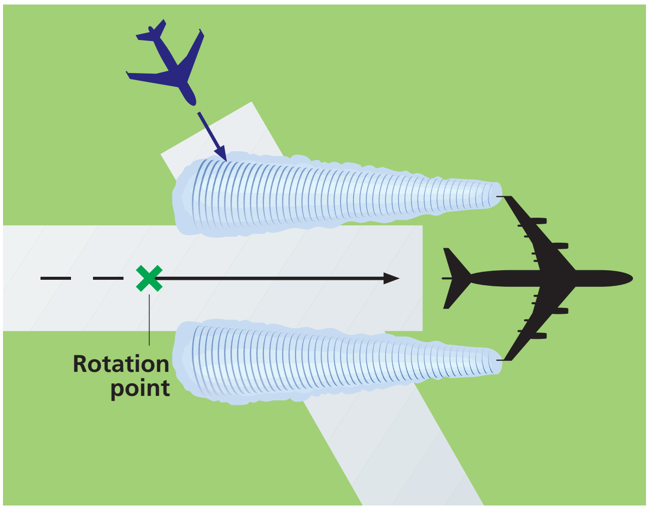
Note larger aircraft's rotation point, and land well before it.

(2) crossing runway



Note larger aircraft's rotation point. If the point is past the intersection, continue the approach and land preferably before the intersection.

(3) crossing runway



If the larger aircraft rotates before the intersection, avoid flight below its flight path, Abandon the approach unless a landing is assured well before reaching the intersetion.

How to Avoid Wake Turbulence

Pilots should remember three basic warnings concerning wake turbulence.

- Do not get too close to the lead aircraft.
- Do not get below the lead aircraft's flight path.
- Be particularly wary when light wind conditions exist.

The following avoidance procedures should be followed at all times:

Takeoff. If you think wake turbulence from the preceding aircraft may be a factor, wait between 2 and 3 minutes before taking off. Before taking the active runway, tell the tower that you want to wait. Plan to lift off prior to the rotation point of the lead aircraft, and use full takeoff power/thrust.

Climb. If possible, climb above the lead aircraft's flight path. If you can't out-climb it, deviate slightly upwind, and climb parallel to the lead aircraft's course. Avoid headings that cause you to cross behind and below the aircraft in front of you.

Crossing. If you must cross behind the lead aircraft, try to cross above its flight path or, terrain permitting, at least 1,000 feet below .

Trailing. Endeavour to stay either on or above the leading aircraft's flight path, upwind, or terrain permitting, at least 1,000 feet below.

Approach. Maintain a position on or above the lead aircraft's flight path with adequate lateral separation.

Landing. Ensure that your touchdown point is beyond the lead aircraft's touchdown point. Land well before a departing aircraft's rotation point.

Crossing Approaches. When landing behind another aircraft on crossing approaches, cross above the other aircraft's flight path.

Crosswinds. Remember crosswinds may affect the position of wake vortices. Adjust takeoff and landing points accordingly.

Helicopters. Remember that their wake vortices may be of significantly greater strength than fixed-wing aircraft of the same weight. Avoid flying beneath the flight paths of helicopters. When piloting a small aircraft, avoid taxiing within three rotor blade diameters of a helicopter that is hovering or hover taxiing at slow speed.

Visual Approach. When making a visual approach, do not assume the aircraft you are following is on the same or lower flight path. The flight crew of the lead aeroplane may have flown a steep approach (typical of cargo operations). Stay above and at least 3 miles behind the normal flight path; remember at least 4 miles behind a B757.

Wake turbulence is one of the factors that pilots and air traffic controllers must avoid to ensure safe flights. It takes co-operation, awareness, and the understanding of each other's requirements to safely avoid aircraft generated wake.

It is your responsibility as flight crew or pilot in command to anticipate the likelihood of encountering wake turbulence and to alter your flight path accordingly, or if necessary, request an alternative clearance from ATC. Don't always rely on others to provide warnings. Safe flying! ■

Wake Turbulence Separation in New Zealand

The article above by Grant Brophy is written mainly from an American perspective. The following translates the lessons into the New Zealand context (based on NZAIP Planning Manual, RAC9) – but remember that both countries experience the same laws of physics!

Wake turbulence separation is provided by ATC to all aircraft which may be affected by wake turbulence, **except in the case of VFR arrivals, or IFR aircraft making a visual approach**. In these cases it is the pilot's responsibility to provide adequate spacing from preceding arriving or departing aircraft. Pilots should follow the guide-lines below and ATC will make allowance when sequencing.

Wherever practicable, aerodrome controllers will advise pilots of the likelihood of wake turbulence by the phrase: "Caution – wake turbulence".

Weight Categories

For the purpose of assessing wake turbulence separation, aircraft are divided into the following weight categories:

Heavy (H)

All aircraft types of 136,000 kg maximum weight or more (includes A330, A340, C5A, C141, B777, B767, B747, B707, DC8, MD11, KC/DC10)

Medium (M)

Aircraft types of less than 136,000 kg but more than 7,000 kg maximum weight (includes B757, B737, B727, FK27, FK28, DHC8, ATR72, BAe146, C130, DC3, Jet Falcon (all models), P3, Saab 340).

Note: B757 aircraft will be categorised as 'heavy' (H) aircraft for the purpose of assessing wake turbulence to following aircraft.

Light (L)

Aircraft types of 7,000 kg maximum weight or less (includes Cessna 402, Cessna 421, Islander BN2, Nomad, PA31, Be99, Bandeirante E110, Metroliner).

Wake turbulence separation standards do not apply when a 'light' aircraft will cross the track of, or follow the track of a 'medium' aircraft of less than 25,000 kg MCTOW.

This is a recent change, and the 'medium' type aircraft involved include the ATR72 and DHC8. Pilots can still request separation by advising the Tower prior to entering the runway for takeoff.

Wake Turbulence Separation

The New Zealand situation is similar to the US for separation of aircraft following or crossing behind a 'heavy' aircraft during the approach and departure phases of flight, when the aircraft is under radar control. If the following aircraft is a 'heavy', separation is 4 miles, if a 'medium', 5 miles and if a 'light', 6 miles.

If the leading aircraft is a 'medium', then separation for a following 'heavy' or 'medium' is 3 miles, and for a 'light', 5 miles (the latter only if the 'medium' is above 25,000 kg).

When the leading aircraft is a 'light', then separation is 3 miles for all following aircraft.

As noted above the B757 is categorised as 'heavy' in relation to following aircraft.

Non-radar separation standards for arriving or departing flights for aircraft using the same (or close parallel) runway are between 2 to 3 minutes, as follow:

- Separation between arriving flights following a 'heavy' is 2 minutes for a 'medium' and 3 minutes for a 'light'. A 'light' behind a 'medium' is normally 3 minutes, but the recent change means there is no time requirement behind a small 'medium' such as ATR72 and DHC8.
- Separation between departing flights of all categories is two to three minutes depending on the second aircraft's takeoff position (2 minutes from the same position, 3 minutes from an intermediate takeoff position).
- Separation between arriving and departing flights of all categories is normally 2 minutes.

These are elaborated on, and there are further standards listed in the AIP, for example, for opposite direction runway operation and for crossing runways.

Remember wake turbulence separation is not provided to landing VFR arrivals, nor to IFR on visual approach. In these cases, it is up to the pilot to provide adequate spacing from preceding arriving or departing aircraft.

Pilot Options

If a pilot considers the wake turbulence separation standards inadequate, an increased separation may be requested by specifying the spacing required.

Conversely, if pilots indicate that the effect of wake turbulence can be nullified by ensuring that flight profiles do not cross, they may request and be granted exemption from these separations. **This option should be treated with caution.** (See "Wake Turbulence Encounters".)

Jet Blast

Another hazard to bear in mind when taxiing, particularly for light aircraft, is jet blast and propeller slipstream. Beware of passing close behind aircraft with engines running, particularly large jets.

Jet blast and propeller slipstream can produce localised wind velocities of sufficient strength to cause damage to other aircraft, vehicles and personnel – and to buildings. A B727 on engine tests blew in a hangar door some years ago at a New Zealand airport – clear testimony to the force which can be produced.

Wake Turbulence Encounters in New Zealand

Many pilots have received a fright from unexpectedly encountering wake turbulence. Fortunately, in New Zealand accidents resulting from wake turbulence have been rare.

A recent example, however, occurred after a pilot at Wellington Airport exercised the option of requesting exemption from wake turbulence separation standards. The Cessna 185 aircraft was departing behind a Boeing 727, and the pilot elected to maintain own wake turbulence separation. After getting airborne the Cessna flipped in a right turn and crashed on the western boundary of the airfield.

