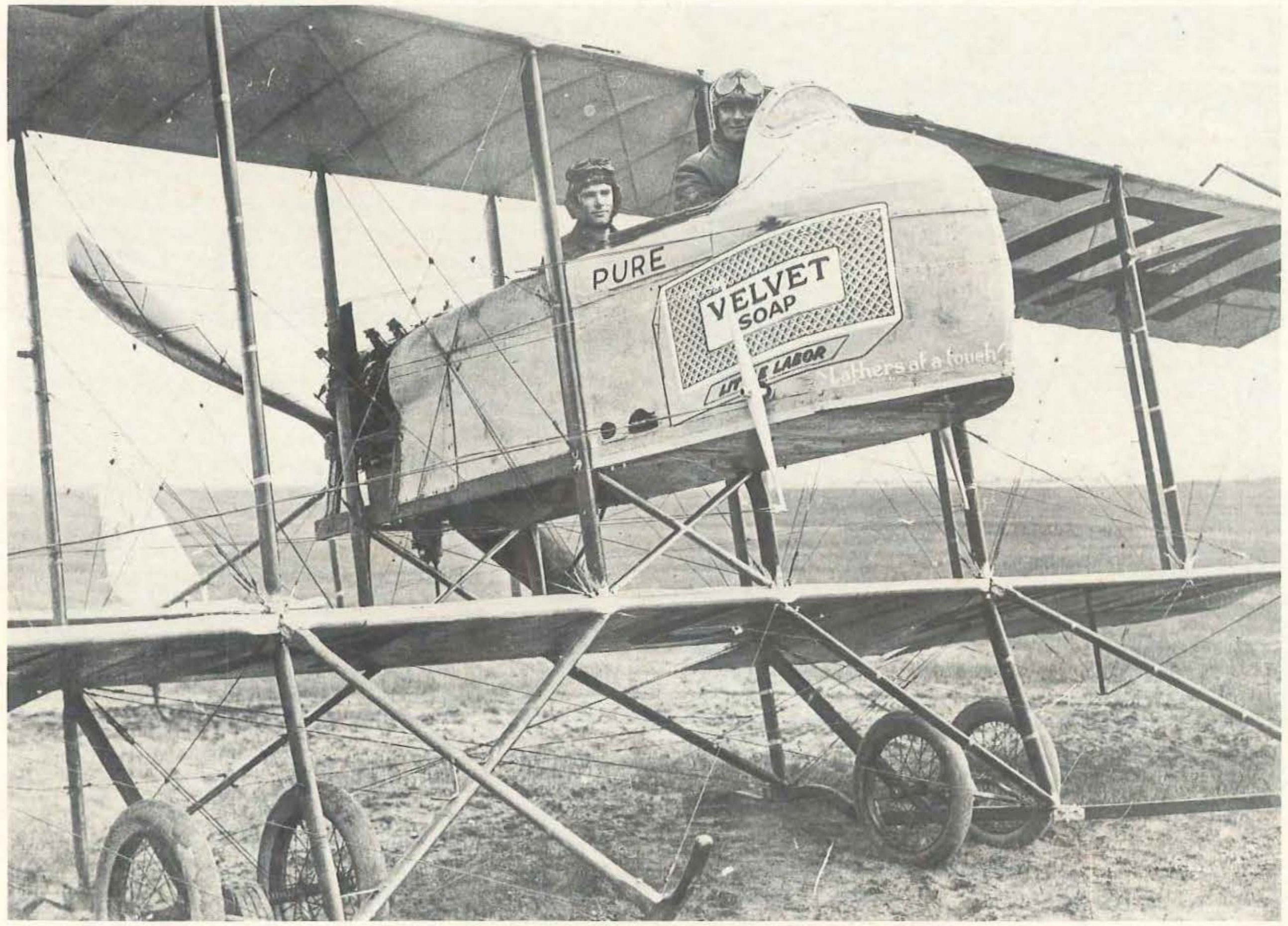
Regulations for Operation of Aircraft

— commencing January 1920 —



1. Don't take the machine into the air unless you are satisfied it will fly.
2. Never leave the ground with the motor leaking.
3. Don't turn sharply when taxiing. Instead of turning sharp, have someone lift the tail around.
4. In taking off, look at the ground and the air.
5. Never get out of a machine with the motor running until the pilot relieving you can reach the engine controls.
6. Pilots should carry hankies in a handy position to wipe off goggles.
7. Riding on the steps, wings or tail of a machine is prohibited.
8. In case the engine fails on takeoff, land straight ahead regardless of obstacles.
9. No machine must taxi faster than a man can walk.
10. Never run motor so that blast will blow on other machines.
11. Learn to gauge altitude, especially on landing.
12. If you see another machine near you, get out of the way.
13. No two cadets should ever ride together in the same machine.
14. Do not trust altitude instruments.
15. Before you begin a landing glide, see that no machines are under you.
16. Hedge-hopping will not be tolerated.
17. No spins on back or tail slides will be indulged in as they unnecessarily strain the machines.
18. If flying against the wind and you wish to fly with the wind, don't make a sharp turn near the ground. You may crash.
19. Motors have been known to stop during a long glide. If pilot wishes to use motor for landing, he should open throttle.
20. Don't attempt to force machine onto ground with more than flying speed. The result is bouncing and ricocheting.
21. Pilots will not wear spurs while flying.
22. Do not use aeronautical gasoline in cars or motorcycles.
23. You must not take off or land closer than 50 feet to the hangar.
24. Never take a machine into the air until you are familiar with its controls and instruments.
25. If an emergency occurs while flying, land as soon as possible.

AUSTRALIA

Aviation Safety Digest

BUREAU OF AIR SAFETY INVESTIGATION

114/1982

Contents

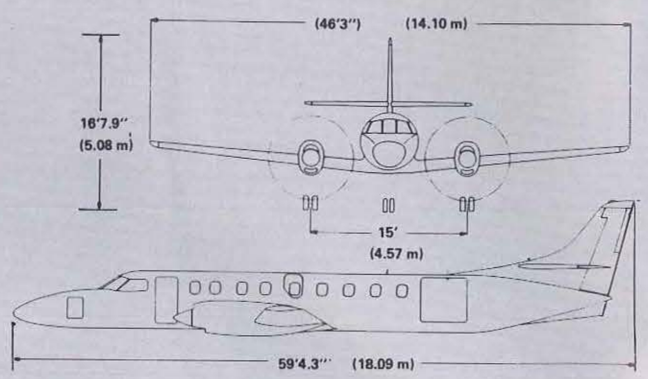
Front cover

Passengers disembarking from a Kendell Airlines Metroliner at Melbourne Airport.

Kendell Airlines commenced business at Forest Hill Airport, Wagga Wagga, in 1966 as Premiair Aviation Pty Ltd, engaged in charter work, flying training and aircraft maintenance. Scheduled services were commenced in 1971 under the trading name Kendell Airlines, operating a Piper Navajo aircraft between Wagga and Melbourne twice daily. Since then the routes Melbourne to Merimbula, Cooma, King Island, Portland and Warrnambool have been added, and the types of aircraft operated have included Navajo, Aero Commander and De Havilland Riley Herons. Today the company operates a fully-pressurised fleet of three Swearingen Metro aircraft on 100 flights weekly to and from Melbourne Airport, carrying about 50 000 passengers per year.

Swearingen Aviation Corporation, manufacturers of the Metro II, is a subsidiary of Fairchild Industries, a diversified American aerospace and communications company which builds military and civilian aircraft, spacecraft and aircraft subsystems, industrial and electronics products and operates a domestic satellite communications system.

(Photograph by Daryl Sheridan)



Back cover

Maurice Farman 'Shorthorn'

(Photograph courtesy of Mr Doug Pardey)

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A message from the Secretary

On 7 May 1982 the Prime Minister, Mr Fraser, announced new administrative arrangements which included the creation of the Department of Aviation. He also announced that Mr Wal Fife would be Minister for Aviation. I was appointed as Secretary to the Department. Two Deputy Secretaries were also appointed.

Included in the new arrangements was the formation of the Bureau of Air Safety Investigation which became effective on 7 June 1982. The Bureau consists of a Central Office and five Field Offices which are outposts of the Central Office organisation. They are located at Brisbane, Sydney, Melbourne, Adelaide and Perth. The Superintendents of the Field Offices are directly responsible to the Director of the Bureau, who, in turn, reports to me.

The Bureau will continue to investigate the circumstances of aircraft accidents and incidents to determine the factors involved, recording the resulting information in a computer-based system for data analysis directed towards accident prevention.

The air safety investigation system is only as good as the information available to it. The quality of its output is largely dependent upon the extent to which it is supported by members of the industry.

Some years ago, in an effort to encourage people to report and share the knowledge gained from their experiences, it was declared that immunity from punitive action would be granted in certain circumstances. Also it was declared that no person calling for assistance when encountering difficulties in flight would incur punitive action by the Department. Unfortunately statistics on the submission of reports suggest that the industry is still not bringing to light all the incidents which could contribute to overall improvements in safety.

The policy of immunity was last restated in *Aviation Safety Digest 100*. It has been suggested in the industry that the policy no longer exists. That is incorrect. It is therefore appropriate to again restate clearly the objective of air safety investigation and to reiterate previous assurances about immunity and the reporting of air safety incidents.

The fundamental objective of the investigation of an aircraft accident or incident is the prevention of accidents and incidents — it is not the purpose of this activity to apportion blame or liability. I will not impose any punitive measures upon any person who, because of navigational or other difficulties, requests assistance from airways operations units. In addition, I will not impose any punitive measure on the originator of the air safety incident report for any of his actions in an incident which is brought to the notice of the Department solely by his submission of such a report. This undertaking is given to encourage the submission of reports of situations and circumstances, which could lead to safety improvement measures, that would not otherwise have come to notice. In cases where other parties are involved, eg. airways operations units, other aircraft etc, clearly, immunity will not be applicable.

There is a further exception to the overall policy on immunity. If the investigation of any incident, however it comes to notice, shows that persons or property have been exposed to danger because of a deliberate or contemptuous disregard for the law, or because of dereliction of duty amounting to culpable negligence, it clearly will be necessary for me to consider initiating punitive action against the person concerned.

Every reported occurrence will, of course, be investigated to the extent necessary to determine and record the facts for it is absolutely necessary to ensure that proper information is available for future analyses in our continuing accident prevention efforts.

Finally, it has been brought to my attention that there have been statements by various sources that publication of the *Aviation Safety Digest* is to be discontinued. I hasten to assure you that this is not the case.

The frequency of the magazine has been restricted in recent times by difficulties in recruiting and retaining suitable personnel within the Bureau of Air Safety Investigation. The consequent staff shortage resulted in a situation where the exigencies of day-to-day accident investigation had to take precedence, temporarily, over the requirements of the Digest.

The Bureau is very conscious of the need to maintain regular production of this important magazine and every effort is being made to improve the frequency of publication. I can assure you that the *Aviation Safety Digest* is seen to be an essential part of the Commonwealth's accident prevention program and there has never been any intention of discontinuing its production.

(C.W. Freeland)

Wire strikes: the threat and the defence

Acknowledgement is made to the New Zealand Civil Aviation safety magazine *Flight Safety* for approval to reproduce this article. It is offered as a follow-on to the article 'Wire Strikes', presented in *Aviation Safety Digest 108*. Although some of the pilot comments in the article refer to New Zealand locations, the situations, hazards and recommendations apply equally to operations in this country.

Collision with wires has long been recognised as one of the greatest hazards facing the aerial work pilot. Other than legislating for the non-erection of any wire or cable above ground level — a most unlikely enactment — it seems there is no possibility of eliminating entirely this man-made threat to air safety. In consequence, our wire infested country must continue to be regarded by pilots as a hostile environment in which to operate aircraft at low level.

