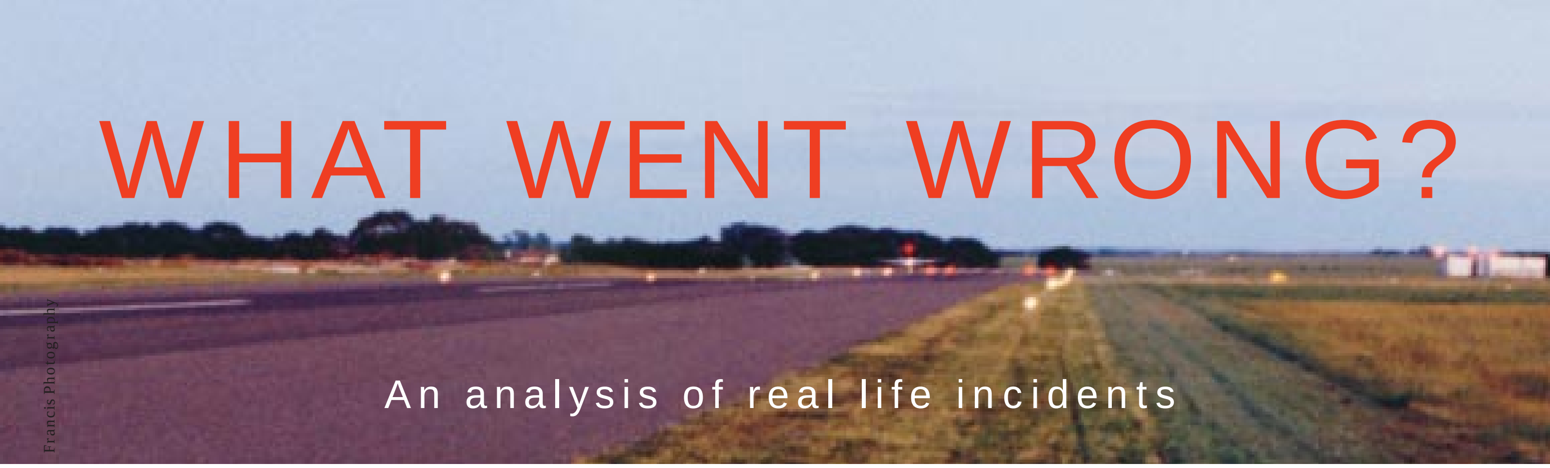


VFR nightmare

A fatal chain of events leads to disaster for a night VFR flight.

RUTH KING

PICTURE THE EVENING OF 10 October 1995 at Warrnambool Aerodrome, Victoria, a private business flight under night VFR.

The night-VFR-rated private pilot was legally current, but his night flying experience was low. He was known as careful and conscientious, certainly no cowboy. He departed Moorabbin at 8am that day, collected his 2 passengers from Melbourne Airport, and flown to Warrnambool, intending after the day's business to return to Moorabbin.

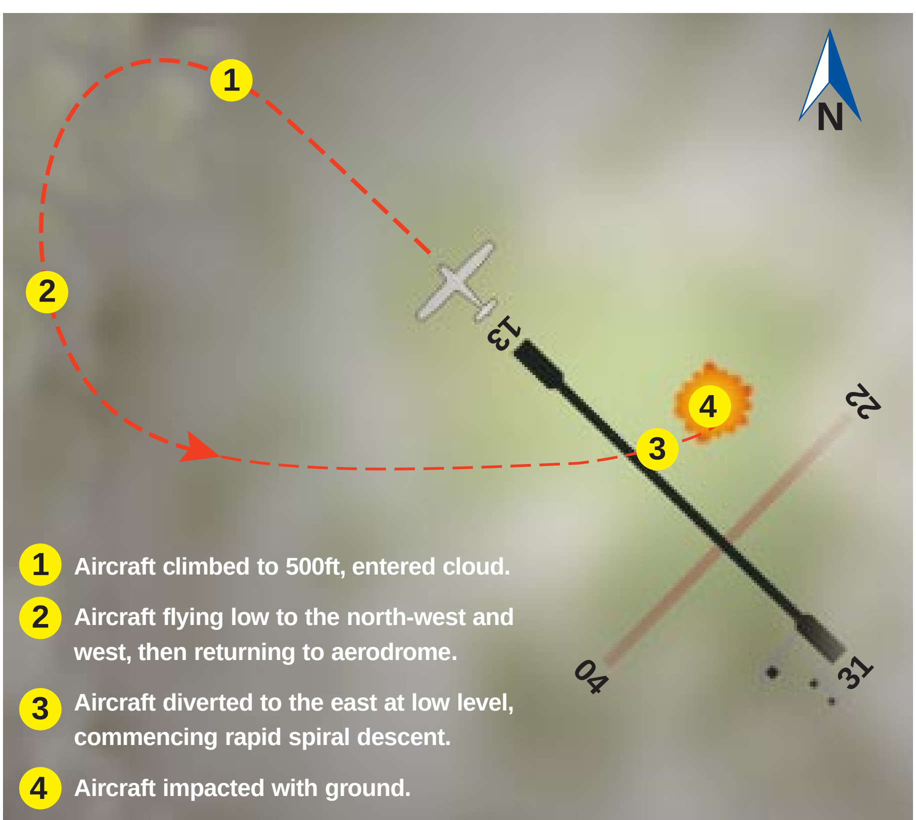
After getting a detailed weather briefing by telephone, he decided conditions were OK for the return flight – provided he departed before the arrival of a forecast front.