Other incidents recorded on the CAA database include:

- In 1993 a Fairchild SA227-AC on approach at Christchurch airport encountered strong wake turbulence at about 50 feet agl and made a go-around.
- In 1994 a Saab SF340A on approach to Auckland behind a Boeing 747 encountered wake turbulence requiring extreme control input and power application. A go-around was made.
- In 1994 at Christchurch a Boeing 767 had departed full length from runway 20. A Cherokee PA28-140 then departed from grass 20. The Cherokee encountered severe wake turbulence resulting in a 60 degree wing-down upset.
- In 1996 during an approach to Auckland a PA31-350 experienced a short burst of wake turbulence from a preceding Boeing 747 while over Westpoint. The pilot reported that the 747 was descending through their level, and the PA31 pilot was trying to position on its upwind side before commencing the ILS for Runway 05 visually into Auckland.

Other incidents recalled by pilots include:

- A Piper Cub departing the circuit to the west from Christchurch passed under the flight path of a Boeing 747 joining downwind. Although some distance behind and below the 747, a sudden 80 to 90 degree upset was experienced.
- The most severe wake turbulence experienced by one light aircraft pilot was from aircraft of a similar type – on takeoff close behind – showing that light aircraft can also generate significant wake turbulence for another light aircraft.

An air traffic controller recalls the following incidents at Wellington in past years and makes a pertinent observation regarding Wellington. On windy days in Wellington, the challenge is in battling the windshear, gusts and crosswinds; wake turbulence is not a great danger because in these conditions it is rapidly dispersed. On the other hand, there is a danger that pilots relax when flying on a fine calm day at Wellington – when they should be alert to the hidden hazard of wake turbulence!

- A light aircraft was downwind at Wellington and accepted the controller's request that an overtaking Boeing 737 could pass overhead and then descend in front of the light aircraft. The 737 was slow, clean and then levelling out (all factors which produce the strongest wake turbulence). The light aircraft experienced a 270 degree roll, with the startled pilot electing to continue the roll to reach level flight again.
- A Cherokee Six on approach behind a Boeing 737 experienced a 90 degree roll to the right. The flight path was the same profile as the Boeing. The pilot describes the experience as if someone had grabbed the propeller and stopped it but the aircraft continued rotating. It was then spat out the side like a surfer on a big wave getting flipped off the surfboard.
- A Cherokee 181 made a reduced length takeoff behind a Boeing 737 which had used full length on Runway 16. Just after takeoff the Cherokee experienced a severe upset sufficient to alter heading to the left towards buildings and parked aircraft. The pilot regained control while over the main taxiway and was then able to return to the original runway heading.

Be warned. It can happen to you.

Introducing Taupo UNICOM

What is a UNICOM Service?

As of 14 August, the Aerodrome Flight Information Service (AFIS) will be withdrawn from Taupo and a Universal Communications (UNICOM) service will be provided. The following looks at what a UNICOM service comprises and how it operates. It is worth noting that a UNICOM service is currently operating at Mount Cook.

UNICOM is a radio base provided by trained operators. It provides some information to aircraft operating at an aerodrome, but it does not provide the same service as an AFIS. Perhaps the best way to describe the system is to compare it to an AFIS. See table below.

Taupo UNICOM

Effective from the evening of 13 August 1997, the Airways Corporation AFIS will be withdrawn from Taupo. From the morning of 14 August, the Taupo District Council will operate a UNICOM service.

These changes are being made after a long period of consultation between Airways Corporation, the Taupo District Council, airport users, and the Civil Aviation Authority. The CAA carried out a safety assessment at Taupo and determined that the provision of an AFIS was not required under the current conditions. The CAA did, however, require the Taupo District Council to consider other safety initiatives. "Taupo UNICOM" has been developed to meet some of the safety recommendation needs.

In developing this UNICOM, it was necessary to consult widely with the users and establish new operating procedures for when the AFIS closes.

The Taupo Service

During operating hours, the Taupo UNICOM system will provide the following services:

- Hourly MET Reports, METARS, and SPECI (and these will be available nationally).
- An Aerodrome Terminal Information Service (ATIS) on 125.2 MHz, updated as required.
- A base radio service on 118.4 MHz, available during published hours, generally 7.00 am – 6.30 pm.
- A telephone service during published hours.
- Hotel, taxi, rental car bookings and payment of landing charges.

More specific operational information will be circulated as the changeover time nears. In the meantime, if you have a query, ring or write Roy Carmichael, Airport Manager, Taupo District Council, Private Bag Taupo. Ph 0–7–378 7771, Fax 0–7–378 7776.

An AFIS ...	A UNICOM service ...
Operates regular hours, based around the operation of the aerodrome.	Is not necessarily provided around the general operational hours of an aerodrome. It depends on the priorities of the provider.
Provides an alerting service (including SAR) to all aircraft.	Does not provide an alerting service.
Is certificated by the CAA under Rule Part 172.	Is not certificated.
Provides traffic avoidance information as well as aircraft position information.	May relay traffic position information only.
Provides meteorological information.	May provide meteorological information. It may provide an ATIS.

New Airspace Procedures

There will be changes to airspace management in the Taupo area. These changes are intended to make the airspace safe and user-friendly. The procedures are being developed with the full cooperation of the Taupo Airspace Users Group, operators, CAA and the Airways Corporation. The changeover date has been deliberately set to coincide with the reissue of the VFG amendments.

A Mandatory Broadcast Zone (MBZ) will be effective on 14 August. At first it will be designated as a Restricted Area until the implementation of the new airspace Rules, when this will allow it to be designated as a Mandatory Broadcast Zone. Until this time the Restricted Area has special conditions that are as follows:

You may enter and operate within the Taupo MBZ only if you:

- broadcast aircraft callsign, position, altitude and intentions on the appropriate frequency:
  - at entry,
  - every 10 minutes, and
  - upon exit; and
- have the landing lights or anti-collision lights on if practicable.

You do not require the permission of the controlling authority, CAA, to enter the MBZ, as long as the conditions above are complied with.

For depiction of this area, see the Taupo VTC, effective 14 August 1997.

For more information, your attention is directed towards the AIP Supplement describing the Taupo MBZ.

Note that the above MBZ explanation will apply also to Paraparaumu, also with effect from 14 August 1997 (see the Wellington VTC). Whether Paraparaumu would have a UNICOM was a decision not evident at the time we went to press.

It Can Happen!

A fire officer inspects the wreckage of the Lancair as it rests partially submerged in the Pauatahanui Inlet, near Wellington. Photograph by Mark Round, Dominion.

The reporter (a flying instructor) and the pilot in command of this aircraft experienced what every pilot hopes will not happen to them. This account shows the importance of staying calm (relatively), remembering to Aviate, Navigate and Communicate, and keeping current on forced landing procedures.

Contrary to popular belief I was not looking for an excuse to go swimming – I had one of those experiences that proves the old joke to be true. You know the one, "The only reason an aeroplane has a propeller up the front is to keep the pilot cool, because you watch them sweat when it stops going around."

"I've survived this crash, and now I'm going to drown …"

I wouldn't say that I sweated, but the stress level went through the canopy.

I was a first-time passenger in a homebuilt Lancair aeroplane, which is a two-place fibreglass, high-speed aeroplane with short stubby wings designed for speed – not for gliding.

We were coming home from the RNZAC national competitions in Whangarei, and it had been an interesting trip with diversions around weather and an early stop required in Hamilton to get gas and relieve my Woolworth's bladder. After topping up in Hamilton we went through to the west coast just south of Raglan and took a straight line down the coast and through 'tiger country' to Hawera. Some localised cloud between Hawera and Wanganui took us down to 700 feet, but that cleared and we were back at 1500 feet for the rest of the trip down the west coast, past Paraparaumu and then on the home run into Wellington.

After we had called Wellington Tower and been identified and cleared to enter the Control Zone, we headed towards Avalon. Just as we were crossing the eastern side of the Pauatahanui Inlet, however, the engine stopped – no warning, no coughing, no spluttering – just silence. We began some immediate actions and it roared back into life at about 80 percent power. Dave (pilot flying) advised the Tower that we were going back to Paraparaumu due to low fuel; it was the first thing that came to mind. After the call, and after we had started a lefthand turn back towards Paraparaumu, the engine stopped again. This time it stopped totally – which is when all the action started.

Dave called a Mayday and completed some checks but was mostly concentrating on where we were going to land. Because this aeroplane was not built to glide well and has a considerable landing distance, there were no paddocks big or near enough in which to land. Our only other option was into the inlet. Luckily, because we regularly fly around Wellington, landing in the water has always been a likely option to be considered. But we had to make it to the water, and this was not as easy as it would seem, as we were now over the hills to the northwest of the inlet.

