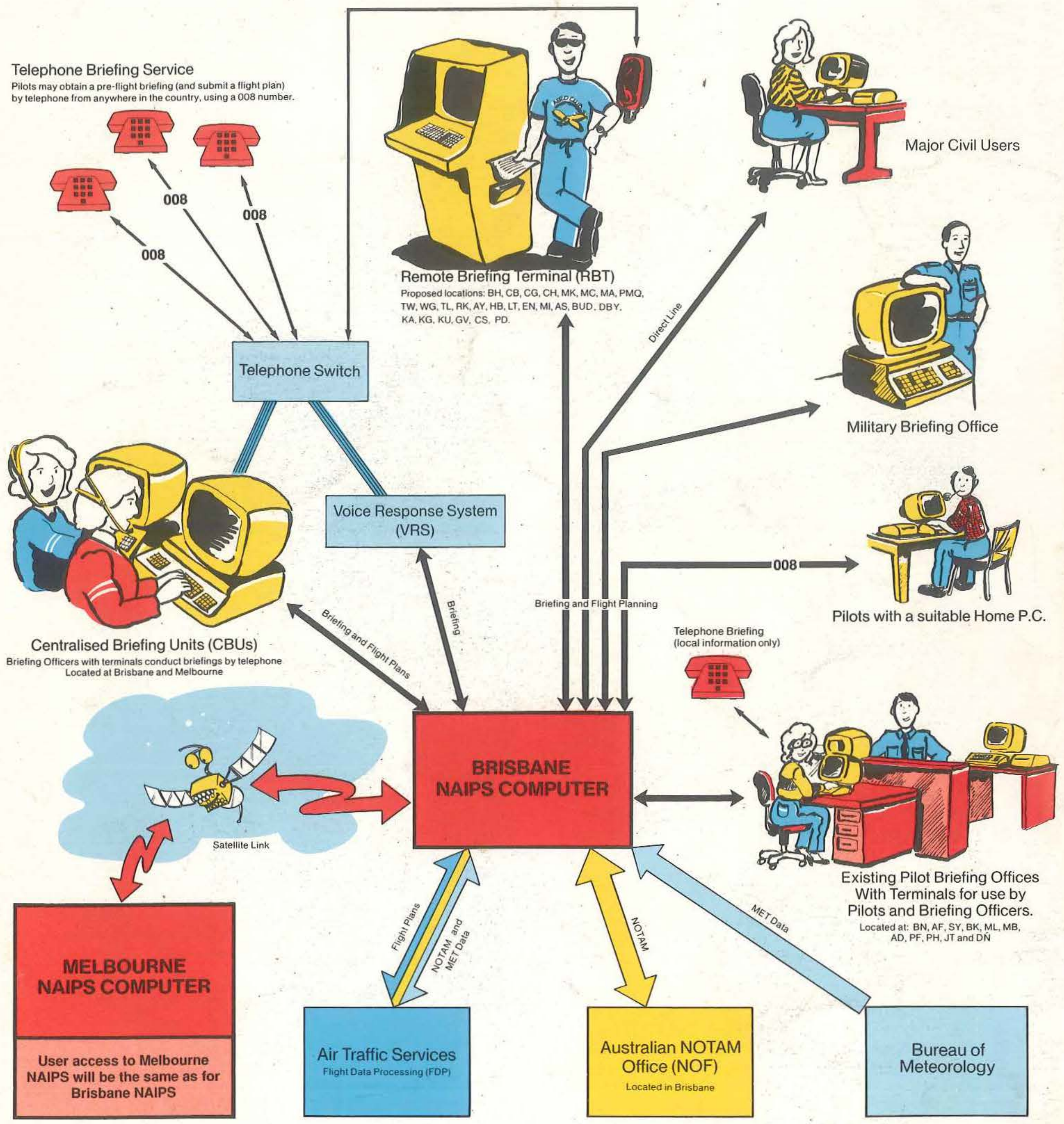
National Aeronautical Information Processing System
NAIPS
Available 1992



NAIPS will:
- Provide route-specific pre-flight briefings
- Prepare flight plans for pilot acceptance
- Validate and accept flight plans for distribution to ATS units
- Provide pilots and companies with the means to store regularly used flight plans
- Receive and store NOTAM and MET data
- Contain a database which includes: aircraft performance, AGA data, all air-routes, standard flight plans, topographical data etc.

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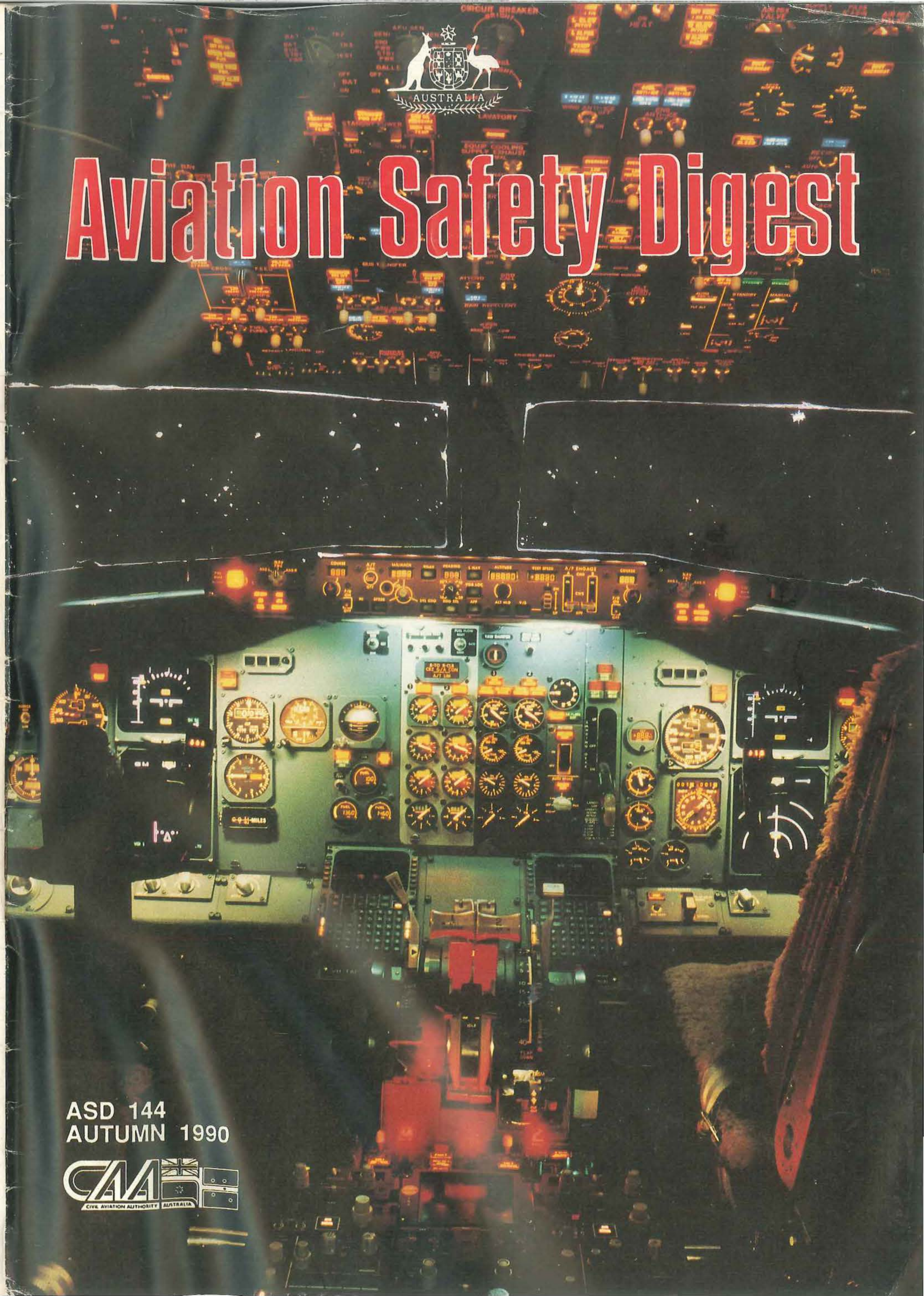

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AUTUMN 1990

CAA — CIVIL AVIATION AUTHORITY AUSTRALIA

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Unless otherwise noted, articles in this publication are based on Australian accidents, incidents or statistics.

Reader comments and contributions are welcome but the editor reserves the right to publish only those items which are assessed as being constructive towards flight safety and will make editorial changes to submissions in order to improve the material without altering the author's intended meaning.

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Contents

Editorial

The main article in this edition is concerned with autopilots, and is competently introduced by a senior member of our Airworthiness staff. I make no apology for the fact that it is lifted, completely, from a sister publication because, whereas on the most obvious level it is an explanation of what can go wrong with your autopilot and is replete with case histories, what attracted me was the underlying, and continuous, plea by the author(s) — 'Learn, Know and CHECK'. This, it seemed, was flight safety discipline in microcosm. The best pilots I know never, but never, stop learning. They take advice from wherever it may be available, consider it carefully, then use what they have confirmed to be correct. They are never too hurried to check and double check, and, knowing that aviation is an achievement in the face of Nature, maintain a continued healthy scepticism concerning the safety of any operation. You will note I said 'best' — alas, BASI statistics indicate that over the last 20 years in Australia 76% of all aircraft accidents have had assigned to them at least one human error as a 'major factor'; this gets us nicely back to the article, the thrust of which is that, no matter what goes wrong (short of a catastrophic failure), the PIC of any aircraft should be fully aware of the reversionary procedures available to at least mitigate the problem. Things generally work as advertised but, as Allan Sherman said in another context, 'each large appliance . . . treats us with defiance'. It's up to us to show machines who's the boss; to do that we have to know all their little ways.

I hope the quiz is of interest; given the source of the questions it certainly should be relevant, and those who are still to sit theory exams might do well to consider the content quite carefully.

Notwithstanding industrial turmoil, aviation in Australia grows year by year. There were some 800 new aircraft registrations 88-89; all we in the business have to do is increase our proficiency and enjoy our flying (necessarily in that order).

Covers

*Front: Shows the Flight Station on a Boeing 737-300
Photograph taken by Bob Finlayson*

Back: Facilities available via the National Aeronautical Processing System

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Microbursts

Bureau of Meteorology

Over the past 10-15 years there has been a considerable amount of research on the impact of microbursts on aircraft operations. This research has been directed towards a better scientific understanding of microbursts, the development of detection and warning systems and enhanced knowledge of aircraft performance within a microburst. The bulk of this R & D has been conducted in the USA, where there have been several major accidents attributed to microbursts.

As recent studies suggest microbursts present a significant hazard to aircraft operating in Australia, the following brief summary represents current knowledge on the phenomena, and is offered as assistance to pilots generally.

Description

A MICROBURST is a strong, concentrated downburst of cold air from the base of convective cloud, inducing an outburst of strong winds near the surface over a limited horizontal area. The peak wind gusts last only two to five minutes, but the associated downdrafts and horizontal wind shear can present a very serious hazard to aircraft operations at low altitudes.

Microbursts may be associated with heavy convective precipitation (the 'wet' microburst), or there may be little or no rain reaching the surface (the 'dry' microburst). Typically, the wet version will emanate from a large convective cell or a thunderstorm, and observations from USA suggest approximately 5% of thunderstorms produce microbursts.

On the other hand, in situations where the cloud base is high and the sub-cloud layer is unstable and relatively dry, a very light shower from a thin layer of cloud is sufficient to generate a microburst. In such circumstances the precipitation may not even reach the ground (the 'dry' microburst).

Evaporation and melting of precipitation as it falls through the sub-cloud air causes cooling of that air. This cooler, more dense air accelerates downwards as a downdraft. Downdrafts associated with microbursts are typically only a few hundred to 3 000 feet across. When the downdraft reaches the ground, it spreads horizontally and may form one or more horizontal vortex rings (Figure 1). The outflow region is typically 6 000 to 12 000 feet across, and the horizontal vortices may extend to over 2 000 ft AGL.

When an aircraft flies through a microburst at low altitudes it will initially encounter an increasing headwind, followed rapidly by a strong downdraft and increasing tailwind. This may result in a rapid and potentially hazardous decrease in airspeed and angle of attack. In America, Doppler radar wind measurements indicate the wind speed change you might expect when flying through an 'average' microburst is around 45KT, although differences of up to 100KT have been measured.

Microburst outflows may be asymmetric, and in these situations there may be no sudden ASI increase to alert you to the imminent — and possibly catastrophic — drop in airspeed.

Windspeeds associated with microbursts typically intensify for about 5 minutes after initial ground contact, then dissipate in 10-20 minutes' time (Figure 2). Because of its short life-cycle a reported encounter during the initial stage of microburst development may not be considered significant, but an aircraft following only a few minutes later may get into extremely hazardous shear.