Much has been written from time to time on the subject, and, as is often the case, it has been easy to be wise after the event and perhaps condemn a normally conscientious pilot for an indiscretion he had no intention of committing. Avoiding overhead wires involves many factors relative to a particular operation, and it is up to the individual pilot to assess the situation and decide on the safest plan of action in the circumstances. However, the continuing high number of wire strike accidents does give cause for concern and suggests that some pilots engaged in this role are either not fully aware of, or are not adhering to, common safety practices and procedures.

Most articles on the subject, apart from outlining general precautions applicable to low level operations and the types of wires likely to be encountered, add little to what many pilots already know.

It therefore became clear that the best possible advice for preventing wire strike accidents should come from those who have done just that over a long period of time. Accordingly, a number of very experienced agricultural pilots throughout the country, with upwards of 20 000 hours in the role and 200 000 sorties flown, were invited to review their long flying careers and explain for the benefit of all concerned — especially pilots new to the industry — how they have managed to escape serious injury or death through wire strikes.

The exercise proved most rewarding. Nearly all the pilots surveyed responded with detailed, modest accounts of the practices and procedures they have diligently maintained with obvious success. Not surprisingly, perhaps, there was general accord on a number of factors considered vital for the avoidance of wires. These are set out in logical sequence as follows. The supporting comments in each case are a composite of views as expressed by the experts themselves.

Discipline

The first requirement for safe conduct of any flight, whether agricultural or not, is a strong sense of discipline and self preservation. This applies to all phases of the flight from aircraft preparation to shutdown.

A pilot cannot for a moment allow himself the luxury of relaxing the discipline, no matter what the temptation may be. As the old adage goes, 'Rules are made for the protection of idiots and the guidance of wise men', but a pilot who bends the basic rules has only two chances. He may survive, with a lot of luck, and learn to be a far wiser pilot to carry on to greater things. Without luck, the result is either death or permanent injury, with its pain and suffering. Both not only affect the pilot concerned, but also reach to relatives and friends.

*

Discipline, being a trained condition of the mind to obey a system of rules, is your primary means of survival in a relatively hazardous occupation. It not only boils down to learning to identify the likelihood of wires and then to spot them; it is equally important to develop good habits as a result of personal discipline at a very early stage in one's career.

*

On every briefing, whether it be to topdress, spray poison or supply drop, I discipline myself to ask, '. . . are there any wires — power, telephone, flying fox, television or electric fence?'. Then, whilst flying out I watch all the ridge tops. If I see a post or pole, I orbit to locate the wires and align them (or their sag) with a visual reference before continuing work.

Memory and awareness

Once you have identified the obstacles on a particular farm or area keep them etched in your memory for future use. But remember that the human memory is not infallible. Each time you approach the area go about the procedure of asking and observing to refresh the memory, and also to find out if any new lines have been erected.

*

Some of the most experienced pilots have struck wires, so the problem is not one of an experience gap between the old and the young. It is a matter of being aware that wires and aeroplanes don't go together!

*

I suppose it must be part of my background thinking, similar to my fuel management. I always seem to have an internal clock which gives me an image of my position, time-wise, in my fuel endurance. If, for some reason, I become unaware of my fuel state, the sudden realisation is like a shock or a physical blow, even though I may still have an hour's fuel left. The same thing happens with wires. If there is a wire problem on a particular job, I don't consciously remember them, but the awareness is there. If I suddenly realise the awareness is gone, maybe even while landing, it is like the fuel state shock of re-remembering. The memory lapses may last only about five seconds or even less.

*

I am conscious of wires. I don't like the bloody things! Most of my flying has been done in sparsely populated areas where there are fewer wires — unlike Manawatu, Waikato and Taranaki, although I have flown in these areas as well. I put my lack of wire strikes down to the fact that I am always conscious of them. I use the system of repeating to myself in a loud voice, 'power lines' when near potentially dangerous ones.

*

I consider power lines to be the biggest hazard by far in top-dressing; especially to experienced pilots. Although they learn to cope with other hazards such as downdraughts, downwind take-offs, out-of-wind landings on short strips, etc., the wire hazard is more likely to catch them unawares because of boredom or complacency. One can always pull off a reasonable landing or take-off when half asleep, but if one hits power lines when half asleep it is probably curtains. My advice to the young pilot is to think power lines every time he flies low or up a gully. This is how important it is to me. The signal starts up in my head every time I head up a strange gully. Even then I sometimes get caught out. It takes a long time to develop the habit, but it is the only answer.

*

Once I have located all known wires in an area, I then rely purely on memory. However, for those with any tendency to forgetfulness, a warning placard next to the trip meter, or the word wires on the job card, are excellent reminders.

*

I don't really know if I have any special formula except wire awareness. The need for this awareness was brought home to me by a horrible experience I had many years ago. A close friend and I were working adjacent strips. He was flying a PA18A and I a 225 FU24. The strips were a mile apart and we were working load for load. The main 200kV lines ran between us, with me turning away from them and the other aircraft turning around them.

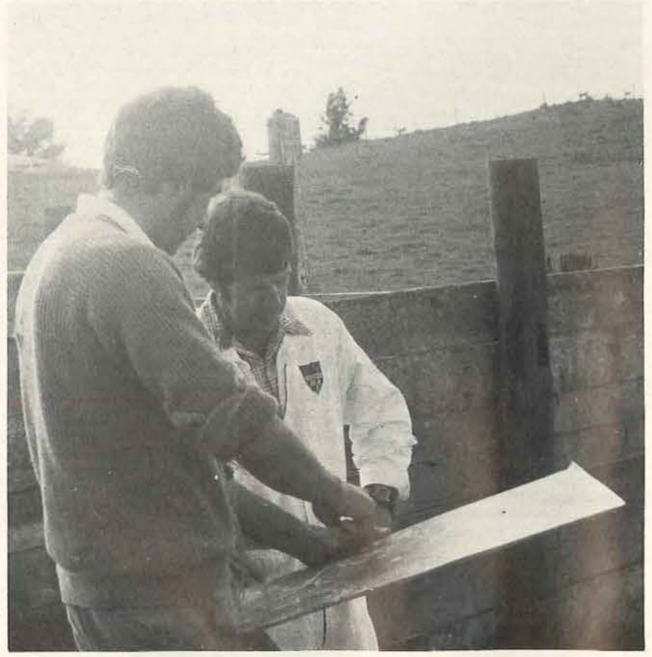
After our lunch break I was finishing my first sowing run when I looked over toward the other strip. The PA18 was becoming airborne. On my next glance I thought, 'Bloody hell, he's forgotten the wires!' I yelled at him in sheer futility, and at that moment he impacted. The Cub stopped in the air with a blinding flash and was left dangling, caught up in the wires, then caught fire. After a few seconds the blazing aircraft plummeted to the ground. There was no hope of my friend surviving that inferno.

That experience early in my career still lives with me and contributes greatly towards my constant awareness of the presence of wires and their hazards.

*

Try to be conscious of wires at all times. One does tend to forget or become complacent about them, and it is only by reading reports and articles on wire hazards, and talking about them, that tends to keep them in one's mind. I must say I have been known to talk aloud to — or rather about — wires. It is an effective reminder.

Briefing



To my mind, the avoidance of wires starts on the airstrip before flight with a positive inquiry to the farmer on the nature and location of wires, not only in the treatment area but also to and from the airstrip. During the subsequent survey, all those wires must be visually located.

*

As for on-the-job briefings, it pays to ask again about wires — even for experienced pilots who have flown in the district on many occasions. I just ask 'Anything new since last time?' Generally, new wires include those connected with television installations, electric fences and sometimes flying foxes. I've had a fright or two with flying foxes when they've been erected for running hay bales across a gully. They are usually temporary things or used only in the winter and spring, and even the farmer can completely forget they are there.

*

Most aerial work pilots, at some time in their career, have experienced the situation where a client has assured them there were no wires or obstacles to be wary of, only to be confronted with an awkward situation after crossing the boundary and turning over the neighbouring property. Don't rely implicitly on what you've been told — carry out your own inspection as you work.

*

I had commenced operations on a particular property where the sowing runs were parallel to the road. After completing three loads I began working up quite a steep slope to a high ridge, and the farmer, who was assisting me with the loading of the aircraft, casually asked me not to knock down his telephone line. After inquiring further about this hazard, I was informed there was a telephone line running at 45 degrees to my sowing runs. On my next load I located the wire, which ran alongside the road to a point where it cut across the farm and over the ridge. The roadside poles blended in with the boundary fencing and were very difficult to pick up.

I later reflected on how lucky I'd been not to have struck that wire. Since that experience, I have always made a point of ensuring that the farmers brief me properly on all overhead wires on their properties.

It pays to have a check list or questionnaire demanding such information as the location of power lines, telephone lines, electric fences and flying foxes on the property.

Observation and reconnaissance

By continual observation of the terrain as habit, it will become second nature to anticipate where the local authorities are likely to erect power or telephone lines in relation to the siting of houses, wool sheds, cow sheds, etc. This is relatively easy on flat terrain, but is more difficult in hill country where lines can be, and usually are, slung from ridge to ridge with no poles in between. It is therefore essential to commence work by flying the ridges first to locate poles and observe the lie of the lines between the poles. It is very dangerous to fly up or down a gully at low altitude before ascertaining first that the area is, in fact, clear of wires.

*

Wire strikes often occur when power poles are difficult to see because they are hidden by trees. These accidents commonly take place between the farm house and out-buildings, where the last pole is often obscured by a tree or hedgeline — a classic example of not being able to identify the location of wires by the position of poles. Other accidents commonly occur through striking secondary wires on the same poles (if you are flying under the main wires) or striking earth wires (if you are going over the top). Milking sheds and pump houses should be treated with the utmost suspicion and be investigated for emanating wires if they are not readily seen. Tall structures such as windmills, aerials and some power poles should be checked out for guy wires.

*

Some old pilots I know can sniff out wires without being objective about it. Sheer cunning tells them where to look for those hidden wires, or steers them away from places they haven't already checked out. For example, an old pilot would never go through a gap in the trees unless he looks at the other side first. He would not skid his aircraft around a pole where the line changes direction unless he checks for guy supports.

*

My second wire strike occurred when I arrived at the strip first thing in the morning. I was landing into the east and promptly flew through a set of wires the local power board had erected since I left the previous morning!

*

One of the rules I apply to my own operations is never fly low unless I have first flown over the area at higher level to assess the flying conditions — looking for likely area of updraughts, downdraughts, turbulence and the location of wires. I bear these in mind the whole time I am working. If I can't see the wires I picture them as I would the downdraughts, etc.