All hell was breaking loose inside the cockpit as Dave tried to restart the engine twice, fly the aeroplane, choose a landing site, as well as having the controller ask for another position report. Dave and I worked together confirming each other's decisions – proving that two heads can be better than one.

The sensation was one of plummeting as opposed to gliding, and we had to pick our way down to the water very carefully. The landing had to be downwind so that we could land in the clear shallow water and not on the nearby rocks. We were losing height very quickly and I estimate that we were doing about 1000 feet per minute down and maintaining 80 knots, so as not to stall. Needless to say we were moving very quickly when we hit the water.

As we struck we were in a tail-low and left-wing-low attitude, and the first thing to give was the tail which broke off. Then the left wing struck the water and ripped, but it remained connected. This spun us around so that we were facing in the opposite direction. The cabin stayed intact and I was pretty much unharmed apart from a few cuts and bruises and a knock on the scone.

"Being aware of the priorities during a forced landing, and being fairly well practised."

I must have blacked out because I don't remember the crash; all I can remember is what it looked like just before we hit the water, water coming in the canopy at me and then waking up sitting in the aeroplane facing in the other direction, up to my waist in water.

When I came around I immediately thought "I've survived this crash, and now I'm going to drown", so I grabbed at my seatbelt to undo it, but soon realised that I wasn't getting any lower in the water. First panic over.

Dave and I checked that each other was okay, and we debated who was going to swim to shore. I told him there was no way he was leaving me there, we were going together. When Dave jumped out, however, the water was only waist deep, so we waded out.

On the shore were a number of people just sitting looking at us and we must have looked a sight. Two drenched people, clinging to each other and holding onto bleeding heads. Unfortunately at this point I lost my cool, because none of them even tried to help us out of the water, and I swore at them (as I tend to do) to go and get blankets or towels.

The ambulances were pretty quick to arrive, and as soon as they did I could start relaxing and leaving the aftermath for someone else to deal with. Up until that point I was concentrating on keeping Dave awake and trying to slow any chances of hypothermia setting in.

Answers to questions.

- Yes, I thought I was going to die. I thought this twice, once when the engine stopped the second time, but only for a millisecond, and then again just before we hit the water.
- No, my life did not flash before my eyes. Some say this was because I have yet to have one!
- No, time did not slow down. I have had time slow down on a number of occasions before and this time it definitely seemed to go very quickly. In fact we had about a minute and a half before we hit the water and it went very quickly.
- Being aware of the priorities during a forced landing, and being fairly well practised. I wouldn't consider that I was particularly good at forced landings, but I was familiar with them because I teach them to others.
- Dave and I worked very well together as a team, he flew the aeroplane and I talked to him, reassuring him that what he was doing was right and confirming our decisions.

I am not sure whether this will make me a better pilot, but I consider myself very very lucky, not only to walk out of an aircraft wreck like that, but also that the engine didn't spit its dummy somewhere a lot more uninviting. ■

The complete Lancair prior to departure on the day of the accident. Photograph by Peter Lowe.

- Yes, I am flying again and enjoying it, although it took me a while to be confident again.
- No, I do not want to do anything like that again, and when I am teaching students about forced landings without power I will never again say that catastrophic engine failure is very rare and unlikely to happen.

What actually saved my life?

- A full harness with both shoulder straps firmly attached.
- A fibreglass aeroplane that was strong around the passenger compartment and yet able to break at the extremities to absorb some of the impact.
- A level head.
- Having someone know where we were so that they could send ambulances, etc, to a precise location. An accurate Mayday call, and a filed flight plan.

It Can Happen!

The Civil Aviation Authority investigation into this accident revealed the probable cause as a jammed valve spring within the engine.

The investigation showed there was nothing wrong with the fuel supply.

The only item found defective during a complete strip of the engine was a broken inlet valve outer spring which had become jammed with the inner spring.

The positioning of the valve could not be conclusively determined, but if it had been jammed open it would have resulted in complete power failure.

The Trusty Tomahawk

*In recent times the safety of the Piper Tomahawk has been questioned in a number of publications, so people have started to question the airworthiness of this trainer. We received a letter from Ken Wells, an 'A' Cat Instructor from Nelson, asking us to confirm that this popular aeroplane is still safe. The CAA and **Vector** believe that, yes this aeroplane is still safe, but, it does require skill and caution when flying it – as do many other aircraft.*

What the Article Said

The original article that caused most of the concern in New Zealand was reprinted in *New Zealand Airline Pilot* magazine in June 1996. This article seems to have originated from *Aviation Safety* magazine, February 1995, and it worked its way around the world in a number of magazines.

It was a particularly damning report on the aeroplane by the reporter and by some ex-Piper employees. It made a number of claims, some of which we repeat here.

"It may be that no Tomahawks stall the same and that no Tomahawk stalls the same from day to day"

"…it appears that the PA-38-112 prototype built at Piper's Vero Beach, Fla, facility was not the aircraft produced at the Lock Haven, Pa, facility … major structural changes [were] made without consulting the design engineers … contrary to the FAA-approved conformity specifications and the sealed drawing lists. [These changes were made] to reduce production costs."

"new evidence indicates that the production design team at Lock Haven changed many things in an attempt to cut production costs … [including] lightening the wing structure."

"This noticeably 'softened' the wing, making it a new commodity in stalls and spins."

"The production aircraft has an entirely different wing spar arrangement."

"The aluminium skin covering the airplane was changed to a thinner gauge, apparently without testing and FAA approval. Engine offset angle was changed, too, without benefit of flight testing."

"NTSB investigators have been unable to determine who retested and approved this new aileron design."

"The aileron controls are a booby trap. They can generate large undesirable yaw excursions."

"Removal of the wing root glove was the greatest mistake."

"The Tomahawk wing under G loading tends to 'crease' just outboard of the fuel tank, rather than bending smoothly upwards as the lift load is increased."

These claims are of concern to all of us who fly or have flown Tomahawks, but they are not all as accurate as they seem. It has been pointed out by one commenter (James Allen, *Pilot* magazine January 1997) that "In context one should perhaps remember that it is quite easy to find ex-employees of any company that has gone into liquidation who feel rather bitter about things", and another commenter, Bruce Landsberg of the AOPA Air Safety Foundation agrees that these claims have little substantiation.

A number of the claims made above have been repeated in other articles, but repetition does not mean validation.

What the FAA Said

As soon as the CAA became aware of the article, Geoff Connor, Continuing Airworthiness Analyst (the man that writes the Airworthiness Directives) wrote to the FAA asking for further information on the airworthiness of the Tomahawk, and asked if they intended any action in response to the recent accident investigations.

"It is important that instructors know and teach the correct standard technique for recovery."

The FAA were more than satisfied with the certification and flight tests completed on the type-certified aeroplane. A total of 85 certification flights totalling 69.5 flight hours were carried out. Of this, 11 hours was used to determine the stall characteristics and 11.75 hours to conduct a total of 99 spins. This included a series of 18 spins conducted by an FAA pilot.

Conforming drawings for the certification aeroplanes show that the wing assemblies and aileron assemblies are the same as shown in the current Illustrated Parts Catalogue. The FAA goes on to say that they conducted static tests on the wing assemblies and concluded that the wing is not "soft and flexible".

The FAA confirmed that there was an experimental prototype, but it was never certificated and it was significantly different from the production aircraft.

Furthermore, a meeting was held at the Piper facility in August 1995, where representatives of Piper engineering, the NTSB (National Transportation Safety Board) and the Atlanta Aircraft Certification Office of the FAA were in attendance. Video tapes of spin tests on the Tomahawk were reviewed, and the participants concluded that the aeroplane behaved as expected and did not exhibit wing flexing nor poor aileron response. The FAA, NTSB and Piper agree that there is no need for change in the aerodynamic design.

CAA Comment

The CAA is satisfied with the response from the FAA, especially as the NTSB are in concurrence with the recommendations. As for the accident rate in New Zealand, there are no known cases of stall-spin accidents in New Zealand, and it seems that there are very few cases in the UK.

CAA does point out, however, that Airworthiness Directive DCA/PA38/19 requires installation of additional flow strips within the next 100 hours time-in-service as from 19 August 1983, to standardise and improve the stall characteristics. This should mean that there are no Tomahawks in service in New Zealand without inboard and outboard flow strips (unless of course the Tomahawk has not done 100 hours since 1983).

Views of Experienced People

Vector canvassed a number of experienced New Zealand operators and pilots about the Tomahawk.

