How to find digital north

Introduction: The advent of digital watch technology has brought with it its own set of problems. For example, how can pilots determine North by using a digital watch? Scientists have conducted extensive research on this subject, and have now come up with a solution to the problem.

Aim: The aim of this precis is to provide a stand-by means of finding True North for those ill-equipped 'navigators' who are frequently in need of inspiration but rarely at loss for excuses.

Step one: Find the sun. This is done by looking skyward when a blinding glare, often accompanied by pain in the eye, will indicate the direction of the sun. Alternatively look at the ground (to find ground, see step two) and find your shadow. Then, keeping yourself upright align the tip of your shadow (SH) with the top of your head (H) and slowly turn H through 3,200 mills to look along the line SH-H-Sun.

Step two: Shadow stick. Find a straight stick and place it upright in the ground (to find ground, look immediately below your feet where ground will normally be parallel to and continuous with the soles of your boots). Note that stick (S) will cast shadow (SH) on the ground (G).

Step three: Clock face. Refer to digital watch and ensure that time shown is correct by either (a) checking with conventional watch owners nearby, or (b) when out in the bush, by dialling 1194 from nearest telephone.

Then having established the time of day, draw on ground (G) a conventional clock face around stick (ST) using ST as pivot for clock hands not normally shown on digital watch. Onto representational watch face draw in the hands of conventional watch at correct time of day as per digital watch.

Step four: Aligning clock face. Align the figure 12 on clock face with sun (S) by rotating ground (G) around stick (ST) until figure 6 coincides with shadow (SH) to achieve the alignment 6-SH-ST-12-S.

Step five: Find North. Draw a line on the conventional clock face from pivot (P) to a point mid-way between 12 o'clock (12) and the hour hand (H). This line, P-(12-H) should indicate North. If in doubt, firmly close your eyes and spin around until you feel dizzy and fall down, whereupon rising from the ground (G) there is at least a chance that you will be facing North (N).

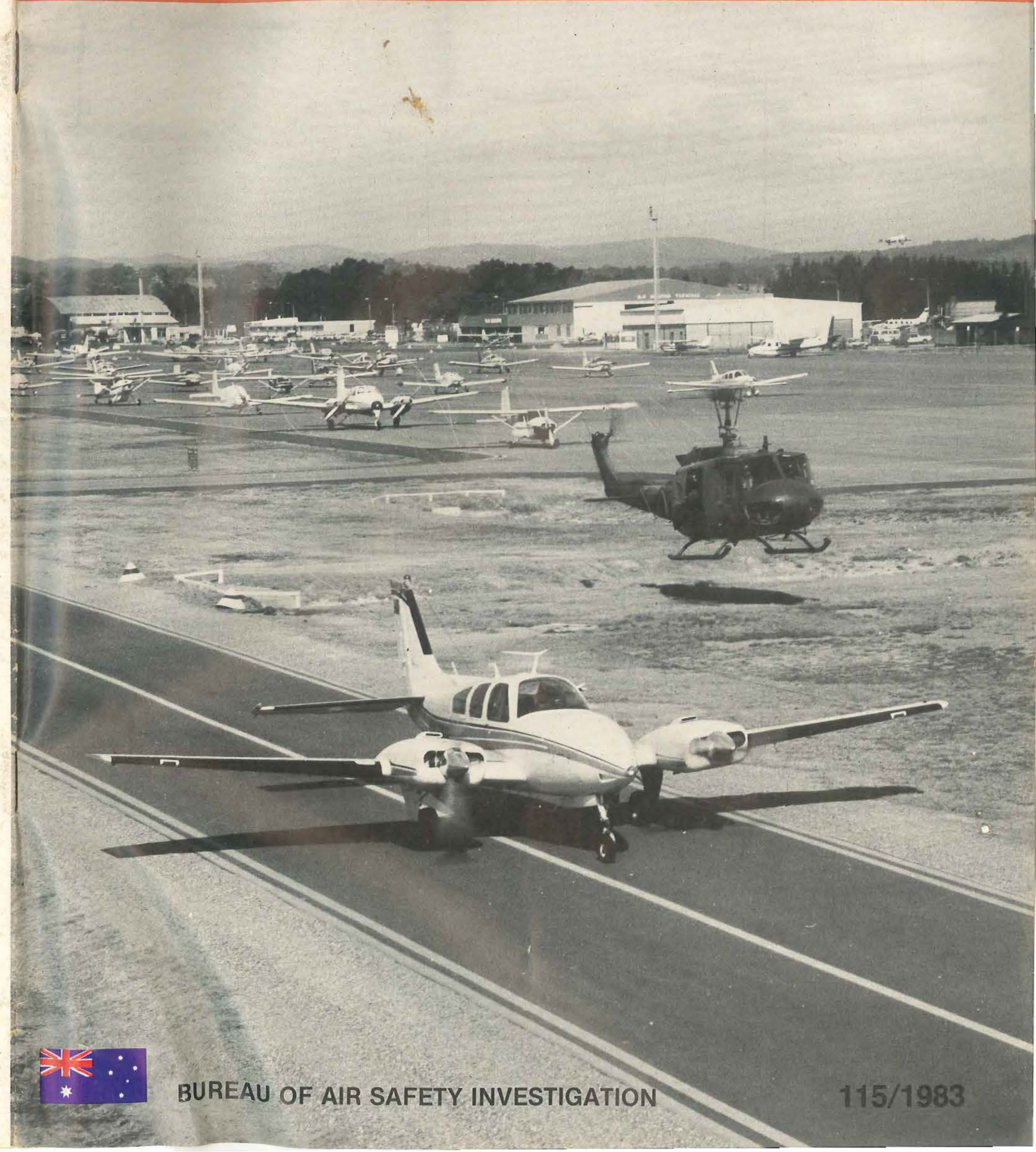
Finally: If all else fails, remove digital watch from your arm and swing it around overhead AND LET GO. Your digital watch will then have 'Gone West' in which case True North is probably over your right shoulder.