The single-engine aircraft crashed shortly after take-off at about 7.50pm EST, killing the pilot and his 2 passengers.

Pilot error? Yet another night VFR accident. "Pilot error" again? This diagnosis is strangely comforting, removing the element of fate, and distancing the accident from the rest of us.

Yet most accidents are the result of a chain of decisions and actions, rather than a single fault on the part of the pilot. At what "link" would you have broken the fatal chain?

Put yourself in this pilot's situation and assess yourself as pilot in command.



Decision chain: It had been a long day. Commercial pilots can only be rostered for 11 hour tours of duty, maximum. Are private pilots less prone to fatigue? A degree of fatigue was probably involved, and that affects decision making. What would you have done?

Let's look at the weather. The accident report says, "Conditions in the circuit area were very dark with limited ground lighting, high overcast cloud, some low cloud and patches of drizzle". The pilot should not have taken off with these actual conditions. You can't necessarily see clouds at night. Sometimes you don't know they are there until you are in them.

At night, a pilot must be guided by the forecast, and what limited observations can be made at the departure aerodrome in the dark. In fact, AIP OPS 1.2 states that "CHTR, AWK and PVT operations under the VFR at night must not be conducted unless the forecast indicates that the flight can be conducted in VMC at not less than 1,000ft above the highest obstacle within 10nm either side of track". What would you make of these same forecasts if you were in these circumstances?

TAF YWBL 100044Z 0214 34016KT 9999 -RA 6AS100
FM08 25013KT 9999 RA 3ST012 5SC020 6AC100
INTER 0814 5ST010

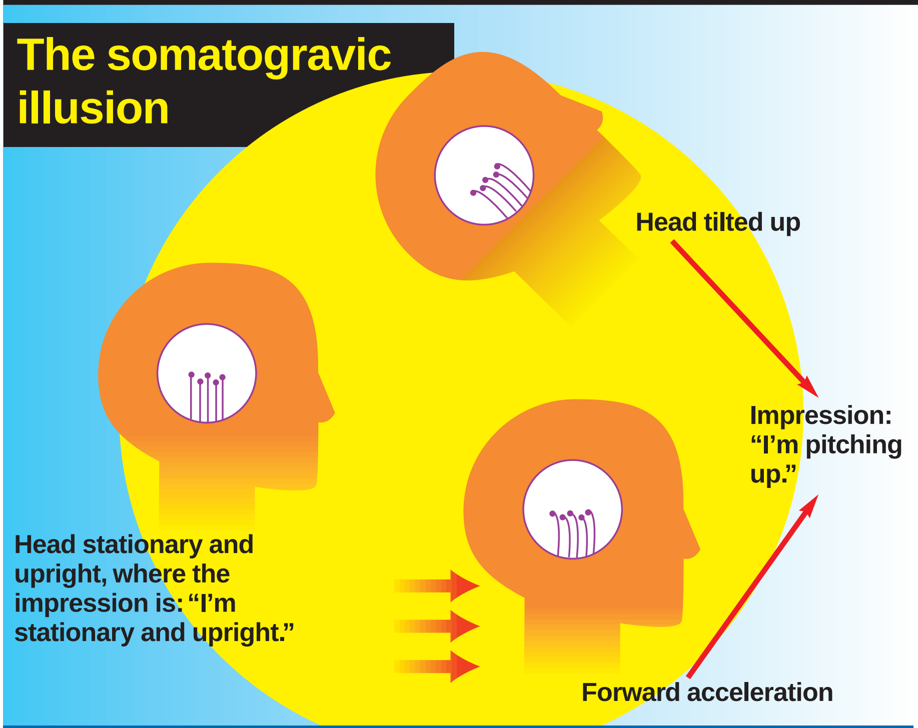
AMEND ARFOR 100400 TO 101700 AREAS 30/32

