May / June 2001

VECTOR

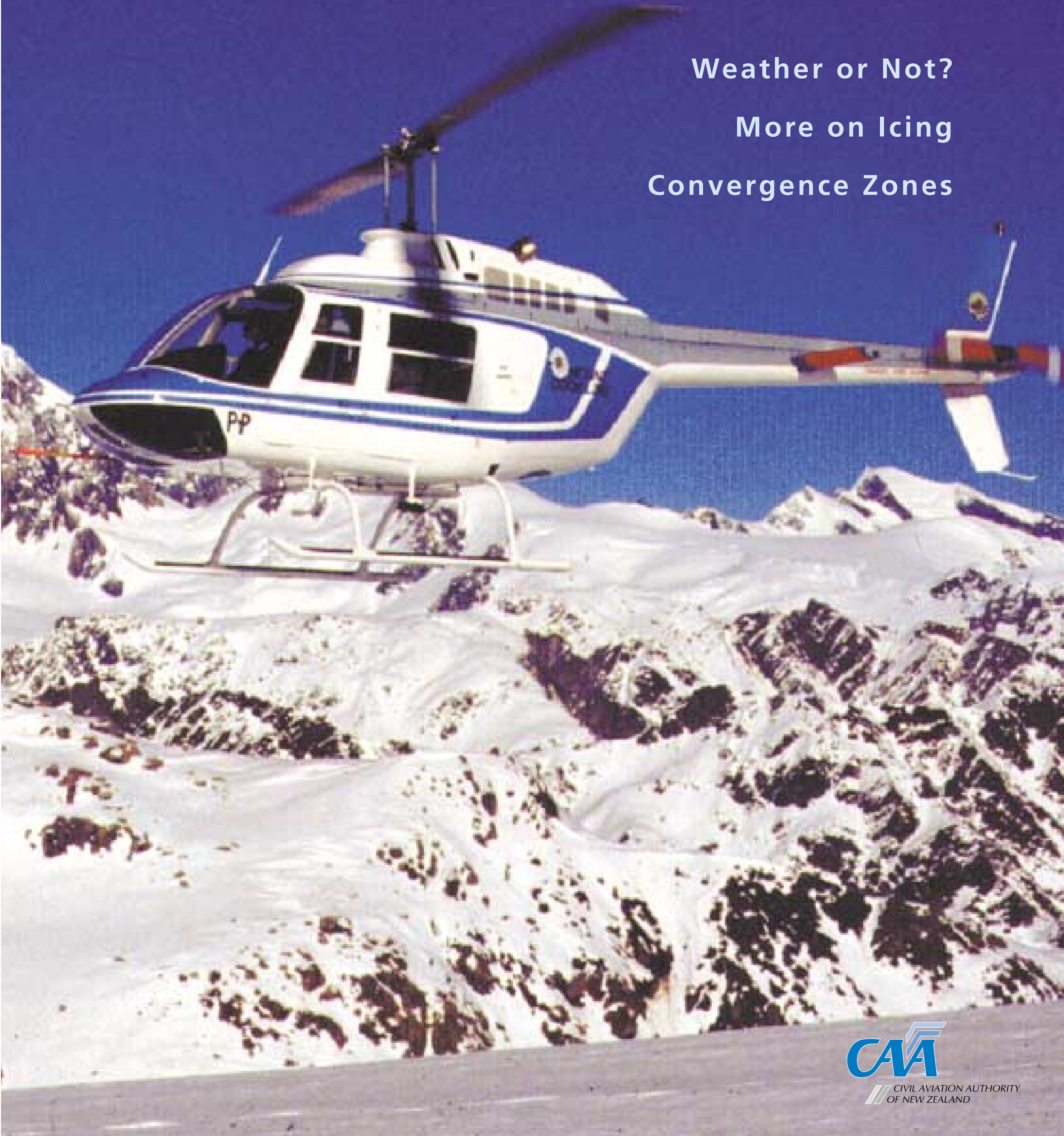
Pointing to Safer Aviation

Surviving on Limited Panel

Weather or Not?

More on Icing

Convergence Zones



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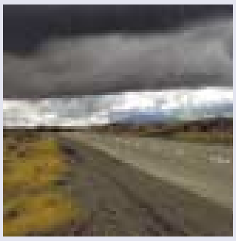
May / June 2001

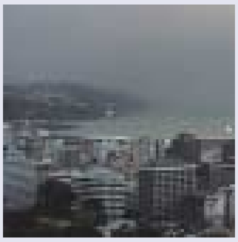
CONTENTS

Failure of the vacuum system will cause the failure of the AH and DI. If the pilot is not proficient at limited panel flying in IMC, there is a high probability that they will lose control of the aircraft.



There is an increasing trend for GA pilots to fail to obtain adequate pre-flight weather information, which is a cause for concern. How can you help to reverse this trend?

The second article in a series aimed at increasing pilots' awareness of airframe icing and its effects.



Anticyclonic conditions don't always equate to fine weather and trouble-free flying. Find out why.

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Cover photo:
A Bell 206 hovers near the Almer Hut (top end of the Franz Josef Glacier) with the Fritz Range in the background. Photograph courtesy of Merv Falconer.

SURVIVING ON LIMITED PANEL

Losing the artificial horizon while in IMC is one of the worst scenarios an IFR pilot can face. John Laming looks at what can go wrong with gyroscopic flight instruments, why their functionality should be thoroughly checked before takeoff, the importance of reporting instrument system defects, and why pilots should keep current on a limited panel.

The pilot of a Mooney M20J was cruising at 9000 feet on an IFR flight plan en-route Adelaide to Dubbo. The weather was clear, with no restrictions to visibility, and with scattered cloud at 30,000 feet. Sky conditions were dark, with no moon. A few minutes after making a frequency change he advised Flight Service that the engine-driven vacuum pump had failed, and that he was diverting to Mildura with an ETA in 23 minutes. In response to enquiries from Flight Service he advised that he had "electric back-ups" and felt it would be safer to return to Mildura. He confirmed that his approach and landing would not be affected. One minute later Flight Service asked him for his approximate distance from Mildura. The pilot asked Flight Service to repeat the request, but then failed to reply.

"Vacuum pump life cannot be accurately predicted and pumps can, and do, fail without warning."

The wreckage of the aircraft was found some hours later. It had crashed at high speed in a steep nose-down attitude killing the occupants. With the exception of the vacuum system, the aircraft was considered to have been capable of normal operation prior to impact. There was evidence that the AH (artificial horizon) gyro was stationary at impact and that the engine-driven vacuum pump had failed. A check of maintenance records revealed that the vacuum pump was more than 700 hours beyond its recommended replacement time.

(Note that this article is set in the Australian regulatory environment, which differs in some repects from New Zealand.)

Instrument Failures

Failure of the vacuum system will invariably cause failure of both the AH and directional indicator (DI). If the pilot is not proficient at limited panel IMC (Instrument Meteorological Conditions) flight, it is highly probable that control of the aircraft will be lost.

Vacuum pump life cannot be accurately predicted and pumps can, and do, fail without warning. This can be the result of various factors including, but not limited to, normal wear-out of components, improper installation or maintenance, premature failure, or use of sub-standard overhauled components.

You should not fly IFR without a back-up system to power your gyro instruments. Equally important is to have the skills to use that back-up system. In most light aircraft that back-up is an electrically powered turn-and-slip indicator, or turn coordinator.

Cockpit Ergonomics

For IFR charter flights in aircraft below 5700 kg, Australian CASA regulations require that the aircraft be equipped with a second AH. This is a safety measure in case one fails. Twin-engine aircraft usually have a vacuum pump on each engine, with either pump able to run the air-driven gyro flight instruments. The back-up gyro instrument (turn coordinator) must have a separate power source – usually electric.

Let's examine the reality of using the second AH in IMC or at night. In doing so we need to think about ergonomics, which means the art of matching the environment and the machine to the operator. Or in simple terms, matching the pilot to the flight deck or cockpit. This subject was covered in the Australian *Aviation Safety Digest* several years ago, but some parts of the

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An example of poor cockpit ergonomics. This ILS indicator is positioned low down and behind the control yoke resulting in obstructed vision and parallax error.

Photograph courtesy of John Laming

... continued from previous page

article bear repeating in the context of flying on limited panel.