Instructors note: Finding North by digital watch is to be regarded as 'confidential information' and should only be taught to pilots who are advanced in map reading ●

(Courtesy RAAF Spotlight)

AUSTRALIA

Aviation Safety Digest



BUREAU OF AIR SAFETY INVESTIGATION

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Front cover

As the Bureau of Air Safety Investigation is currently in the process of relocating its Central Office from Melbourne to Canberra, this issue's cover features a photograph of operations at Canberra. Civil operators share the airport with the RAAF, and here, a Beech Baron from the locally-based VeeH Aviation is pictured with an RAAF Iroquois helicopter. Enthusiasts will have little problem in identifying the aircraft on short finals.
(Photograph courtesy of RAAF)

Unsurveyed landing area

View of wheel marks in lake surface.

Right view of aircraft. Note how the nosewheel has dug in.

A Cessna 172 flown by a commercial pilot had been hired by a professional photographer to carry out aerial photography over central Australia. After several uneventful sorties a flight was conducted over the Simpson Desert and Lake Eyre North. The aerial photography presented no difficulties, but the photographer then asked the pilot if it would be possible to land on Lake Eyre to take some ground shots. The pilot selected the whitest area, which he believed would be the hardest surface, and flew over it at about 50 feet. The surface looked satisfactory. He had also been told at one of his staging points that there had been no rain at Lake Eyre for two years and this, together with his airborne inspection, led him to conclude that it would be safe to land.

Weather conditions were fine as the pilot touched down gently into a 20 knot headwind. He had asked his passenger to monitor wheel penetration of the surface. Initially the surface seemed firm but, as the aircraft decelerated, the wheels started to dig in slightly. Just as the pilot decided to initiate a go-around at about 40-50 knots, the main wheels dragged more heavily and forced the nosewheel through the surface of the lake, eventually to a depth of about 30 centimetres. The aircraft rolled only about seven metres after the nosewheel dug in before the propeller struck the surface, stopping the engine. Although subsequent examination revealed only superficial damage to the aircraft, its recovery presented considerable difficulties.