*

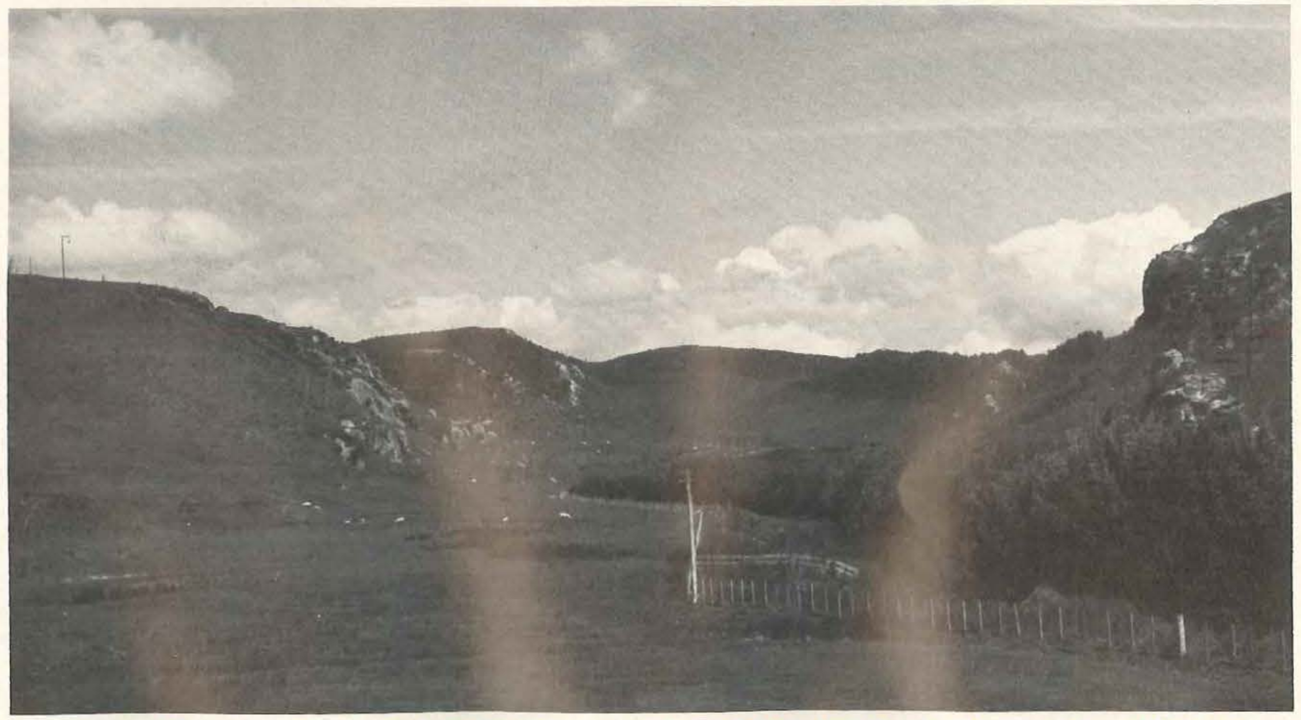
I have done mostly top-dressing and little spraying, but I think the most significant reason why I have avoided wires is that I am always conscious of them, especially since the advent of low cost electric grass-fencing. Nowadays, before I dart through an inviting looking saddle on a ridge I look to see that the farmer hasn't decided to save himself a couple of poles by stringing a high tensile feeder line across from top to top.

*

With my trainees I always impress upon them the golden rule of never venturing into gullies or down rivers, etc., without a prior reconnaissance from a safe height. Whenever flying down a valley keep a good lookout along the ridges above for poles, pylons, etc. They stand out against the sky better than the ground. And always remember that just because you've had a good look around the place, doesn't mean you have located all wires. They can leap out from the most unexpected places. One thing worth mentioning is that it is all too easy to miss a wire during a reconnaissance if it is in close proximity to another, especially if it is smaller and strung with longer spans. It's almost as if the mind has subconsciously 'fixed' that particular area and the eyes look further afield once the major or first line is located.

Watch out in saddles on a ridge that has a fence line running up to it. Sometimes there is a wire running across the saddle. Try to follow every wire you observe slung across a gully or over any long span.

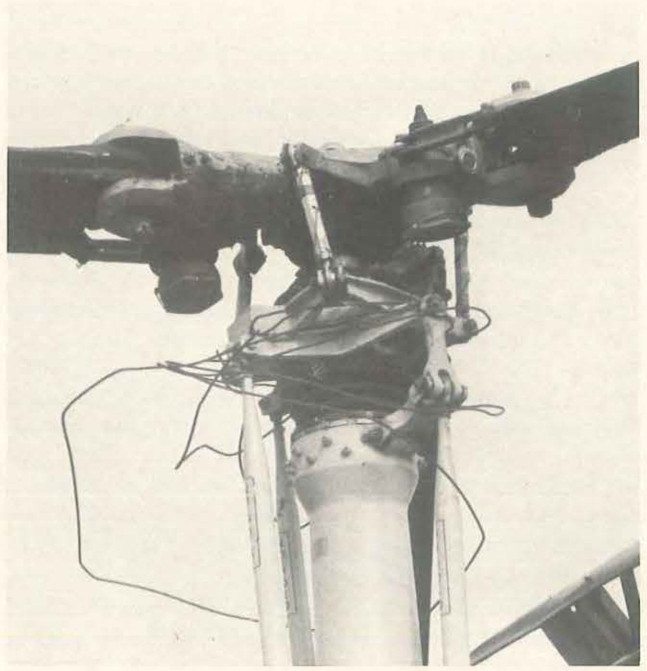
*



Never venture into valleys without a prior reconnaissance from a safe height. Location of poles must be identified prior to low level operations as wires may be virtually impossible to see. When working in valleys maintain a good lookout along the skyline.

My own feeling regarding prevention of wire strikes is to have a thorough local knowledge of existing wires and to keep in touch with the authorities responsible for the erection of new wires. Our operations people, as well as the pilots, endeavour to do this and make sure that all are kept informed of wire locations at all times.

*



Wire entanglement around the pitch change rods can make control extremely difficult and in some cases impossible, with dire consequences.

Prior to landing at a farm house (helicopters) check where the power and telephone wires come in. Look for any wires to the pump house, and in hill country look for a television aerial on top of a hill. When approaching the hover, if near a shed, check for electric fences. Watch for odd telephone insulators or broken bottle necks on posts, sticks, pieces of timber or poles stuck in the middle of a fence line. They sometimes have wires strung along them. Along boundaries and roadsides observe the power or telephone pole cross-arms. See that they are in unison. Beware of cross-arms that are at 90 degrees to the usual run. They invariably carry wires running from the main line to a shed or other out-building. The first pole in this secondary line always seems to be hidden behind a tree.

I have found it wise to check out the property myself prior to commencing operations. This has a dual purpose. It enables me to remind myself of the property owner's boundary fences and obstructions and to check for any new obstructions erected since my last visit, and provides an opportunity to check that there are no left-behind stock on the airstrip paddock.

*

Flying techniques

There is a height at which a particular aircraft type will give its maximum spread. Below that height the swath width is reduced, but above it the swath width will remain about the same. It may therefore be more desirable to fly the aircraft at heights above the optimum and enjoy that extra margin for error. This applies more so if there are wires in the sowing area. This procedure refers of course, to top-dressing of fertilisers only — spraying is a different ball game and is best left to helicopters.

*

Don't guess the amount of sag of a line if you can't see it. Maybe it is tighter and higher than you estimate. If in doubt, fly higher. It also pays well to, as much as possible, do all turns above ridge top height, thereby avoiding the possibility of tangling with lines that may be slung taut across a gully.

*

If there are wires in the treatment area, they should be sighted at every procedure turn before the run-in to spray. This allows you to concentrate later on the lining up and planning of the next swath, and to anticipate the proximity and resighting of the wires at the appropriate time. Where possible, poles should be used as sighters during your approach to the wires as it is far easier to judge both the closing speed and the direction of the wires.

Pull-ups should be made early, and the effects of weight and air temperature on performance constantly assessed. However, I have always maintained that, provided there is reasonable clearance, it is easier and safer to pass under the wires rather than pulling up and over them if they are located in or on the boundary of the treatment area.

*

Plan a flight path that ensures adequate wire clearance. This will look after you should you temporarily forget about the wires. Any deviation to planned track and altitude should be avoided or investigated first.

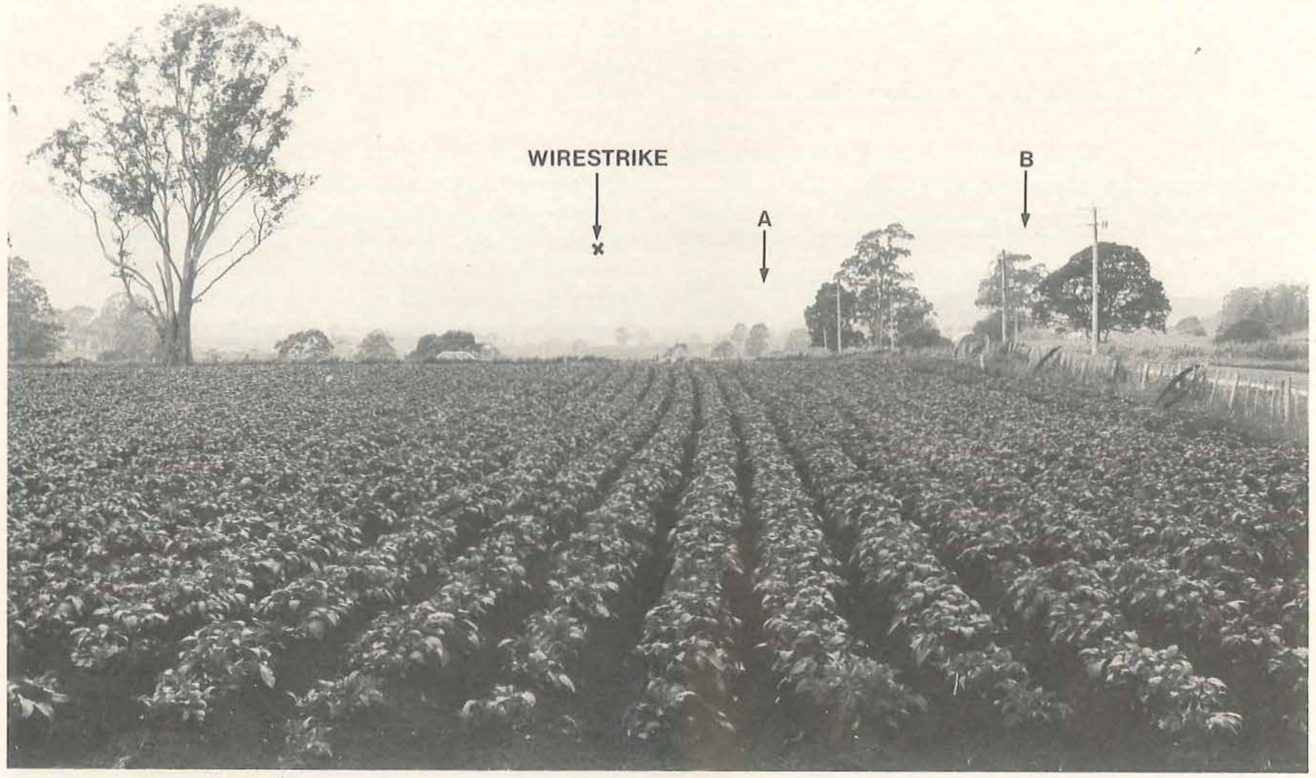
*

Power line strikes were more frequent a few years ago when dustier materials were being dropped, causing us to contour sow if it was windy in order to get a little more work done. Today with the more granulated supers it is not necessary to fly so low — in fact, it is preferable to sit up higher and achieve a better spread.

*

Wherever possible, it is better to fly under power lines than to try and scramble over them — as long as you know your aircraft and are experienced enough to judge your height above the ground. Power lines are easier to see against the sky than merged in with the ground. I have several farms in my area with high tension lines on them, and I find it much safer to fly under these lines, alongside the pylons. This way one has plenty of reference — the pylon, the wires and the ground.

*



Constantly change focal length of eye scan ahead — long distance fixation can cause you to 'look through' close-in wires. An accident occurred here when the pilot saw the lower power line (A) in the distance but lost sight of the higher main spur power line (B) in the potato paddock.

Wire strikes are common on the return for another load. The pilot tends to relax, and his returning flight path and height can be a little erratic as he is not monitoring aircraft performance as he was on the way out. We all tend to be a little inattentive under these circumstances. By sitting up higher on the return trip you can afford to 'rest up' a bit before the next load. Hedgehopping back to the strip achieves a negligible time saving and markedly increases fatigue and exposure to wire strikes.

*

Pilots should constantly change the focal distance of their eye scan along the projected flight path. It is very easy to fix one's eyes on the end of a paddock and 'look through' wires that are within or just outside the boundary. It is also quite easy to fix one's eyes for relatively long periods on objects that gain a pilot's attention, such as loaders and airstrips. This lessens the chance of seeing intermediate obstacles such as wires.