The subject is important to the aviator because the aviation environment is unforgiving and intolerant of mistakes. A control that is awkward to operate, the instrument that is difficult to read, the cockpit lighting that is poor, an emergency gear handle that is hard to operate – these are all potential accident causes and yet they are all fairly easy to correct. Good ergonomic design is just as important in general aviation aircraft as it is in a Boeing 747.

"As an aircraft owner, ensure that any second AH is installed to a safe ergonomic standard."

While there is no doubt about the excellent ergonomics and reliability of jet airliner multi-crew flight instrumentation, the same is not always true for light aircraft engaged in single-pilot IFR operations. In many cases the location of the second AH to meet IFR charter regulatory requirements, is left to the maintenance organisation. Invariably, the only spare space available is outside the direct view of the pilot and somewhere in front of the right-seat passenger. Often the pilot's viewing angle is obstructed by a radio stack. Either way, there is no CASA ergonomic test of the operational suitability of the second AH or altimeter. Space must be found or the aircraft cannot be used for IFR charter. The usual result is that there is no way that the unfortunate pilot can safely fall back on the second AH if they have to. It is small comfort to the pilot that the chances of having to use the second AH in IMC are statistically insignificant! Later in this article we shall see the difficulties that can be encountered when the pilot is forced to use the second AH for real. Meanwhile, the following examples show that gyros do fail and, if in IMC, the situation can quickly get out of hand.

Instrument Failure Examples

The opening paragraphs described events leading to the fatal crash of the Mooney M20J. The pilot held a PPL, had a total of 549 hours, and his instrument rating had recently expired. Although no evidence could be found of the pilot having flown in IMC in the previous 12 months, he had flown at night six weeks prior to the accident. A passenger on that flight reported that they did not encounter cloud. In short, the pilot was inexperienced at instrument flying and almost certainly lacked currency on limited panel flight.

In 1955, I was flying a Lincoln four-engine heavy bomber on a night flight from Townsville to Darwin. The Lincoln was a war-time specification based upon the well-known Lancaster bomber. With a crew of seven or more, it was designed to be flown by one pilot. A fold-down seat next to the pilot was available for a second pilot. The anti-submarine and SAR role of the squadron involved long flights, and for these a relief pilot was carried. The flight instrument panel was basic and included one AH and a turn-and-slip indicator – both vacuum driven by engine-driven pumps. The main compass was electrically operated, but there was no back-up electrical power to the instruments.

The instrument layout of a Lincoln MK31 that I flew. Sometimes we flew with one pilot and a navigator, who operated the starboard panel. Note the caging knob next to the AH.

Photograph courtesy of John Laming

The flight proceeded normally until abeam Mornington Island, where the AH toppled without warning. Remedial action, such as the operation of the re-erection caging knob and selection of the alternate vacuum pump from the No 3 to No 2 engine, failed to bring the AH back to life. Fortunately the automatic pilot was unaffected and it was decided to leave it engaged for the time being. Without the AH, I was now down to the 1940s-vintage turn-and-slip indicator. Continuing towards Darwin and now in cloud, the situation was potentially serious, particularly as thunderstorms had been forecast. If the autopilot failed to cope safely with severe turbulence, hand flying on limited panel was the only remaining option. Fortunately I was current and well trained in limited panel instrument flying. The RAAF placed strong emphasis on limited panel skills because most service aircraft only had one AH. Early model artifical horizons were not that reliable and would topple beyond high angles of bank and pitch.

We arrived over Darwin in the dark with an hour remaining before daylight. Fuel reserves were ample and rather than chance my arm at a limited panel IMC night approach, I decided to hold over Darwin until daylight. By then we might see gaps in the cloud cover and let down visually. After an hour of circling, we could see breaks in the cloud and dodging between build-ups, we landed without further incident. My logbook from those times shows several instances of total failures of artificial horizons in both IMC and VMC (Visual Meterological Conditions) – all of which resulted in happy endings, which I attribute to good training on the RAAF pilots' course.

More recently I have been involved in Boeing 737 flight simulator instructional duties and general aviation instructor flying. In common with most airliners, the B737 is equipped with a third or standby artificial horizon (ADI). For this reason it does not have a turn coordinator. The captain and first officer have a primary ADI on their respective instrument panels, with the standby ADI in full view of both pilots in the centre panel. Various caution devices alert the crew to failures of these instruments or their power sources. Limited-panel flying is practised in the simulator using the standby ADI, and is generally easier than flying a light aircraft on just the turn coordinator.

I was to confirm this observation during a recent dual IFR trip in a Cessna 172.

While the student was taxiing I noticed that the turn coordinator damping mechanism was over-sensitive. In the air, even slight turbulence would cause the instrument to oscillate wildly and it was obviously marginal for accurate instrument flying. The turn coordinator was electrically powered, and when the master switch was turned on the power failure flag stayed on until the glass face was lightly tapped. This meant that a power failure may not cause the failure flag to operate. I made a note to enter these defects in the maintenance release (or Technical Log in New Zealand) on our return.

During an NDB (Non-Directional Beacon) approach, the student (who was under the hood), remarked that the AH was indicating a left climbing turn while the turn coordinator was showing a right turn. Reference to the other flight instruments indicated that the aircraft was in a righthand descending turn, and as the aircraft had just emerged from cloud, the right turn was confirmed visually. Although the AH was fitted with a gyro warning flag, this did not appear. Later it was found out that the AH gyro flag was only actuated by low vacuum – not by any internal failure within the AH, which in this case had occurred. The Pilot's Operating Handbook for this aircraft made no reference to the presence of a gyro failure flag as an integral part of the AH.

It was fortunate that the flight had just become visual as the AH failed. The inoperative AH coupled with an unreliable turn coordinator, could have proved a fatal combination in IMC or at night. We flew home VFR and the defects were logged in the maintenance release. Enquiries revealed that not only had the AH failed on previous flights, but the pilots concerned had deliberately failed to record these defects in the maintenance release. I had been left holding the baby because of their complacent attitude.

A few months later I acted as safety pilot during simulated instrument flying practice in a Baron B58. A second AH had been fitted to meet IFR charter requirements. This AH was placed on the righthand instrument panel and was partially blocked from the view of the pilot by the radio stack. In order to use it, the pilot was forced to lean well to the right and in front of any occupant of the right seat. From the pilot's normal seating position, there was a parallax error of around 60 degrees when viewing this instrument. I had seen many similar installations in Navajos, Senecas and Barons.

During the taxi, the turn coordinator continued to show a turn after the aircraft was lined up and stationary on the runway. This fault was confirmed during airborne manoeuvres. We found that the electrically operated elevator trim and automatic pilot were inoperative. During flight beyond 10 miles from the station, it was not possible to obtain any ATIS (Automatic Terminal Information Service) on the ADF (Automatic Direction Finder) or ANT (Antenna) position of the radio compass. The ADF needle also had significant lag. The HF (High Frequency radio) was also inoperative. Despite all this, the maintenance release was a clean sheet. The aircraft had flown 25 hours since the last 100-hour inspection. Whoever had flown this aircraft previously had failed to enter these defects in the maintenance release.

Part of the flight sequence included covering the pilot's AH to simulate instrument failure. The pilot then attempted several turns by leaning well across the cockpit and using the second AH on the right-side instrument panel. These were unsuccessful, resulting in flight well outside instrument rating limits. The difficulty was that, while the pilot could scan the ASI, VSI, DI and altimeter which were in front of him, he became quickly disorientated when forced to split his instrument scan to include the second AH way out of his field of view.

Because of the difficulty experienced by the pilot in using the second AH, he decided to switch his scan to the turn coordinator as primary reference. The main AH was still covered up to simulate an inoperative instrument. Accurate instrument flying became impossible because of the already faulty turn coordinator, which was slow to recover from turns. Fortunately the conditions were VMC and there was no danger of loss of control. Somewhat disturbing was the fact that this aircraft was touted for IFR charter. Really disturbing was that after landing, the pilot elected not to record any of these defects in the maintenance release. By now I was beginning to get the message that in general aviation the recording of defects appears to be treated in a cavalier fashion.

The AH as viewed from the lefthand seat of a Baron B58. The parallax error associated with its position is very apparent; being partially obscured by the radio stack does not help either.