AMD CLOUD:
(E of trough):SCT SC 5000/8000 IN RA. BKN ACAS AREAS 12000/20000, SCT IN FAR NE BUT BASE 8500 VCTY TROUGH
(W of trough):SCT ST 1000/2000 LOC BKN SEA/COAST AFTER 11Z. BKN SC AREAS 2000/4000. BKN ACAS 8500/20000, CLEARING 60 NM W OF TROUGH

AMD VISIBILITY:
6 KM IN RAIN, 3000 M DZ

WEATHER:
(E of trough):PATCHY RAIN CHIEFLY S OF DIVIDE WITHIN 150 NM OF TROUGH

(W of trough):ISOL DZ COAST/SEA FROM 11Z. PATCHY RA CLEARING 60NM W OF TROUGH



As an aeroplane accelerates forward after take-off, the somatogravic illusion results in an overwhelming sensation of pitching to a high-nose attitude. The illusion is produced by the otolith organs in your ears which sense orientation.

Obviously, it all hinges on where the front was likely to be at the time of departure (about 0950UTC) and during the course of the flight. The pilot had advised the briefing officer that if he could depart quickly, he would be ahead of the trough. The pilot's night flying experience had not included any marginal weather flying. The second link in the fatal chain.

The third link was the desire to get home. This can be strong enough for anyone to lose their objectivity about the weather or their level of fatigue. How badly would you have wanted to go? Would you have been prepared to make a decision to stay on the ground?

Front: Unfortunately, the departure from Warrnambool occurred just as the front was passing.

Witnesses say they heard and saw the aircraft flying low to the north-west and west not far from the aerodrome.

At least one witness saw the aircraft disappear, consistent with it entering cloud. The pilot turned left soon after take-off and returned to fly back over the lighted runway at about 500ft. The aircraft then diverted to the east, commenced a rapid spiral descent to the left and crashed, bursting into flame.

Why did the pilot turn back? If, after climbing initially on instruments, he looked out at 500ft to find himself in cloud, it could have been quite a shock. Had the pilot anticipated this happening? What would your first reaction be in this situation? Would you continue climbing to LSALT on instruments? Then what? You can't do an instrument approach: you are not instrument rated.

Should you track overhead the NDB on instruments and set course as per your flight plan, confident of becoming visual as you leave the trough behind? That would be the safest option – but only if your instrument flying skills are up to it. But your night VFR training has probably included only limited instrument flight.

Plus of course it is illegal: you are supposed to be flying visually. The "I must stay out of cloud" mindset is likely to prevail. The decision the majority of pilots seem to make is to descend to become visual – and hope there is no terrain in the way. The fourth link in the accident chain.

From a position roughly downwind for runway 31, at about 500ft, the pilot should have had some good visual cues. The runway lights were on. He was now flying towards the lights of the town; assuming they were not obscured by low cloud or drizzle. A safe low-level circuit may have been possible.

So why did the aircraft spiral into the ground? Two significant factors have been proposed in the BASI report on the accident: disorientation and pilot incapacitation.

The textbook, night VFR take-off accident involves what is known as the somatogravic illusion – a failure to tell the difference between forward acceleration and pitching upward. While this accident was not a result of this illusion, it is useful to briefly look at the issue.

The source of the somatogravic illusion is the otolith organ which senses head tilt and linear motion.

Picture a little fluid-filled bag in your ear, with hair-like projections from the walls into the fluid. On the ends of the hairs are little rocks. When your head is upright and at rest, the hairs are also upright, and send a signal to your brain which you have learned to interpret as "head upright and still". If your head tilts upward, the pull of gravity on the little rocks bends the hairs back. The signal sent to your brain is interpreted as "head tilting up" (*see diagram*).

However, a forward acceleration will also cause the rocks to pull the hairs back, sending exactly the same signal to your brain. If you are flying in the dark or in cloud, your brain simply cannot tell the difference.

As an aeroplane accelerates forward after take-off, there is an overwhelming sensation of pitching to a high nose attitude. Your urge is to lower the nose. If you push the stick forward, the aeroplane accelerates more, increasing the pitch-up sensation, so you push the stick forward more.

The classic somatogravic accident results in a crash shortly after take-off, more or less off the end of the strip. The best way to prevent it is to maintain the right take-off and climb attitude using the instruments. In other words, provide a visual reference from instruments to overcome the incredible urge to push the stick forward.