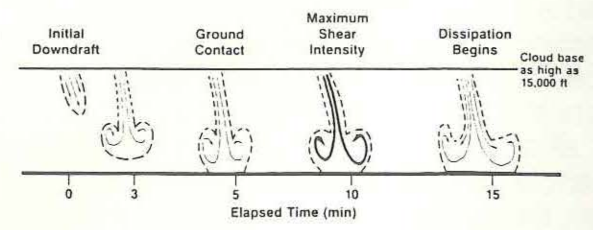


Figure 2. Evolution of a microburst. Microburst winds intensify for about 5 min after ground contact and typically dissipate 10 to 20 min after ground contact.

Microbursts will often occur in groups, and if a microburst is encountered or reported, pilots should be alert to the possibility of further bursts occurring in the area. If several microbursts are closely spaced a series of horizontal vortices can form near the ground; these can produce very powerful updrafts and roll forces, in addition to the more familiar downdraft.

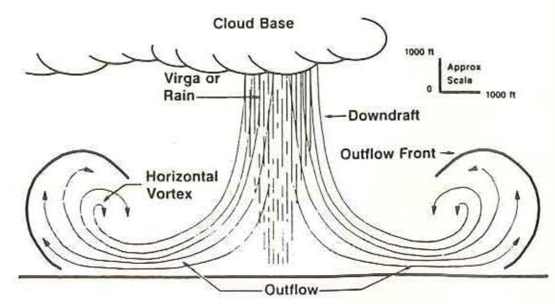


Figure 1. Symmetric microburst. An airplane transiting the microburst would experience equal headwinds and tailwinds.

Occasionally, microbursts in close proximity can become organised into a 'microburst line', which can persist for a long time. Typically, the microburst line has a lifetime of about an hour, although individual bursts within the line may be much less persistent. Microburst lines in the vicinity of an airport's arrival and/or departure lanes obviously pose a most serious hazard to operations.

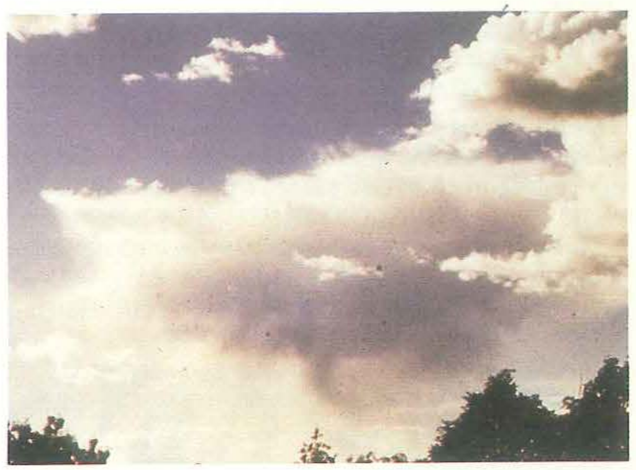
Visual recognition of microbursts

This should begin in the flight-planning stage, with a close examination of current weather and the forecast for each aerodrome to be used. Any convection in the atmosphere presents the potential for microbursts. Remember that if the conditions are hot and dry and there is a high cloud base, it takes only small cumuliform clouds and virga showers (precipitation that doesn't reach the ground) to generate 'dry' microbursts.

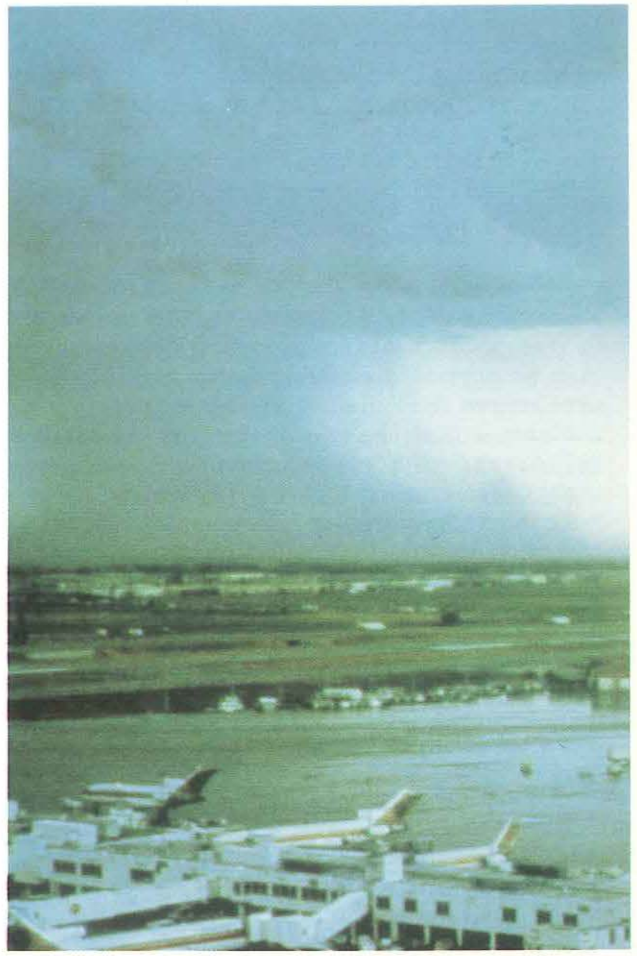
Some 'clues' to look out for include:

- reports of hazardous wind shear from other aircraft operating in the area
- unusual fluctuations during take-off or final stages of landing
- unusual vertical airspeed fluctuations (ie rate of climb/descent)
- blowing dust, particularly if it appears to have a circular pattern: for 'dry' microbursts this may be the only indication of hazardous wind shear.

- virga. The pilot should be alert to the possibility of 'dry' microbursts particularly if the cloudbase is high and the sub-cloud layer is hot and dry.



- precipitation from convective cloud, particulary if a curling outflow is evident near the surface.



If wind shear is encountered during take off or landing, it is essential that it be reported to ATS, or details broadcast, even if it is not considered particularly dangerous. Should the shear be associated with a developing microburst, following aircraft could be placed in peril.

Aircraft encounters with microbursts

Microburst encounters have been responsible for over 600 fatalities and several major aircraft accidents involving US air carriers over the last 10-15 years. In Australia, recent studies suggest a microburst was responsible for the crash of the Fokker Friendship at Bathurst in 1974.

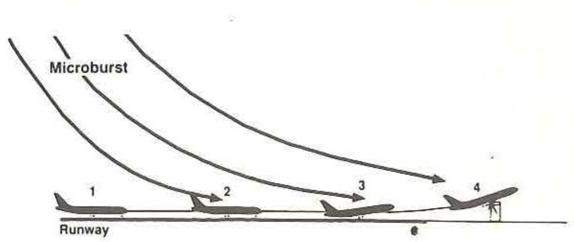
The best method to avoid an accident associated with a microburst is to avoid the encounter in the first place, for some bursts cannot successfully be negotiated by any known technique. Nevertheless, meeting a microburst may be unavoidable, so familiarity with the conditions surrounding past accidents and incidents may well be of vital value.

Reported accidents and incidents associated with microbursts can be divided into three types:

- during take-off on the runway
- after lift-off
- on the approach to land.

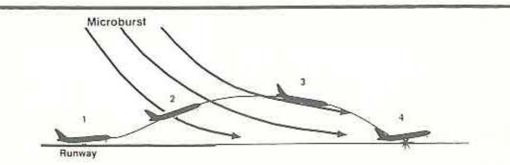
Familiarity with these three possibilities will help the pilot understand what is happening should he be unfortunate enough to fly into a microburst. Early recognition of a microburst encounter will enable him to initiate immediate and appropriate recovery action. In some cases as little as 5 seconds may be available for this. Worst cases could be:

- **Encounter during take-off on the runway:** in this case initial indications at brakes-off may be normal. However, as the aircraft accelerates the tailwind increases, possibly to the extent that the end of the runway arrives before take-off speed is achieved. Even if initial acceleration seems normal, the microburst may induce an over-rotation by the pilot, in an effort to get airborne, even to the extent of the rear fuselage striking the ground. After lift-off the tailwind continues to increase, the aircraft fails to gain altitude and consequently strikes an object off the departure end of the runway (ie crashes).



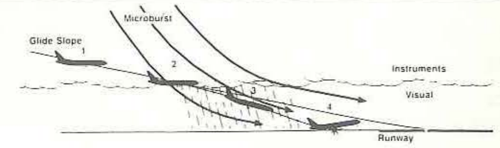
Windshear encounter during takeoff on runway. (1) Takeoff initially appeared normal. (2) Airspeed buildup slowed due to windshear. (3) Airplane reached V_R near end of runway, lifted off but failed to climb. (4) Airplane contacted obstacle off departure end of runway.

- **Encounter after lift-off:** The take-off typically proceeds as normal until a few seconds after lift-off, when the aircraft encounters a rapidly-increasing tailwind. Airspeed is lost, the aircraft descends to crash some distance beyond the end of the runway



Windshear encounter during takeoff after liftoff. (1) Takeoff initially appeared normal. (2) Windshear encountered just after liftoff. (3) Airspeed decrease resulted in pitch attitude reduction. (4) Aircraft crashed off departure end of runway 20 sec after liftoff.

- **Encounter on approach to land:** In the final stages of approach the aircraft experiences an increasing downdraft and tailwind. Airspeed is lost, flight continues increasingly below the glidepath, resulting in a crash short of the threshold.



Windshear encounter during approach. (1) Approach initially appeared normal. (2) Increasing downdraft and tailwind encountered at transition. (3) Airspeed decrease combined with reduced visual cues resulted in pitch attitude reduction. (4) Airplane crashed short of approach end of runway.

Changes to wind speed and direction (either vertically or horizontally) alter both airspeed and angle of attack, thus altering lift. Whereas the lift coefficient for an aircraft as a function of airspeed and angle of attack is of course dependent upon aircraft type and its flight settings, the Lift Force Table is representative of commercial swept-wing aircraft during a flaps-extended take-off. It shows the fractional loss of lift due to a one-knot increase in the tailwind, or a one-knot increase in any downflow speed. It can be seen that the loss of lift due to an increase in tailwind is independent of the angle of attack, whereas the loss of lift due to an increase in downdraft speed increases significantly as the angle of attack decreases.

LIFT FORCE TABLE

Fractional (%) loss of lift force due to a one knot increase of the tailwind or one knot increase of the downflow. For simplification, A = G = 150 kts was assumed.

Angle of attack	0°	5°	10°	15°	20°	
Loss of lift by tailwind	1.3	1.3	1.3	1.3	1.3%	per kt.
Loss of lift by downflow	13.2	4.5	2.5	1.3	0.5%	per kt.

The table further suggests that decreasing the pitch attitude of an aircraft in order to gain airspeed will lead to increased loss of lift where there is increasing tailwind and downdraft.

Because of the short life span of microbursts and their limited horizontal extent, it is not really possible at this stage to forecast their occurrence. Systems are being developed in the USA to identify microbursts and alert ATS and pilots of their presence. However, the introduction of such system in Australia may be some years away. It is therefore imperative that pilots be aware of any clues, visual or otherwise, that may suggest the likelihood of microbursts upon departure or approach.

Frequency of microbursts in Australia

Recent studies in Darwin with Doppler radar indicate the frequency of thunderstorms during the wet season lead to a high possibility of microbursts. The events observed were all 'wet' microbursts, and it is reasonable to extend this possibility across all tropical areas of the country whenever convectively unstable conditions prevail.

In southern and inland areas of Australia the chance of microbursts also increases with any increase in convective instability.

In particular, pilots should be alert to the possibility of 'dry' microbursts over inland and southern parts of the country. □

Quiz Quiz Quiz

WE decided that the people in daily contact with the industry were perhaps the best to pose questions. Therefore, examiners, airways surveyors, airworthiness engineers, air traffic controllers and flight service officers were asked to provide questions that best represented the sort of thing that 'bugged' them as far as the aviation knowledge of their customers was concerned. A selection, with (most) authors' names, follows (answers on page 16):

Q1.Is it legal to test an ELB without notifying the appropriate authorities?

(Gareth Phillips and Kees van Riel, Flight Service Officers).

Q2. Who are required to report arrival at non-controlled aerodromes outside an AFIZ and what is to be included in such circuit area reports?

(Stuart Hunt, Flight Service, Townsville).

Q3.You are operating a passenger-carrying charter flight by night in a twin-engined aeroplane not exceeding 5700kg MTOW. Your destination is Dogsville (DGV). DGV has only one instrument approach procedure (NDB/DME), and your aircraft is suitably equipped with a single ADF and a single DME. The lowest holding altitude and initial approach altitude for the IAP is 3 000'. DGV has an aerodrome elevation of 75'. The ARFOR and the TAF indicate that except for '5CU030', the weather forecast for your arrival could be described as CAVOK. The LSALT for both IFR and NGT VFR on the final route segment to DGV NDB is 4 300'.

(a) May your flight be planned 'NGT VFR'?