Graham Leach
Flight Examiner – ASL

I have been instructing and/or testing in Tomahawks since they first arrived in New Zealand in the late 1970s. In fact, at Masterton we were one of the first clubs to purchase two aeroplanes, the first, ZK-WRC with outboard flow strips only, and ZK-WRB with both inboard and outboard strips. In my opinion, both displayed quite positive stall characteristics, with the outboard flow strips making for classic wing drop at the stall, while with the inboard strips as well, this effect was reduced. I was always of the opinion that the original aeroplane displayed all the desirable stall characteristics of a good basic trainer (ie, stall leads to a wing drop and, if no corrective action is taken, possibly a spin). This behaviour is consistent with two of the most successful training aeroplanes of the past, the Harvard and the Tiger Moth.

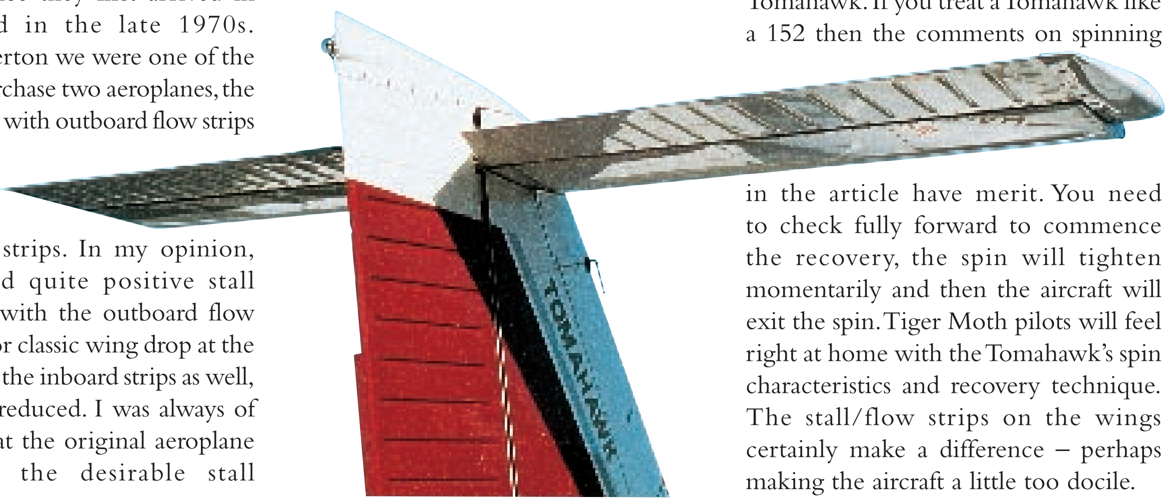
As far as the spin is concerned, I can only speak from personal experience of many spins, both as pilot in command and as an examiner. I can honestly say that I have had no problems with recovery **provided** the **correct standard recovery** technique is employed.

It is important that instructors know **and** teach the **correct standard technique** for recovery. I have spun the Tomahawk from level flight and from steep and gliding turns with predictable results, **provided the correct procedure is followed**.

"All aircraft have different traits, and the Tomahawk is no exception."

In summary, I have had no problems with the PA-38 and neither, to my knowledge, have my students. It is refreshing to see a basic trainer that behaves in a 'classic' fashion in the stall/spin regime. Many modern trainers have had these characteristics designed out of them, and pilots tend to expect the Tomahawk to be just as docile – which it is not.

If I have a criticism of the aeroplane, it would be the lack of time between the stall onset and the nose/wing drop. This is not really a problem, but often it results in a slightly greater height loss than in other aeroplanes when recovering at the incipient stage.



Warren Sattler
CFI – Ardmore Flying School

The recent article on the Tomahawk which found its way into various publications is certainly one of the most biased articles I have ever read. My favourite Tomahawk, ZK-EVB, has just passed the 14,000 hour mark, which includes around 6,000 hours completed by myself. If the article is a true statement of the Tomahawk, then I am certainly lucky to be alive.

My first real experience with Tomahawks started in the late 1980s. I must admit that initially I wasn't all that impressed – it was different from what I was used to. After a short time though, I really started to appreciate the difference.

The Tomahawk was designed with a cockpit four inches wider than its direct competitor, the Cessna 152. T o compensate for the increased drag caused by the increased frontal area, the designer selected the GAW 1 wing section (a maximum critical wing section

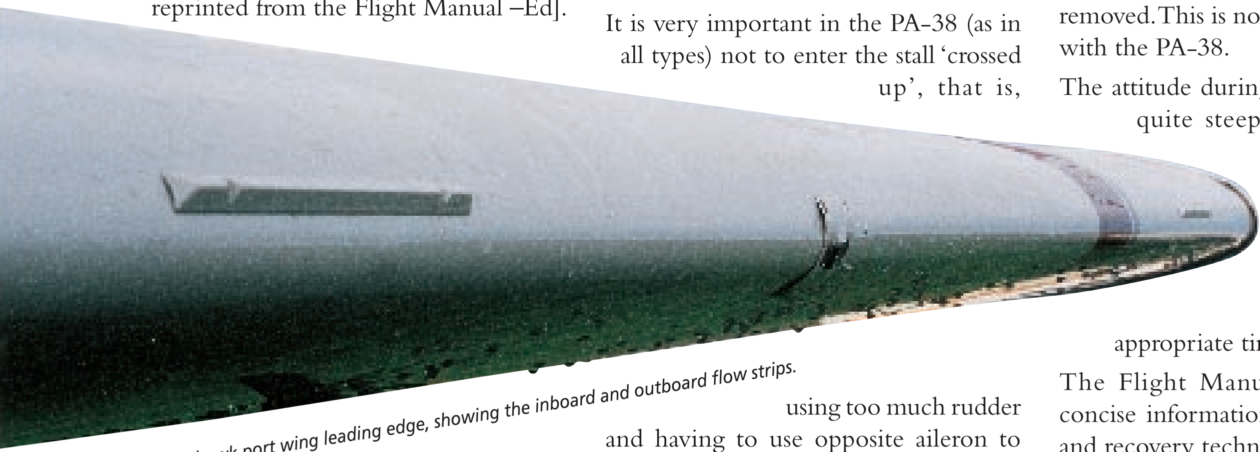
"We must … not assume that one light trainer is like another."

developed by Richard Whitcombe of NASA – the wing was found to have a 14 percent increase in efficiency over the **total speed range**). This enabled the designer to reduce the wing area of the Tomahawk to 124.7 square feet compared to 159.5 square feet for a Cessna 152.

Turns and stalls are standard, with a wing-drop stall being a good deal more docile than a 152. However if you try to spin the Tomahawk like a Cessna 152, watch out. Spin recovery in a 152 is straightforward, but not so in a Tomahawk. If you treat a Tomahawk like a 152 then the comments on spinning in the article have merit. You need to check fully forward to commence the recovery, the spin will tighten momentarily and then the aircraft will exit the spin. Tiger Moth pilots will feel right at home with the Tomahawk's spin characteristics and recovery technique. The stall/flow strips on the wings certainly make a difference – perhaps making the aircraft a little too docile.

I wonder how many pilots bother to read the Flight Manual fully before flying a particular aircraft. All too many pilots believe that, because they can spin one aircraft, then they can spin all aircraft. The Tomahawk Flight Manual is very specific when it comes to spinning [see excerpts reprinted from the Flight Manual –Ed].

"… there are no known cases of [Tomahawk] stall-spin accidents in New Zealand …"



Tomahawk port wing leading edge, showing the inboard and outboard flow strips.

Depending on the year and model (and we've got 16 Tomahawks on line to compare) some will tin-can, some won't – it seems Piper learnt a bit about sound-proofing and noise prevention as time went by.

I have total confidence in the structural integrity of the aircraft and have never had cause to doubt it. I am more than happy training in Tomahawks and will continue to do so, and hopefully for some time to come.

Tips From Professionals

The following is supplied by Murray Fowler, CAA Field Safety Adviser, and Graham Leach.

Turns

Accurate speed control, balance and correct technique using power entering turns, in particular at low level, is a must. An out-of-balance and inadvertent stall can produce a stall-spin situation with rapid height loss. The PA-38 can enter this predicament very quickly for the unwary or careless.

Stalling

The PA-38 can demonstrate abruptness and unpredictability at the stall, particularly in the 'clean' configuration. If the aircraft is kept in balance, it is still prone to drop a wing quite easily, and it will go either way. The stall onset (buffet) is usually short and sharp followed by the wing drop, if it is going to occur in this configuration.

If flap and a little power is employed entering the stall, the stall characteristics are generally softened somewhat, and the aircraft is usually less prone to drop a wing.