> **"So why did the aircraft spiral into the ground? Two significant factors have been proposed in the BASI report on the accident: disorientation and pilot incapacitation."**

Incapacitation: It is true that the somatogravic illusion has killed many pilots at night, and given a scare to countless others. In this accident, the loss of control occurred when the pilot probably had reasonable visual reference to ground lighting in level, unaccelerated flight. In nearly all cases of loss of control due to disorientation, there is some attempt to correct the unusual attitude prior to impact, even if the attempt is wild and inappropriate. Not so in this case; the plane simply spiralled in and impacted at a very steep nose-down attitude.

This points to some form of pilot incapacitation. The autopsy showed significant coronary artery disease, which in the pathologist's opinion was "an adequate cause of death due to sudden arrhythmia".

The coroner considered that the level of stress which resulted from being in weather the pilot was not equipped to handle could have triggered a heart attack given the pre-existing heart disease, particularly if he had become disoriented at some stage in the flight, and panicked. The fifth link.

The coroner concluded that the pilot should not have attempted the flight in the prevailing weather conditions.

Training: The pilot's decisions and actions must be examined in the context of his training.

The night VFR rating is attained after a minimum of 10 hours instruction. It was introduced mainly to enable pilots to begin or end flights after dark, rather than for whole flights at night.

A pilot who wishes to fly extensively at night, particularly for business, should get an instrument rating, rather than push the night rating to limits for which it was never designed.

The requirements for recency can be a problem. Does your night VFR "recency" consist of a 1-hour annual flight around a metropolitan area, to return for 3 take-offs and landings at your familiar, well-lit city aerodrome?

Would this equip you for the sort of conditions and critical decisions faced by the pilot at Warrnambool that night?

What can we learn from this incident? Here are some fundamental points we should all keep in mind:

- Have a realistic personal limit for flying and "duty" times and stick to them.
- Be pessimistic in your interpretation of changeable weather, not optimistic. Avoid deadlines.
- Brief passengers before the day to exclude last minute pressure to "go".
- Brief yourself prior to take-off on actions in the event of inadvertent cloud entry.
- Obtain instruction in marginal weather operations – then avoid them.
- Understand the somatogravic illusion and adhere to correct instrument technique.
- Recognise the potential effects of panic and stress, and avoid situations where you would be out of your depth.
- Ensure that you are current in all aspects of a proposed flight.
- Be prepared to make the hard decision not to "go".

Ruth King is a commercial pilot and aviation ground instructor. She is the author of a range of aviation theory books and teaches ATPL theory for the Australian College of Aviation, Moorabbin.

Fuel containers ignite

MOST PEOPLE WHO FLY ULTRALIGHT OR GA aircraft, have been exposed to the hazards of transferring fuel.

Before I left home to go flying recently, I decided to transfer standard unleaded fuel from one plastic fuel container (approved type) to another of the same type.

The day was a warm 25°C, with humidity at 65 per cent. I was in the shade – not exactly what you would call ideal static generating conditions. Suddenly – *whoomph!* – instantaneous combustion. Result: 2 burning containers plus myself from the knees down.

Fortunately I carry 2 BCF fire extinguishers in my aircraft trailer, the door of which happened to be open at the time.

So the "inflammable man", mumbling "stay calm" and "kill the source" ran for the trailer and grabbed one of the extinguishers (mounted at the rear of the trailer, just inside the door) and with 3 squirts put out the containers and my burning legs.

–Name withheld by request.

PM Photography

Make sure when you are using plastic or metal fuel containers that you have them appropriately earthed. For plastic containers, ensure they are conductive and are of the approved type.

ANALYSIS

The importance of voltage

WE ALL KNOW THAT THE LITTLE DEVICE screwed into the engine cylinder head has the all important function of igniting the fuel/air mixture in the cylinder; it provides a gap where high voltage from a coil or magneto is induced to spark across.

Unfortunately, nature can provide the same high voltage source: if there is the right kind of gap present during refuelling, then you risk ignition of the fuel.

In the same way that a comb brushed through dry hair produces static electricity, so does fuel sloshing around in a container. If the container is made from non-conductive material, for example, plastic or fibreglass, the static electricity can build up to a high charge.

Current flow: The problem arises when the fuel in a container of high electrical charge comes close to something of a different charge – that is, there is a "potential difference". Electrical current will flow if it gets a chance.

If a solid electrical conductor is provided, such as an earthing strap, then the current will flow safely from one body to another.

However, if there is no conductor, and there is a big enough difference in the electrical potential, then the a spark can bridge the gap.