Because there was nobody on the ground to assess properly the suitability of the area, the pilot would have been wise to have declined the photographer's request to land. After the incident the pilot surveyed a larger area of the lake and found that while there were some hard areas, the surface generally was soft to a depth of about 10 centimetres. This incident, like previous similar occurrences, showed that the only safe way to assess a proposed landing area is from the ground, and that a low-level flypast is no substitute for a thorough ground-level survey.

On the credit side of the ledger, the pilot's safety planning for this trip deserves mention. He had packed light camping equipment, a good supply of food and water, and the aircraft was fitted with a serviceable ELB — all wise precautions given the terrain over which he was operating ●

When you're outa gas . . .

Good airmanship and regulations alike dictate that a pilot ensures he carries sufficient fuel to get him to his destination and still have a bit in reserve. Yet not all do this: an alarming number of engines fail simply because they 'ran outa gas'.

Investigations into fuel exhaustion occurrences often reveal that the reason, when reduced to the simplest terms, is that the pilot did not look in the tanks before flight. It would be easy to stop there and point the finger; however, the question *why* often reveals pressures that induce pilots to omit that last-chance check. For example, how many of us feel self-conscious about opening the caps to check when the refueller has just closed them, or when an instructor or friend has assured us that there is plenty of fuel in the tanks? It is so much easier to simply check the gauges. However, fuel gauges in many light aircraft are insensitive to changes in fuel quantity at near-full tanks; many are limited in their accuracy; and most are affected by aircraft attitude. As this account of a fuel exhaustion accident attests, reliance on the gauges alone to validate assurances or assumptions is most unwise.

The pilot had planned a sight-seeing holiday to Central Australia. She had held a private licence for a little less than two weeks at the time and had accumulated about 80 hours flying experience. After submitting a flight plan for the first day's flying, she went to the operator's lounge to complete her preparation, where she was advised by a staff instructor that the aircraft was ready and that it had been refuelled to full tanks. She accepted this information without visually checking the tanks, claiming later when she requested a ladder to do so the instructor again insisted that the tanks were full. During her daily inspection the pilot checked the fuel gauges and believed that they did indicate full tanks.

The flight that day was to be conducted in three stages without refuelling. The planned flight time was 206 minutes and an endurance of 360 minutes was recorded. The first stage of the flight and the landing were uneventful, as was the second stage, but the pilot decided to continue to her overnight destination without making the planned second landing.

When about 20 minutes into the final stage she looked at the fuel gauges for the first time since departure for the second stage of the flight — a time interval of some 85 minutes. They indicated empty. Shortly afterwards, the engine failed and the pilot was committed to a landing on unsuitable terrain.

The engine had failed through fuel exhaustion after a total engine-on time of about 216 minutes. Investigation revealed that, contrary to the assurances given to the pilot, the aircraft had not been refuelled. It had in fact not been refuelled since it was flown by this same pilot five days previously.

This account has illustrated the danger of placing total faith in the assurances of others and the accuracy of fuel gauges. But it has also shown that the gauges — with all their faults and inaccuracies — are still a useful aid in fuel management. Had the pilot monitored calculated fuel usage against contents indications, the gauges should have alerted her to the low fuel situation before it became critical.

* * *

Perhaps the second most common cause of fuel exhaustion occurrences is the pilot's lack of understanding of cruise control procedures and fuel management, both in general and for particular aircraft. This next account illustrates one such case in which an experienced pilot did not apply basic fuel management principles or understand the appropriate cruise control procedures for his aircraft. It also embodies in the one incident many other factors common to most fuel exhaustion occurrences. The aircraft, a Cessna 210, was on final for a night landing on return from a long non-stop cross-country flight when the engine failed through fuel exhaustion.

The pilot held a private licence with a class four instrument rating and had considerable experience on Cessna 210 and Bonanza aircraft. His total aeronautical experience was about 600 hours. He had undergone a check flight in the Cessna 210 when he started flying with this operator and had hired the aircraft on other occasions prior to this flight, but he had not previously conducted such a long-range flight in it.

The outbound flight two days earlier had been conducted in two stages with the aircraft being refuelled at the intermediate stop. The pilot did not conduct a fuel consumption check on either of those stages.