It is very important in the PA-38 (as in all types) not to enter the stall 'crossed up', that is, using too much rudder and having to use opposite aileron to keep the wings level. In this situation the aircraft is prone to quietly drop the wing in one direction and then rapidly flick into a spin in the opposite direction.

A fully developed stall can produce quite a steep nose-down attitude, but it is important to ensure that the elevator control is moved forward enough to positively unstall the aeroplane. Failure to do so may recover the aircraft just enough to put it back into the buffett and re-enter another stall immediately with further height loss. Because of this, normal stall entry and recovery techniques should always be employed.

Ease forward, full power and top rudder to prevent yaw. If you must lead with any control it would be the elevator, but the actions should be 'simultaneous'.

Using the normal recovery technique you will have no trouble recovering a PA-38 from the stall.

Spinning

The PA-38 spins quite easily, as already mentioned. It is quite predictable in the recovery, once again using accepted 'normal' technique.

This is:

1) Power **off**
2) Ailerons neutral
3) **Full** opposite rudder – pause*
4) Stick forward **until spin stops**
5) **Centralise** rudder
6) Level the wings and ease out of dive
7) Apply power as the nose rises through the horizon

The "stick forward" part is important to any spin recovery. Some modern trainers recover as soon as pro-spin control is removed. This is not necessarily the case with the PA-38.

The attitude during the autorotation is quite steeply nose-down, and therefore self-discipline is required to briskly move the elevator forward at the appropriate time in the recovery.

The Flight Manual gives clear and concise information on spinning entry and recovery techniques.

The C of G limits are very important, and it will be noted from the Flight Manual that the forward and aft limits are the same for the Utility and Normal categories.

"… how many pilots bother to read the Flight Manual fully before flying a particular aircraft."

Conclusion

The Tomahawk is a classic case of getting what you asked for. When 10,000 instructors were asked by Piper what they wanted, they wanted an aeroplane than spun well, and that is what they got.

All aircraft have different traits, and the Tomahawk is no exception. We must be aware of these differences and not assume that one light trainer is like another. ■

* The pause in the normal recovery technique is to allow the rudder to become effective. In a conventional configuration tailplane, if the elevators are moved down too soon they could have a blanketing effect on the rudder, thus reducing the anti-spin yawing moment obtained from the rudder. The recommended recovery technique in the Tomahawk Flight Manual does not advocate a pause, presumably because this is not necessary with the T-tail configuration. In all other respects the spin recovery technique is 'normal'.

Tomahawk

Flight Manual Extracts

It is vitally important to study the aircraft flight manual for any specific spinning characteristics of any particular aircraft type. The PA-38 Flight Manual section on spins is quite comprehensive. A few pertinent points are quoted here.

Before Spinning

"Carrying baggage during the spin is prohibited, and the pilot should make sure all loose items in the cockpit are removed or securely stowed, including the second pilot's seatbelt if the aircraft is flown solo."

"Spins should only be started at altitudes high enough to recover fully by at least 4000 feet agl, so as to provide an adequate margin of safety. A one-turn spin, properly executed will require 1000 to 1500 feet to complete, and a six-turn spin will require 2500 to 3000 feet to complete."

Spin Entry

"The spin should be entered from a power-off glide by reducing speed at about 1 kt/sec until the airplane stalls."

Spin Recovery

"Normal recoveries may take up to 1 to $1^1/_2$ turns when proper technique is used; improper technique can increase the turns to recover and the resulting altitude loss."

"The recommended procedure has been designed to minimise turns and height loss during recovery. If a modified recovery is employed (during which a pause of about 1 second – equivalent to about one half turn of the spin – is introduced between the rudder reaching the stop and moving the control column forward) spin recovery will be achieved with equal certainty. However, the time taken for recovery will be delayed by the length of the pause, with corresponding increase in the height lost.

In all spin recoveries the control column should be moved forward briskly, continuing to the forward stop if necessary. This is vitally important, because the steep spin attitude may inhibit pilots from moving the control column forward positively.

The immediate effect of applying normal recovery controls may be an appreciable steepening of the nose-down attitude and an increase in rate of spin rotation. This characteristic indicates that the aircraft is recovering from the spin, and it is essential to maintain full anti-spin rudder and to continue to move the control wheel forward and maintain it fully forward until the spin stops. The airplane will recover from any point in a spin in not more than one and one half additional turns after normal application of controls."

"Because the aircraft recovers from a spin in quite a steep nose-down attitude, speed builds up quickly in the dive out. The rudder should be centralised as soon as the spin stops. Delay in centralising the rudder may result in yaw and 'fish-tailing'. If the rudder is not centralised it would be possible to exceed the maximum manoeuvre speed (Va) of 103 kts with the surface fully deflected.

Unintentional Spins

In the "Emergency Procedures" section of the Flight Manual, the spin recovery advice includes the important additional points for an unintentional spin of closing the throttle, retracting flaps if extended, and neutralising the ailerons.

Mishandled Recovery

"The airplane will recover from mishandled spin entries or recoveries provided the recommended spin recovery procedure is followed."

"Delay of more than about $1^1/_4$ turns before moving the control wheel forward may result in the aircraft suddenly entering a very fast, steep spin mode which could disorient a pilot. Recovery will be achieved by briskly moving the control wheel fully forward and holding it there while maintaining full recovery rudder.

If such a spin mode is encountered, the increased rate of rotation may result in the recovery taking more turns than usual after the control column has been moved fully forward.

In certain cases the steep, fast spin mode can develop into a spiral dive in which the rapid rotation continues, but indicated airspeed increases slowly. It is important to recognise this condition."

Cessna Owners

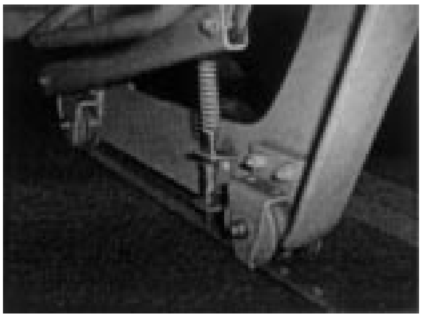
A Letter from the Field

A Cessna owner-operator submitted the following observations to the CAA.

Uncommanded Sliding Seat

The following report was taken from a club newsletter, and it highlights an often neglected part of a preflight inspection that is worthy of consideration.

"The Cessna 172 pilot and his three passengers were leaving for a one hour local scenic flight. At a height of 40 to 50 feet the aircraft nose was seen to pitch violently up and the power suddenly reduced to idle. The aircraft subsequently stalled heavily into the ground, with the pilot suffering a broken leg and passengers suffering minor back injuries."



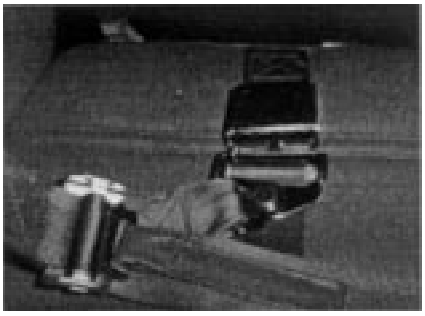
The cause of the accident was the pilot's seat moving rapidly fully aft. The pilot, with his hand on the throttle, was taken by surprise and pulled both the control column and the throttle aft with him. Unable to move the column or throttle forward the aircraft stalled. There was insufficient height to recover the situation.

CAA Comment

While it is important to ensure that seats are correctly locked in place, it is equally important that thorough inspections of seat tracks and locking mechanisms are carried out during maintenance. Cessna introduced Service Bulletin SEB89 in April 1989 which provides for the installation of secondary seat stops on the pilot's seat to limit the amount of rearward travel in the event that the primary seat lock fails. CAA New Zealand also issued Airworthiness Directives for Cessna 100 and 200 Series aircraft, for applicable serial number ranges, requiring detailed inspection of the seat tracks to preclude the possibility of lock pin disengagement. **These are repetitive inspections at 100 hour intervals.**

Loose Shoulder Harness

The second occurrence refers to the shoulder-harness to lap-belt connection. The submitter reports that the connection became loose at the shoulder-harness to lap-belt attach stud location. Investigation revealed that the plastic bushing on the shank of the shoulder harness lock stud (on the lap belt) had broken and was missing, resulting in a totally unreliable shoulder harness. Replacement of the plastic bushing (part number S-2237-3) cured the fault. Cessna Service Bulletins MEB 96-4 and SEB 96-2 refer.