And if there is enough fuel-air mixture around, you risk ignition.

It is not hard to reduce the risk of fuel igniting.

You should consider:

- Sparks are only a problem when a fuel-air mixture is present.
- Metal and other conductive containers will reduce electrostatic build-up. If you must use a plastic container, make sure that it is one of the conductive types.
- Before you move fuel from one container to another, you should connect or touch the conductive bits together first in an area that is not surrounded by fuel fumes – that is, connect the earthing straps before taking the caps off.
- If possible, have everything at the same electrical potential as the ground - that is, earthed to a ground spike.
- Minimise sloshing or splashing when moving fuel.
- Just in case all these precautions fail, have an effective fire extinguisher handy.

–Aussie Pratt, airworthiness inspector, CASA

A CLOSE PASS

Rob fox

A Tiger Moth and a Cessna 172 come within 75ft of a disastrous collision, reinforcing the need to "see and avoid".

THE VALUE OF A CLEAR AND concise message transmitted, received and understood was never more aptly demonstrated to me than when I became involved in an incident that could have cost 5 lives.

Just over 6 months ago, I was pre-flighting a Cessna 172 at a Victorian country airfield before taking my brother-in-law and the 10-year-old son of his best mate up for joy ride. The weather was fine, though slightly foggy.

The airport has a 17-35 grass strip of about 800m and 08-26 grass cross strip of just over 400m. Soon after completing the check, an ultralight trike took off on runway 35 into a wind I estimated to be from about 020 degrees at 5-6kt.

The trike returned after completing a circuit, landing on the same strip. Shortly after, I loaded my passengers and took off on runway 35.

About 20 minutes later we returned. I gave an "all stations" call 5nm south-east and inbound on the local CTAF, then overflew the strip, advising "all stations" that I was joining the circuit on the downwind leg for 35.

When flying across the departure end of 35 during my descent to circuit height, I noticed 2 ultralights and a Tiger Moth parked outside a hangar located in the south-west corner of the field between the western end of the 08-26 strip and the southern end of the 17-35 strip. The sight of these 3 aircraft was of only cursory interest. Turning on to base, I gave a further call and set the 172 up for landing.

The threshold of strip 35 on which I was approaching was displaced about 100ft to ensure landing aircraft overflew the main road on the southern boundary at a safe height. On my approach, I planned to touch down between the displaced threshold markers. Despite full flap and jockeying the throttle, I realised on short final that I wasn't going to drop it in where I had planned. I then aimed to touch down at the intersection of runways 17-35 and 08-26 some 100ft further in.

> "Fighting to control the 172, I pushed the nose down to maintain airspeed as the Moth took-off to my right and climbed away."

Sudden movement: While I was crossing the fence at 60kt and about 40ft above ground, a sudden movement on runway 08-26 to my left caught my eye. To my amazement, I recognised the Tiger Moth I had seen parked outside the hangar crossing my path, its tail up, in the final stages of a take-off run.

Instinctively I lifted the nose of the 172 to give myself clearance, washing off speed in the process. Fighting to control the 172, I pushed the nose down to maintain airspeed as the Moth took-off to my right and climbed away.

At this point I was coming dangerously close to minimum flying speed. Sinking rapidly, I applied full back stick and touched down with a small bounce.

I braked sharply, vacated the runway, taxied in and parked the aircraft. On alighting, I noticed half a dozen onlookers, all ashen faced and silent, having just witnessed the closest pass between 2 aircraft that I hope they ever have the misfortune to see.

After making my feelings known and collecting a few facts, the reasons I nearly came to grief are all too clear to me.

The pilot of the Tiger Moth elected to use a runway that was not in use by other aircraft on the field and for which the wind direction was appropriate under the circumstances.

In doing so, he began his take-off roll behind a hangar which obscured his view of the final leg of the circuit of the active runway. His first view of anything coming in to land would have been when he was within 50ft of the intersection of the two runways, with no hope of stopping.

I think that the major cause of this incident was that his aircraft did not have a VHF radio, so he could not broadcast his intentions. More importantly, he could not maintain a listening watch for other aircraft conforming with normal movements on the airfield.

To his credit, the pilot did a tight circuit and returned immediately to the strip offering his unreserved apologies – which I accepted.

– Alan Young.

ANALYSIS

See and avoid

THE CESSNA PILOT ARGUES THAT THIS incident demonstrates a necessity for all aircraft to be fitted with VHF radios. This is an understandable reaction, and one no doubt shared by many pilots. Nobody would disagree with the need for good communications, or the value of using radio to alert other traffic.