*

Ask the farmer about wires during briefing then sight the poles during each sowing run, and if the wires are not visible, fly as high as the poles. Never let the farmer or other operators talk you into flying lower than you feel happy about.

*

I think that if a pilot can see he is going to hit power or other lines, he should try to hit them with the propeller. Never, never, with the wings in a turn if it can humanly be avoided.

*

During spraying operations I must have flown under literally hundreds, if not thousands of power and telephone lines. My method is to make an initial reconnaissance around the field to determine the height of the wires, the spacing of *the poles, location of trees and other obstacles, the run of all lines (a surprising number go to ground for various reasons) and then confirm the feasibility of the planned spray pattern. After that, the height of the lines becomes secondary to their location, and it's only a matter of following two golden rules:*

- *Look a fair distance ahead of the aircraft and never focus too close.*
- *Never look up at the wires as they approach, but concentrate on maintaining height relative to the ground.*

*

However, spraying under lines is a different kettle of fish to top-dressing under them: firstly because the terrain being dressed is often undulating and the lines not of uniform height, and secondly because of the need to maintain at least a moderate height for spreading purposes, thereby lessening the separation between the aircraft and the lines. I generally discourage top-dressing beneath power lines, although there are some situations where it is the best procedure.

*

Another hazardous situation exists where wires are the same height, or higher than sowing height and a climb has to be made every time to avoid them. In this situation if I cannot see both poles clearly I use some other prominent feature as a marker to start climbing. A reassuring back-up procedure is to get an early altimeter check on the height of the line. I've used this method when working in poor visibility (rain, dust, sun, glare, etc.), and also as a safety factor when a good visual sighting of the wire can't be made but other markers are clearly visible. However, the altimeter should never be used as the sole method of assuring wire clearance.

*

Some farms have a real confusion of wires running across them. If the farmer wants his spray job done in the area of the wires, explain that you will have to spray from above them. Don't duck and dive, there's bound to be a set of wires that you have forgotten about. Don't try to 'just miss' the wires as they are too difficult to see properly for judging distance during momentary glances.

*

Try and spray parallel to the wires. If at any stage you have to spray toward them, pull up well clear of them and complete the unsprayed section later with one or two parallel runs. It may take longer, but it is much safer.

Weather factors

At sunrise and sunset, and for about one hour or so each side, it is almost impossible to detect lines, poles, pylons or obstacles when flying directly into the sun. It is better to leave the job until another time, for surely you are courting disaster by trying to fly blind. Where possible always plan runs so as to avoid this situation.

*

One of my more serious power line strikes was caused by disorientation in rain. I ran into a rain squall in the middle of a sowing run. I knew the power lines were there, but thought I had miles of room above them and steep turned away. I was horrified to see the wires wrap around the port wing. The only thing to do in a case like this is to keep turning — which I did. The wires eventually shorted and burned through, but not before I had pulled down two concrete poles and a hell of a lot of wire. This brought home the lesson — 'exercise extreme caution when flying low in rain'. I was amazed at the misjudgment I had made in height because of it. This is a very important factor — low flying over power lines in rain is very dangerous.

Ferry flights

When flying from job to base or from job to job, fly at a regulation height above terrain. It is amazing the number of wire strikes that have occurred during positioning flights. Many ag. pilots seem to think that the regulations for cross-country flying do not apply to them. I can relate several cases of wire strikes that would not have happened had the 500 ft terrain clearance minimum been adhered to.

*

The need for prior reconnaissance of an area from a safe height to locate wires applies equally when ferrying from base to job, and vice versa. In many areas there are logical bad weather routes from the job to base and it pays to know these intimately. Every now and again it pays to follow them when coming home in good weather conditions to keep an eye on any developments — poles going in, erection of flying foxes, etc. It takes a lot of worry out of the next bad weather trip. I had an incident with a set of 11 000 volt power lines back in 1966 when I had only been in the area a short time. After I had done about an hour's work one morning, a front moved in with accompanying low cloud and light rain. I then headed back to base, but being unfamiliar with the area I elected to follow the Manawatu River which I knew passed close to the aerodrome. Unfortunately, I struck the wires which span the river between a hill on the northern side and a pole set well out on a flat on the southern side. Fortunately, the Beaver struck the wires with the propeller and chewed its way through them, with only moderate damage to the wings and fuselage.

Summary

From the foregoing, the principal safety factors for avoiding wires may be summarised as follows:

Discipline
Without a strong sense of discipline you are bound to succumb to temptations that inevitably lead to dangerous, unplanned manoeuvres. Get to know the safety rules and adhere to them rigidly on every operation.

Memory and awareness
Be constantly aware of the existence and lethality of wires on every spraying/sowing run, on every flight to and from the treatment area, on every ferry flight to and from base. Don't let complacency, boredom or sleepiness interfere with your mental attitude to wires. If some form of memory jogger is required use any method that is guaranteed to gain and maintain your attention. Etch WIRES into your mind.

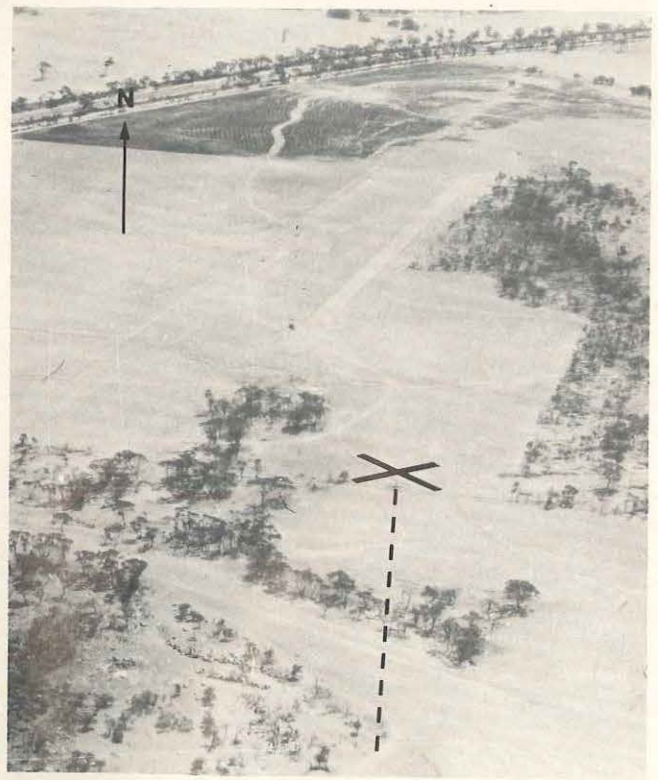
Briefing
A preflight briefing from the farmer is essential to confirm the nature and location of all wires and significant obstructions on his property, especially in the treatment area and along the route to and from the airstrip. He may also be able to warn you of such hazards on properties adjacent to his boundaries. All these wires and obstructions must be visually located during the subsequent inspection.

Treat with caution any assurances that there are no dangerous wires on the property. Farmers are apt to forget about old or seldom used lines, flying foxes, electric fences, etc. and even newly erected aerials and cables. Carry out a further inspection if in doubt.

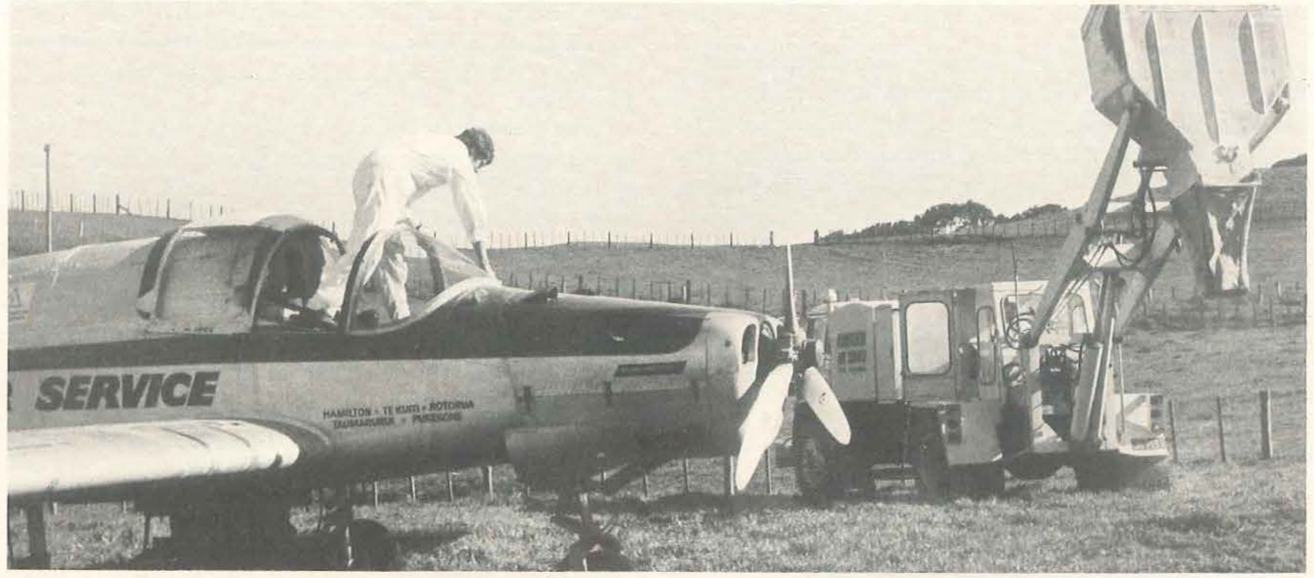
Use a check list to ensure that no item is overlooked. If necessary, use a map of the area to positively identify and mark in each hazard.

Reconnaissance and observation
Continual observation of the terrain in your general area of operations enables early recognition of current or likely erection of power and telephone lines in relation to farm building projects.

Before commencing work, make a reconnaissance of the total area at a safe height. Positively locate all power pylons and power and telephone poles. Look for those partly obscured by trees, those with cross-arms denoting secondary lines and those forming part of a fence line. Determine the direction of wire runs and spur lines (especially electric fence lines or feeder lines slung between saddles on ridges). Locate radio and television aerials, supporting guy wires on structures, and flying fox cables. Beware of smaller wires slung in close proximity to major lines.



Wire strikes often occur when the poles are hidden by trees. An Airtruk on final approach to land in the clear area to the south east of the strip struck double power lines, the supporting poles of which were hidden amongst the trees shown in the photograph. This accident was reported in Aviation Safety Digest 102.



A clean, polished windscreen is vital.

Flying technique

- Allow an extra margin for error by flying sowing runs higher than the optimum for maximum spread — the swath width will remain about the same, particularly when granulated material is being used.
- Where possible, make all turns above ridge top height to avoid wires slung across gullies and saddles. Wires in the treatment area should be sighted on every procedure turn before the run in.
- Where possible, use poles for sighting wire runs, and if the wires are not visible fly as high as the poles. Whenever poles cannot be seen clearly, use some other prominent feature as a marker for the pull-up point.
- Don't guess the amount of sag in a line that is difficult to see. If in doubt, fly higher. It also pays to get an early altimeter check on the height of a wire.
- When establishing a pull-up point to clear wires don't forget the effect of high gross weight and air temperature on aircraft performance.
- Endeavour to make runs parallel to wires. Where you have to spray toward wires pull up well clear and finish untreated areas later with parallel runs.
- With high power lines it is sometimes safer to fly under them: providing there are no other obstructions, that you look well ahead when approaching, that you never look up at the wires as you pass under and that you concentrate on maintaining height above ground. This technique is mainly applicable to spraying — it is not generally recommended for top-dressing.
- Where a farm is covered by a profusion of wires, don't 'duck and dive' — maintain a safe height above them at all times, no matter what the effect on spread.
- Maintain extra vigilance when returning for another load, and also during final 'tidy-up' runs. The tendency to relax and be inattentive to detail at these times is a common cause of wire strikes.
- Develop a 'rubber neck'. From take-off to touch down keep looking up and down, left to right — everywhere — for wires, obstructions and possible forced landing sites.
- Constantly change focal length of eye scan ahead — long distance fixation can cause you to 'look through' close-in wires.
- Finally, if you are going to hit wires of any sort, try to hit them with the propeller, never with the wings in a turn.