(b) Would you be required to provide for an alternate aerodrome?

Enroute, you discover that your aircraft's DME is faulty...

(c) Are you required to notify ATS of the DME problem?

(d) Does the faulty DME affect your plan to use DGV as a destination? Why?

(e) If your answer to (d) is 'yes', may you continue to DGV with the intention of landing there after making a visual approach?

(f) What requirements must be satisfied before a visual approach is commenced at night?

(Barry Cowdell, Airways Surveyor).

Q4.Without rushing to your aeroplane, decode the colours marked around the ASI.

(Paul Middleton, Assistant General Manager, Standards Projects).

Q5.You are planning a flight to Melbourne (AMML) with an ETA of 0500UTC. At pre-flight briefing you obtain AD forecasts for AMML which commence as follows:

'TAF AMD AMML 0324.....'

'TTF/METAR AMML 0230....'

Which statement regarding the applicability of these forecasts to the planned flight is correct?

(a) Neither forecast should be used because they both expire before 0500 UTC.

(b) The TAF should be used because it is valid until 2400 UTC, whereas the TTF METAR expires at 0230 UTC.

(c) The TAF should be used because it is valid until 2400 UTC, whereas the TTF METAR only provides a weather trend.

(d) The TTF METAR should be used because it is valid until after your ETA, and supersedes the TAF.

(Paddy Earle, Theory Examiner).

Q6. What is the correct procedure to be employed in a 'step climb'?

(Rockhampton ATC). □

Talk and tank

Pilot contribution

HAVING held a Private licence for 33 years, I can be identified as one of those pre-radio pilots for whom 'clearance' was a green light from the Tower, and for whom a relayed phone message usually meant 'Sarwatch terminated'. Now and again, if lucky, one might be afforded the privilege of a ride in a new luxury machine which actually sported that modern miracle called two-way radio.

Now, thirty years down the track and still flying, I am amazed and appalled at the radio procedures used by some GA pilots, even those with thousands of hours under their belts and all having known no way of communication other than radio. I am at a complete loss to understand why these (certainly not all) pilots think it as clever, or at the very least acceptable, to deliver a report which could be likened more to an underwater kindergarten party than an integral part of the general flying safety spectrum. Surely a message that is so slurred or mis-modulated that it needs to be repeated two or three times cannot be deemed to be smart, efficient or time-saving. Yet it is true that most radio calls are understood by ATC and FS, because the personnel there are anticipating THAT call from THAT aircraft and they know almost word for word what the call will contain. But other aircraft in the area have the utmost difficulty in translating these sloppy calls. This is of course wrong — they should know what is being said, and indeed have a right to know. The old rule of 'see and be seen' is just as important today as it was thirty years ago, but so is the 'new' rule 'hear and be heard'. Aircraft separation is the concern of pilots as well as ATC and FS, and those flyers who are too lazy to open their mouths and let others hear who and where they are should not be afforded the privilege of holding current licences.

While FS and ATC are generally above this criticism, some of the ATIS recordings that must be endured are also beyond belief. Once again, if the message can be anticipated and the pilot is familiar with both the area and the aerodrome, there will be little trouble deciphering the message. But this is not always the case, with the result that pilots are still making mistakes in busy circuits. Surely a message that is being repeated over and over again on a tape is not restricted by time duration, and therefore should be clearly enunciated and correctly punctuated. A message that promotes confusion is worse than no message at all.

On another matter, there seems to be no standard fire safety procedures regarding the fuelling of aircraft from bowser hoses. Recently, I was involved in heated exchanges with refuellers at several aerodromes because I had observed with great concern and displeasure the refueller removing the cap from the fuel tank of my aircraft BEFORE connecting the earth lead from the hose. It seems they remove the cap, place the fuel hose nozzle in the tank — and only then connect the earth strap. Someone please tell me if I am right or wrong. Surely any static discharge must be allowed to happen before the tank is opened. Am I old-fashioned to be paranoid about this small thing? And if I am right and they are wrong, why is no one else bothering to tell them so? In other words:

'Earth strap on,
Fuel tank cap off,
Fuel hose nozzle into tank,
Fuel hose nozzle out of tank,
Fuel tank cap on and secure,
Earth strap off.'

We referred these two important aspects of flight safety to one of our oldest and boldest examiners. 'Why!', he said, 'Was not everyone in the aviation game taught 'RSVP'?' Well, we asked around, and no-one knew what it meant (perhaps he is too old!). Anyway, the mnemonic is well-worth committing to memory, for it reminds us, when transmitting, of:

Rhythm — a steady, even flow of words
Speed — slightly slower than normal
Volume — slight increase
Pitch — slight increase

Incidentally, Air Traffic Services instructions (AOI-GEN 12-1-1) limit ATIS transmissions to 30 seconds: 5 for station ident, 25 for information. The need for clarity is therefore obvious.

Concerning refuelling procedures, Steve gave 100% to the writer's sequence of events, but remarked that he wondered how many of us really knew why this was the only safe way to treat the operation. We believe every pilot and every refueller knows full well that the aircraft has to be earthed from before commencement to after completion of the fuelling process. There is no other safe method; certainly sticking a AVGAS nozzle into an unearthed aircraft that has perhaps just taxied in from a trip in thundery weather seems suicidal (and/or murderous).

There are formal requirements: CAO 20.9 lays down that the aircraft and all items of refuelling equipment be connected in such a way as to ensure that they are of the same electrical potential. The fuel companies, too, have strict operating procedures and of course they include the sequence of action described by the correspondent.

And yet, and yet...slipshod practices do exist. It is only to your advantage as the pilot/owner to keep a sharp watch on refuelling. If you see something being done that you think is stupid — speak up! It's possible that you might be wrong on occasion, but far better that than letting a disaster develop due to your timidity. □

Of course, there's earthing and 'earthing'...

'Prove all things; hold fast that which is good'

(1 Thessalonians)

'THAT WHICH IS GOOD' is, of course, you and your nearest and dearest, and you certainly don't want to compromise the safety of any of them. OK, so you make sure seat belts are done up as part of the pre-take off checks. But what do we need to know about the equipment itself?

The pilot of a glider involved in a mid-air reports thus:

'I ejected the canopy and released the harness, but could not get out. Looking down I realised that the harness had not released properly and I was still held in by the waist straps. I released these and pushed my feet out of the glider, which was now in a vertical dive and commencing to spin to the right.'

Inspection of the harness buckle revealed wear marks which indicated that the first element of the buckle had been protruding too far into the second element, thereby allowing it to jam.

The buckle could assume this position because part of the original harness the abdominal pad had been replaced with a smaller pad which did not restrict the buckle elements to their correct positions. The GFA has issued an Airworthiness Directive.

Seat belts and harnesses are a bit like instruction books — their value becomes obvious only when all else fails! But:

when a seat belt/harness is needed, you definitely want it to work as advertised

That is why the gear needs to be kept in good repair. When there's a catastrophic deceleration, or application of negative 'G', it's too late to be thinking about that small cut in the webbing or those torn threads.

There are two answers for damaged or worn webbing: **REPLACE** or **REPAIR.** Strictly speaking, 'repair' is not the right word, as the only acceptable fix is to replace it completely using the existing hardware. Each seat belt design is approved by strength and functional tests. Once approved, subsequent belts are exact 'clones' of the prototype. **NO** variation can be legally made without further tests. Therefore, any re-webbing of a belt must be carried out by an approved organisation. The stitch pattern, cotton and webbing must be exactly similar to the original. However, as this information is often unavailable, alternatives must be sought **AND APPROVED.**

Maintenance organisations, operators and particularly pilots, whose lives might depend on it, need to be confident that all seat belts are in good condition and either original or have been re-webbed by an approved organisation.

REMEMBER — it is dangerous to fit unapproved seat belts, not because they are *unapproved* but because there is no guarantee that they will work properly □

NIL DEFECTS

Traps await unwary users of autopilots

The following article is reprinted in toto by permission of **Aviation Safety**, *75 Holly Hill Lane, Box 2626, Greenwich, Connecticut 06836-2626 (all rights reserved).*

Frank Grimshaw*, Principal Engineer, Avionics, Airworthiness Branch comments thus:*

All pilots should be aware of the potential for disaster that exists when the untrained, led by the uncaring, step into the unknown.

Perhaps those last words are a little provocative, so before reading the article, you might care to ask of yourself these few questions:

- *do you know how to operate the autopilots in the aircraft you fly?*
- *do the aircraft you fly have electric trim systems?*
- *have you read the operating instructions?*
- *is a copy of the operating instructions for the autopilot and electric trim installation available in the aircraft you choose to fly?*
- *have you read the flight manual supplement that spells out the limitations applying to the use of the autopilot?*
- *do you, as a matter of course, perform the required pre-flight tests of the autopilot and/or electric trim system?*
- *do you know the drill for in-flight autopilot malfunction?*
- *do you know how to override and disengage the electric trim system following a runaway?*
- *what happens if you, as instinct would have it, overpower the autopilot?*
- *what did the person who checked you out for endorsement on the aircraft you fly tell you about the autopilot and/or electric trim system fitted? and finally, and possibly of most importance,*
- *WHAT DID YOU ASK?*

Please read on; the article needs no further introduction...

ONE OF THE more complex devices found on light aircraft is the autopilot. However, as with any mechanical system, the possibility of both mechanical failure and operational error goes up drastically with increasing complexity. FAA certification regs require that no single failure of the system will lead to loss of aircraft control, and the manufacturers go to great lengths to ensure that the pilot can take control of the airplane should the autopilot go bad. However, as the record shows, there are traps inherent in autopilot systems that can lure an unwary or inattentive pilot into difficulty or even disaster.

Insidious failures

Some of the ways in which an autopilot can go wrong could sneak up on a pilot, and under some circumstances the failure could go unnoticed until it was too late.

Aviation Safety's own Mooney 201 displayed just such a problem at one time. It was first noticed while flying down the New York VFR corridor over the Hudson River. The pilot engaged the autopilot (a Century 41) in altitude-hold mode. A short time later, he switched on the landing light to increase the airplane's visibility to oncoming traffic. Almost immediately, the autopilot began to slowly pitch the aircraft down, and some altitude was lost before the problem was rectified. The effect was relatively mild and easily controlled given that the system was shut off almost immediately. But, it was still an undesirable and, more importantly, uncommanded change in trim.

However, the trouble was not in the autopilot at all. It was the aircraft's alternator, which was not producing sufficient power to run the landing light, pitot heat and radios as well as the autopilot. After the alternator was replaced, the problem never recurred.

Under different circumstances (like on a night-IFR flight, with strong turbulence and a high stress level in the pilot), the pilot might have shut off the autopilot, but not noticed the nose-down trim the autopilot had cranked in until a dangerous condition had developed.

It should be noted that, though the Century 41 has many fail-safe modes that will shut off the autopilot automatically, this is not one of them. The only response to low voltage is a flashing of the autopilot annunciators. The autopilot remains engaged. A Century representative, when told of the incident, responded that the company had not heard of the model 41 producing uncommanded nose-down trim with low power input (nor have we — it may be an isolated incident).

Mechanical glitches

When the trouble is in the autopilot, all sorts of things can happen, some of them alarming. *Aviation Safety* obtained printouts of Service Difficulty Reports dating back to 1973 concerning autopilots and related control system components. We include here the control and automatic trim systems, since autopilots are so intimately tied to them that there is no real dividing line.

NIL DEFECTS

Failures that manage to get past the safeguards built into the system are relatively rare, but they still happen. Occasionally, these failures also produce control difficulties.

For example, one report told of an incident in which a Piper PA-34-200 Seneca went into a dive while cruising. A contact had broken off of the pitch-trim sensor and shorted the unit out, leading to full nose-down trim. Fortunately, the pilot was able to recover. A similar failure affected another Seneca, only in the opposite manner. The contacts in the pitch-trim sensor were damaged, preventing nose-down operation of the electric trim.

There were a few reports of sticking vacuum actuators in Brittain autopilots. These systems are unusual in that they are not electromechanical, but rather vacuum-driven. The failures may lead to autopilots that will not disengage — and Brittain autopilots have no alternate method of shutting the system down.

For example, a Brittain B4 autopilot was involved in an incident in which the pilot of a Beech S35 Bonanza found he was unable to move the aileron control to the right shortly after takeoff due to binding components behind the instrument panel. He made a successful landing.

In another report, a Cessna T210M equipped with an ARC 400B autopilot encountered runaway trim while in altitude-hold mode. The autopilot would not disengage, and the pilot recovered within 200 feet of the ground. The exact nature of the failure was not reported.

However, one mechanic found four separate ARC 400B installations (all in Cessna 421Cs) in which the pitch actuator relay contacts fused together. As a result, the autopilots could not be shut off.

Another report told of a Cessna 421C equipped with an ARC autopilot. The unit had a defective computer, reportedly causing violent pitch and roll oscillations whenever the unit was engaged.