Photograph courtesy of John Lanning

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... continued from page 4

Some Considerations

Pilots

Pilots intending to fly IFR should be aware of the dangers inherent with IMC flight on limited panel. Loss of a vacuum pump, leading in turn to loss of the AH and possibly the DI, is a serious emergency even to the most experienced and current pilot – military or civilian trained. It is bad enough to have to fall back on a turn coordinator in IMC or at night. At least it is situated directly in front of the pilot. On the other hand, any attempt to fall back on the second AH, more often than not installed well out of direct view of the pilot, may paradoxically, be more hazardous than use of the turn coordinator. If the turn coordinator is also not serviceable – and this includes unstable operation due to poor dampening, slow erection from turns, or a sticky magnetic failure flag, then in IMC the end is near for the charter pilot and his or her unfortunate fare-paying passengers.

Prevention is better than cure, and that means using good airmanship. First, ensure that the flight instruments and their air systems are serviceable before takeoff. This includes checking that the gyroscopic instruments function correctly while taxiing, If they don't, then **do not fly** until they are fixed. On completion of the flight, ensure that any problems associated with the flight instruments **are endorsed** in the maintenance release. This is a legal and moral obligation, which could save the lives of the next occupants of that aircraft. Night IMC is not the most auspicious time to find out that the AH had a problem on previous flights. If the turn coordinator flops about while taxiing or in mild turbulence, then write up the defect. In the event of a vacuum pump or AH failure, the turn coordinator is your lifeline.

Aircraft Owners

As an aircraft owner, ensure that any second AH is installed to a safe ergonomic standard. That applies to fitment of second altimeters as well. Put yourself in the seat of someone hiring your aircraft and faced with a sudden AH or vacuum failure at night in IMC. Was your aircraft safe to fly in that situation – or was it merely legal to fly? If your aircraft has defects reported either verbally or formally in writing, then have them rectified sooner than later. In other words, do not put them off until the next 100-hour check, purely to save costs. Your perceived financial prudence could cost lives.

Summary

While gyroscopic instruments in GA aircraft may be generally reliable, we have seen that vacuum pump life cannot be accurately predicted and to a certain degree is in the lap of the gods. As a pilot, you have no idea of the standard of the last maintenance service, and no idea if the last pilot to fly the aircraft is leaving you a lemon.

It is for this reason that it is important to keep current on limited panel instrument flying. If you cannot afford to practise in a real aircraft then there are excellent simulator programs available for home personal computers. For serious limited-panel handling skills, stick to Cessna 172 or similar PC programs where failure of vacuum systems and the AH can be readily simulated – you never know when you might need these skills. ■

About the Author

Over a 50-year flying career with the RAAF, Australian Civil Aviation Safety Authority and four airlines, John Laming has flown a wide variety of aircraft types including Mustangs, Vampires, Lincoln bombers, DC3s and Boeing 737s. He was awarded the Air Force Cross in 1962 and was later to obtain the rank of Squadron Leader before leaving the Air Force in 1969 to fly as a civilian pilot.

John lives in Melbourne and is a Boeing 737 simulator instructor who likes to write aviation articles in his spare time.

Aviation Safety Coordinator Courses

ATTENTION ALL AVIATION COMPANIES!

Three Aviation Safety Coordinator training courses are planned in July and August 2001. These two-day courses will be held in Dunedin on 12–13 July, Wellington on 23–24 July, and in Auckland on 6–7 August.

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What Is an Aviation Safety Programme?

An aviation safety programme is a formalised and documented plan that focuses on creating safety awareness and reducing accidents. It achieves this through two primary functions, risk management and safety awareness.

The safety programme includes all activities carried out within an organisation in order to maintain and promote safe practices. Such activities will usually include a hazard identification system, an occurrence reporting system, and safety surveys. Awareness will be raised by seminars, videos, magazines, meetings, posters, etc. A good safety programme will stimulate good communication.

A safety programme is a very important part of sound professional work practices. Safety should be very much a part of all aspects of your organisation's activities.

A Safety Coordinator can advise and make recommendations – the authority and instructions for implementation must come from a management level. The success or failure of any aviation safety programme rests at that level.

The first step must be top management commitment to a safety programme.

The CAA can provide formal training for your Aviation Safety Coordinator.

Why Have a Safety Programme?

The short answer is, "If you think safety is expensive, try having an accident!"

You may be insured for direct costs, but the indirect costs of an accident are many times greater. A safe operation could be critical to staying in business.

The benefits are many and include a safer operating environment for employees and passengers, a more cost-efficient operation, and a positive image leading to public confidence and business opportunities. ■

Weather or Not?

The CAA has become aware of an increasing trend for GA pilots to fail to get adequate pre-flight weather information, either by not bothering to get any form of forecast, or by getting inappropriate information for the planned flight. Given the range of services available to obtain this information, and the fact that many of them are free (or very low cost), this is both surprising and a cause for concern. There is also evidence that some weather-related decision-making has not been up to the standard required. The following text outlines some issues for you to consider with respect to aviation weather.

Weather Variation

Something that every pilot can agree on is that our weather is changeable and can be difficult to predict. Weather can vary in a given location over relatively short periods. How many times have you gone to work in fine weather and come home in rain? Weather can also change markedly over small distances, the most obvious example being the difference between west and east coasts. A half hour drive can take you from brilliant sunshine and drought to overcast and drizzle.

It is therefore possible, even on a short local flight, to encounter marked changes in the weather. Such changes can be brought about by rapidly approaching or departing fronts, or by local diurnal effects. Coastal areas in particular can often see areas of low cloud sweep in from the sea, turning clear days into marginal VFR in a matter of minutes. Provided the pilot is being vigilant in monitoring local conditions, this should not prove too big a hazard, since a landing back at the home airfield is usually an available option.

Of greater concern is a cross-country flight. The pilot may be faced with weather that changes en route, and also destination weather that can change during the course of the flight. Have you ever been on a flight where the destination weather was not what you expected when you departed?

Weather Information

There are really only three sources of information for the pilot regarding weather – what the pilot can personally see or observe, someone else's observations, and someone else's forecasts.

The best of these is the pilot's own observations. This is the weather that the pilot can directly relate to – it is here and now, not a maybe, not historical, not someone else's interpretation. The pilot will best appreciate how the observed conditions will affect the desired flight path, aircraft type, passengers and personal minimums. As part of the regular activity cycle, the pilot must be constantly monitoring the weather conditions, both ahead and behind (in case a turn back is necessary). Get used to interpreting the phenomena you can see or feel – cloud, indications of wind, drift, reducing visibility, turbulence – and applying that to your decision-making process.

"Being faced with bad weather – observed, forecast or unexpected – provides one of the sternest tests of a pilot's judgement and self-discipline."

Conditions may well be fine at your departure airfield but be unsuitable down track. At worst, this could put you in a bad situation. Conversely, you might save yourself a lot of precious dollars by avoiding the necessity to turn back half way. Therefore, for any flight that will exceed the distance that the pilot can see from departure airfield, some form of forecast, combined with actual observations both en route and at the destination, is a prudent precaution.

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Weather Forecasts

It is all very well having a look at the weather on the TV news or in the local paper, possibly supplemented by a phone call to someone at your destination. We need, however, to be aware that general weather forecasts are designed for the general public, not aviators, and they do not cover information vital to pilots. Also, they do not cope well with local effects, being general rather than specific. The phone call to the destination is great for confirming the forecast (as long as the person describing the weather knows what they are talking about in pilot terms), but remember that weather can change while you are en route.

Meteorological information tailored specifically for pilots is now freely available through the Airways web site (www.ifis.airways.co.nz) or by using Fax on Demand. It is there, it is free – use it! You can also get NOTAMs at the same time.

MetService is also currently trialling a web site for aviation meteorological information. This site not only contains the traditional GAWX, METARs and TAFs, but also (and this is significant) forecast charts, satellite imagery, weather radar imagery, and detailed area forecasts. This will be a great asset for aviators and should be fully utilised.

Don't forget to obtain the appropriate GAWX forecast as well as TAFs and METARs for your destination and enroute airfields. TAFs and METARs are specific, and will take into account local effects that may affect a given airport and **should not be solely relied upon** for enroute planning. The GAWX forecast gives you the big picture in plain language, and also it gives you essential enroute information not contained in TAFs, including winds for planning purposes (up to 9000 feet), freezing level information, cloud top heights, icing, and turbulence. This information will give an indication of whether your intended route is a practical option.