Loose Front-Seat Lap Belts

During operation in turbulence, or during sudden deceleration, the lap belt tension was being loosened by the upward force applied by the occupant on the shoulder harness. This can be caused through several reasons:

- The knurled clamping bar on the lap belt that clamps the webbing is worn or rusty and loses its clamping effect. Where this condition exists, the belt should be replaced.
- The webbing is worn or abraded, and the knurled clamping bar can not provide the required grip on the webbing. Where this condition exists, the belt should be replaced.
- The seat belt buckle is positioned incorrectly, ie, in the centre of the lap of the occupant. The submitter suggests shortening the lap belt (the half with the buckle end) so that the locking assembly is positioned more towards the thigh of the occupant. This provides for a greater angle across the occupant and reduces the tendency for upward force to loosen the lap belt.

CAA Comment

Where the last option above is selected as the only cure to the problem, operators should ensure that there are no promulgated modification restrictions on the belt and that the belt modification is done in accordance with approved modification data from the manufacturer, an approved design organisation, or the CAA. Reference material for webbing replacement procedures is contained in FAA's AC43.13-1A. **Before attempting any seat belt modification, the operator should ensure that the seat belt assembly is the correct part number for that installation.** ■

New Problems with Ice

By Dan Manningham

It is no secret that inflight icing compromises the function of airfoils. In all cases, ice accumulation reduces the efficiency of an airfoil so that its ability to produce lift is decreased and its stall speed is increased. Ice is a detractor to all airfoils at all times and has serious safety implications.

Traditional icing cautions have focused on the effects of wing icing, such as reduced lift and increased stall speed. In recent years, a new generation of airplanes has demonstrated susceptibility to control problems due to icing. The aerodynamic logic is identical, but the results are far different.

And while the icing effects discussed in this article can affect virtually any airplane, newer turboprop designs in the lightweight to mid-weight category with sophisticated computer-designed wings seem to be the most vulnerable.

Elevator Effects

In recent years, a number of accidents and incidents have occurred involving uncommanded airplane pitch down during or shortly following flight in known icing conditions. These incidents almost exclusively involve airplanes with the following design characteristics:

1) reliance on aerodynamically balanced elevators without power boosting,
2) very efficient flaps,
3) non-trimmable stabilizers in conjunction with efficient airfoils, and
4) relatively small stabilizers.

Many airplanes are susceptible to tailplane icing, but these four characteristics are most common among the newer turboprop designs and are particularly found in those airplanes designed for commuter operation. In fact, the FAA has issued nine ADs against six airplanes in this category: the YS-11, the BAe Jetstream 3101, the ATR 42, the Saab SF-340A, the Embraer 110 and the Cessna T-303.

Turboprops are thought to be more prone to tail-icing problems because of their operating environment at lower altitudes and speeds where ice-avoidance options are limited.

Research in this area is far from complete, and many of the conclusions and actions are, necessarily, anecdotal.

Loss of elevator effectiveness in icing conditions is the result of several interrelated factors:

First, recall that the horizontal tail of an airplane provides longitudinal stability by creating downward lift to compensate for the downward pitching moments of the wing and fuselage. In cruising flight, those pitching moments are relatively small so that the required (downward) lift can be produced by the tail with a minimal (downward) angle of attack. During the approach phase of flight, the required (downward) angle of attack on the tail changes considerably.

Second, when the flaps are extended, the wing center of lift moves aft, increasing its downward pitching moment. Further, when the flaps are extended, the downwash over the horizontal tail is increased, which creates a higher (downward) angle of attack when the tail needs to produce greater (downward) lift. Due to these combined effects, airplanes with very efficient flaps and relatively small stabilizers may operate close to maximum CL at the tail on final approach with flaps extended. In that condition, even a small amount of ice could cause the tail to stall.

Third, tail surfaces are smaller than wing surfaces and, therefore, accumulate ice more efficiently. And, any given thickness of ice will have a more adverse effect on the tail due to its smaller leading-edge radius and the ratio of thickness to chord length. There are reports of ice accretion on tailplanes three to six times thicker than ice on the wing and two to three times thicker than ice on the more visible windshield-wiper arms or some other protrusion. Many pilots routinely allow one inch of ice to accumulate on the wing leading edge before operating the boots. In such cases, as much as three to six inches of ice could have accumulated on the tail, and that ice may not be shed. Remember too, that even equal accumulations of ice will have a greater effect on the tail.

Fourth, the tail can accumulate significant amounts of ice before the wing accumulates any. Several accident airplanes were found with inoperative tailplane ice-protection systems, or the tail ice-protection switch not in the "on" position. In addition, when the tailplane is immersed in the propwash, it may be susceptible to icing at static air temperatures above freezing because of adiabatic cooling in the accelerated propwash air.

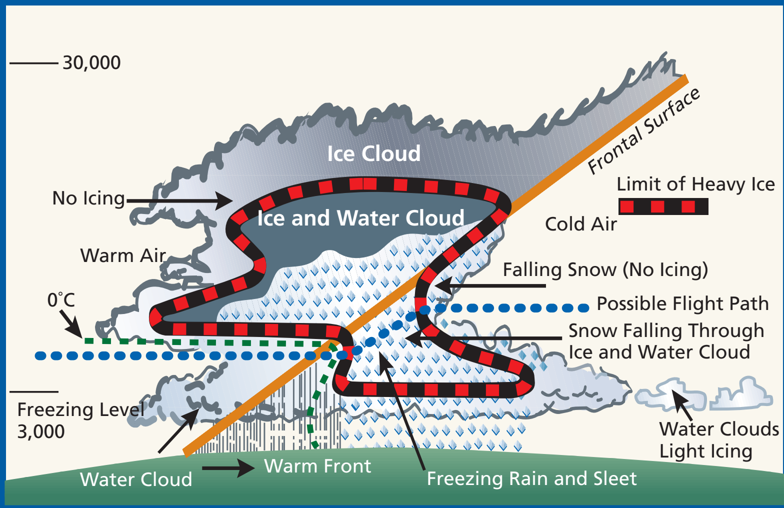
One more aerodynamic principle in the loss of elevator effectiveness in icing conditions would apply to any airplane, and it is an important concept. The (negative) angle of attack on the tailplane for any given flap setting increases with speed. It is the reverse of what happens to the wing. All other things being equal, at faster speeds, a wing will have a lower angle of attack, which lowers the nose and raises the tail. When the tail is raised in this fashion, it will have a higher (negative) angle of attack and be operating closer to a stall.

The classic tailplane icing accident or incident occurs (but is not limited to) a relatively new turboprop design in the lightweight to medium-weight category. It occurs during, or shortly after, exiting icing conditions, and it occurs on the final approach when full flaps are selected. At that point, the combined effect of tail ice and increased flaps produces a tail stall. When the tail stalls, it can no longer compensate for the wing's (downward) pitching moment, and the airplane pitches over abruptly. When it does, the yoke may be snatched abruptly forward to the instrument panel.

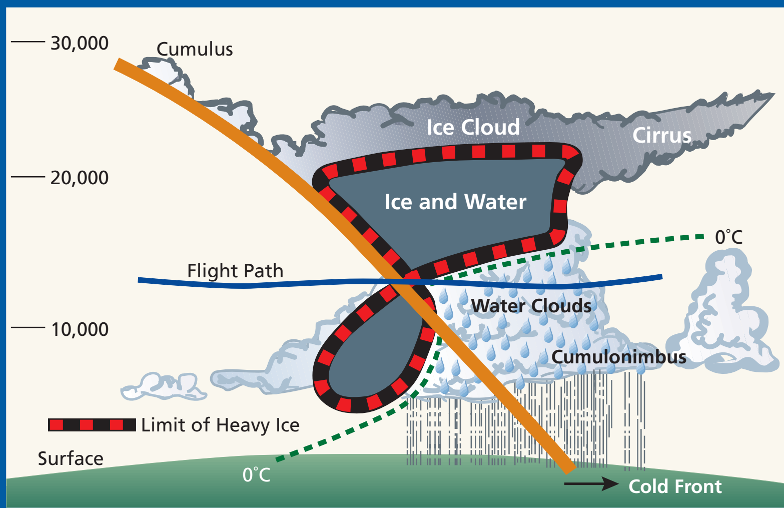
But, there is an important point here: In almost all cases, there is still adequate elevator-control force available to recover and control the airplane, although stick forces will be excessive. Pilots may have to apply as much as 100 pounds of pull force to recover pitch control. Unfortunately, when tail stall occurs at low altitude, recovery may not be possible before ground contact.