The Tiger Moth pilot was within his rights in operating without radio in the CTAF. Anyone who has taxied a Tiger would understand his decision to take-off on the closest runway, given the light wind conditions. But in doing so, he was likely to conflict with other aircraft that could be expected to use the longer runway.

He appears to have started his take-off from a position where it would have been difficult for him to see the approach to runway 35, and for the Tiger Moth to be seen by the Cessna. Under the circumstances, we might expect that he would have taken extra care.

The fact is that both pilots failed to "see and avoid".

Civil Aviation Regulation 163A requires all flight crew, both IFR and VFR, to "maintain vigilance so as to see, and avoid, other aircraft".

Most pilots today learn to fly in an environment where the use of the radio is commonplace. Operation of the radio, particularly during training, can place great demands on a pilot, to the extent that there is a danger of over-emphasis on the use of radio as a means of avoiding other aircraft.

Radio is not enough: I recall an incident at my home base, a busy CTAF, when a Piper Navajo passed over the top of a C172 at the intersection of the two runways. Both aircraft were radio equipped, carried instructors on board, and had broadcast their position in the circuit. Radio did not prevent that incident. It may have even contributed to the incident, as both pilots had made contact by radio, and falsely believed the other to be clear.

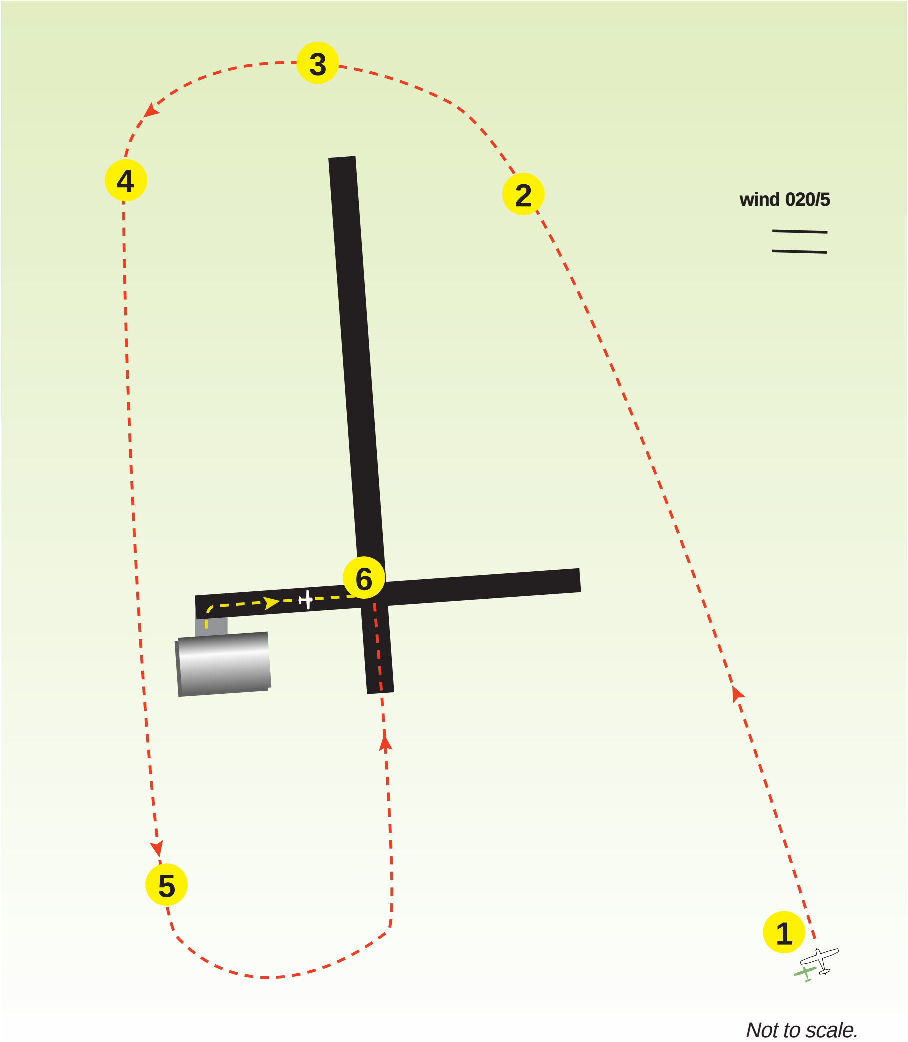
At a CTAF, pilots of radio-equipped aircraft are required to broadcast while taxiing and before entering the CTAF. Additionally, AIP OPS 46.2.3 states that "position in the circuit should be broadcast if considered of value to other aircraft for separation purposes". The Cessna pilot was doing all the right things.