Enroute Weather Updates

While en route, continually monitor the weather conditions, both through your own observations and from the various reports available. These include ATIS broadcasts and METARs, SPARs or SPECIs broadcast by Christchurch Information or other ATC units. You may also hear weather reports from other pilots. If in doubt, ask. You will not be charged anything for any enroute weather request made to ATC.

Unforeseen Weather

With the best of planning, you may encounter conditions significantly different from those forecast. The accompanying article, "Convergence Zones", by Erick Brenstrum of the MetService, neatly illustrates the dynamic nature of aviation weather in New Zealand and the difficulty in forecasting weather that could be of concern to pilots. In future *Vector* articles we will look at other such weather phenomena that pilots can encounter in New Zealand.

If you do run in to unforeseen bad weather, let someone (preferably ATC) know. The new information may be of immediate value to other pilots, as well as allowing MetService and Air Traffic Services to take appropriate amendment or warning action.

Being faced with bad weather – observed, forecast or unexpected – provides one of the sternest tests of a pilot's judgement and self-discipline. Decision time – press on, divert, or retreat?

One of the problems pilots have in making that decision is that they often ask themselves the wrong question. Being goal-oriented people, they tend to ask *"How can I get to my destination in these conditions?"* rather than first thinking *"Is it a good idea to try to get to my destination in these conditions?"* The first question does not allow for the possibility of diverting or waiting. The decision to press on has subconsciously already been made, so the problem becomes a technical one of *"How do I do it?"* rather than *"Should I do it?"* External pressures, such as passenger demands, can exacerbate this, as can 'get-home-itis'. It is far more likely to get the pilot into difficulty with weather than asking oneself if it is a good idea in the first place. If in doubt, don't press on. Better to arrive late than dead on time!

Summary

Weather in New Zealand is highly variable, a fact of which we are all well aware. Changes can occur rapidly in both time and place. While no forecast can be guaranteed to be 100 percent accurate, the prudent pilot obtains all available information and combines this with personal observation to determine whether a given flight is safely achievable. The pilot then monitors conditions while in flight, again using all available means, to ensure that the flight comes to a safe and comfortable conclusion – even if means changing your original plans. Delays due to weather are an unavoidable consequence of flying GA aircraft in New Zealand. Remember the old adage 'time to spare, go by air', and accept it as a small price to pay for the privilege of flying in this wonderful country of ours. ■

The least experienced press on while the more experienced turn back to join the most experienced, who never left the ground in the first place.

More on Icing

This is the second article in a series of articles that is part of an on-going educational campaign aimed at increasing pilot awareness of airframe icing and its effects.

The lead article in the last issue of *Vector* gave readers an overview of the New Zealand icing environment, the main types of airframe icing, where and how they occur, and what effect they have on aerodynamics. (Try the accompanying quiz to see if you understood and retained what we published then.) This article continues to develop that theme. Specifically, it looks at other types of airframe icing, then at some of the practical aspects of ice avoidance through the identification of conditions that are conducive to icing.

Having briefly discussed clear ice, rime ice and freezing rain in the previous article, we now take up the story with other types of airframe icing.

Types of Airframe Icing (cont)

Frost

Airframe icing can occur any time an aircraft surface has cooled to below zero degrees Celsius and sufficient water exists in the air. This can happen to an aircraft on the ground during a cold night as frost, when water vapour freezes on contact with the cold aircraft surface. We are all familiar with frost covering our car on a winter's morning, and nowhere in New Zealand is immune. While frost does not have the same weight and aerodynamic penalties as true icing, it can act to disrupt the smooth surface and hence the airflow over the wing. This can lead to flow separation and reduced takeoff performance. Just like your car, frost-covered windows can degrade visibility, making navigation and lookout a problem. Unlike your car, it is not that easy to pull over and give the windows a wipe while in flight! It is therefore essential to ensure that the airframe – particularly the wings and tailplane – and all windscreens are cleared of ice before flight. Frost can be carefully brushed or washed off the aircraft. Be careful that the means you use does not scratch surfaces, or on very cold mornings just provide extra water to add more ice!

Frost can also form in flight. It usually occurs when the aircraft

A quick quiz

Without looking at the accompanying text, name the three major types of ice and the conditions in which they are most commonly encountered? Answers on page 11…

has spent long enough in temperatures below zero degrees Celsius to have 'cold soaked' to that temperature, and then encounters moist air. This can occur after takeoff on a winter's morning, or when an aircraft descends into warm moist air after a period at altitude where the temperature was below freezing. It is important to remember that this phenomenon can afflict aircraft being flown VFR in clear conditions just as much as ones flying in cloud.

Snow and Freezing Drizzle

As well as the freezing rain previously mentioned, any precipitation falling on a cold enough airframe has the potential to cause icing. Snow, sleet, freezing drizzle, and a particular form of freezing drizzle called Supercooled Drizzle Drops (SCDD) can all afflict aircraft flying in clear air below the producing cloud mass, as well as within the cloud. Again, aircraft flying VFR are not immune from picking up airframe icing in these conditions. For more information on these phenomena, refer to the *Aircraft Icing Handbook* GAP.

Icing Prediction

The previous *Vector* article noted that the most conducive conditions for icing in New Zealand occur in what are known by meteorologists as 'conveyor belt' conditions. These occur when the synoptic situation causes a stream of relatively warm and moist maritime air to be directed onto the country and lifted, either orographically or by frontal systems.

Such conditions make icing more likely, but they do not help to isolate exactly where the icing will be found, either geographically or in terms of altitude and time. Forecasts of icing conditions are often therefore not particularly specific.

In many ways it is like predicting turbulence. We know intuitively that a strong airflow over mountains will create turbulence somewhere, but it can be very difficult to predict in advance exactly where, and how severe. It is a fairly good bet that most weather systems and conveyor belt flows contain conditions conducive to icing, but the right conditions for icing can be quite localised, and therefore hard to predict. Where cumuliform clouds are involved, the lifetime of a cell producing

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conditions conducive to icing may be measured in tens of minutes, so icing may be limited to temporary periods. Stratiform clouds tend to persist for longer periods and can be more spread out, but the icing layer may be quite thin.

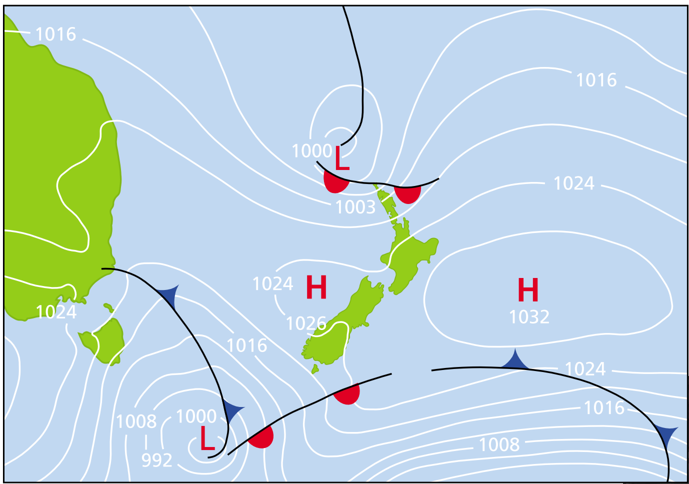
To a large extent this uncertainty about exactly where icing will occur puts the onus on the pilot to vary the flight path where possible, and as required, to avoid situations where icing appears more likely.

Again, the analogy of turbulence can be used. Where an area of likely turbulence is observed – maybe a forming rotor cloud or other such cue – the prudent pilot will alter the flight path to avoid or minimise exposure to the upcoming bumps. In the case of icing, the Outside Air Temperature gauge and a detailed knowledge of the synoptic situation are the best cues to possible icing. Sometimes the only way of knowing where the icing is actually located is to encounter it, or to hear from someone else who has had the misfortune to do so.