Weather factors

Never plan or make runs into a rising or setting sun. If you can't avoid sun glare by completing the job across or down-sun, delay the operation until such time as glare conditions become less hazardous.

Beware of operating in rain showers: misjudgment of height, and distance from wires can result through disorientation or visual illusion.

Ferry flights

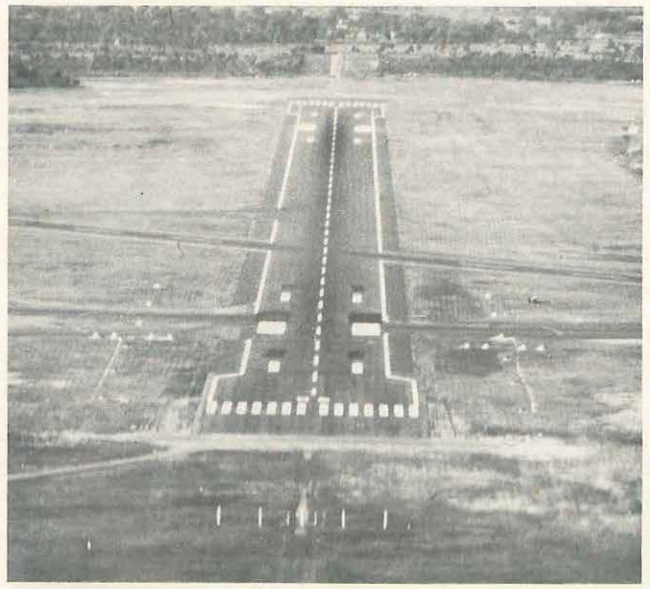
Maintain regulatory minimum height above terrain during all ferry flights. If a bad weather route can be followed carry out a reconnaissance in good weather to identify the location of newly erected wires and other hazards.

Conclusion

That so many highly experienced agricultural pilots have succeeded in flying for so long, in such a demanding role without serious injury is clear proof that wires can be avoided, simply by placing self preservation above all else. Other aerial work pilots, whether experienced or new to the industry, would do well to study and put into pratice the precautionary measures adopted by the experts in this field.

It really boils down to establishing a personal set of safety rules and disciplining oneself to adhere to them at all times ●

T-VASIS glide slope displaced by fog



Since its introduction some 15 years ago, T-VASIS has been installed at a number of airports and aerodromes throughout Australia, proving itself to be an invaluable approach aid, at night in particular, at the many locations where there is neither high intensity approach lighting nor electronic approach slope guidance. However, a recent incident at Perth Airport illustrated an inherent limitation of visual approach slope indicating systems such as T-VASIS, VASIS and PAPI in conditions where visibility is affected by airborne moisture. During a night approach the flight crew observed a full fly-down indication on the T-VASIS while the aircraft was on the correct glide slope according to the ILS. The fly-up lights were also visible, but only as 'pin point' sources at very low intensity.

Approaching Perth, the Captain had prepared for an ILS approach on the basis of the terminal information and approaches made by preceding aircraft. Visibility was reported to be variable and as low as 1200 metres in fog patches. At Parkerville, the airport and city lights were visible, though some blurring and 'halo' effect were evident. Shallow fog patches were also evident around the airport but visual conditions seemed to prevail. At the start of the ILS approach to Runway 24 the crew could see all of the runway lights, and at 1200 feet the Captain took manual control of the aircraft to make a visual approach. At about 800 feet he started to ease down to obey a T-VASIS fly-down indication; however, the first officer, who was monitoring the ILS, advised that the aircraft was going below the glide slope. The Captain regained the ILS glide slope and continued with the ILS approach. The approach was completed without further incident, but the T-VASIS continued to provide a false fly-down presentation throughout. At about 50 feet at the beginning of the flare the aircraft entered shallow fog and visibility was reduced considerably, but all of the runway lights remained visible and the Captain had no difficulty making a visual landing nor in maintaining the centre line during the ground roll.

The T-VASIS installation was flight tested the next day and found to be operating correctly.

It has been recognised for years that there can be problems with the interpretation of visual landing aids when visibility is affected by airborne moisture. The most common problems experienced arise as a consequence of two basic effects that result from the passage of light through water droplets. These are diffusion, from the refraction of the light beams as they enter and leave each water droplet, and the scattering of the light by reflection from the surfaces of the water droplets. The net result is that a light beam may be seen at an angle different from the correct one and a light source may be visible over a wider angle in space. These phenomena are evident in the halo effect seen around individual lights and, at times, the ability to see both the fly-up and fly-down lights of the T-VASIS at the same time.

However, the Perth incident cannot be completely explained by the process outlined above. In this case there appears to have been a general downward shift of the T-VASIS glide slope, accompanied by the other effects as well. This was probably brought about by refraction as the light beams passed from the fog laden air in the lower 50 feet into the clear air above. The light originating in the dense lower layer would have been refracted downwards as it passed into the less dense air above, thereby effecting the observed downward shift of the glide slope.

This incident is published to refresh pilots' knowledge of the limitations of visual approach slope indicating systems and to help preserve the good reputation that T-VASIS has earned since its introduction. However, like all navigation systems, T-VASIS and the other systems have limitations which it is important to remember. In this case, the limitation is that they are likely to produce erroneous indications in fog or mist and the systems cannot necessarily be relied upon in these conditions. Any unusual indication, such as fly-up and fly-down lights being visible at the same time or a pronounced halo effect around the lights, should be sufficient reason to discontinue use of the visual approach slope indicating system, as it is usually not possible to know the overall effect on the system unless the runway is also served by ILS ●

Controlled flight into terrain at night

This account of a night landing accident at a remote strip illustrates some of the dangers and difficulties a pilot can encounter when making a night approach, and reinforces once again the validity of conforming to standard circuit procedures — particularly when operating under difficult conditions.

The pilot of the Piper Navajo, concerned about the close proximity of high ground, deviated from an established habit pattern in the execution of his descent to circuit height and then joined the circuit on base leg. He then misinterpreted visual cues to his height before turning onto final and flew into rising terrain short of the strip. Fortunately, neither occupant of the aircraft was injured.

The purpose of the flight was to provide an aerial ambulance service to a remote station where an injured child required medical attention. The north/south strip into which the operation was to be conducted was adequate for the task, but high terrain some three kilometres to the west dictated that all manoeuvering be done to the east. Lighting was provided by portable flares supplemented by car headlights shining on the threshold and the upwind end of the strip.

The weather at the time of the accident was VMC, but a layer of high cloud made the night very dark, and ground features were not discernible from the aircraft. Consequently, the strip lighting was the only external reference available to the pilot for orientation. Observers on the ground noted the presence of some low cloud in the area and a weather report to this effect was passed to the pilot while he was enroute.

The topography of the area was dominated by a 3627 foot mountain rising abruptly out of otherwise relatively flat terrain. The strip ran parallel to this escarpment at an elevation of 1300 feet.

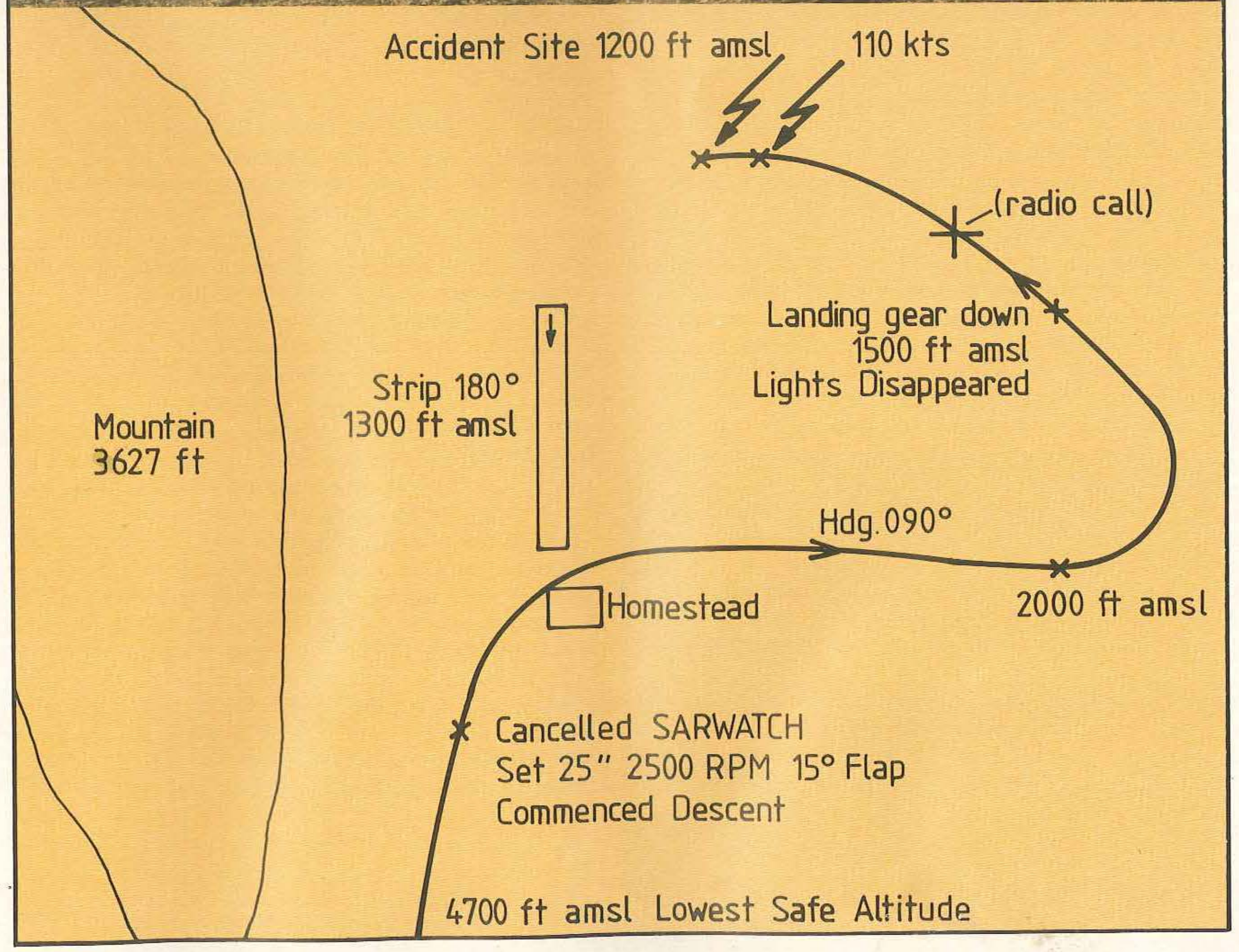
On receiving notification of the flight requirement at about 1750 local time the pilot alerted the nurse who was to accompany him and then proceeded to the airport to prepare for the flight. He obtained the relevant area forecast and filed an IFR flight plan for the flight out and back. Take-off, departure and cruise were without incident.