Before departing for the direct return flight he had the aircraft fuelled to capacity and completed a detailed VFR/NVMC flight plan. He based his fuel planning on an expected fuel flow of 90 lb/hr with a usable fuel load of 75 gallons, from which he calculated an endurance margin of eight minutes over the fuel required.

After take-off the pilot was given a step climb to his selected cruising level, 6500 feet. On reaching that level he leaned the mixture by setting an indicated fuel flow of 90 lb/hr with reference to the fuel flow meter. He was not familiar with the use of the EGT indicator, and did not attempt to check the accuracy of the flow meter by, for example, leaning to rough running and reading the indicated fuel flow at that mixture setting. Enroute he ran the left tank to one-quarter by the gauge and then switched to the right. When the right tank was similarly down to about one-quarter by the gauge he re-selected the left and ran it dry, getting only another 15-20 minutes out of it.

At that point, with about 60 miles to go, the pilot was becoming concerned about his fuel state, but even then he did not conduct a consumption check by comparing gauge readings against time and distance gone. He only re-checked his original flight plan calculations and 'hoped they were right'. Shortly afterwards he enquired about the availability of flares at an ALA on track 40 miles short of his destination. But because there was no suggestion of an emergency in the enquiry, and because the pilot advised that he did not intend to land there 'at this stage', the Flight Service Officer assumed that the enquiry had been made out of academic interest, perhaps in relation to a future operation, and did not react with any urgency. The pilot gained the impression there would be some delay in arranging lights and decided to continue to his destination.

The declaration of an emergency or even a positive statement of concern about his fuel would have eliminated the misunderstanding, and the incident (near accident) could have been avoided. It later transpired that runway lights were available at the ALA and that they could have been switched on in time for the pilot to divert.

Entering controlled airspace, the pilot was handed over to ATC and cleared to track direct to his destination. Three minutes later he was identified and cleared to make a visual approach when ready; however, he wisely elected to maintain his altitude until he was sure he could make the field. The fuel ran out on long final and a successful forced landing was made on the aerodrome. The investigation revealed that the pilot's sole mixture control reference, the fuel flow meter, was under-reading by 20 lb/hr.

The chain of events leading to this occurrence started when the pilot attempted to conduct a flight that demanded a degree of skill beyond that exhibited during the flight's progress. The pilot missed the last chance to break the chain by substituting wishful thinking for positive action when his fuel shortage became evident to him.

* * *

Remedies

Fuel exhaustion accidents and incidents such as these can be eliminated. The following pointers have been assembled from the experience of these and other investigations, and cover most of the factors pertaining to fuel exhaustion occurrences.

Pre-flight preparation and planning

- Understand the aircraft fuel system. Know the usable fuel capacity of the particular aircraft and know how to manage the system so that all of the usable fuel can in fact be used.
- Be familiar with and use the aircraft performance charts. Understand the conditions required to achieve the published performance figures and be aware of the effect of operations outside the published parameters.
- Calculate fuel needed with regard to all known requirements and conditions: weather forecast, availability of fuel enroute, holding requirements (NOTAM and weather), fixed and variable reserves, etc.
- Ensure by all means possible that the required or expected amount of fuel is in the tanks, remembering that most gauges are limited in their sensitivity and accuracy — particularly near-full tanks — and may be affected by aircraft attitude; that a visual estimate of contents is only accurate at full tanks or at other defined levels such as are provided by indicator tabs, and again that aircraft attitude may affect these readings; that dipsticks are a reliable aid in measuring fuel quantity for most aircraft types, but these should only be used in the tank for which they are calibrated, and yet again that these may be affected by aircraft attitude.
- Ensure that all fuel drains are closed and that none is leaking after taking fuel samples.