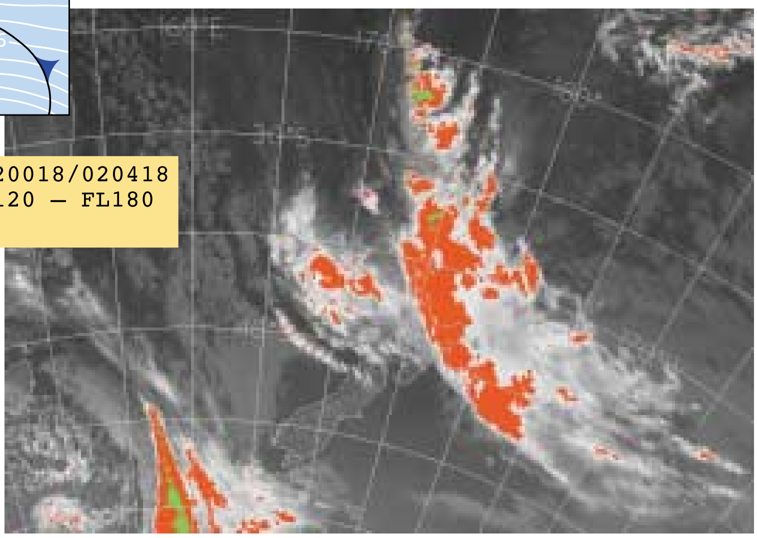
……snow was brushed from the leading edges of the wings and a takeoff was attempted with nearly a full load ... Due to hoar frost on the wings ... A token effort was made to remove frost and ice from the aircraft wings before flight, but water used for this operation froze before takeoff ... The pilot noticed some frost on the wings and tail surfaces before the aircraft was loaded but had not removed it before takeoff ... Dry snow was cleaned from the aircraft, but in the early morning light it was not realised that a layer of ice remained on the wings …....

In every instance, the aircraft failed to get airborne enough to avoid colliding with obstacles. The pilots all held CPLs. Four of the five accidents were to agricultural aircraft of various models, the other to a single-engine air transport aircraft. Three of the five accidents occurred in the North Island.

The lesson is simple. A layer of frost, snow or ice on the wings will adversely affect the ability of your aeroplane to fly.



The satellite image pictured below (at midnight on April 1st, 2001) clearly shows two conveyor belts of cloud over the North Island. The lower level conveyor belt is associated with the northeast surface flow across the northern half of New Zealand (see the accompanying MSL Analysis chart for 1200 UTC, 01-APR-2001). It can be clearly seen on the satellite image flowing out from underneath the higher-level conveyor belt and away to the west and northwest of the North Island. This flow has a long 'fetch' from well east and north of New Zealand, and is very moist. The upper level conveyor belt is carrying moist mid-tropospheric air from the tropics across Northland and Auckland, then away to the east of the North Island across Hawkes Bay. This flow is being forced to rise as it moves southwards across the North Island along the slope of the warm front drawn on the synoptic analysis chart just to the north of New Zealand. As this flow ascends and flows southwards, forced-cooling produces large super-cooled cloud droplets conducive to severe airframe icing (see accompanying SIGMET).



Images courtesy of RNZAF Met Service Ohakea

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NZZC SIGMET 04 011218/011618 UTC OR 020018/020418
NZST NZKLNZFIR ISOL SEV ICING FCST FL120 – FL180
E OF A LINE NZWK/NZNR. INTST NC.
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PIREPs

The best way to warn other pilots about actual icing conditions is to broadcast a PIREP (pilot's report).

This serves the dual purpose of warning other pilots and alerting ATC to the problem. ATC can then assist by giving you routing or altitude changes that can facilitate clearing the icing conditions as soon as practicable. The same service can then be provided to other aircraft to help them avoid the area of known icing. PIREPs help aircraft operators and aviation authorities to form a picture of where icing is most likely to occur, which is something that the whole industry can benefit from.

PIREPs are also passed on to MetService, who will use the information to update weather forecasts, and if necessary issue SIGMETs. Any information pilots can supply about icing they have encountered also serves, over a period of time, to improve the ability of MetService to more accurately predict icing conditions.

Nothing is Ever New

An article in a 1992 *New Zealand Flight Safety Supplement* (the predecessor to *Vector*) contained the following extracts from past New Zealand accident reports:

You must remove the deposit completely before attempting to take off. The removal process must be done carefully to avoid introducing further hazards. If you use water to wash away frost or snow, it can create its own problem; if it does not completely drain away, it can later freeze and the resulting expansion cause damage or control imbalance.

Summary

Frost can form on the ground or in the air, as long as sufficient moisture is present and the airframe temperature is below zero. Precipitation (eg, snow, sleet, and freezing drizzle) impacting on an airframe cooled to below freezing can also form significant icing. In all cases temperature is the key.

Accurate prediction of icing is difficult. It is, however, possible to identify the general synoptic conditions that make icing more probable, and plan the flight accordingly.

PIREPs are an essential tool to warn other aircraft about the presence and location of icing, make ATS aware of your problem, allow MetService to update weather information, and help in forming a picture of where icing is likely to occur. They should be made whenever icing is encountered or suspected.

While airframe icing is primarily a problem for IFR pilots, pilots of VFR aircraft need to remember that they are not immune from it.

Further articles in the series will examine what to do if the worst happens and, despite your best attempts at avoidance, you end up in icing conditions. Recovery techniques from upsets and stalls caused by airframe icing will be discussed, as will airframe certification standards for flight in icing conditions. ■

Answers to quiz:

Hopefully, your answers were:

1. Clear ice – normally caused by large supercooled water droplets in cumuliform cloud immediately above the freezing level.
2. Rime ice – normally from smaller drops that instantaneously freeze on the aircraft and are found in stratiform cloud at temperatures between –10 to –20 degrees Celsius.
3. Freezing rain – where rain from warmer air falls through a cold layer, often associated with cold sectors below warm fronts.

Note that in practice, most icing encounters in cloud will involve a mixture of the two types – clear and rime, leading to what is known as mixed or cloudy ice. To encounter clear or rime ice the aircraft must be in cloud. Freezing rain is normally associated with a reasonably narrow band quite close to a front. Hopefully not too many VFR pilots will get into any of these situations, so they may be excused for thinking that icing is something for IFR operators to worry about. WRONG!

The assistance of Greg Reeve (Meteorologist Ohakea) and NZ MetService staff in the preparation of this article is greatfully acknowledged.

Friendly Fire!

The November/December 2000 issue of *Vector* highlighted the dangers of flying into permanently restricted military airspaces, particularly incursions into the military airspace surrounding the Desert Road VFR corridor, in an article titled "In the Line of Fire". The type of material likely to be flying about was described to enhance pilot appreciation of just how dangerous straying into these areas can be. Subsequent letters to the *Vector* editor suggested that CAA was perhaps being a bit dramatic.

This was not, however, the view taken by a BK117 helicopter pilot transiting the Desert Road corridor last February, when he and his crew suddenly encountered at least three large incandescent parachute flares burning around them, which required evasive manoeuvres to avoid. The pilot reported literally 'feeling' the concussion of the flares as they ignited. A collision with any one of these burning objects and their drogue chutes might have resulted in a very different ending to the flight.

Investigation has shown that the flares were fired by NZ Army personnel from outside of the boundaries of Military Operational Areas (MOAs) M300 and M301 either side the VFR corridor. A full Army internal inquiry is under way as to how this happened.

The immediate lesson is that the dangers in or near a MOA are real, and that when operational protections fail or are violated by any party, the risk of being involved in an incident increases. Hence the need to heed the safety advice given in articles like "In the Line of Fire", even if does not seem immediately relevant to you and the type of flying you do.

To reiterate, be familiar with all the restricted airspace associated with your proposed route, know what the hazards contained within and near them are, navigate accurately, and remain vigilant at all times. ■

New Video

Survival – First Aid

A new CAA safety video entitled *Survival – First Aid* has just been released. This 26-minute video highlights the importance of pilots being competent in first aid, to be able to assist their passengers if injuries are suffered as a result of a forced landing.

Dr Terry Richardson and paramedic Tony Nunan cover essential first aid techniques such as the primary assessment of injuries (ABCs and administering CPR are covered), the recovery position, bleeding control, burns management, and fracture immobilisation.

This video can be viewed in conjunction with two other survival videos in our series, *Survival* and *Mountain Survival*. These video titles, combined with a first-aid and/or survival course, are strongly recommended. You never know when you will need such skills as the pilot in command of an accident situation.

AIP Supplement Cut-off Dates

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

Supplement **Cycle**	*Supplement* **Cut-off Date**	*Supplement* **Effective Date**
01/6	14 June 01	9 August 01
01/7	21 June 01	6 September 01

Convergence Zones

Photograph courtesy of NZ Met Service

In this article, Erick Brenstrum explores the dynamic nature of New Zealand weather and some of the difficulties meteorologists face when trying to accurately forecast weather conditions that affect aviation. Erick provides some detailed examples of how anticyclonic conditions occasionally don't equate to fine weather and trouble-free flying.