During the flight the pilot prepared an approach plan, taking into consideration the high ground and the reported wind. A few minutes before his ETA he descended from his cruising level, 5000 feet, to minimum safe altitude and saw the strip lights when they came into view from behind the mountain shortly afterwards. After over-flying the strip, he cancelled Sarwatch and started his pre-planned descent on an easterly heading. His intention was to descend to the east until 1000 feet above circuit height and then turn inbound and track to a left base position while continuing the descent to circuit height. Believing the strip elevation to be 1000 feet he set that level, rather than circuit altitude, on the assigned level indicator as a reminder. He then continued the descent outbound to 2000 feet and commenced his turn to the left. Although now less than 1000 feet AGL, he continued to descend towards what he now took to be circuit altitude while tracking inbound towards the base position. Approaching 1500 feet altitude (approximately 300 feet AGL), he selected gear down and completed the landing checklist. Shortly afterwards the strip lights disappeared briefly. When they reappeared, they seemed to the pilot to be flashing on and off, leading him to believe that he was flying through the patches of low cloud reported earlier. He thought at the time that this might cause difficulties on final but did not believe that he had a problem at that stage of the approach. At about this time the station homestead called him on a private network HF radio suggesting he land into the south (which was already his intention) and the nurse expressed her concern about the proximity of the high ground, as she had done a number of times during the flight. The pilot answered the radio call and, appreciating the anxiety in the nurse's voice, leaned forward with his face against the windshield, from where he saw the faint outline of the mountain and indicated to the nurse that they were clear of it. Very soon after that, the aircraft hit trees. The pilot applied full up elevator, but without significant effect; the aircraft continued to plough through trees and scrub for 180 metres before coming to rest about two kilometres from the strip.

Analysis

This accident happened because the pilot lost his awareness of the strip elevation and then misinterpreted available visual cues to his height. However, most pilots would agree that he was faced with a very demanding exercise, and to put the accident into perspective we should examine it in the light of all the significant factors. Let us look at these as they were identified by the investigation and discuss them in relation to their effect on the outcome of the flight.

Pilot experience. The pilot held a commercial pilot licence and Class One instrument rating. He had accumulated some 3600 hours flying experience in general aviation — but only 70 hours of that was at night. He therefore did not have a large store of night experience to draw upon in his planning and execution of this approach and landing. Furthermore he had not landed at this strip at night, but he was sufficiently familiar with it through daylight operations to appreciate the position and nature of the high ground and to know that he could manoeuvre to the east of the strip with safety. However, the fact that he could not see the mountain in the darkness caused him more concern and apprehension than the situation warranted and, as will be seen later, this distracted him from his primary task of flying the aircraft.



Descent plan. The descent plan was sound in concept — but it was deficient in detail in that it lacked positive altitude checks from which the pilot could quickly and unambiguously monitor terrain clearance. That deficiency, when combined with his deviation from an established habit pattern (when he set strip elevation instead of circuit altitude on the assigned level indicator) set the scene for disaster. He said later that after setting the assigned level indicator he did not look at it again during the descent; however, the fact that he descended outbound to 2000 feet and then continued to descend inbound strongly suggests that at some time during the descent he subconsciously misinterpreted the significance of the 1000 foot setting and took it to be circuit altitude. Had he been more specific in his plan and identified specific altitudes rather than the more general approach of selecting heights above circuit altitude he would not have entrusted the integrity of his descent plan entirely to his memory of the circuit altitude throughout the descent. For example, had he planned to descend outbound to 3300 feet and then turn inbound and continue descent to 2300 feet (circuit altitude) a constant awareness of the strip elevation would have been largely unnecessary during the descent, and the opportunity for misinterpretation and confusion minimised.

A second, but perhaps somewhat academic, point is the pilot's understanding of the strip elevation: he thought it was 1000 feet, when the actual elevation is 1300 feet. Any discussion on the effect this error may have had would, however, be hypothetical: use of the correct elevation may have only displaced the accident site closer to the strip. But on the other hand had he got closer in, the pilot might have correctly interpreted the visual cues and recognised the error in circuit height in time to recover.

Circuit procedure. The pilot elected not to fly a full circuit. He was too high to join on crosswind from overhead the first time and believed that he would have to fly too close to the mountain to make a normal circuit entry later. This is but one of the decisions and actions that point to his apprehension over his inability to see the mountain in the dark.

By not flying a circuit, and in particular the downwind leg of a circuit, he denied himself the opportunity of starting his final approach from a familiar position relative to the flare path, and set himself one of the most difficult judgement tasks a pilot can experience. He also lost the only opportunity he had of detecting the mistake in his descent plan and of overcoming the visual illusions that can distort perception under the conditions that prevailed at the time. (See *Aviation Safety Digest 111* page 10). By flying a circuit and starting his approach from a familiar position and height relative to the runway a pilot does not have to rely totally on his perception of the flare path picture for orientation. Furthermore, when an aircraft is established on the correct glide slope from the start, deviations are more easily recognised and, as stated earlier but worthy of repetition, visual illusions are less likely to intrude on a pilot's perception of his position.

Misinterpretation of visual cues. At no time during the approach did the pilot suspect that he was low. This was almost certainly a result of his erroneous belief that he was still above circuit altitude, but was compounded by the difficulties inherent in the interpretation of a flare path picture and the total lack of any visual reference other than the flare path. He commented that when he lost sight of the flares it did not occur to him that he might be low. Pre-conditioned as he was to expect low cloud in the area, that became the logical explanation in his mind for the disappearance and, later, the flashing on and off of the flares — even to the point of his expecting difficulties later on final. That analysis of the situation was interesting in its predictability; history has shown that in circumstances where an aircraft has gone low on glide path and the runway lights have disappeared because of intervening vegetation or terrain, the pilot has almost invariably attributed the disappearance to low cloud or fog patches. This apparent reluctance of the human mind to recognise or accept that things may not be going according to plan dictates but one course of action to a pilot if the lights disappear during a visual approach at night — he must climb immediately!

Distractions. The pilot allowed himself to be distracted from his primary task — flying the aircraft — at a critical stage of the flight. Shortly before impact his attention was diverted from the flare path on two occasions; firstly to answer a radio call, and secondly to search for the high ground in response to a concerned enquiry from his passenger.

To answer the radio call he had to reach back into the aircraft cabin, where the HF radio was installed, and locate the handset. Then to find the mountain he had to lean forward with his face against the windshield out of the glare of the instrument lights and peer into the darkness.

The radio communication was unimportant and its timing inopportune; the position of the high ground was similarly unimportant at that time since the aircraft was to the east of the strip and had not deviated in plan from the intended approach path. The pilot should therefore have known where the mountain was without having to look for it. It should be noted that the terrain into which the aircraft flew was not associated with the high ground of concern and, in fact, the elevation of the accident site was 100 feet below the strip elevation.

Other factors. One other point worthy of discussion, but not actually a factor in the accident, was the pilot's cancellation of Sarwatch before landing, when the facility was there for him to do so on the ground. Nobody on the ground was aware of the accident until about an hour after the event, when the pilot and his passenger arrived on foot at the station homestead. They had walked about three kilometres from the accident site. The people at the homestead were by then trying to find out why the aircraft had not landed, and would eventually have established that it was missing, but by then valuable time would have been lost; time in which, under other circumstances, lives might have been lost ●

Confusion in the cockpit

The two pilots and one passenger on board a commuter aircraft miraculously escaped with only minor injuries when the aircraft flew into the side of a mountain during an NDB approach. The aircraft was destroyed.

History of the flight

The flight was a scheduled commuter service which involved a number of enroute stops. It was also being used for route familiarisation for a pilot who had joined the company only two days earlier. He was flying the aircraft under the supervision of the pilot in command, who was acting in the capacity of route training pilot.

The first stage of the flight was completed without incident. The aircraft was landed off a visual approach during which the pilot in command had pointed out significant local features to the other pilot and virtually talked him through the approach. Take-off and departure for the second stage were similarly uneventful, but the weather deteriorated for the cruise with the aircraft in cloud most of the way at 5500 feet, the lowest quadrantal level above minimum safe altitude. Because there were no radio navigation aids at the destination aerodrome the intention was to make an NDB approach to another aerodrome about 20 kilometres away and proceed visually, weather permitting. The aircraft was descending, supposedly on this NDB approach, when it hit the mountain (see chart overleaf).

Cockpit activity during the approach

Cruising altitude was maintained until the pilot in command obtained a visual fix through a hole in the cloud above five miles north of the NDB, when a descent was commenced.

The pilot under supervision was flying the approach. When asked by the pilot in command what his intentions were he explained that he would intercept 120 degrees inbound to the aid, fly the procedure turn depicted on the approach chart and then fly the approach according to the published procedure, ie. descend outbound on 300 degrees to 1900 feet then reverse course through an 80 degree procedure turn left and track inbound on 120 degrees, continuing the descent to the minima. To this he received a reply something like, 'Forget the turn, get straight into the descent'. At that time the aircraft was over the NDB at about 5000 feet heading 120 degrees. The intention the pilot in command meant to convey was to forget the first procedure turn and intercept 300 degrees outbound from a right turn overhead. He then, because they were higher than the published altitude at the start of the approach, told the pilot to turn inbound early at about 2500 feet in order to avoid going too far out.

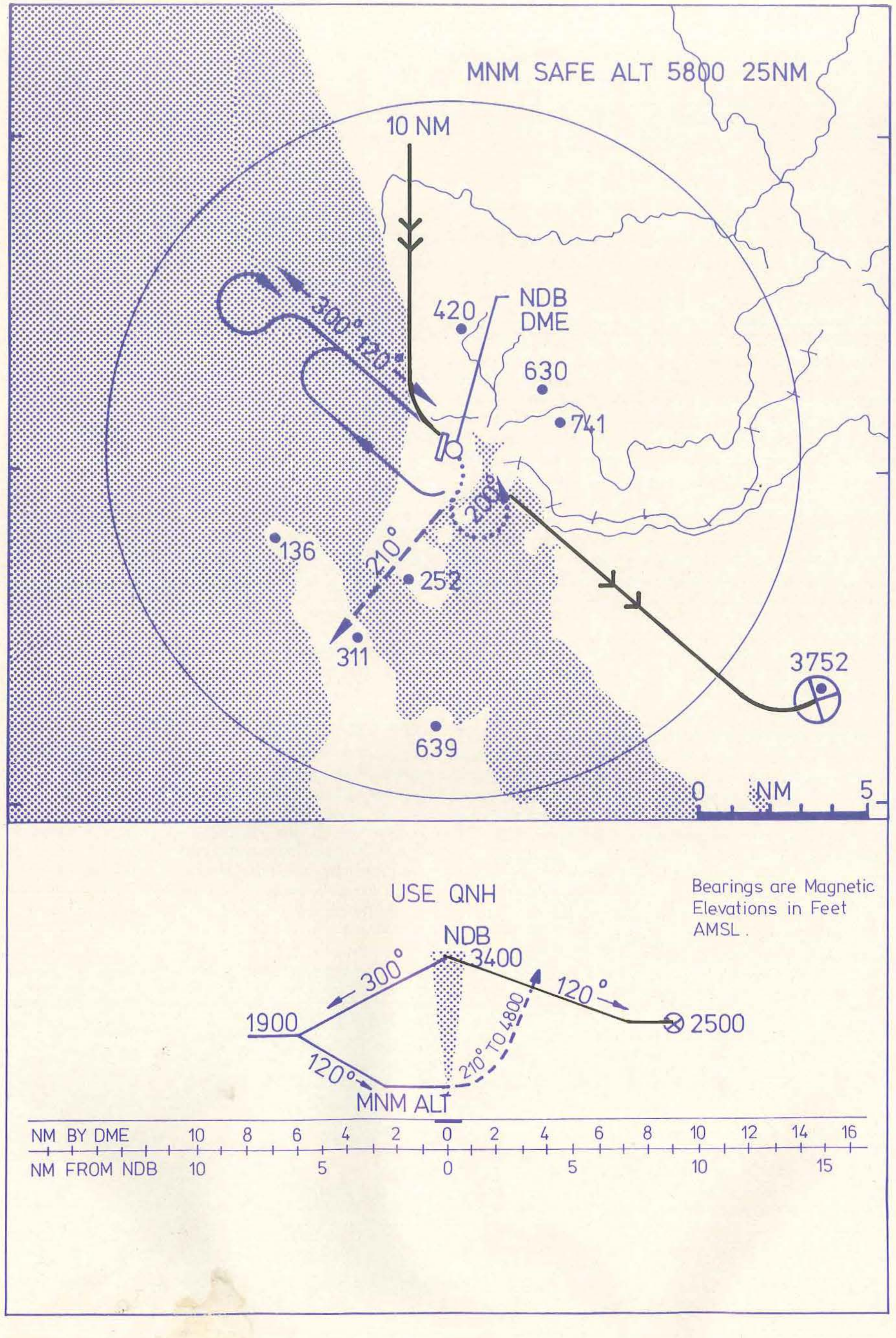
The pilot misunderstood these instructions and, believing that he was to be talked through a non-standard approach, went straight into the descent on 120 degrees, the reciprocal of the published outbound track. Meanwhile, the pilot in command had become occupied, first with a radio call that took some time to complete and then with the fuel management tasks. He did not monitor the pilot's entry to the approach and remained unaware of the track being flown; however, during the descent he glanced out of the side window at one point and saw water through a break in the cloud. As the aircraft would have been over water on the correct track he was satisfied that all was well and, on completion of his fuel management task, concentrated on looking outside to assess the cloud base when they became visual.