Loss of elevator effectiveness is a particular risk in certain airplanes in icing conditions on final approach. You can minimize your risk by checking with your manufacturer and the FAA for applicable operating procedures. In addition, consider these guidelines:

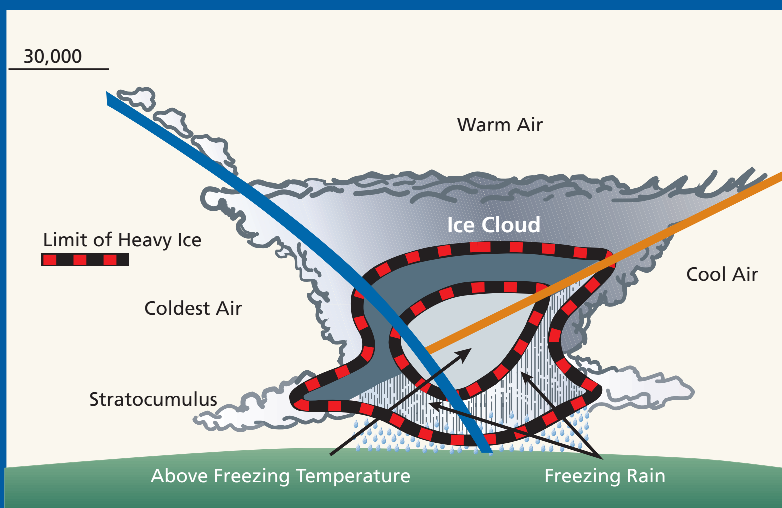
ICING UNDER A WARM FRONT



ICING ZONES ALONG A COLD FRONT



ICING ZONES ALONG AN OCCLUDED FRONT



Source: U.S. Air Force

- Never fly into known icing conditions with inoperable anti-icing or deicing components, especially those associated with the tail.
- When you observe ice on the wings, the windshield-wiper arm or some other protrusion, assume that even more ice has accumulated on the tail—a lot more—and that it will have a disproportionate effect.

Inflight icing has always been a problem for aircraft, but recently the scope and intensity of that problem have expanded.

- When you are in icing conditions, or have just left icing conditions, make the landing approach with something less than full flaps. Check with your manufacturer, but in most cases half flaps is about right.
- Make final flap selections at least 1,000 feet above ground level. Make those flap selections in small increments and re-trim between each one.
- When selecting flaps in icing conditions, leave your hand on the flap selector until the flaps reach the intended position. If the airplane pitches down when flaps are extended, immediately return the flap handle to its last position.
- When you suspect airfoil icing, be cautious about adding airspeed for the final approach to compensate for degraded aerodynamic efficiency of the wings. Each knot of speed added to avoid wing stall will put you one knot closer to tail stall. It is an either/or situation, so fly the approach by the numbers with a firm grip on the controls.
- When icing conditions prevail on the approach, fly the airplane manually. Use of the autopilot/auto-coupler will mask the changes in control force that telegraph the presence of tail ice.
- If you do encounter pitch-over on final approach, muscle the yoke back, and it will provide adequate control authority in almost all cases.

The root problem is not control authority but hinge moment, and you can override it with enough pull force.

Tailplane icing is a real threat—especially to mid-size, propeller-driven airplanes. And while the problem isn't new, our understanding of it is.

Ice-Induced Roll Upsets

On Halloween night, 1994, an ATR 72 operating as American Eagle Flight 4184 suffered a roll upset over Roselawn, Ind. during descent, after holding in icing conditions. During the hold, the airplane was flown with flaps extended and the autopilot engaged. Both of those conditions—in the presence of what was later found to be severe icing conditions—contributed to the eventual upset and loss of control. This accident was a landmark tragedy that ultimately exposed a pernicious type of inflight icing previously not understood.

FAA icing certification has traditionally assumed a maximum droplet diameter of 40 microns. Water droplets of any specified size have predictable inertia and drag properties that determine their travel along the wing chord line. Thus, any given droplet size ultimately defines the size of ice-protection systems. Currently, ice-protection systems are designed to cover that portion of the airfoil on which ice would be expected to form if the droplets are no larger than 40 microns.

Larger droplets have greater inertia and proportionately less drag, so they travel farther back along the chord line, cover a larger area and spread the iced area farther back on the wing. A case in point: Water droplets over Roselawn that Halloween night were larger. In fact, compared to 40 microns, they were monsters, up to 10 times larger.

One result of the Roselawn accident was new awareness of what are now called Supercooled Large Droplets. SLD can occur in several forms, with droplet sizes as large as 4,000 microns—100 times larger than the droplet size assumed by FAA certification. When your airplane is subjected to an environment of SLD, icing can lead to roll-control problems in three distinct ways:

First, at reduced speeds, ice from freezing drizzle can form sharp-edged ridges over a large chordwise expanse of the wing's lower surface and fuselage. This buildup increases drag, which reduces the speed, which requires an increase in angle of attack, which produces more drag, and so on. This trend then can lead to a conventional stall that is normally followed by roll-off.

Second, at higher speeds (lower angles of attack), ice can form in ridges just forward of the ailerons. When such ridges form, they can disturb the airflow over the ailerons in such a way as to create an imbalance in the aerodynamic forces over those controls until the ailerons "snatch" or deflect of their own accord, causing the airplane to roll.

When ailerons snatch, the control forces in the cockpit are effectively reversed. Instead of having to exert force on the control wheel to deflect the ailerons, you will have to make the same effort on the control wheel to hold the ailerons in a neutral position. Aileron snatch will cause the airplane to roll, but you can override that response by muscling the ailerons where you want them with the control wheel. It will require deliberate action and some strength, but the airplane will probably be controllable. You can anticipate aileron snatch in icing conditions when aileron forces become noticeably different, when there is any oscillation or vibration, or when you can feel buffeting in the wheel.

SLD can occur in several forms, with droplet sizes as large as 4,000 microns . . .

Third, loss of roll-control effectiveness can result when ice forms ahead of the ailerons and disrupts the airflow over them in a way that reduces their effectiveness. This is different from the "snatch" scenario in which aerodynamic balance is disrupted but effectiveness is essentially retained. When ice forms in front of the ailerons in such a way as to degrade aileron effectiveness, those controls will not produce the rolling moments you expect. In the worst case, they may not produce adequate rolling moments to control the airplane. This is the most disastrous possible roll-control problem because the airplane may not be controllable.

Finally, one further condition can contribute to roll-control problems, although probably not cause them directly. On most turboprop or jet airplanes, ice will tend to accumulate on the wingtips before it does on the roots. This happens because the wingtips are different from the roots, and they are almost certainly thinner. They may have a different camber and shorter chord, and they may have some degree of washout relative to the root section. For all these reasons, the wingtips will tend to accumulate ice quicker, thicker and farther aft. In fact, even identical accumulations will have a more adverse effect on the tips due to the smaller chord. All of this is conducive to airflow separation at the tips that compromises aileron effectiveness.

When you do suspect that aileron effectiveness is (or may be) compromised by severe icing conditions, take the following precautions:

- Disconnect the autopilot and hand fly the airplane because the autopilot will mask important handling cues.
- Immediately advise ATC and exit the area/altitude, being careful to avoid any abrupt control inputs.
- Reduce the angle of attack by increasing airspeed or selecting the first increment of flaps. If flaps are extended, do not retract them unless you can determine that the upper surface of the wing is clear of ice.

Signs of Severe Icing

Roll-control problems, in particular, have been clearly identified with flight in areas of SLD. Flight in SLD conditions should not be continued, under any conditions, so you should take whatever means are necessary to depart those conditions when encountered. True SLD conditions are sufficiently hazardous that you should seriously consider declaring an emergency if that is required to obtain a clearance away from them.

How can you tell if you are flying in environmental conditions of SLD?

- Check for any ice formation aft of the deiced area on the upper or lower surface of the wing. You can facilitate this task by painting a portion of the wing immediately aft of the deiced area in a dark, flat color, different from the color of the deicing boots, and by installing wing lights or using a high-powered flashlight.
- On turboprop airplanes, check for ice on the propeller spinner any farther aft than the first few inches. Ice that extends back close to the propeller-blade roots is very likely caused by SLD. As with the wing, you can enhance this visual check by painting the spinners with a dark, flat paint.
- Check for granular ice crystals or clear ice on the unheated portions of the front or side windshields.
- Watch for any signs of unusual ice coverage, including ice feathers or fingers that extend onto portions of the airframe not normally contaminated with inflight icing.

SLD is particularly hazardous at ambient temperatures near freezing. When operating in conditions near the freezing point, watch for the following visual cues:

1) Any sign of visible rain is a clear indication that droplet size is well above the certification assumption of 40 microns.
2) Droplets that splatter or splash on the windshield can be assumed to be SLD. Droplets of 40 microns or less are not individually visible and will not appear on the windshield in such patterns.
3) Rivulets of water streaming across windows is an indication of high liquid water content and should be treated as SLD.
4) Radar returns showing precipitation suggest water droplets large enough to be considered SLD for flight safety purposes.