Orographic Lifting

The land causes dramatic changes to the weather. The most obvious of these in New Zealand, are the way mountain ranges like the Southern Alps affect the distribution of rainfall. When the prevailing westerlies meet the mountains the air is forced to rise. As it rises, the air encounters lower surrounding atmospheric pressure and consequently expands, which causes it to cool. This cooling (1°C/100 metres) causes water vapour to condense, forming clouds and rain.

Once the air crosses the main divide it descends on the lee side of the ranges. As the air descends, the higher air pressures at lower levels compress it, and consequently its temperature rises and any liquid water droplets in the air quickly evaporate.

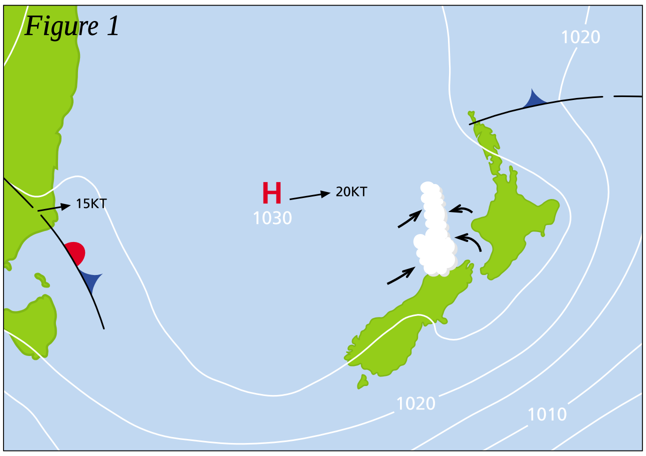
The end result is 5–10 metres of rainfall a year in Westland and Fiordland, but only a third of a metre in central Otago, and just over half a metre along the East Coast. If there were no Southern Alps and the highest part of the South Island was only 100 metres above sea level, then the rainfall would be much the same across the South Island, probably between one and two metres per year.

Converging Airmasses

Another well-known effect of the land on weather patterns is the way the wind is funnelled around the ends of the mountain ranges. This produces far more gales through Cook Strait, near East Cape, and about Puysegur Point at the southern end of Fiordland, than occur over the open ocean at the same latitudes.

Over the last few decades, satellite cloud pictures have revealed more subtle effects than this. For example, after a trough of low pressure has crossed New Zealand and an anticyclone approaches from the west, the air gradually becomes more stable and therefore more resistant to upward motion. Consequently, instead of rising over the Southern Alps, the low-level air splits into two streams that flow around the Alps and then collide on the far side – much like what happens at the beach when a wave rushing up the sand meets a rock. The water parts and goes either side of the rock, then the two wave crests wrap around behind the rock and collide with each other.

In the atmosphere, when the two airstreams collide – or converge – in the lee of the Alps, some of the air is forced to rise, despite being stable, forming a line of cloud and sometimes showers under the eastern side of the anticyclone, where there are no fronts.



MSL (Mean Sea Level) analysis for midday 10 May 1995. Meso-scale cloud band northwest of Buller formed by convergence of low-level wind flow.

An Example

A good example of this process occurred in May 1995. On 9 and 10 May a front crossed New Zealand in a southwest flow. Convergence then occurred in a lee trough west of Buller between easterly winds blowing over the sea between Taranaki and Nelson, and southwest winds coming out of the anticyclone west of Hokitika (see figure 1). Cloud and showers formed in this convergence zone and went on to affect the whole western coast of the North Island over the next two days.

By midnight on the 10th the anticyclone centre had moved to 37 degrees south, the southerly flow through Cook Strait had reversed, and westerly winds were becoming established between Taranaki and Nelson. The area of cloud from the convergence zone then moved eastwards towards the North Island. It crossed the Farewell Spit automatic weather station, where there was a wind change from 330/16 knots to 230/10 knots at midnight. The winds were then 5 knots or less for the next 6 hours apart from 250/21 knots at 3 am. There was 0.8 mm of rain in the two hours up to 5 am.

As the cloud approached Wellington, the radar detected two narrow lines of weak echoes. Conditions at Wellington airport deteriorated at 7 am on the 11th, with two hours of poor visibility and four hours of broken low stratus. The airport had only 0.4 mm of rain, but 1.8 mm occurred in the hill suburbs of Wadestown and Karori.

Further north, Levin had 6.0 mm of rain from 11 am to 2 pm.

Palmerston North airport had only 0.6 mm but they had several hours of poor visibility with a cloud base of 1500 feet from 5 pm to 7 pm.

No rain was recorded at Wanganui airport or at Normanby in south Taranaki. At New Plymouth airport, the tower reported light showers, although without significant visibility or cloud restrictions, and no rain registered in the raingauge. There was a small wind shift at New Plymouth from 300/12 knots to 280/13 knots between 2 pm and 3 pm, but offshore at the Maui platform the wind briefly rose to 25 knots with the change just before 1 pm.

Significant rain did occur at Taharoa, near Kawhia, the next day, with 3.8 mm at 11 am and another 2.8 mm over the next five hours. The wind change there was hard to detect, with a northeast wind of 9 knots becoming calm followed by a 2-knot westerly. By this time the visible satellite picture showed a single line of cloud out to sea but a larger area of cloud over the North Island.

At Hamilton airport a major deterioration occurred at 2 pm on the 12th, with visibility down to 4000 metres and a main cloud base of 1100 feet. The cloud and visibility lowered further, and fog set in by 6 pm. It did not clear until late morning the following day with stratus lasting into the afternoon.

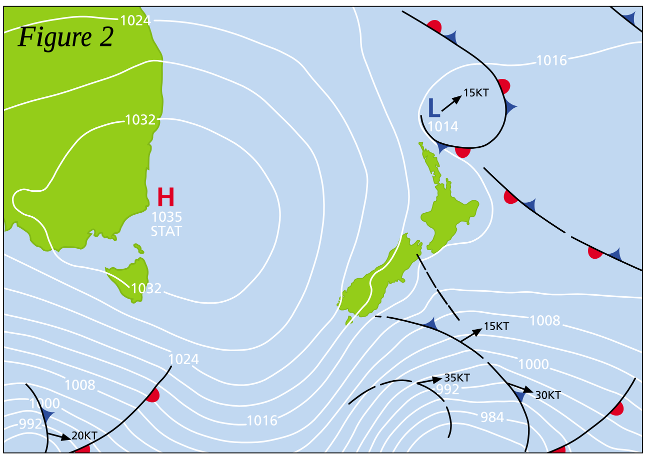
As the cloud line approached Auckland it showed up on the radar as a narrow line of weak echoes. Rainfalls across Auckland were modest, and the airport had no cloud or visibility troubles. At the airport, the wind changed from 290/04 knots to 250/11 knots at 6 pm on the 12th, but the change was stronger over the Hauraki Gulf, where it reached Passage Rock at 7 pm as a westerly of 27 knots.

Among the many interesting features of this cloud band were its long lifetime and the fact that it was confined to the lowest 6000 feet of the atmosphere, with no sign of an accompanying trough in the upper atmosphere. Also interesting were the dramatic variations of cloud base and visibility conditions that occurred from place to place.

A Further Example

Another example of a convergence line affecting Wellington occurred on 28 June 1999, this time with a southerly airstream.

At midnight on 27 June 1999 a large anticyclone was moving slowly east across the south Tasman Sea (see figure 2). A cold front southeast of New Zealand was moving northeast towards the Chatham Islands. A lee trough had formed ahead of the front over Canterbury and had passed Kaikoura by midnight. As the lee trough moved eastwards, a southerly change spread

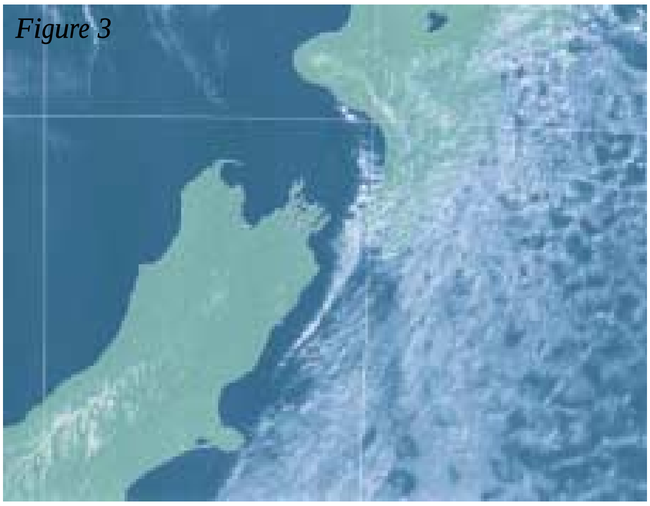


MSL analysis for Midnight 27 June 1999.

up the Kaikoura Coast and reached Wellington airport at 7 am. The southerly was initially dry, as is usually the case with lee trough southerly changes, but by 9 am adjacent showers were reported in the hills to the east of Wellington airport as the air behind the front arrived.