The pilot flying the approach did not feel any concern until he was about to start what, in his mind, was the proposed early procedure turn at 2500 feet, when he noticed a 3752 foot spot height on the approach chart just outside the 10 mile arc. He then realised the danger of the situation they were in, alerted the pilot in command, and applied maximum power. However, the combined efforts of the two pilots were too late. The aircraft hit the trees and crashed into the 30-40 degree slope of the mountain side.

Impact information

The aircraft broke up on impact and one fuel tank exploded, but the main wreckage continued beyond the area of the fire. Two smaller fires broke out near the engines but these apparently died out quickly without spreading to the fuselage or wings. Fortunately, the impact forces were greatly attenuated by the dense canopy of vegetation into which the aircraft crashed. The two pilots suffered only minor injuries. The passenger was uninjured.

Photograph courtesy of The Sun.



Discussion

As a starting point for discussion of this accident we can say that the accident would not have happened if the pilot had flown the published approach procedure — an academic observation, perhaps, but one which must be made. More importantly, we can say with some degree of certainty that the accident would not have happened if either pilot had been flying the aircraft by himself. We need then to examine how the presence of a second pilot in the cockpit could have had such an influence on the operation that the published approach procedure was ignored and the aircraft flown towards the mountains instead of over the sea.

The pilots. Both pilots held commercial pilot licences with Class One instrument ratings. Both were experienced in single-pilot IFR operations, but neither had any significant multi-pilot crew experience.

The pilot flying the aircraft was an experienced general aviation pilot with some 2500 hours flying experience. However, he was only a new employee of this company, having joined it on the Monday preceding the accident, when he also completed his aircraft type endorsement. His total experience on the aircraft was that gained during the endorsement plus some flying on Monday afternoon and Tuesday, during which he flew for about ten hours on scheduled services with a route training pilot and afterwards flew one service by himself. On Wednesday, the day of the accident, he was being checked on routes not covered on Monday or Tuesday: these covered areas in which he had no previous experience or local knowledge.

The pilot in command was also an experienced general aviation pilot with over 6000 hours flying experience. He had operated in the area of the accident commercially for about five years and knew the topography intimately. He was not employed as a route training pilot on a regular basis; he acted in that capacity infrequently and was not experienced in it. He understood that his duties in this capacity were to introduce the pilot to the company agents at each port and to familiarise him with the ground procedures. However, in this case he knew that the other pilot had not flown in the area before and considered it his responsibility to also show him the approaches and point out significant terrain. He did not consider it his duty to continuously monitor the other pilot's flying or operating procedures.

Briefing. There was no pre-flight briefing in relation to the operational procedures, the types of approach to be flown, or the terrain at any of the ports for the day's flying. Furthermore, the pilot flying the approach commented later that he had been unable to self-brief because of the sheer pace at which things were happening in his new employment. The extent of the briefing for this approach related to a discussion of the procedure to be followed should they not be able to continue to their destination.

The approach. The pilot flying the approach had intended to fly the published procedure, until the pilot in command instructed him to 'forget the turn'. At that point he believed that he was going to be talked through the approach, as had happened previously, and that he was being instructed in a non-standard pattern. He did not question what he understood to be an instruction to descend outbound on 120 degrees for a number of reasons: he was not familiar with the terrain and therefore did not appreciate the danger of descending in that direction; he perceived the comment of the pilot in command to be a clear instruction to fly the pattern that way and did not suspect that there had been any misunderstanding; he knew that there was at that time a shortage of fuel in the area and believed the modified approach was a time-saving measure; he believed that the approach was based on the other pilot's wealth of experience in the area and assumed that it would be safe. Furthermore, in the belief that his flying was being monitored, the lack of comment from the training pilot as the approach progressed would have been taken as confirmation that he was complying with that pilot's intentions.

Comment

It would be easy to say that the pilot should have followed the published procedure; and so he should. With few exceptions, approach patterns are constructed as they are for very good reasons of safety. It is also easy with hindsight to say that he should have questioned the instruction to modify the pattern, but when we consider the points already discussed and the fact that this was only his third day in the company, the pilot understandably had some reservations in questioning the judgment of one acting in a position of relative authority.

However, with all the factors considered, and even tempered with hindsight, there can be little doubt that the major contributory factor in this accident was inadequate monitoring of the approach on the part of the pilot in command. One of the requirements explicit in the exercise of command is the acceptance of the responsibility that goes with it. That responsibility does not allow the pilot in command to simply assume that the other pilot will do the right thing.

Conclusion

This accident serves a useful purpose in illustrating the inherent dangers of two-pilot operations without standardised procedures, with inadequate briefing and without clear, unambiguous communication. It also clearly demonstrates how essential it is for there to be a complete and clear understanding of their respective roles by the two pilots involved. With the introduction in the near future of two pilot crews in many aircraft that have been traditionally operated by one pilot, a number of pilots will find themselves in a formal 'crew' environment for the first time. Operators will need to recognise the potential problems and prepare pilots in command, in particular, for their new role through a comprehensive training program supported by a good operations manual ●

Cessna 200 series fuel system malfunctions

Unexplained fuel system malfunctions in Cessna 200 series aircraft have been the cause of several engine failures through fuel starvation over the years. In the latest occurrence the pilot of a Cessna 210D was only eight minutes from his destination when the aircraft's engine suffered a complete power loss without warning.

When the engine lost power the pilot selected the other fuel tank and attempted to restart, but when he was not immediately successful he selected a suitable landing area and set up a forced landing pattern. When confident that he would reach the selected site he went over the re-start checklist again, and this time was successful in restoring engine power. He then diverted to a nearby airstrip and made a precautionary landing without further incident.

After landing, he inspected the engine and fuel system, but could find no reason for the failure. Then, after conducting an extensive trouble-free ground run, he discussed the incident with a maintenance facility and decided to continue the flight. The short flight to his destination was uneventful.

Inspection of the fuel system revealed the presence of lint-like material in the fuel filters — enough to restrict fuel flow. But this finding did not explain the abrupt power loss and, as a possible cause, was inconsistent with the power recovery and normal operation later when the pilot had changed tanks. However, significant amounts of this lint-like material have been found in several other Cessna single-engine aircraft, and for this reason it is worth dwelling on this subject briefly before examining another possibility. The following extract from the United States FAA *General Aviation Alerts* No. 41 of December 1981 summarises the problem. It concerns the result of a fuel filter inspection on a Cessna TU206G, an aircraft with a similar fuel system to the Cessna 210D.

> Inspection of the fuel strainer following an inflight engine problem disclosed the filter was covered with a cloth-like fibre or lint. The finger screen in the fuel distributor also contained some of the same material. This was the third such occurrence that this operator had experienced with new aircraft. A Cessna dealer advised that a significant amount of fibrous lint-like material has been found in the fuel filters of 22 various Cessna single-engine aircraft over the past six months. Time on the aircraft averaged 30 hours. Inspection of low-time aircraft for this condition is recommended.

Investigation of the Cessna 210D incident revealed that a fuel cell had been replaced some 30 hours prior to the inflight power loss. It is suspected that this new cell was the source of the lint-like material found in the fuel filters.

In the absence of any other evidence to explain the abrupt power loss, an examination of overseas experience was indicated. The United States National Transportation Safety Board has for some time been concerned about the number of accidents involving Cessna 206, 207 and 210 aircraft as a result of power loss caused by fuel starvation, and requested the manufacturer to construct a representative fuel system mock-up of those models so that its operation could be studied. In the course of the tests that followed, it was found that all systems worked satisfactorily most of the time, but under some not clearly understood conditions, vapour locking of the fuel feed system would occur. In an aircraft this would result in complete power loss. The tests established that the action of selecting another fuel tank could cause the vapour locking to occur, but it also revealed that this same action could clear an established vapour lock. However, the occurrence of vapour locking was seen to be unpredictable. Experimentation revealed that the problem could be solved by the installation of separate vapour return lines from the fuel selector to each tank. This discovery suggests that the condition arises from fuel vapour and released air returned from the fuel injection unit accumulating in, and finally filling, the fuel collector tank and supply lines.

The question arises as to whether the reported incident was caused by the foreign matter in the fuel, by vapour locking, by a combination of the two, or by something else. With regard to the latter thought, there is no evidence to suggest the existence of a third problem.

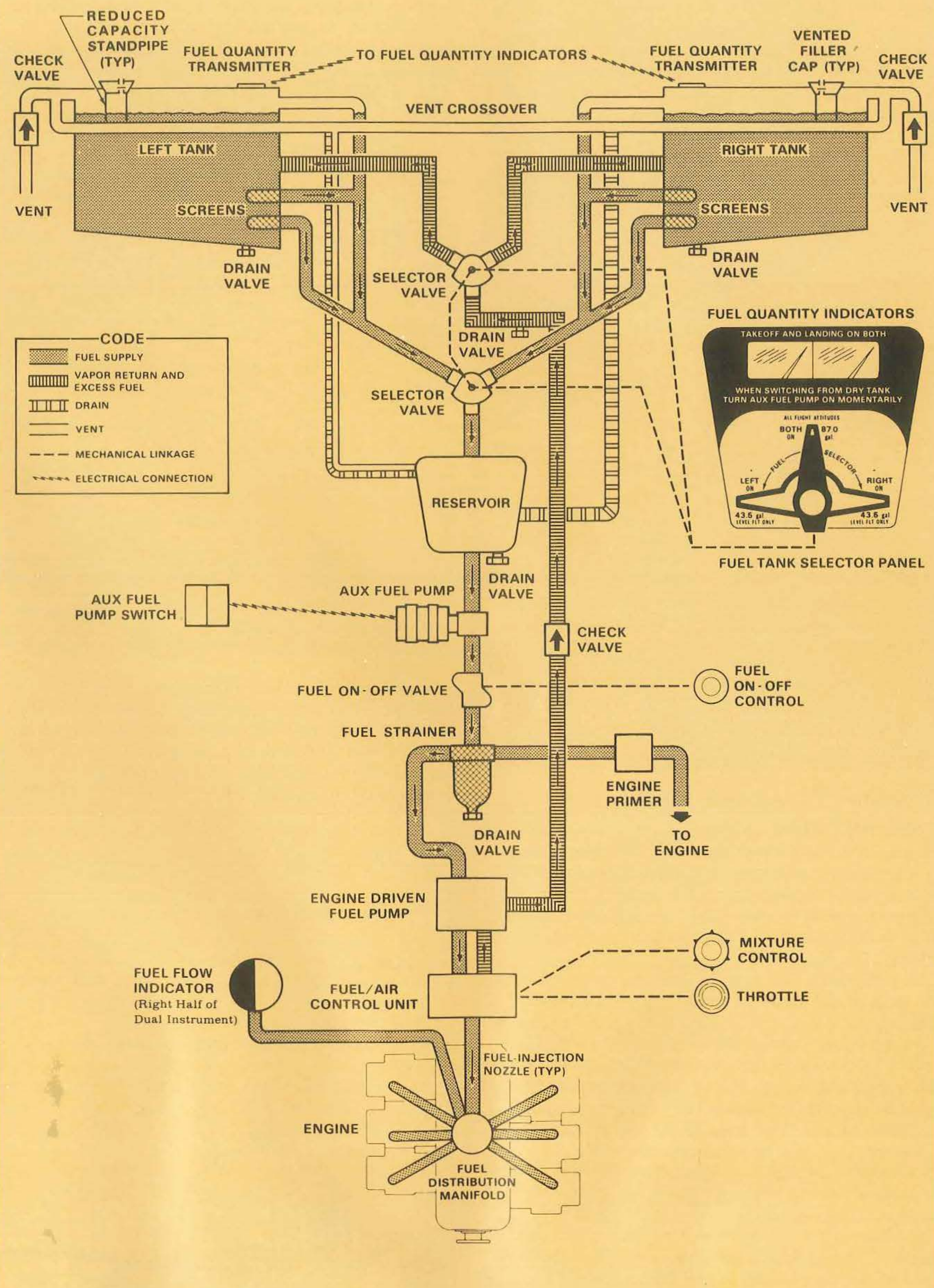
The problem of the collection of foreign materials on the fuel filter screens can be controlled by cleaning them at frequent intervals until the foreign material is eradicated. This action is recommended for new aeroplanes and for other aeroplanes after having flexible fuel cells replaced; in both cases flushing of the fuel system before the aeroplane is placed in service will also help remove any accumulations of the troublesome material.