What he failed to consider was that despite making numerous calls, he could not assume that other aircraft had received and understood, or that a lack of response indicated that there were no other aircraft in the area.

Where winds do not require particular runway direction, pilots need to be especially alert for the possibility of traffic on other runways. It is always good airmanship to conform to the circuit pattern established by other aircraft.

Radio is a tool that greatly enhances our ability to avoid other aircraft. Despite our increasing familiarity and dependence upon radio communications, all pilots inside and outside controlled airspace need to be aware that radio will never relieve pilots of their responsibility to see and avoid other aircraft.

– Bob Kennedy, chief flying instructor for Aircraft & Marine Services, Caloundra, Qld.



1. Cessna reports 5nm SE, inbound.
2. Overflies; joining downwind for 35.
3. Crosses threshold of 17 to join the circuit, notices Tiger Moth parked outside hangar.
4. Cessna joins downwind.
5. Turns base, makes call.
6. At 60kt, 40ft AGL, sees Tiger Moth on take-off roll directly in front of him.

EXPERIENCE COUNTS

PM Photography

Fudging log book hours leads to trouble.

SOME TIME AGO I RETURNED FROM a visit to one of the company bases to check on an operation and get some hours in my log book.

Word soon got out of my arrival, and I found myself seated with friends at the hotel bar. The talk got round to a pilot of ours who had just been employed by another carrier. Rumour had it that another 500 hours had been added to his logbook since he left us a month before. I do not know how true this was because the carrier didn't bother calling to check on his previous employment record.

One of the mechanics said, "The two-crew structure will sort him out. At least he won't kill anyone while he learns how to fly". I had to disagree, knowing from experience how the two crew environment can sometimes fail to sort out inexperienced pilots.

Images of a captain I had flown with flashed through my mind and I became detached from the conversation.

Pencilled in: I always knew this captain had pencilled in extra hours into his log book. It was obvious when you compared his "war stories" to his employment record. Everyone knew he was the best captain we had – all you had to do was ask him. But the reality was different, as became apparent when incorrect power settings were set, or when there were arguments over which gauge showed NI power.

I recall one time when we were to track outbound from Frankfurt to Berlin on the localiser through the south corridor.

The needle went right of centre, and the captain proceeded to turn the aircraft right. He couldn't understand why the needle drifted off further and further right. I tried to explain that we were following a back course localiser, and that we needed to steer the aircraft left to avoid flying outside the corridor.

Of course, there was no way he would listen to a young first officer. He proceeded to twist the omni-selector and try to centre the needle to find out exactly which radial we were on, and see how close we were to the corridor boundary. When the needle did not move he smirked at me – assuming that I was wrong again – and ordered me to get the maintenance release so he could write up the instrument.

I stared at him, not knowing how far he would go. On the one hand I wanted him to write it up so that everyone would know what I had to put up with; on the other hand, I felt I should explain to him some features of a localiser.

So with a pen and paper I did a diagram of our situation. I thought by showing him the two lobes of a localiser, and demonstrating how it was impossible to centre the needle without actually being on track, would be sufficient.

I don't know, because Berlin Centre piped in with "Clipper 1202, turn left to a heading of three-two-zero degrees, you are about to enter East German airspace and safety of flight can not be assured". We continued on to Berlin normally, dialling up the Tempelhof VOR while observing an unusually sterile cockpit for the rest of the flight.

– Name withheld by request.

ANALYSIS

Professional responsibilities

THIS STORY HIGHLIGHTS WHAT'S WRONG with the culture that exists in some aviation circles. Pilots who doctor their hours act in an unprofessional and immoral way.

In Australia, they are in breach of Civil Aviation Regulations 283 and 5.52. Log books serve a purpose – they indicate experience in terms of operational context and hours flown. It is an offence to make false entries. Fudging hours is dangerous – minimum requirements are in place for safe practice.

Organisations should ensure that measures are available to check for differences between log books and other documentation. At the very least, employers should check work history.

Perhaps the culture acts against dobbing people in. But what about professional responsibility? Anonymous reporting systems and crew resource management programs may provide this solutions necessary.

A frightening aspect of this story is the assessment and evaluation processes that allow a pilot with such a blatant lack of understanding and integration of knowledge to progress through the system.

Flight training: I don't think that this would be an isolated case, when you think about how flight training is based on the repetition of facts about procedures.

Yet today, when you are operating in an automated cockpit, the best performance results from abilities in prediction, problem-solving, decision-making, monitoring, modifying and evaluating processes and procedures, both human and system.