When it comes to Bendix autopilots, clutches seem to be a trouble point. For example, a Bendix M4-autopilot, installed in a Beech E90 King Air, had worn teeth on the main servo clutch, preventing the clutch from disengaging.

Clutch problems plagued other Bendix autopilots as well. The roll servo clutch in a Cessna 310L failed, locking the ailerons. The pilot reported the controls to be very restricted. In another incident, the pilot of a Beech Duke encountered a frozen elevator in cruise flight. He suspected ice, and reported that it took a force of 120 pounds to move the control. The actual cause was later traced to a damaged autopilot clutch.

There were numerous reports of trouble with bridle cables and their associated capstans on Edo/Mitchell autopilots. In most cases, failure of the cables simply disabled the autopilot. In some instances, though, there were complications. A Beech E18S had a bridle cable get tangled in the capstan, locking the aileron cables. A Piper PA-30 Twin Comanche suffered a frayed and broken aileron bridle cable, which led to the cable clamp getting caught on the aircraft primary structure. This, in turn, caused the ailerons to jam in a right-wing down position.

Many autopilot problems are elusive to maintenance personnel. One report told of an Edo/Mitchell Altimatic 2 installed in a Piper PA-23-250 Aztec. The Aztec suffered runway nose-down trim in flight, but the problem could be reproduced only intermittently on the ground — a complaint not uncommon with autopilot systems.

Some reported failures were of the most mundane nature. A Beech Super King Air 200s Sperry SPZ200A refused to disengage. The reason: The engage switch was stuck in.

Poor workmanship by field mechanics was targeted in several reports. In one report, an ARC autopilot computer installed in a Cessna 414A had 15 wire splices in its wiring harness, one of which had not been insulated properly, leaving a bare wire.

In another report, failure to clean up properly after completing other work caused a King KFC-200 installed in a Mooney 201 to operate erratically. Metal chips left from working on the instrument panels with a drill were found shorting some of the autopilot's connectors.

The clutch settings on one KFC-200 installation in a Piper Navajo had been done in reverse — the pitch servo clutch had been adjusted to the roll servo setting, and vice versa.

Three seconds

Just how long does a pilot have to deal with a problem if the autopilot malfunctions? Should a major failure of the flight control system occur, sooner or later a significant change in altitude and/or airspeeds is bound to occur (probably sooner). Exactly how long that is depends on the airplane and circumstances, but FAA standards call for only three seconds.

Part of the certification process of a flight control system involves flight tests in which failures are imposed on the system and a FAA-certified test pilot employed by the manufacturer deals with them. According to Kevin Jones, a spokesman for Century Flight Systems, Inc., the test pilot waits three seconds to react (measured by stopwatch), and the deviation from normal flight experienced in that time is recorded and ultimately winds up in the airplane's flight manual.

NIL DEFECTS

The three-second delay is meant to simulate the time it would take a pilot, once he has noticed the problem, to decide on a course of action and perform it. It is measured not from the time the failure is instigated, but rather from the time the test pilot first notices it. Determinations of exactly when the problem becomes noticeable is left to the test pilot.

Failure tests are also performed with the airplane in approach configuration, but here the delay before action is taken is only one second. This is based on the heightened awareness a pilot supposedly has during this phase of flight, said the manufacturer.

Under ordinary circumstances, a pilot should have no difficulty in reacting to a systems failure in the time allowed. However, should he fail to do so in the flight-tested three seconds (or one second), he has entered a realm of flight where it is not really known what the system will do.

Sneaky pitch trim

One malfunction theme that shows up consistently in the accident record stems from the way some autopilots control the pitch of the airplane. In general, autopilots control pitch by moving the elevator itself. This works well, as long as the airplane is trimmed properly; an out-of trim condition will overpower the autopilot's clutch and allow the airplane to climb or descend.

But in airplanes equipped with electric trim the autopilot also has control of the trim mechanism. It will sense whether or not constant pressure is being applied to the elevator in order to maintain altitude and interpret it as an out-of-trim condition, running the trim motor to correct it.

A system failure in an airplane without auto-trim can very easily be overpowered by the pilot. With auto-trim installed the pilot may be able to overpower the elevator clutch, but the trim motor may still continue to run, causing a real problem. It is for this reason that 'fail-safe' trim interrupt switches are installed on these autopilots.

Using electronic switching, the autopilot can perform self-checks of the auto-trim system, the gyros, the altitude information provided by the static system, and sensing of correct electrical power input. When the self-check turns up something amiss, the autopilot can shut itself off.

Yet, despite trim interrupt switches and automatic interrupts, runaways still occur. Unless the pilot realizes fairly quickly that he needs to shut off the electric trim and retrim the airplane by hand, he may find he is about to either exceed V_{ne} or stall.

'Runaway trim in an airplane equipped with an electric trim system is one of the more insidious failures,' said Century spokesman Jones. If the pilot fails to catch the trim problem in time, he may not be able to deal with it at all. It may take both hands and all his strength just to hold the control wheel. Many small planes have enough trim authority that a typical pilot may not be able to hold the airplane in straight-and-level flight against the trim if its run up against its stops.

To see what level of force is involved in fighting against unwanted trim, we took up our Mooney and tried to maintain straight-and-level flight while cranking in trim. At about 125 knots (close to turbulence-penetration speed), there was no way to reasonably hold the airplane level after the trim had passed a point about two-thirds of the way to the stops. A runaway electric trim condition could reach this point in considerably less than a minute. At higher speeds, even less deflection would be needed to produce a serious problem. Although there are safeties built into the system to prevent a runaway from happening, these may not always work, as evidenced by reports of the condition occurring. The trick is to catch a trim imbalance and correct it before it is too late, regardless of its source.

'Main strength'

An accident that graphically shows the danger inherent in a runaway trim situation occurred on May 26, 1984 Birmingham, Alabama. The pilot, an instrument-rated doctor with 350 total hours, 305 of which were in type, was killed when his Beech A36 Bonanza dove into the ground.

The accident came just a few minutes after departure. The pilot's final transmission to controllers indicated he thought the problem was with the autopilot. 'I'm over here on Fayette heading this way', he said. 'My, uh, automatic pilot is stuck. It's taking main strength to hold it. I'm heading back to Birmingham... How about, uh... talking to somebody that knows about a Bonanza to see what I can... to see what I can...'

The Bonanza crashed seconds later. Witnesses reported seeing the airplane nose over in a broad arc and dive vertically to the ground. The attitude at impact was slightly beyond vertical. At the scene, investigators found the Bonanza's trim tabs in the full nose-down position, indicating the possibility of runaway trim.

The autopilot, a King KFC-200, had been malfunctioning prior to the accident. A pilot who flew the Bonanza the day before the accident said the autopilot would not disconnect by using the OFF switch. The accident pilot had aborted a flight earlier that day due to 'HSI problems.'

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AVIATION SAFETY DIGEST reports incidents, recounts stories, relays technical information, represents the pilot and others involved in aviation, and, to the extent that it falls short of being a legal document, reflects the viewpoint of the CAA.

We have noted previously that regulation alone may well have been exhausted as a means of reducing accidents. This is not to say the CAA is on autopilot — there are moves afoot to make CARs, CAOs and subsidiary legislation more user-friendly (or at least, somewhat simpler).

Although an aviator will always benefit from reading about another's brush with disaster, we are all fortified in the diligence of our personal pursuit of safety by the knowledge that there are a lot of fellow flyers who think twice — nay three times even — before committing themselves (and their passengers — never forget the pax) to operations in marginal conditions. Self-discipline, mechanical reliability and the correct application of hard-gained expertise are but the three leading links in the chain of circumstances that define a truly successful flight.

The wide range of submissions that cross the editor's desk are testimony that 'marginal conditions' cover practically everything. There are a million articles out there in the real world, and a zillion incidents (99% of which you wouldn't dream of putting your name to — that's OK, we'll respect your desire for anonymity). So why not share your hard-earned lessons? As I said, **your** story is unique!

To be part of this accumulated wisdom, those with an interest in flying, be it as a professional or paid-for-by-yourself, will do themselves a favour by reading the Digest on a regular basis; if you do not obtain a free copy, the subscription form is, as they say, overleaf.

AIRFLOW

Feeling a little query?

The AIRFLOW column is intended to promote discussion on topics relating to aviation safety. Input from student pilots and flying instructors is particularly welcome.

Anonymity will be respected if requested. 'Immunity' applies with respect to any self-confessed infringements that are highlighted for the benefit of others.

Write to: AIRFLOW
Aviation Safety Digest
G.P.O. Box 367
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Australia

ASD 142 carried an article on the possible results of the ingestion of certain substances. The burden of the message was 'Be aware; check your reactions!'. In an expansion of the discussion, the Director of Aviation Medicine here tells us of the sort of thing aircrew particularly should look out for.

Food, Drink, Drugs, Illness and Flying

IN THE SPRING issue of the ASD, an article was printed quoting anecdotal evidence concerning the use of the non-sugar sweetener aspartame. The tenor of the article was that the use of sweeteners containing this substance would on some occasions be associated with effects which could incapacitate an individual. The fact is that there is no clinical medical evidence to support this view. The article however, raised a hornets nest of questions and dogma about food, drink, medical drugs, illness and their effects on the pilot.

The problem with the human animal is that the only thing that we can be sure of medically is life and death. Between those two extremes there are no absolute certainties just many shades of grey. To say that a drug will cause unpleasant side effects on everyone is just as wrong as to assume that another drug will have no side effects on any user. We all know of people who only have to take an aspirin and it can almost kill them or an orange or chocolate may effect another with incapacitating migraine. Yet most of the population happily take aspirin and chomp chocolates and oranges with pleasurable indifference.

Similarly the effects of illness and injury vary from individual to individual. A problem which leaves one individual moribund in bed may leave another feeling well enough to work. This individual variation in the effects of foods, drugs, illness and injury is no indictment of the individual but is a characteristic over which the individual has little control.

In most forms of recreation or occupation it is of little consequence if an individual is feeling below par because of food allergy or the effects of illness or drugs to treat that illness. In aviation however there is no place for individuals attempting to operate aircraft when they are distracted by anything which effects their well being and ability to concentrate.

When the treatment of an illness or injury involves the taking of medication, whether or not these drugs are prescribed or purchased over the counter, the fact that undesirable side effects are not mentioned is no assurance that the individual will not experience some side effects. Equally if an individual is dieting or materially altering the food and drink from that which is normally consumed, in some small percentage of people some adverse effect will be experienced.

This leaves us with the fact that because of individual variability nothing can be assumed to be without some form of deleterious side effect. The only sensible path for any aviator is to make sure that no first time drugs, food or drinks are consumed when aircrew duties are anticipated.

The following is a guide regarding several of the more commonly consumed drugs.

a. **Antihistamines:** These drugs are prescribed for allergic symptoms. The most common condition for which they are prescribed is seasonal hayfever. Many over the counter preparations for the treatment of the common cold also contain an antihistamine along with other preparations.

   The most frequent side effect noted with these drugs is sedation, however they can also cause a dry mouth and difficulty with focusing. There are available now newer generation antihistamines which as a rule do not have any side effects. These are Terfenadine and Astemazole.

b. **Antibiotics:** The most commonly prescribed groups of antibiotics are, tetracycline, penicillin and its derivatives and the erythromycins. Most individuals find that they can take a course of antibiotics without the drug having any effect on their well being, or their ability to work. The most important problem when antibiotics are being used is the underlying illness which has required their use. If this problem is not such that it causes incapacity of any sort and provided the first dose of antibiotic is not taken on a day during which the individual wishes to operate an aircraft then these drugs may prove to be compatible with flying.

c. **Sleeping Drugs**: From time to time individuals may go through a phase of having sleeping difficulties. In situations such as this, it is not uncommon to have sleeping drugs prescribed to help achieve sleep. The problem with many of the older generation of sleeping drugs is that they remain in the body and have a slight residual effect well into the next day. This situation is not compatible with air crew duties. Fortunately here are available newer generation drugs which have a very short half life in the body. The effects of these drugs have completely gone 8 hours after taking the drug. These drugs are short acting benzodiazepines such as Temazepam and Triazolam. Sleeping drugs should not be relied upon for sleep on a long term daily basis.

d. **Tranquillises and Antidepressants:** These drugs by their very nature act to slow down reaction times, and allow the individual to take a more relaxed and casual attitude to all things. The attributes of this group of drugs do not relate well to air crew duties. Your Aviation Medical Examiner's opinion must be sought regarding the use of these drugs whilst flying.

e. **Stimulants:** Most stimulants are now not available either over the counter or on prescription. The reason for this is that despite keeping the individual awake, they effect the decision making process, causing over confidence, tremors, anxiety, and in some cases bizarre hallucinations. Their use is not compatible with air crew duties.

f. **Antihypertensive Drugs:** Drugs used in the control of blood pressure do not usually cause any problems, or effect an individual's performance. Apart from the usual caution of not participating in aircrew duties whilst becoming established on the drug, and clearing its use with your Aviation Medical Examiner, the drugs are generally quite compatible with flying.

g. **Alcohol:** The use of small quantities of alcohol as a social drink has not been shown to have any significant deleterious effects in most people. Alcohol is a tranquilliser and sedative, and is not compatible with air crew duties. Fortunately alcohol is fairly rapidly dealt with by the body and provided at least 8 hours pass after moderate alcohol consumption there should be no residual effect. This is not the case after heavy alcohol consumption, and a period of at least 12 hours should elapse before flight crew duties and even this length of time may be insufficient for certain effects to cease. Attention should be drawn to the deleterious effects of long term heavy consumption, and the high incidence of alcoholism amongst regular heavy consumers.