The more serious problem, however, is unpredictable vapour locking. The manufacturer has, at various times, issued Service Letters and other instructions detailing fuel system modifications and engine handling instructions to prevent fuel system vapour locking, and also suitable emergency procedures to clear the fuel system should it occur. But the only fully reliable remedy is modification of the fuel system by the incorporation of vapour return lines from the fuel selector direct to the main fuel tanks.

Reported incidents in this country which could be attributed to vapour locking have been assessed from

(cont'd on page 22)

Redesigned fuel system (Cessna model T210N)



Note: The fuel tank selector valve has NO off position. The fuel ON-OFF selector is a push/pull control.

Shoulder harness

Do you always wear your shoulder harness when flying? The pilot involved in this accident does, now, after learning the hard way.

The helicopter was engaged in transporting supplies to line cutting crews. As it was climbing out over a heavily wooded ridge the pilot heard the rotor speed beginning to decay. He confirmed this by the RPM gauge and entered autorotation, turning away from the hill. Flaring into the 70 foot trees along the side of the ridge he was able to cushion the helicopter as it settled, but the machine received substantial damage and both occupants received serious injuries. They were found by another company helicopter which was aided in the search by the ELT signal.

Extensive testing of the engine and associated components revealed no reason for the loss of power.

The following is a direct quote from an interview after the accident: questions by the accident investigator, answers by the pilot.

Q. Would you like to make a comment about shoulder harnesses?

A. Shoulder harnesses, yes. The machine had shoulder harnesses in it. I was not wearing them, to my regret. I feel that whoever I fly for, whatever machine I fly, from now on I demand shoulder harnesses or I don't fly. I make my living flying and I feel that they are a definite advantage if you ever are in an accident, and in this particular accident I don't feel I would have got face lacerations. Possibly I wouldn't have got my back jimmied up either. It would have stopped the forward slumping and movement of my body.

Q. Can we quote you on that last statement if we have to, to prove a point about using shoulder harnesses?

A. Yes you can ●

Courtesy Transport Canada *'Synopses of Aircraft Accidents 2/21'*

Cessna 200 series fuel system malfunctions *(cont'd)*

the airworthiness viewpoint as not frequent enough to warrant a mandatory requirement for installation of a separate vapour return line to each main tank. Airworthiness Directives AD/Cessna 210/31, 45 and 47 are all intended to minimise the occurrence and effects of vapour locking.

A redesigned fuel system has been incorporated in all 1982 model Cessna 210 aircraft and is shown schematically in the diagram. Forward feed lines have been increased in diameter and the selector system now ensures that vapour return goes direct to the main tank being used to feed the engine. It is not known whether Cessna will make this system available as a retrospective kit for earlier models.

Cessna 206, 207 and 210 operators who are concerned that their type of operation could give rise to vapour locking problems should be aware that local modifications have been approved which introduce separate vapour return lines to the main tanks. These represent simpler solutions than would be achieved by retrofit to the 1982 system. Operators considering the fitment of such a modification can obtain further details from appropriate maintenance organisations ●

Fuel theft from aircraft

There have been sporadic reports of fuel theft from light aircraft over the years, but recently the problem has taken on some of the characteristics of an epidemic. At one general aviation airport alone, thefts totalling more than 1000 litres were reported in one week. Disturbing as this is, however, a more sinister aspect is appearing in conjunction with these activities. In two recent occurrences in Queensland not only was fuel stolen, but the drained tanks were filled with water in an effort to disguise the crime. The potential for disaster needs no elaboration.

As a consequence of these developments the importance of conducting a meticulous pre-flight inspection of the aircraft needs emphasis. Pilots must be aware of the possibility that their aircraft has been tampered with and should check, in particular, that the liquid in the tank is in fact unadulterated fuel, that the quantity is as expected, and that a thief, or would-be thief, has not caused damage to the aircraft or fuel tanks during such activities.

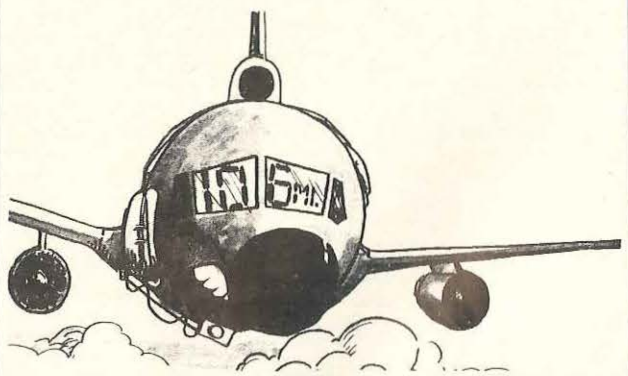
The best insurance is, of course, prevention. But as we know, that is not always easy. For example, a lockable fuel cap is a rarity, and continuous surveillance of all aircraft parked in the open is an impractical ideal. Moreover, the trust and concord that has been part of aviation since its inception is the very thing that works against the apprehension of these criminals. Against this background it is difficult for a pilot to accept that any person would approach an aircraft with malicious intent and he therefore remains silent when in other circumstances he might challenge a person's presence. Obviously, all suspicious activity around an aircraft should be investigated.

The Department of Aviation and other aerodrome owners do provide a degree of security at some locations, but aircraft owners, operators and pilots should be aware that security of their property is their own responsibility and should take appropriate precautions ●

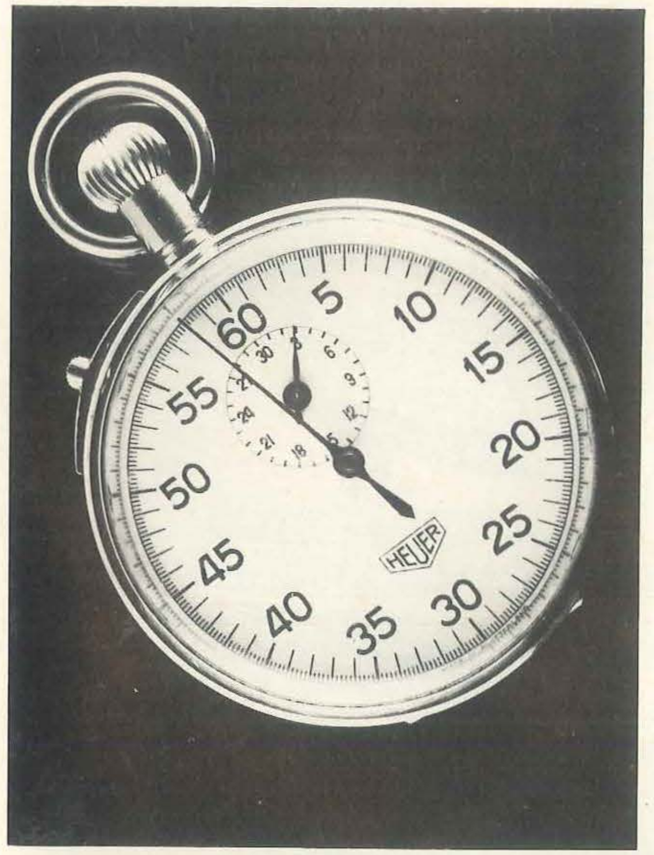
Traffic watch

ATC to Aircraft:
'You have traffic at 10 o'clock, 6 miles.'

Aircraft to ATC:
'Give us another hint — we've got digital watches.'



178 seconds...



'Pilot continued visual flight into adverse weather conditions.' Familiar words? For those associated with aircraft accident investigations they are, for they summarise the type of occurrence which continues to cause the greatest loss of life in Australian general aviation accidents — in spite of the publicity given to the subject over the years. One would think that the futility of pressing on in bad weather should be obvious, but without getting into the pilots' minds, the compulsion behind their fatal decision will remain elusive. This article, courtesy of *Transport Canada*, attempts to reproduce the thoughts of a pilot who gets himself into cloud in what might be a typical scenario. Read it and if you are ever tempted to press on in marginal weather recall its advice. If then, for whatever reason, you decide to continue, and lose visual contact, start counting down from 178 seconds. That is how long a pilot who has no instrument training can expect to live after he flies into bad weather and loses visual contact — according to researchers at the University of Illinois. Twenty student 'guinea pigs' who flew into simulated weather all went into graveyard spirals or roller-coasters. The outcome differed in only one respect: the time required until control was lost. The interval ranged from 480 seconds to 20 seconds. The average was 178 seconds — two seconds short of three minutes.

Here's the fatal scenario. . .

The sky is overcast and the visibility poor. That reported five kilometre visibility looks more like two, and you can't judge the height of the overcast. Your altimeter says you're at 1500 but your map tells you there's a local terrain as high as 1200 feet. There might even be a tower nearby because you're not sure just how far off track you are. But you've flown into worse weather than this, so you press on.

You find yourself unconsciously easing back just a bit on the controls to clear those none-too-imaginary towers. With no warning you're in the soup. You peer so hard into the milky white mist that your eyes hurt. You fight the feeling in your stomach. You swallow only to find your mouth dry. Now you realise you should have waited for better weather. The appointment was important — but not that important. Somewhere a voice is saying 'You've had it — it's all over'.

178

You now have 178 seconds to live. Your aircraft feels on an even keel but your compass turns slowly. You push a little rudder and add a little pressure to the controls to stop the turn but this feels unnatural and you return the controls to their original position. This feels better but your compass is now turning a little faster and your airspeed is increasing slightly. You scan your instrument panel for help but what you see looks somewhat unfamiliar. You're sure this is just a bad spot. You'll break out in a few minutes. (But you don't have a few minutes left. . .)

100

You now have 100 seconds to live. You glance at your altimeter and are shocked to see it unwinding. You're already down to 1200 feet. Instinctively, you pull back on the controls but the altimeter still unwinds. The engine RPM is in the red — and the airspeed nearly so.

45

You have 45 seconds to live. Now you're sweating and shaking. There must be something wrong with the controls: pulling back only moves that airspeed further into the red. You can hear the wind tearing the aircraft.

10

You have 10 seconds to live. Suddenly you see the ground. The trees rush up at you. You can see the horizon if you turn your head far enough, but it's at an unusual angle — you're almost inverted. You open your mouth to scream but. . . ●