The showers continued about these hills for the next six hours while dry conditions prevailed over Wellington airport and city. During this time the intensity of the radar echoes gradually weakened, and cloud tops warmed as the anticyclonic subsidence inversion steadily lowered.

About 4 pm, however, the radar showed that a line of stronger echoes had developed in conjunction with the line of enhanced cumulus lying parallel with the Kaikoura coastline and about 25 kilometres offshore, as can be seen in the visible satellite image for this time (see figure 3). The corresponding infrared image showed cloud top temperatures as cold as –6°C in the line of enhanced cumulus compared to –1°C further east. This shows that the enhanced cumulus towers in this line had penetrated some way through the subsidence inversion.



Visible satellite picture for 4 pm 28 June 1999, showing line of enhanced shower cloud parallel with the Kaikoura coast.

The southerly flow directed the line of cumulus and their associated showers across Wellington airport and over the city. Total rain over the city was only 2–4 mm, but the light showers were almost continuous for four hours. There was a period of poor visibility at the airport, with 3400 metres being recorded at 6 pm.

The line of enhanced showers formed in a zone of low-level convergence between a straight southerly flow offshore and a southwest barrier current, which developed along the coast as the cold southerly flow blew against the Seaward Kaikoura mountains.

Barrier currents form when a large-scale component of wind is directed towards a mountain chain and the air is forced to rise over the barrier. When the air is stable, the forced ascent is resisted and appreciable deceleration occurs. This leads to a damming up of air against the mountain and consequently an increase in pressure along the windward slopes of as much as 4–8 hPa. This results in a pressure gradient force directed away from the mountains. If such conditions persist for more than a few hours, Coriolis effects become important. The local pressure field will then support a wind blowing parallel to the mountains, from high to low pressure.

On this occasion, the hourly reports from Kaikoura show the formation of the barrier current. The wind at Kaikoura was

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southerly at 19 knots at 7 am, and then tended westerly 13 knots by 9 am. It strengthened to 20 knots and tended back to southwest by midday, and stayed in that direction for the next four hours.

By contrast, during this period the wind at Wellington airport remained southerly, as did the wind at Ngawi, on the southeast tip of the North Island.

The development of the barrier jet contributes significantly to the strong winds experienced through Cook Strait, which lies immediately downwind of the northern end of the Seaward Kaikoura ranges. On this occasion the southerly wind through Cook Strait reached a maximum of 38 knots at Brothers Island at 3 pm.

In Conclusion

So, when frontal cloud, rain and poor visibility clear up and the next anticyclone moves in from the west, beware! There will sometimes be one of these convergence lines bucking the trend to fine weather and making trouble for a few hours. ■

About the Author:
Erick Brenstrum is a MetService lead forecaster with 25 years experience. He has been writing articles on the weather for *New Zealand Geographic* and flight safety magazines for over 10 years and is the author of *The New Zealand Weather Book*.

Letters to the Editor

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

Milford Track

Having recently walked the Milford Track, I would like to acknowledge the efforts being made by those aircraft operators operating Milford Sound scenic flights who have moved in a voluntary capacity to reduce the effect of aircraft noise on trampers walking the Milford.

In particular, the effort being made by pilots to fly higher and further away from MacKinnon Pass and avoid the Clinton Valley in fine weather conditions has been widely appreciated by users of the Milford Track.

We certainly appreciate the continued effort being made by pilots and aircraft operators to seek voluntary mechanisms to reduce the effects of aircraft noise in the Milford area.

Lou Sanson
DoC Southland
March 2001

Vector Comment

It's good to get positive feedback of this nature, especially from an organisation outside the aviation industry. Well done to all those involved in achieving this result – being considerate to the needs of other National Park users is good for our industry. We hope that visiting pilots to the area will help continue this trend – the new GAP on operating in the Milford area specifically covers appropriate noise abatement procedures.

Airmanship Standards

I read your parable "Airmanship Standards" article in March/April *Vector* with interest. Regrettably it looked at only one side of the story. Would it not have been an idea for you to have got some GA input rather than rely solely on what ATC people think about the situation? Because of that, you have come up with some fairly sweeping generalisations. We GA wallahs actually do know something about training pilots you know, and some of us are quite conscientious about our task.

It is possible that RT is not as good as it should be, which I think is more to do with Airways charging for flight plans, SARWATCHs and centralising the Flight Information Service in Christchurch, than some of the reasons outlined in your article.

Since the introduction of charges for flight-following, some pilots are not putting in plans, thereby keeping ever-increasing operating costs within bounds. No flight plan equals no RT calls, which equals possibly reduced RT standards. But even if one does put in a plan, there is no longer a requirement for 30-minute position reports or 'ops normal' calls, which further reduces RT practice. In any case, it is a moot point whether one's backside is covered during a flight at all, since ATC does not know the plane's whereabouts – only that it did not arrive! Further, overworked controllers are so busy on the ether that they sometimes seem to resent being called and sound quite bolshie if they are disturbed. For that reason many new pilots avoid talking to them. This continual chatter on FISCOM frequencies about fairly inconsequential happenings all over New Zealand, means that the chance of getting a MAYDAY (or anything else!) heard is very questionable. So what point is there in talking to ATC?

Many more operators these days are relying on their own flight-following systems – which I think is very wise. 'User pays' and Airways' cost-cutting has undermined what hitherto was a pretty good system. If governments want air safety, they need to recognise that it does not come cheap. At present they don't.

It seems too that over recent years we are required to repeat back just about everything, such that at some airfields a couple of planes in the circuit sounds like 'Biggin Hill revisited'. Contrary to the view expressed in your article, we seem to have gone overboard with RT. Some controllers think that if they are not saying something on the radio they will be summarily 'terminated by the great controller in the sky!' Maybe they need a refresher about 'clipped' RT?

Certainly the other 'problems' alluded to in your missive need attention. Many are nothing to do with RT. If pilots do infringe airspace, use inappropriate language, or commit some other indiscretion, surely a note to them or advice at the time would fix it? Many pilots, like controllers, are on a learning curve even after getting their licence. Controllers can help or hinder that process. Some are very helpful – others are not. Cooperation should be the name of the game.

ASL (Aviation Services Ltd) might well take heed of some of your points and inject exam questions to cover the perceived weaknesses in pilots' knowledge. Training organisations too should pay attention to the deficiencies in airmanship you outline. Field Safety Advisers should advise pilots or operators of observed or reported indiscretions. The now defunct ICARUS was another good way of getting the message across. Flight Examiners need to test these things more closely. And, controllers could help out by advising what should have been done – and they certainly should say a prayer each night reminding themselves that if there were no pilots they'd have no job!

John Clements
North Shore Helicopter Training
April 2001

Vector Comment

Thank you for your thoughts on airmanship standards. You make some interesting and valid points, but we do not agree that they can all be related to the charging regime.

It is true that, as in other parts of aviation, some controllers are not always as helpful as they might be and some incidents do involve controller errors.

Regarding your comment that no flight plan equals no RT calls, this is not necessarily so. Because a procedure is not mandatory does not mean it is not good practice – 30-minute position reports, for instance, can be made whether on a flight plan or not.

Excessive readback does seem to be creeping in with pilots and with controllers.

Vector Content

As a PPL VFR pilot I read with interest the letter by Ian Boag of December 2000.

I disagree totally with his criticism of the magazine. I read widely on matters of aviation practice and safety, and I find Vector a very useful and enjoyable publication. I do not share Mr Boag's enthusiasm for the electronic world. The aircraft we fly and our environment is very little changed by the existence of GPS. The unfortunate reality is the aircraft we fly do hit wires, do sometimes need to be hand swung and are often landed where terrain and weather are not kind. Pilots are fatigued and airspace limitations are complex and changeable.