In all cases, be particularly vigilant for changes in the control feel of the ailerons and elevator. Any perceptible change to the normal control response is cause for serious concern.

SLD can quickly compromise the flightworthiness of your airplane by substantially affecting aileron and/or elevator effectiveness. No airplane is certificated for flight in such conditions, and pilots should take every precaution to avoid and exit these conditions.

Inflight icing has always been a challenge, but now it appears that the problem is considerably greater than we thought. ■

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Ice Too

*Many recent articles on tailplane icing draw attention to the apparent increased sensitivity of aircraft with high performance wings, typical of modern commuter aircraft. Tailplane icing can affect virtually any aeroplane, however, and the following reports in a recent **GASIL** magazine (published by our opposite number in the UK) highlight the need for vigilance in any aircraft. The aircraft type involved, the Piper Seneca, is also a popular training type in New Zealand.*

These scenarios occurred in January 1997.

Airframe Icing

The aircraft was engaged in night flying, Whilst at FL40, in VMC on top, the righthand vacuum pump warning light illuminated, so the instructor elected to return to his base airfield. They were required to join the hold at 4000 feet QNH, which coincided with a thick layer of stratocumulus. The outside air temperature was –5∞C and the aeroplane started to accumulate ice. The water droplets were tiny, and the ice accrual rate was very slow. The commander elected not to activate the de-icing boots for fear of losing the second gyro pump and by implication both artificial horizons. Instead, he monitored the ice using the wing-ice lamp. The ice was affecting only the extreme leading edge of the wing and looked slightly larger than a ragged sugar cube. The commander did not consider the small amount of ice to constitute a handling hazard.

During the outbound leg of the procedure, the wing-ice light failed and, although the pilot had a small torch, this was ineffectual in further ice checks. During the inbound turn, the aircraft broke cloud at about 2500 feet. The student was flying the aircraft and, although he had been struggling to maintain accuracy, he hadn't passed any comment on the feel of the aircraft.

After completing the landing checks, the descent was commenced at 2000 feet on the glideslope and flap 25 was selected. Almost immediately, the aircraft started pitching down, and the instructor's instinctive reaction was to pull back with both hands. The aircraft did not respond for a few alarming seconds before recovering. As the nose approached the horizon, the aeroplane again pitched down hard and the commander selected flaps up as he was pulling back, and again regained level flight. The aeroplane felt totally unstable in pitch with an oscillatory motion. He exercised the de-icing boots and almost immediately the aircraft felt normal.

He transmitted a PAN call informing ATC that he had experienced an uncontrolled pitch down, but it now appeared under control. The approach was continued and a flapless landing was made.

The pitch down was quite severe, but the commander found it impossible to recall height/speed/attitude parameters. It is highly probable that the landing gear and flap speeds were exceeded, and the commander distinctly remembered that the pull-out from the second dive was not what he would wish to inflict on a Seneca.

After shut-down there was significant ice on the stabilator.

Shortly after details of this were reported, an instructor who had been flying a few hours earlier that day reported the following:

He had been asked to remain in the hold at 4000 feet QNH for approximately 25 minutes. There was a stratus layer, base 2400 feet with tops at 4200 feet and the OAT was –3°C at 4000 feet. The pilot noticed that ice started to accumulate on the leading edges in a granular open structure. Due to the small water droplets, the rate of accretion was slow but steady, and there was minimal flow-back over the leading edges. The student was failing to carry out frequent icing checks, and the commander allowed the ice to accumulate, as the thickness was less than that required for de-icing boot operation. The aircraft was simulated asymmetric, and the student began to experience difficulty maintaining altitude. After prompting, he eventually maintained level flight at an attitude 3 to 5 degrees nose-higher than normal, with an increase of 5 inches of manifold pressure to the live engine to maintain indicated airspeed.

The commander was surprised by the significant reduction in performance for a relatively small amount of ice accretion, and he was, therefore, using the opportunity to make a training point to the student. However, a student passenger in the back advised him that there was a large amount of ice on the stabilator. The structure of the stabilator ice was similar to that on the leading edge of the mainplane, but with little flow-back and a more pronounced 'beak' of approximately half an inch. The commander operated the de-icing boots, with complete success on the mainplane leading edges. However, there was only partial clearance on the stabilator of about 30 to 40 percent, and two further operations of the boot were required to effect a full clearance,

The aircraft was climbed to 5000 feet, out of icing conditions, for the remaining holds, but picked up moderate ice during the descent, which cleared with the boots but required a further inflation to fully clear the stabilator.

The captain of the second aircraft pointed out that the degradation of performance was considerable, given the amount of ice accretion, and the loss of performance occurred well before the ice had accumulated to the recommended thickness for de-icing boot operation. The ice was thicker on the stabilator, probably due to the increased energy imparted to the airflow by the propellers. Worryingly though, the ice did not clear immediately from the stabilator, despite full clearance from the main wing leading edges. At night, it is almost impossible to see the stabilator.

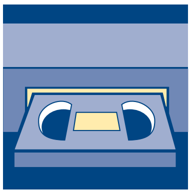
[UK] CAA Comment

It would appear from the above that certain combinations of temperature and super-cooled water droplets produce this span-wise accumulation of ice, similar in looks and effect to stall strips fitted to some aircraft. It is likely that tailplanes, in the influence of prop-wash, are subject to higher mass flow and therefore rates of icing higher than the wings. As a consequence, pilots can misjudge the probability of tailplane stall when using ice accretion on the mainplane as the criterion. The severe pitch-down when flaps are selected, particularly with the Cessna 400 series, has been highlighted in *GASIL* in the past.

Trim Tab Icing

Whilst simulating an engine failure, the aircraft climbed to FL50 through an inversion at a constant –4°C throughout. The aircraft was in cloud for some 10 minutes, and light ice accretion occurred with a maximum of about 5 mm of rime ice on the wing leading edge, with approximately 8 mm on the OAT probe, fuel cap, leading edges, etc. With full left rudder trim applied, about 75 percent left rudder travel was needed to sustain balanced flight at 100 knots. On levelling out in clear air (–4°C) the pilot was unable to move the rudder trim. He suspected that it had frozen at full travel or otherwise jammed. Even maximum manual force would not release it. After an uneventful landing, where the OAT was still –2°C, the aircraft was taken to the maintenance organisation for inspection.

After landing, 5 to 8 mm of ice was still adhering to the airframe projections. The rudder trim was freed using manual rudder trim application after taxiing for three minutes. The pilot inspected the trim actuator rod which is on the lefthand side of the rudder surface, where a small, 5 to 8 mm, knob of ice was still adhering to the hinge attachment point between the rod and the trim surface. This and other ice was easily removed before the next flight. ■



Videos

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

Civil Aviation Authority of New Zealand

No	Title	Length	Year released
1	Weight and Balance	15 min	1987
2	ELBA	15 min	1987
3	Wirestrike	15 min	1987
4	Mountain Flying	15 min	1988
5	The Human Factor	25 min	1989
6	Single-pilot IFR	15 min	1989
7	Radar and the Pilot	20 min	1990
8	Fuel in Focus	35 min	1991
9	Fuel Management	35 min	1991
10	Passenger Briefing	20 min	1992
11	Apron Safety	15 min	1992
12	Airspace and the VFR Pilot	45 min	1992
13	Mark 1 Eyeball	24 min	1993
14	Collision Avoidance	21 min	1993
15	On the Ground	21 min	1994
16	Mind that Prop/Rotor!	11 min	1994
17	Fit to Fly	23 min	1995
18	Drugs and Flying	14 min	1995
19	Fatal Impressions	5 min	1995
20	Decisions, Decisions	30 min	1996
21	To the Rescue	24 min	1996

Miscellaneous individual titles

Working With Helicopters	8 min	1996*

*re-release date

Civil Aviation Authority, Australia

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

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

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

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

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

Publications

***0800 800 359 — Publishing Solutions,** for CA Rules and ACs, Part 39 Airworthiness Directives, CAA (saleable) Forms, and CAA Logbooks. Limited stocks of still-current AIC-AIRs, and AIC-GENs are also available. Also, paid subscriptions to Vector and Civil Aircraft Register.*

***0800 500 045 — Aviation Publishing,** for AIP documents, including Planning Manual, IFG, VFG, SPFG, VTCs, and other maps and charts.*

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CAA Act requires notification "as soon as practicable".

CIVIL AVIATION AUTHORITY
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