An individual starting a course of drugs or changing diet significantly, should always enquire as to whether this activity is compatible with aircrew duties. If the answer is yes that is still no assurance that there will be no side effects. The most reliable indication as to the effects of any medication on an individual is how that individual feels in the hours following the taking of the drug. Common sense dictates therefore, that when anything different in the individual's diet therapy is being commenced, wait at least 24 hours before commencing aircrew duties.

Finally the salient point remains: that it is the responsibility of the licence holder to approach the problem of fitness to exercise the privileges of a licence in a mature and sensible manner and to err on the side of safety if there is ever any doubt.

Dr R W Liddell

Accident and Incident Response

Beech 95-C55, 25 July 1988

After all attempts to extend fully the nose gear failed the aircraft was landed on a grass runway with the nosewheel some 20 from the locked down position. During the landing roll the nosegear collapsed and the aircraft settled on its nose.

Prior to making the approach and landing, the pilot said he had shut down the right engine and feathered the propeller, which was then parked in a horizontal position. On short final, the left engine was shut down and the propeller feathered. Insufficient time was available to park the propeller, which struck the ground in a vertical position. The left engine crankshaft fractured rear of the propeller hub mounting.

BASI recommendation

The actions of the pilot, although done with the best of intentions in shutting down both engines prior to landing, be the subject of a report in the *ASD*. The report should highlight the dangers involved in this practice, both airborne and after touchdown.

CAA action

The Authority agrees with the BASI opinion; we accept the recommendation, and this sort of pilot action will be discussed in our new safety promotion video, currently in production, entitled 'Going Down - a guide to in-flight emergencies'.

Boeing 737-376, 14 May 1989

On descent to Mackay the pilot was instructed by the Tower to make a DME arrival and to report at 10 DME. He was advised that there was a shower at the field, moderate rain and that the visibility was about 6000 metres. A few minutes later the Tower controller indicated that the weather was improving and the showers were mostly to the SW of the field. He then gave the pilot a choice of left- or right-hand circuits and advised that there were a few patches of low cloud.

Two minutes later the pilot advised he would be making a left-hand circuit for R/W 14 and was instructed to report on final. Approximately one-and-a-half minutes later the controller asked the pilot to confirm that the aircraft was making a missed approach. The response from the pilot was 'Negative'. Following this the controller advised that the aircraft was very low to the west of the aerodrome and suggested that a climb should be commenced. The pilot later reported that he had the runway in sight and would make another approach. A left circuit was carried out for runway 14 and the aircraft landed without further incident.

Examination of the flight data recorder information has shown that the aircraft was in a landing configuration and aligned with the Bruce Highway. It was subsequently descended to 168 ft (radio altimeter) on a heading of 180M, the same heading as the highway, and that the CAS was reduced to 137kt. Witness reports confirm that the aircraft was flown over the highway in a southerly direction at a very low altitude.

An inspection of the area surrounding Mackay Airport and the Bruce Highway was carried out in an attempt to ascertain if there were similarities between the runway and the road. Runway 14 is 1981 metres long and is lit by side variable-intensity white lights 65 metres apart. The runway is also equipped with T-Vasis approach lighting. The relevant part of the Bruce Highway is lit by post-mounted street lights on either side of the road. The lights are approximately 30 metres apart and run for a distance of about 1200 metres before becoming a single row of lights. The northern end is flanked either side by two 24-hour service stations. These provide an intense pool of light on each side of the road. There was no similar lighting on the threshold of runway 14, nor does any lighting on the highway resemble T-Vasis.

It is apparent that the pilot flying the aircraft at the time (the captain) misidentified the highway as Mackay runway 14.

The flight crew declined to make themselves available to the investigators for interview, apparently under direction from their industrial association. This action by the crew hampered the investigation and resulted in the reasons for the misidentification not being determined.

Significant factors

The following factors were considered relevant to the development of the incident:
1. The pilot flying the aircraft misidentified part of the Bruce Highway for Mackay runway 14
2. Neither pilot became aware of this error until late in the approach to a landing

BASI recommendation

That the CAA should take immediate steps to survey the lighting situation at Mackay in order to establish whether corrective action be required to prevent a reoccurrence of this nature.

CAA action

The survey has taken place and a recommendation has been made to DTC for the inclusion of a modified simple approach lighting system in the Consultant's master plan for the redevelopment of Mackay aerodrome.

AERONAUTICAL INFORMATION SERVICE AUSTRALIA

NOTICE

CURRENT DOCUMENTATION AND PLANNED NEXT ISSUE

Document	Current Issue #	Planned Next Issue #
DAP(E)	14.12.89	08.03.90
DAP(W)	11.01.90	05.04.90
AGA 0 - 1 - 2	01.06.89	31.05.90
AIP (book)	14.12.89	03.05.90
VFG (book)	14.12.89	03.05.90
AIP/MAP	14.12.89	23.08.90
VFG/MAP	14.12.89	23.08.90
DAH	14.12.89	23.08.90
ERSA	14.12.90	08.03.90
ADDGM	11.01.90	*

* Next issue will be incorporated into ERSA (08.03.90)

Dates quoted are effective dates

NOTE : NOTAM CLASS 1 AND CLASS 11 ARE TO BE READ IN CONJUNCTION WITH THE ABOVE DOCUMENTS

ISSUE : 9
DATE : 08 FEB 1990

NIL DEFECTS

The pilot's brief radio transmission suggests he thought he was fighting the autopilot, not the airplane's trim condition. While the autopilot might have caused the trim condition in the first place, the key to recovering was to shut off the electric trim system and correct it manually, which he apparently never did. He had only moments to realize the true situation before the airplane was headed straight towards the ground.

Coupled with this was the known problem with shutting the autopilot off in the normal manner, further complicating the situation.

Part of the investigation into the crash involved tests of the autopilot installation. NTSB investigator Preston Hicks said that though tests of the autopilot computer were attempted, it was too badly damaged to learn anything from. 'In fact, we blew the test rig out trying,' he said. Hicks further noted that the pitch trim servos and sensor microswitches appeared to be serviceable at the time of the accident.

NTSB's probable cause statement highlights the pilot's failure to deal properly with the situation. Listed among the probable causes were failure to understand the proper remedial action to take, failure to correct the trim, and failure to correct the autopilot.

The King KFC-200 has also been implicated in a number of other incidents involving altitude hold problems. In one particularly ironic case, the pilot of a V35 Bonanza wrote a letter to the NTSB about two weeks after the Birmingham crash. It detailed problems he was having with his autopilot.

'The problem would occur only occasionally and without prior warning. Each time it happened, the autopilot was engaged in straight-and-level flight, and the airplane would suddenly begin nosing over in an ever-steepening dive.'

Three-and-a-half months later, the Bonanza broke up in flight over South Carolina. Again, tests of the autopilot were inconclusive because of damage, and the probable cause statement does not mention the autopilot as a factor in the case.

It is important to note that there is no direct evidence specifically implicating the autopilot in this crash as there was in the Birmingham incident. Further, the crash occurred before the Bonanza tailmod AD was issued. None the less, lawsuits were filed against both King and Beech, and both companies settled out of court.

The KFC-200 has historically had some troubles with its altitude-hold function, some of which were traced to the altitude-hold printed circuit board in the computer, one of the first built with a solid-state barometric pressure sensor. The company received several complaints about airplanes that would wander up and down when the altitude-hold function was engaged. The SDRs contain numerous complaints of altitude-hold problems.

Is it off?

When the automatic interrupts do function correctly, it is often up to the pilot to determine if the autopilot has packed it in. In most cases this is obvious, but some installations and circumstances effectively require that the pilot look directly at the autopilot control to determine its status.

One pilot we interviewed has occasional failures of his autopilot that have been so persistent he now treats them as routine. He says his installation (a Century IV in a Beech Baron) will give uncommanded pitch changes in cruise. 'You'd be on altitude hold and for some reason the autopilot starts trimming against itself. All of a sudden it'll shut itself off,' he said. 'I re-engage and there's no problem.'

The trouble is, the autopilot control panel is located low and to the left on the instrument panel, and the indication of whether the unit is on or not is a light that reads either ON or OFF. 'It is just a short word beginning with O. Unless you are looking at it, it is easy to miss. This is rather insidious, because the airplane will start to drift off altitude without the autopilot engaged.' He commented that a warning horn or prominent light would would alleviate the problem.

Interestingly, Century's Jones mentioned that the manufacturer is installing just such a horn in its new autopilots. It is also worth noting that most airline installations have an autopilot disconnect warning horn.

Forced runaways

Century's Jones outlined a scenario where a pilot could get trapped by an autopilot's automatic trim control that is working properly if he reacts to the system in the wrong way. If the pilot moves the wheel against the autopilot for more than three seconds, the system will 'think' that the airplane needs to be re-trimmed to maintain normal flight, according to Jones.

This might happen in any number of ways. An unwitting passenger may use the yoke as a handhold, or the pilot may accidentally push against it while digging something out of the back seat. The system will trim against the force being applied to the wheel, 'thinking' that it is a result of normal feedback from the control surface. The pilot may interpret this as a problem with the autopilot, and pull (or push) harder, while the autopilot continues to run the trim. Or he may have forgotten that the autopilot is engaged and attempt to manoeuvre the aircraft, interpreting the resistance he feels as a problem with the control system itself.

NIL DEFECTS

After a few seconds the pilot realizes he is fighting the autopilot and turns it off, only to discover that he is still wrestling with a badly out-of-trim airplane. He may well interpret this as failure of the autopilot to disengage, since the controls do not feel any different. Believing the autopilot is causing his problem (when it is actually the trim), he may to try to troubleshoot the autopilot and ignore the trim until it is too late to recover.

Aviation Safety tried fighting the autopilot in our Mooney and found a couple of things. First, it is unlikely a pilot would get into too much trouble in this way unless he were well and truly confused about what was going on. The force pushing against the wheel becomes noticeable before the airplane gets very badly out of trim.

Second, once the force does become noticeable, the inclination of the pilot is to relax somewhat. The trim condition the airplane is now in produces a very sharp, surprising (and disorienting) acceleration 'spike' as the airplane assumes its new attitude. (We only tried this with the autopilot commanding nose-up trim, feeling it unsafe to experiment with strong nose-down trim forces.)

While, in our opinion, it is unlikely a pilot will try to fight the autopilot for very long, it does happen. A 1977 accident is a case in point. The pilot was making a coupled IFR approach at night into Ypsilanti, Michigan. During go-around, he inadvertently tried to manually control the pitch of the airplane with the autopilot still engaged. The autopilot eventually was disengaged, but by this time it had cranked in full nose-down trim in response to the pilot's nose-up pressure on the controls. The result: The MU-2 hit the ground short of the runway, seriously injuring both pilots.

Control consistency

Other traps involve the ergonomics of the autopilot installation. There have been several cases in which pilots got into trouble because they were not thoroughly familiar with the operation of their autopilots, sometimes stemming from poor or inconsistent layout of the controls. In one case, problems related to the pilot's operation of an autopilot led to an emergency Airworthiness Directive on the Mitsubishi MU-2.

A series of incidents, two of which occurred in June, 1986, disclosed a problem with the autopilot control locations in different Mitsubishis. The first, a fatal accident, involved an apparent malfunction of the autotrim system.

The accident happened during a priority mail flight that had departed from Austin, Texas just minutes before. The sequence of events illustrates the short time available for action when a failure is experienced in the flight control system.

Six minutes after takeoff, the pilot, a 5,268-hour ATP, reported level at 9,000 feet. One minute, 44 seconds later, the pilot reported trouble with the autopilot, saying he could not control or disconnect it. 'It is trying to pitch me nose-down,' he said. Fifty-seven seconds later, he said, 'It's descending at 6,000 feet per minute and I can't control it.' A company pilot in another airplane asked if he could find the autopilot circuit breaker, to which the MU-2 pilot replied 'Call you back.' Moments later, radio and radar contact were lost.