"The frightening aspect of this story is the... processes that allow a pilot with such a blatant lack of understanding and integration of knowledge to progress through the system."

We need to train for these abilities. It is not enough to just know about procedures and rules. The question remains: why then do we continue to believe that skill levels are a result of learning facts, and not the development of abilities to think?

To this accusation the response may well be, "We don't have the time, nor the money". Well, you need to think about value for money. You can only find out if you are getting value for your training dollar if you have effective assessment and evaluation of the training.

Organisations and trainers need to be mindful of the effects of training environments and instructional methods on cultural and operational outcomes.

– Susan Cockle, Department of Aviation & Technology, the University of Newcastle.

ENGINE TROUBLE

Engine speed wound down, and there was no torque. It looked like engine fire, but turned out to be something completely unrelated.

WHILE CRUISING AT AROUND 5,300ft, there was what sounded like a muffled bang and hiss from the turboprop engine. The pilot immediately turned the aircraft through 180 degrees with the intention of returning to a known possible landing site, which he had overflown some time earlier.

The pilot then noticed the gas generator (Ng) winding down before stabilising briefly at about 52 per cent. The turbine temperature was between 710 and 715 degrees (the top of the range is 740 degrees).

Oil temperature and pressure remained in the mid range of the green. The pilot at first suspected an engine fire and immediately shut the engine down and feathered the propeller. After confirming there was no indication of fire, he attempted an airstart.

The restart stabilised at 17 per cent Ng on the starter, fuel flow indicated 110lbs per hour, light-off occurred at about 850 degrees, but there was no indication of torque. Ng speed stagnated at between 42 and 43 per cent. The prop unfeathered.

After the airstart attempt the pilot transmitted a Mayday, and again attempted an airstart with the same result as the first.

The pilot then shut the engine down and again feathered the prop. He then concentrated on setting the aircraft up for an engine out landing on a nearby beach. The landing was carried out safely without aircraft damage or injury to passengers or crew. The passengers were transferred by road to a nearby town.

– Name withheld by request.

ANALYSIS

How to prevent hot corrosion

INVESTIGATION OF THIS INCIDENT showed that there was no external engine damage. However, when the failed engine was stripped down, examination showed sulphidation of the engine compressor turbine blades. This had developed to a level where fracture of a blade had occurred.

The blade fracture resulted in impact fracture of 2 adjacent blades. The blade fractures, combined with significantly eroded turbine sealing shrouds, resulted in the gas generator speed degrading to a sub-idle condition. The engine, in effect, failed to produce power.

Sulphidation is a type of hot corrosion. Turbine blades suffer from sulphidation if corrosive alkali salt deposits are allowed to sit on the blade surface.

The salts attack the protective oxide coating on typical turbine blades. If the salts are not removed, the corrosion penetrates into the substrate material of the blade, which will eventually fail as a result.

The alkali salts result from a combination of heat from the engine, sulphur from fuel and sodium from sea water, industrial pollution and certain crop spraying chemicals.

Prevention: The only way of preventing the corrosive attack of sulphidation is to remove the salt deposits regularly before they build up. The most practical solution is to water wash.

Most turbine engine manufacturers require engines operated in a salt laden or polluted environment to be water washed after the last flight of the day.

Water washing is the process of washing the compressor and turbine components of a turbine engine by spraying clean water into the gas path while the engine is being motored. Motoring on the starter is preferred by most turbine engine manufacturers as it reduces stress on the blades.

The procedure varies between manufacturers and is dependent on the design of the engine.

For example, for PWC PT6A engines, the compressor and the compressor turbine should be subjected to a desalination water wash. The compressor should be washed via the engine inlet, and the compressor turbine through an igniter boss.

For Allison 250 engines, a compressor wash only is required. A hand-held hose can be aimed at the compressor inlet cone.

AlliedSignal publish wash procedures which cover both the compressor and the turbine. The wash is through the engine inlet.

Water washing should not be confused with performance recovery washing. A performance recovery wash uses a chemical and water mixture to remove stubborn deposits which have built up on the blades to the extent that shape is altered, degrading aerodynamic performance.

Most turbine engines benefit from water washing. While the benefit varies with the type of engine and the operating environment, turbine engine operators should familiarise themselves with the purpose and procedures of water washing.

To determine if water washing is appropriate for a certain turbine engine model, you should ask your nominated engine manufacturer's representative. Most engine manufacturers also publish data on water washing.

– Les Lyons, technical specialist, propulsion systems, CASA.