Keep up the good work Vector team, and I hope that your magazine continues to brighten my mailbox with its arrival.

Doug Lyon
Tauranga
March 2001

Vector Comment

Thank you for the compliments and your thoughts on the relevance of *Vector* articles to current aviation safety issues. We try to cover a wide range of topics in the magazine, and we often try to be proactive in addressing specific safety issues before they result in accidents.

The reason why tie-downs are important!

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Accident Notification

24-hour 7-day toll-free telephone

0508 ACCIDENT
(0508 222 433)

CA Act requires notification "as soon as practicable".

Aviation Safety Concerns

24-hour 7-day toll-free telephone

0508 4 SAFETY
(0508 472 338)

For all aviation-related safety concerns

OCCURRENCE BRIEFS

Lessons For Safer Aviation

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

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

Accidents

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

Some accidents are investigated by the Transport Accident Investigation Commission, and it is the CAA's responsibility to notify TAIC of all accidents. The reports which follow are the results of either CAA or TAIC investigations.

ZK-DIS, Piper PA-28-180, 11 May 99 at 1130, Taumarunui. 3 POB, injuries 3 fatal, damage destroyed. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 81 yrs, flying hours 365 total, 350 on type, 20 in last 90 days.

The aircraft had taken off at about 0900 hours from Omaka, in good weather. The intended destination was Tauranga via Wanganui, Taumarunui and Tokoroa. The aircraft was later observed to be flying low in a south-westerly direction in the Whanganui River valley near Kirikau. It was then seen to make a 180-degree turn close to one side of the valley. Shortly after the reversal turn, the aircraft pitched up abruptly, rolled inverted and dived steeply into dense bush. A localised intense fire ensued. A full report is available on the CAA web site.

Main sources of information: CAA field investigation.

CAA Occurrence Ref 99/1311

ZK-EOF, Cessna 172N, 20 Mar 00 at 1200, Waverley. 1 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 34 yrs, flying hours 368 total, 4 on type, 2 in last 90 days.

The pilot advised his instructor that he intended to conduct a local flight and was subsequently authorised for the detail. During the course of the flight he decided to land at a friend's farm airstrip. He had not been checked into this airstrip or been authorised to do so by his instructor. The airstrip was undulating, which was not evident to the pilot until the landing. Upon touchdown, the aircraft hit an undulation and bounced back into the air. It then landed on its nosewheel, which collapsed, causing the aircraft to flip over on to its back.

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

CAA Occurrence Ref 00/641

ZK-FPL, Piper PA-31T3, 24 Mar 00 at 1020, Taupo. 11 POB, injuries nil, damage substantial. Nature of flight, transport passenger A to B. Pilot CAA licence ATPL (Aeroplane), age 40 yrs, flying hours 8296 total, 425 on type, 95 in last 90 days.

The aircraft landed on runway 18 at Taupo Aerodrome with its undercarriage retracted. The pilot had elected to delay lowering the undercarriage because of parachutists landing at the aerodrome, so he passed over that checklist item during his before-landing checks. He subsequently became preoccupied with the parachutists and did not remember to return to the outstanding checklist action of lowering the undercarriage. The aircraft undercarriage unsafe warning system did not give sufficient warning to alert the pilot in time for him to recover the situation. The pilot's omission is an example of an unintended act that can occur when conscious attention is diverted elsewhere. Defences should be in place to prevent such omissions resulting in accidents. Safety recommendations were made to the operator to reduce the potential for this type of accident to recur.

Main sources of information: Abstract from TAIC Accident Report 00-004.

CAA Occurrence Ref 00/658

ZK-HJN, Hughes 369FF, 28 Mar 00 at 1014, West Arm Manapouri. 5 POB, injuries 5 fatal, damage destroyed. Nature of flight, transport passenger A to B. Pilot CAA licence CPL (Helicopter), age 28 yrs, flying hours 1498 total, 445 on type, 34 in last 90 days.

On Tuesday 28 March 2000 at 1014 hours, ZK-HJN, a Hughes 369FF helicopter, was on a charter flight from Te Anau Aerodrome to West Arm, Lake Manapouri. Approaching to land, the helicopter struck a power line and impacted the ground heavily. The pilot and four passengers on board died in the accident and the helicopter was destroyed. Safety issues identified were the criteria for the marking of wires and overhead structures, and the requirement to expedite amendments to Civil Aviation Rules for wire marking. Safety recommendations were made to the Director of Civil Aviation. Further details are available in the full TAIC report. Addendum to the above TAIC abstract: The pilot was probably concentrating on flying her approach and looking towards the intended landing area and away from the power lines when the helicopter flew around the base turn and struck the conductors.

Main sources of information: Abstract from TAIC Accident Report 00-005.

CAA Occurrence Ref 00/683

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

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

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/1078

ZK-BLV, De Havilland DH 82A Tiger Moth, 19 Apr 00 at 1645, Culverden. 2 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence PPL (Aeroplane), age 51 yrs, flying hours 198 total, 121 on type, 10 in last 90 days.

The pilot had flown from Kaikoura to Culverden and then to an airstrip in the Lowry Peaks Range. While locating the airstrip, the weather conditions quickly deteriorated requiring a precautionary landing. During the turn on to finals the aircraft became out of balance and subsequently stalled at approximately 30 feet agl.

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

CAA Occurrence Ref 00/1188

ZK-DAM, Jabiru SK80 Microlight, 23 Apr 00 at 1420, Te Kopuru. 2 POB, injuries nil, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age unknown, flying hours 239 total, 228 on type, 40 in last 90 days.

During cruise, the engine lost oil pressure, and a knocking sound was heard from the engine. The pilot elected to carry out a forced landing into the nearest available paddock. The aircraft went through a fence before coming to rest. The owner indicated that, at disassembly, the oil pump gears were found to be damaged.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/1166

ZK-DDP, AESL Airtourer 115, 1 May 00 at 0900, Kaitaia. 1 POB, injuries 1 fatal, damage destroyed. Nature of flight, private other. Pilot CAA licence CPL (Aeroplane), age 25 yrs, flying hours 577 total, 80 on type, 43 in last 90 days.

The aeroplane was on a private flight in the vicinity of Kaitaia. In the last few seconds of the flight the aeroplane was seen in a vertical climb, which was followed by a manoeuvre resembling a stall turn to the right, and an almost vertical dive towards the ground. The height at which this manoeuvre occurred precluded recovery before the aeroplane struck the ground.

Main sources of information: CAA Field Investigation.

CAA Occurrence Ref 00/1179

ZK-RES, British Aerospace Jetstream Series 3200 Model 3201, 18 May 00 at 0905, Wellington. 11 POB, injuries 1 minor, damage nil. Nature of flight, transport passenger A to B. Pilot CAA licence ATPL (Aeroplane), age 35 yrs, flying hours not applicable.

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

Main sources of information: Accident details submitted by operator.

CAA Occurrence Ref 00/1988

ZK-JKK, Solo Wings Windlass Aquilla, 15 Jun 00 at 1600, Katikati. 1 POB, injuries 1 serious, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age 29 yrs, flying hours 47 total, 47 on type, 31 in last 90 days.

The microlight sustained an in-flight structural failure, became inverted and subsequently crashed in an avocado orchard. The student pilot was performing manoeuvres that were outside the structural limits of the aircraft.

Main sources of information: CAA field investigation.

CAA Occurrence Ref 00/2015

ZK-XIK, Micro Aviation B20 Bantam, 9 Jul 00 at 0930, nr Feilding. 1 POB, injuries 1 serious, damage substantial. Nature of flight, private other. Pilot CAA licence nil, age unknown, flying hours 500 total, 1 on type, 4 in last 90 days.

In cruise flight, the engine suddenly lost rpm, then stopped a few seconds later. The pilot selected a paddock for a forced landing, but at about 60 feet agl the aircraft's rate of descent increased and the undercarriage clipped the top wire of the boundary fence. The aircraft slewed to the right, and the cockpit area struck a concrete post. The aircraft had been refuelled from a drum of fuel that had not had 2-stroke oil added; the engine seized because of lack of lubrication.

Main sources of information: Accident details submitted by pilot.

CAA Occurrence Ref 00/2261