The Mitsubishi impacted in an inverted, 45-degree nose-down attitude at an estimated 400 knots. The total time from the pilot's first report of difficulty to his last transmission was only one minute and ten seconds. The destruction of the aircraft precluded a determination of just what went wrong.

The other June, 1986 incident was much more illuminating. An experienced MU-2 pilot experienced runaway nose-up autopilot trim on takeoff, nearly causing a crash. He was able to regain control of the airplane after pulling the circuit breaker on the Bendix M-4C autopilot.

Even though the pilot had roughly 4,000 hours in the MU-2, investigators learned that he was mistaken about the function of some of the autopilot controls, notably the red yoke button. Some of the installations had the yoke-mounted disconnect switch placed on the right horn of the control wheel, thus requiring the pilot to take his hands off the throttles to disconnect the autopilot — potentially disastrous during a go-around from a coupled approach.

The FAA ultimately issued an AD(88-13-01) that standardized the location of autopilot switches on MU-2s. Compliance with the AD also involved functional tests of the various ways to disconnect the electric trim system.

Shut it off!

There are many ways in which a pilot can cope with mechanical failure of the autopilot or its related systems. Aside from the on/off switch on the unit, there is usually at least one other switch on the yoke, a temporary override (also on the yoke), the avionics power switch and/or the master switch, and the autopilot's circuit breaker. Some airplanes, notably many Pipers, do not allow the option of 'pulling the plug' by yanking the circuit breaker, since they are

NIL DEFECTS

equipped with non-pullable breakers. In airplanes with electric trim, there is a separate switch for the trim circuit. As a last resort, there is also the possibility of physically overpowering the autopilot, though this carries with it a whole extra set of difficulties in certain cases.

Brittain autopilots are very different, however. Since they are entirely vacuum-driven, none of these shut-off procedures apply. According to Brittain vice-president Gerald Walters, the only way to shut off a Brittain autopilot is by opening the master cut-off valve. There is no backup system.

Getting the autopilot turned off quickly can be a real problem, sometimes. A good example was the hard landing of a Beech C90 King Air in January of 1986. The pilot was flying a coupled approach into Akron, Ohio using a Sperry 200 autopilot. The airplane broke out of the clouds at only 300 feet agl and the pilot hit the disconnect switch.

According to the pilot, the autopilot failed to disconnect, and he spent the remaining few seconds of the flight trying all the various ways built into the system to shut the autopilot off. He did not make it through the complete list before impact.

An interesting aspect of the accident is that part of the emergency checklist calls for pulling the autopilot circuit breaker. On the King Air, however, the breaker is located on a crowded panel on the far side of the airplane's 52 inch wide cockpit, and it is debatable whether or not the pilot could have sorted out its location and reached it in time.

After the accident, neither a local avionics shop nor Sperry could recreate the failure, and its cause was never determined.

The weak link

Perhaps the weakest link in the autopilot system is the human pilot. Although the autopilot is functioning correctly, the human pilot's lack of knowledge or understanding of the system can be the source of problems. Operated incorrectly, 'George' can fly the airplane into a corner.

For example, there was the March 5, 1986 crash of a Mitsubishi MU-2. The two-man crew and three passengers died when the airplane entered an uncontrolled spin from cruise flight at 4,000 feet over Eola, Illinois. The flight was on an IFR flight plan, and weather conditions included turbulence and icing. The 4,590-hour, ATP-rated pilot in command had logged some 180 hours in the MU-2.

Post-crash analysis of radar data showed that the Mitsubishi was maintaining a constant altitude for the two minutes before it entered the spin. During this time it steadily decelerated from 180 to 120 knots. At the accident site, the airplane's elevator trim was found in a 13-degree nose-up position.

NTSB concluded that the crew reduced power to slow the airplane on entering turbulent condition. As they did this, the autopilot steadily commanded nose-up trim to maintain altitude as it was programmed to. When the crew advanced the throttles after reaching the slower speed, the trim setting caused the Mitsubishi to suddenly pitch up, roll over, and enter a spin.

The Board, in its probable cause statement said that the crew was not paying attention to what the autopilot was doing to the airplane as they were slowing down. Fatigue was also cited as a factor — the crew had been on duty 11 hours that day. The autopilot itself was not at fault — the crew had fallen into a trap by not thinking of what the autopilot would do in that situation.

Know thyself

Unfortunately, proper use of autopilot, including recognizing failures and dealing with them, is rarely taught. Most pilots wind up learning how the system works by a kind of self-teach method.

'The biggest weakness in the system is that people do not fully understand the information in the autopilot flight manual supplements,' said Century's Jones, pointing out the supplements contain information on exactly what the autopilot will do if various malfunctions occur (the results of the 'three second' flight tests noted earlier). Other manufacturers agree. 'The number one problem, of course, is a lack of understanding on the part of the pilot,' said Brittain vice-president Gerald Walters. 'This includes things as simple as shutting the system off.'

'You have got to realize that if you are going to give control of the airplane to an automatic device, you need to know everything there is to know about that system and how it will react,' Jones said.

'A lot of people move up into an airplane with a sophisticated autopilot, but nobody ever really teaches them anything about it,' he continued. 'They wind up learning by experiment, but never go beyond finding out how to do the basic things they want it to do. They never learn what will happen if something goes wrong, or how to deal with it.' ☐

Answers to the quiz

A1.

Yes, provided it is for less than 10 seconds; any longer requires prior notification [AIP/SAR-2-9.4.1(d) (e); VFG Safety 3-3(d)] With the advent of AUSSAT and its ability to 'fix' transmissions it is even more important not to start the SAR authorities on a wild goose chase.

A2.

All FULLSAR aircraft and aircraft wishing to cancel SARWATCH at this time. Call is:

'(*callsign*) Circuit area (*aerodrome*), Runway (*number of runway or direction intended to be taken for landing*)'.

Additionally, 'Cancel SARWATCH/Report after landing/ETD for SAR' (*as appropriate*). Reference AIP RAC/OPS-0-86.13; -1-35, -1-36, NOTE 1; -1-111.3.3; -1-112.3.4.

A3.

(a) No. Neither the Civil Aviation Regulations nor the Civil Aviation Orders specifically prohibit NGT VFR when more than 4/8 cloud is forecast to exist below LSALT + 500', but AIP RAC/OPS clearly disallows it in:
- 1-11.1.3.4 concerning flight-planning;
- 1-43.6.4 concerning LSALT for NGT VFR; and
- 1-45.7.3, plus 1-45.8.2.1.3 and 4 concerning route specifications and navigation by visual reference to ground or water.

(b) Yes. The primary reference is CAO 20.8.4.2.2.3.

(c) Yes. AIP RAC/OPS-1-14.4.1 refers.

(d) Yes. CAO 20.8.4.2.2.3 states that 'a flight under the Instrument Flight Rules...shall be planned on the basis of executing an instrument approach at its destination for all operations at night...'. With failure of the aircraft's DME, the DGV NDB/DME IAP cannot be used. The pilot is obliged to plan another destination.

(e) Yes. Failure of the aircraft's DME does not prevent the flight from continuing to DGV, using IFR procedures. A visual approach might be possible using NGT VFR procedures, in accordance with AIP RAC/OPS-1-44.6.4.2. It can also be argued that a visual approach is authorised by AIP IAL-2-3.1.8, but a counter-argument is that the pilot cannot use the provisions of the IAL procedures when he is unable to execute an instrument approach. The pilot could advise his intentions by applying the ZZZZ procedure described in RAC/OPS-1-12, while actually nominating another destination to comply with CAO 20.8.

(f) AIP IAL-2-3.1.8(b) requires the aircraft to be established in VMC within:
- the prescribed circling area; or
- 5NM of the aerodrome, aligned with the runway centreline and established on the VASIS.

A4

AIRSPEED INDICATOR TABLE

MARKING	SIGNIFICANCE
Red Radial	Air minimum control speed.
White Arc	Operating speed range with wing flaps set as per Flight Manual. Lower limit is maximum weight stallimg speed in landing configuration. Upper limit is maximum speed permissible with wing flaps extended as per Flight Manual.
Green Arc	Normal operating range. Lower limit is maximum weight stalling speed with flaps & landing gear retracted. Upper limit is maximum structural cruising speed.
Blue Radial	One engine inoperative best rate-of-climb speed at sea level standard day conditions & weight as per Flight Manual.
Yellow Arc	Caution range. Operations must be conducted with caution & only in smooth air.
Red Radial	Maximum speed for all operations.

A5.

(d) , reference AIP/MET-0-6 and VFG 40.4.

A6.

Pilots engaged in a stepped climb/descent shall adopt the following procedure:
- the pilot in command of the lower aircraft shall report approaching each assigned level in the sequence; and
- the pilot of the higher aircraft, on hearing the lower aircraft approaching each assigned level, shall report his last vacated level, thus providing ATC with the next level for assignment to the lower aircraft (reference AIP RAC/OPS-0-20.10.2.3 and 3.1). □

National Aeronautical Information Processing System

NAIPS, which will provide an automated pre-flight briefing and flight-planning system for the Australian aviation community, is expected to be fully commissioned during 1992.

The system will assist pilots in flight-plan (FPL) submission by:
- providing a Specific Pre-Flight Information Bulletin (SPFIB), containing aeronautical information (NOTAM) and meteorological data directly relevant only to the route submitted;
- allowing the pilot to enter the FPL by electronic or manual means, and, if required, storing route details for subsequent use;
- validating the FPL against regulations, orders, instructions and operational requirements currently applicable to the type of flight and aircraft; and
- providing the pilot with an SPFIB update and a FPL printout.

SPFIB will be produced by reference to either a published or non-standard route and will take into account all relevant briefing data within an envelope commencing 25NM before the departure airfield, extending 50NM either side of track and finishing 25NM beyond the destination.

To minimise input required from the pilot, NAIPS will work from a comprehensive database, containing not only time-critical details of NOTAMs and weather, but also items such as airways system data and information on aircraft equipment and performance.

There will be a variety of ways that you can access the system:
- face-to-face briefings at CAA-manned Briefing Offices at SY + BK, BN + AF, PH + JT, DN, ML + MB, and AD + PF. Each of these will also have computer terminals for direct pilot access.
- direct pilot access via remote briefing terminals located at:

  (QLD) Bundaberg, Mt Isa, Cairns, Coolangatta Mackay, Maroochydore, Townsville and Rockhampton.

  (NSW/ACT) Canberra, Coffs, Pt Macquarie, Tamworth, Wagga, Albury and Broken Hill.

  (VIC/TAS) Hobart, Launceston, Essendon and Mildura

  (SA/NT) Alice Springs and Gove.

  (WA) Derby, Karratha, Kalgoorlie, Kununurra and PT Hedland.
- suitable privately-owned computers linked to NAIPS, either directly or via dial-up modems. Compatibility details should be available mid-1990.
- Telephone facilities for those pilots without access to face-to-face or computer briefing
- Centralised Briefing Units (CBU) located at BN and ML, accessible via 008 numbers for long-distance calls. In general, BN CBU will service the north-east portion of Australia, and ML CBU will cover the south-west and south-east of the country. Computer-generated voice briefings will be a feature of these services.
- Access to manned Briefing Offices on local matters will be available via a local phone call.

Apart from provision of appropriate computer systems, a strategy to ensure that NAIPS provides an efficient service from day one includes:
- the establishment of a group of industry representatives, through the Australian Aviation Advisory Committee and the National Airspace Users Advisory Council, to protect the customer's interests;
- the development of an integrated marketing, PR, educational and training plan to fully prepare some 60 000 users for the introduction of the system; and
- close liaison with the FAA, to glean as much information as possible from the US Direct User Access Terminal project.

A pictorial representation of the NAIPS set-up is on the back cover □

GROUND TO AIR

Squawk...and be seen!

Secondary Surveillance Radar (SSR) transponders

Bernie Rodgers, Air Traffic Procedures Section, Canberra

RECENT legislation requires pilots who wish to fly in controlled airspace within radar coverage to have serviceable transponders fitted in their aircraft. This article explains the way in which transponder information is used by ATC.

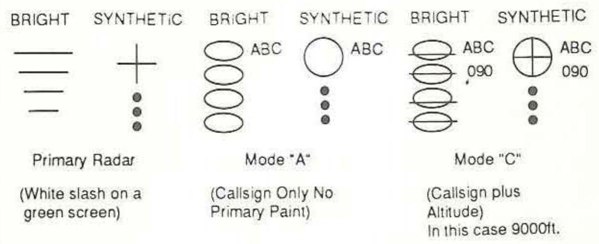
SSR is passive radar; that is, the pilot activates a signal that is sent out from the aircraft and received by a ground station that is 'listening' only. Unlike primary radar, SSR ground installations do not send out any 'active' signals.