In flight

- Operate the engine in accordance with the handbook instructions. Adhere closely to the leaning procedure and power settings prescribed to obtain the published performance figures.
- Conduct the flight in accordance with the flight plan. If a variation becomes necessary consider the effect on fuel reserves.
- Apply systematic fuel monitoring and management procedures appropriate to the aircraft type.
- Conduct fuel consumption checks regularly during the flight and compare fuel usage against progress. If a discrepancy is indicated assume the worst case unless normal operation can be verified.
- Take positive action before a low fuel state becomes critical. Adopt long-range cruise procedures; consider climbing or descending to another level to escape adverse winds or make use of tail-winds; and divert early if appropriate. But above all, declare an emergency as soon as a problem becomes evident and while sufficient fuel remains for you to make use of any forthcoming assistance ●

The myth of the accident prone

How often have you heard the cause of an accident attributed to accident proneness on the part of the individual involved? Accident proneness is a convenient label, but it is not a cause. The term accident proneness is a misnomer, a myth. By calling someone accident prone, you are stating that he was born to have accidents, that his hereditary nature makes him a klutz and that there is nothing that can be done to stop him from having an accident.

This is just plain balderdash. Geneticists have not discovered any accident proneness genes and research studies have shown that we cannot even predict a person's likelihood of having an accident from his past accident history. But accidents can be prevented, as will shortly be pointed out.

If accident proneness is a myth, why do some people appear to have more than their share of accidents? To answer this question let us first examine the reasons why a single accident occurs.

In almost every accident, the accident investigator is faced with a myriad of contributory variables. Very rarely is there a single cut-and-dried cause factor. There are almost always numerous contributory variables, such as poor man-machine interface, supervisory error, limited experience, failure to use accepted procedures, task saturation, overconfidence, etc. Sometimes these variables are transitory and stress related. For example, the accident victim may have been suffering from some temporary physiological variable such as fatigue, hypoxia, hypoglycemia, or a temporary psychological variable such as boredom, anxiety, frustration, or depression. Environmental variables such as weather also play an important role. Often, if one or more of these variables had not been present, the individual's performance may not have been compromised enough to result in a human-error accident.

Although there are several reasons why a person could be involved in an accident, is there a common denominator among these various reasons? Some early psychological research is suggestive. A few years ago a US Navy flight surgeon/psychiatrist developed a psychological profile of the high-accident-risk aviator (he actually used the term accident prone, but we now know that this term is inappropriate). However, when you compare this theoretical profile of the high-accident-risk aviator to the psychological profile of the outstanding aviator, you make a very interesting discovery. Namely, the profile of the outstanding aviator and the high-accident-risk aviator have much in common, with the exception of one very significant factor. The high-accident-risk aviator appears to be undergoing stress, whereas the outstanding pilot is not. Does this suggest to you that an outstanding aviator undergoing stress is, in actuality, a high-accident-risk aviator?

This does not mean that all human-error accidents are caused by stress. What it does suggest, however, is that if stress is present, and if the quantity and/or severity is great enough, an individual — any individual — will be more likely to be involved in an accident. This individual should not be considered accident prone, but rather one who has currently entered a high-accident-risk category. Everyone at some point in time enters this category. If you alleviate the stress, you re-enter the low-accident-risk category where, incidentally, the majority of us are most of the time.

What exactly is stress? Stress is simply a normal 'reaction of the body to the ordinary and extraordinary pressures of life'. The presence of stress initiates hormonal and various other physiological changes, and can cause a drastic impairment in a person's cognitive and motor functioning. Remember Joe (a US Navy cartoon character) and his problems? What if you knew Joe had been undergoing severe stress during the weeks prior to his numerous mishaps? His father, with whom he had a very close relationship, had recently undergone arterial bypass surgery. Joe's daughter, in asserting her independence, moved out of Joe's house, against his wishes, and into an apartment. Joe stopped smoking two weeks ago and has taken a second mortgage on his home. All these events are stressful. In the light of what has been discussed, is it surprising that Joe has had a few close calls? When the stress diminishes, Joe will re-enter the low-accident-risk category and be his old self again.

Prevention of stress-related accidents is a two-step process. First, you must learn to recognise that you are undergoing stress, and second, you must take action to reduce the stress affecting you.