In most cases, an aircraft flying in controlled airspace within radar coverage will be instructed to 'squawk' a particular four-figure code. This assists ATC to identify and subsequently track the aircraft, and so facilitates provision of radar control services. This code is allotted to the aircraft callsign when the flightplan is received by the relevant control centre, and the four-figure group is noted on the ATC flight strip for controller reference (a 'flight-strip' is in this case a strip of card with various aircraft/flight details marked upon it). At this stage the pilot neither knows, nor needs to know, the code allocated to his flight.

In the ATC centre the four-figure code is entered into a computer, along with the aircraft callsign, so that when a pilot responds to the instruction to 'squawk' that code the computer expects that particular response and recognises it as having been allotted to the aircraft. The appropriate information is then displayed on the controller's radar screen.

When an aircraft is given a SSR code (either on taxi if at a controlled aerodrome or with the airways clearance if entering controlled airspace from OCTA), the pilot selects the four-figure group in the display box in the cockpit. The resultant display on the radar screen will be the aircraft callsign (Mode A) and altitude (Mode C). This information, together with a SSR position symbol, is displayed next to the primary paint. Thus ATC can view callsign and altitude information, *including level changes*, on all aircraft being provided with a service (Figure 1). As a bonus, SSR has the ability to identify aircraft in areas where primary radar cannot reach.

FIG. 1
Additional information given by SSR Transponder for both the older "bright" & more modern "synthetic" displays.

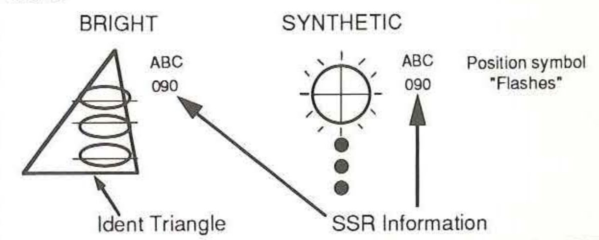


New-generation radars being installed in Australia over the next few years will be reliant on SSR as the principal means of identification and tracking in the en-route phase of flight. Consequently, the use of SSR transponders will become more and more important for flights in controlled airspace.

As can be seen, the more information that can be acceptably shown on the radar screen (too much causes clutter), the easier it is for ATC to identify and keep track of each aircraft. Using primary radar alone makes the identification process cumbersome, needing a radar vector or DME distance check and requiring on the part of the controller time and effort which would be better spent on other duties.

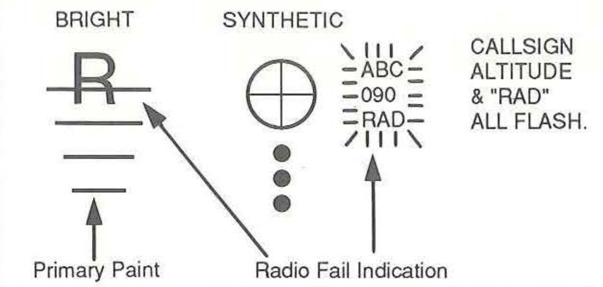
As a check to ensure that the squawk is from the correct aircraft, and not the result of some other pilot who has by chance activated the same code, ATC will often ask for a 'squawk ident'.This will cause a triangle to appear over the primary paint (bright display) or the symbol to flash (synthetic display), and eliminates the risk of a mis-ident (Fig 2).

FIG. 2



In relation to any emergency the pilot may experience, the SSR emergency codes, when selected, provide an aural and visual alarm at any ATC centre receiving the signal. For example, a pilot with radio failure can squawk the appropriate code — they are listed in AIP/ERSA — and a large 'R' (bright display) or 'RAD' (synthetic display) is shown on the radar screen (Fig 3) to draw the controller's attention

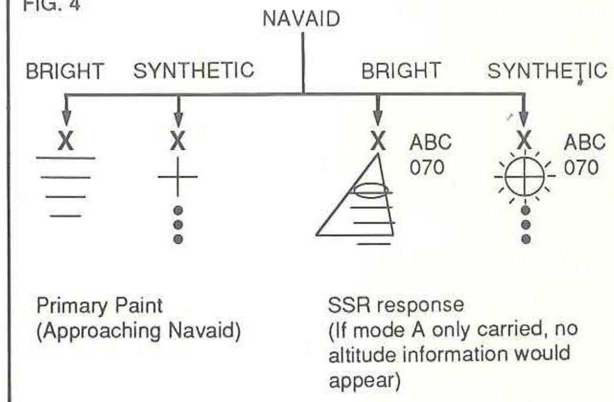
FIG. 3



to the emergency. An alarm bell rings in the radar room; this can only be silenced by the controller carrying out the correct emergency drills. On the screen, the visual warning continues until the pilot deselects the emergency transmission.

The following is an example of what happens when the pilot of 'ABC', a light aircraft equipped with SSR Mode C, wishes to enter controlled airspace within radar coverage (Fig 4 refers):

FIG. 4



'ABC clearance: enter controlled area, track via ....(navaid). Enter at 7000, squawk code 4321 with ident.'

In this case, the computer has been told to expect the response of 4321 to be ABC. It recognises this response from the aircraft's transponder and displays the information received in its correct position (next to the primary paint if within primary radar coverage). It then recognises the *ident* response and places the triangle around ABC, leaving the controller in no doubt as to the identity of the aircraft.

There also exists a Mode 'S'. This is an advanced system, fully compatible with Modes A and C. Australia will shortly begin testing Mode S to ascertain possible advantages; more info on this in a later article □

What fuels these mortals be!

Pilot contribution by M Barber

PERFECT weather, a good friend, and a Piper PA28 Warrior; who could ask for more than this recipe for a pleasant flight? Alas, the subsequent experience was to cast a chill over an otherwise enjoyable experience and teach a valuable lesson.

The pre-flight revealed a very low fuel state — it was not possible to obtain any dip-stick reading on the right-hand tank. The reading on the left tank was minimal.

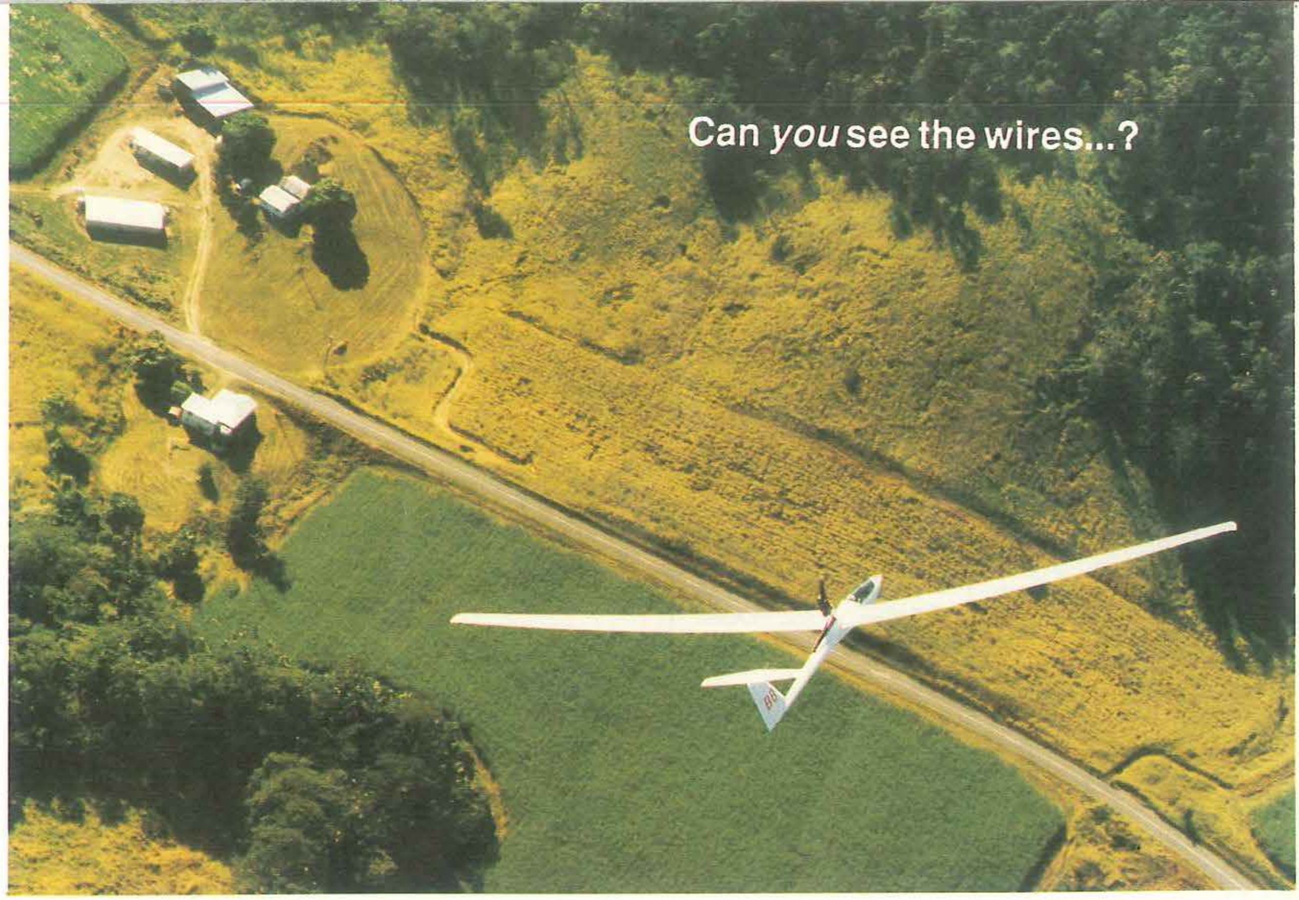
The aircraft was refuelled, both tanks being completely filled. Since this was thoroughly established, there was no need to make any tank change on pre-take off checks and subsequently the flight commenced and proceeded normally.

Approximately one half hour into the flight it was considered timely to change fuel tanks. As this was carried out the realisation struck home: the fuel selector was on the tank found to be 'dry' during the pre-flight inspection!

It would seem that the previous flight very nearly terminated prior to landing — certainly it appeared that the pre-landing checks had included no form of fuel management.

Although perhaps not proof positive of slipshod airmanship this sort of revelation provides a free lesson in procedure, and, since the correspondent found it out for himself, one that is not easily forgotten.

We had a bit of a think about this, then wrote to Mr Barber, asking whether he had pursued the matter. As we had hoped, and indeed expected, the incident had been reported without delay to the organisation responsible for flying operations from that particular base. Mr Barber reports that he has no doubt that the pilot involved was invited to partake in an appropriate educational session. □



A current affair

Extracted from a pilot contribution

WE HAD A devastating accident last year, when our beautiful K13, just 21 years young, was wrecked in power lines. I'm pleased to report it will be repaired, to fly once more.

We have two sets of power lines marked by large fibreglass orange spheres — these were the ones we didn't hit. The ones that caught us were unmarked because they were out of the way of any 'normal' circuit. If you have any power lines within gliding distance of your field you should mark them — if not, they will eventually trap somebody.

When we hit, the K13 finished up on the ground resting on top of the two lines carrying 22 000 volts. My pupil suffered severe electrical burns on his ankles, the right hand through the control column and on the back of his neck from the steel canopy crossbar.

As he was in the front cockpit, I was aware immediately that he was in convulsions. I quickly got out and went to his aid. In that short time he was unconscious and had stopped breathing. Now, I have been farming for forty years and would have 'pulled' about 1000 lambs, always clearing their air passages by a finger down the throat, so it was from sheer habit that I immediately opened Brian's mouth and saw his tongue down his throat. I pulled it back with my forefinger, undid the straps, but was unable to lift him out. Working fast, and in desperation, I gave him resuscitation by hard pressure on the chest. At once he started to breathe and regain consciousness. Fortunately my crew arrived very quickly and we removed the casualty by main force, within about five minutes. The time is important, for two of us, at least, knew about automatic and manual recharging of electrical lines. We took Brian well away from the aircraft and then to hospital. Thankfully he is well, but has a long recovery time from the severe electrical burns from such a high voltage.

Very nasty — but, as the writer indicates, it should never have happened. Let's emphasise it once again: if you're into low circuits, agricultural flying, or, as a glider pilot, faced with the ever-present possibility of an outlanding near the circuit, you must know where the lines are. If the cables are marked with big orange spheres, all well and good, but, if as usual, they're extremely hard to see, then the responsibility's all yours: ***know the local area****.*

We asked the electricity authority about re-energisation and received confirmation of points in the article. Specifically, the following example illustrates a representative auto-reclose sequence followed by a powerline circuit-breaker:

- *open — circuit breaker senses fault*
- *+ .3 second — first reclose attempt*
- *open — fault is persisting*
- *+ 15 seconds — second reclose attempt*
- *open — fault still there*
- *+ 45 seconds — third reclose attempt*
- *open, fault diagnosed as 'permanent' and power automatically cut off.*

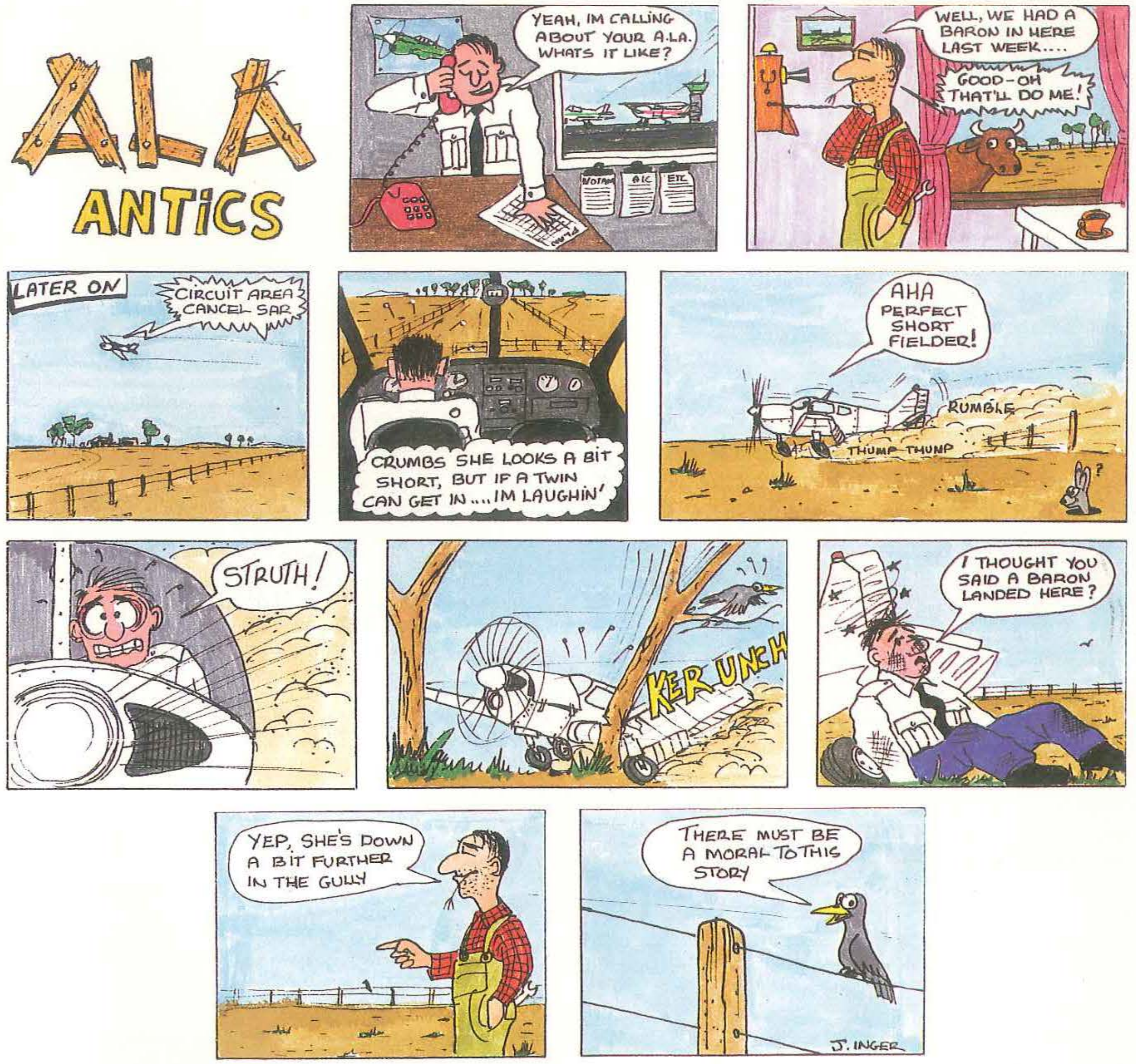
Here, three attempts have been made to re-energise within one minute. We have no statistics on the time it takes to vacate a crashed aircraft (reports are totally subjective,

and we all know that time expands/contracts under intense stress), but it seemed reasonable to assume that, if no electrical injury is sustained at the instant of impact, by the time you're jumping out the broken power line would be carrying no charge and thus be innocuous. Well, we made some more enquiries of the electricity people and what do you know — we were dead wrong! (no pun intended). They were at great pains to point out that the scenario was a likely one, but not guaranteed. Around Australia, there are differing regulations about recharging lines.

After an automatic cut-out, a manual recharge is attempted to establish that the fault is not transient, then the patrol goes out to physically locate the fault. In the country, particularly, the judgement whether to manually recharge after the automatic cut-out has operated is left to the duty manager's discretion: it could be anything from 5 to 30 minutes after the short.

Some places will not manually recharge for a specified time — say half an hour, sometimes it's as soon as the technician can reach the switching station, perhaps only a few hundred metres from the sub-station.

Therefore, they say, you should assume one thing only about power lines — ***they're always live****. So, if you are unfortunate enough to be in an accident involving ground electricity, sit tight until someone outside confirms the absence of electrical current. Any need to vacate the aircraft without delay due arcing, a strong smell of aviation fuel or even actual fire, indicates the absolute necessity to* ***jump*** *clear, making sure no part of your body or clothing touches both aircraft and ground. As the article shows, sometimes a risk has to be taken, but avoiding further trouble is a million times better than accepting the consequences of ill-considered actions.* □



AIRFLOW

C P HIRD (ASD 142) certainly brought a swag of replies! Nearly all were sympathetic and positive: below is the essence of one that best encapsulated the general feeling. It came from Brian Hill, a member of the Canberra Aero Club, who starts by stating what we all know too well:

Sir,

It's a worry, alright: that letter about the difficulties of staying current and safe on a limited budget.

Unfortunately, the problem is further compounded by several fundamental laws of aviation

- if the weather's fine and beaut, every last aircraft will have been booked hours ago;
- if by chance an aircraft does become available, you'll inevitably be stuck at work;
- if it's a perfect flying weekend you're sure to be strapped for cash; and
- on those rare occasions when you can find both time and money for an hour of circuits, it's almost certain to be 8/8 overcast and blowing a gale.

Brian then offers possible ways to get around these and associated difficulties. They include:

- utilising a bank or credit union loan to finance in a less painful way the hours necessary to attain your licence;
- joining in your club's regular competitions (forced landings, spot landings etc). They offer good experience and exchange of ideas for only a modest outlay — say half an hour's flying;
- trying to get an instructor to be the air judge in the aforesaid competition, that's the way to get your errors pointed out! (incidentally, if you consistently shun such events for fear of showing yourself up, best have a long hard look at your reasons for flying in the first place);
- joining in on your club's weekend flyaway (again you may score an instructor in the RHS). Two or three of you together can complete your Unrestricteds in one hit *and* get to see a lot of Australia as a bonus;
- insisting on less than a whole hour's hire of an aircraft if you can only afford less. A mere 30min in the circuit can do wonders for your confidence; two or three circuits a week will probably keep you current;
- forming a syndicate to actually buy a basic aircraft. A once-only buy-in price for say a Warrior should get you flying for $50-60/hr. And of course, you can always sell your share — possibly at a modest profit — if times get too tough;
- teaming up with one other pilot, paying for flying week by week about, but flying together each time, will double your exposure to all the aspects of aviation that go hand in hand with merely poling the beast; and
- getting away from the ultra-expensive capital city aerodromes and taking the family (and the dog) to a country field for the day. Places like Camden and Tyabb represent less traffic, less taxi time, probably friendlier company, almost certainly better value for your dollar.

Wrapping it up, I'll again quote Brian directly:

Ultimately, however, it has to be recognised that for most people the privilege and pleasure of private flying does require some sort of sacrifice — financial and/or otherwise — and that if one is serious about staying current then it costs money, and something has to give.

Sadly, C P Hird, it also depends on how much your long-suffering, non-flying partner will put up with. But no doubt you've found that out already.

(...and an answer to the last paragraph immediately comes to mind — doesn't it?)

We asked, once again, Steve Tizzard (EofA, GA) to comment. He is in basic agreement, but added: 'Do not chase endorsements on, for example, CSU, retractable, tailwheel or twin types ***unless*** *you are going to fly them regularly: low time pilots can get into all sorts of difficulty coping with these additional features if not in constant practice'.*

PC RULES, OK?

If you are a **PIC**, with or without a **PC**, commit these **BASIC** rules to **MEMORY**, that they may **ECHO** in your **CENTRAL PROCESSOR:**

- before you **LOG ON**, always check your **HARDWARE**
- throughout your session, ensure that **DIGITAL SYSTEM** is not **INSERTED** - don't be just a **WORD-PROCESSER**
- Do not **BYTE** off more than you can chew

Never forget that if you have a **SYSTEM CRASH**, the **SOFTWARE** travelling in the **MAINFRAME** may become merely **MEGA-BITS** and end up on **SPREADSHEET** ....& then you are **DELETED!**

AIRFLOW

...and Norm Thomson, of Adelaide, reminds us quite strongly that self-discipline and application on the ground can result in many more pleasurable minutes out of each expensive hour in the air:

Like many other private pilots I, for a variety of reasons, often have to go for quite long periods without the pleasure of 'in command' flight. These days when I do get the chance to fly I want it to be 'visual' and enjoyable; so what's the problem?

Well, it may sound strange to the current professional pilot (commercial or service) but I believe that the last thing to suffer from periods of absence is the 'hands-on' control of the aircraft itself (the old adage of learning to ride a bike!). I confirmed this on return from one 20 year absence from flying when I found both ultralights and ordinary aircraft immediately responsive - and me to them. Similarly, visual navigation was no more difficult than it was in the past. What does deteriorate rapidly with time is what I call 'cockpit orientation'. That is, the instant ability to move hands, fingers and eyes to the correct spot in the cockpit with confident accuracy. Flying different types only compounds the difficulty in maintaining proficiency.

With regular flying, routine tasks like turning switches, moving levers, winding on trim and cross checking instruments are virtually second-nature; but to the Infrequent Pilot it can become the predominant, not the subordinate task. This not only reduces flying pleasure, but can be darned unsafe as well.

Although I address my remarks to the 'irregular' private pilot, many crash reports suggest that they may apply equally to some professional pilots as well. How often do we read of an inadvertent raising of undercarriage (instead of flaps?) while still on the ground, or incorrect fuel management in commercial flight? For those of us with more mundane ambitions it's the hesitancy in 'finding' the electrical fuel pump switch, or groping - and eventually looking to the floor or roof - to find the flap lever or the trim wheel, sometimes tucked away in what feels like the remotest corner of the cockpit. Apart from anything else, without adequate cockpit orientation, confidence is shaky and crispness and speed reduced. I'm always afraid that if I move too swiftly I'll operate the wrong switch. Imagine turning off the master switch instead of the strobe light or fuel pump? For glider tug pilots, imagine grabbing the emergency tow rope release lever instead of the flap lever!

The point is, that for normal visual flight, instead of devoting something like 95 per cent of attention to things outside the cockpit, mixed in with quick and regular cross checks of the panel, cockpit disorientation results in using up eye energy (and time) just locating the instruments themselves! Its neither comfortable, safe, nor enjoyable.

So what can be done about it?

Ideally, the old solution of spending time in the cockpit before start-up still applies. But how often is such time limited, how often are passengers impatiently waiting, and in any case, how often can you get out to the airfield and quietly carry out such a task? Here is an alternative that I have found to be an extremely useful (and completely cost-free!). I call it 'desk flying' and I first learnt it as an 18 year old, when as a junior cadet I was taught useful skills by those more experienced. One gift that I received from the senior classmen who shared our Nissen hut was to make me, as a brand new student-pilot, 'fly' the wooden desk that sat by my bed. That is, pencils, rulers, ink bottles and the like were very carefully measured out around me and I had to instantly and accurately respond to the drills and procedures directed at me. The result was that when I actually flew the aircraft, my hands went unerringly to the correct spot at the correct time thus leaving me free to devote my attention to learning how to actually control and fly the machine.

I was able to apply the same technique later, especially when working for an organisation where it was necessary to fly a variety of aircraft with virtually no dual check-out. In that case the aircraft manual (especially the photographs) always gave me a chance for a pre-flight desk sortie. It's too late to get airborne with an observer at 2 a.m. and be unable to find the circuit breakers because your instrument lights have gone!

Technology today can make refinements easier for the occasional pilot. Any decent camera can pick up the cockpit and instrument panel details. The photographs can be dragged out and referred to whenever you like, although pumping down imaginary flap or mumbling engine-failure drills could prove alarming to fellow passengers during a domestic airline flight! Rusty radio- and other procedures can be similarly polished up. It really depends upon how interested you are in devoting the maximum attention to your fitful flying.

There is nothing new in all this: it's essentially pre-flight preparation. When I get the chance to fly these days I prefer to feel 'at home' in the cockpit; I believe other pilots do too. I hope these suggestions, despite the smirks they may evoke in some, prove of practical use to at least one other Infrequent Pilot. □