Recognition of stress is really not all that difficult, since there are usually accompanying behavioural changes with increased stress. The following are common reactions to stress: anxiety, preoccupation, impatience, humourlessness, inability to concentrate, restlessness, frequent or prolonged headaches, unhappiness, depression, frustration, aggression, irritability, defiance, insomnia, and apathy or indecisiveness. A person undergoing stress will exhibit some but not all of these symptoms. The key is that the stressed person is behaving atypically. He is just not himself.

Reduction of stress in most cases is relatively easy and can be handled in one of several ways. Physical exercise is an outstanding method of stress reduction. Whether it is intense, such as playing squash, or less strenuous, such as walking, it works well. Hobbies and other non-athletic events that you enjoy and derive pleasure from, such as reading, building model planes, needlepointing, or playing backgammon, are also excellent stress reducers. Talking your problems out with someone whose opinion you value, or with someone who will just listen patiently, may be the best stress reducer around. If the stress you are encountering is so intense that these methods provide little relief, do not be afraid to seek professional help. It may save your life.

In summary, remember that everyone (wife, pilot, crew chief) enters the high-accident-risk category at some time or another. Entrance into this category is often preceded by a build up of stress caused most frequently by the everyday variables that upset the normal routine of life. Consequently, when stress is present, increased awareness and caution are required. When you see the telltale behavioural changes taking place in yourself or someone else, take the necessary steps to reduce the stress and get back to being a low-accident risk. And, above all, remember the myth of the accident prone ●

* * *

Door open in flight

If you fly a light aircraft have you ever given any thought to what would happen if a door came open in flight? Most operating handbooks recognise the possibility and prescribe appropriate procedures to deal with the situation should it occur, but they do not convey to the pilot the startling effect such an occurrence can have on the aircraft's occupants. The sudden rush of air and increase in the noise level will probably make your passenger try to climb onto your lap, and your reverie will be shattered as all sorts of visions flash through your mind in the instant it takes to find the source of the disturbance. Then, if you are unsuccessful in your attempts to close the door, you will be forced to operate in a very noisy and probably cold environment until you land. That environment can be exceedingly distracting, as the pilot of a PA24 recently discovered.

The door popped open without warning as the pilot approached his destination. After several fruitless attempts to close it he advised ATC of his problem and on receiving an approach clearance started a visual approach. He selected landing gear down and then changed fuel tank selection to main tank for landing. However, on checking the fuel contents indicators he discovered that they all read empty. While pre-occupied with this development he allowed the aircraft to get fast and high on the approach. He closed the throttle and selected full flap, but the aircraft still failed to decelerate. Continuing with the approach he executed a sideslip manoeuvre down to about 100 feet to wash off the excess energy and finally touched down 1050 metres along the 2528 metre runway — without the benefit of landing gear or flaps. The pilot had not noticed that they did not extend when selected. Nor had he seen the red light directed at him from the control tower.

Distracted and confused, the pilot became pre-occupied with salvaging the approach and landing the aircraft, at the expense of a rational analysis of what was happening around him. Consequently, he failed to recognise that the aircraft had suffered a total electrical failure at some stage after the approach clearance was issued.

This pilot was taken by surprise and did not regain his composure in time to prevent a wheels-up landing. Would you have been any better prepared? ●

* * *

Strobe lights and ELBs

There have been two incidents recently in which faulty strobe lights on aircraft led to the initiation of search and rescue (SAR) action. The following is a summary of one of the incidents, taken from the Air Safety Incident Report submitted by the pilot:

While using the HF radio, I noticed an 'ELB' noise coming through the headphones. After a few radio checks I found the noise was coming through the HF radio only. I then checked my own ELB, which was correctly selected to the OFF position. I notified Flight Service of the occurrence and advised them that I would be landing to check my aircraft for defects which might be causing the interference. After landing, I eventually determined that the strobe beacon on the aircraft's tail was causing the ELB noise and I notified Flight Service of this.

This noise was exactly the same in tone as an ELB emission, but was slightly slower. I have flown many aircraft on which the strobe lights have caused a 'clicking' sound on the HF radio, but never one with this 'ELB' sound.

The Flight Service Unit involved in this occurrence had declared a distress phase as a result of the report from the aircraft. The pilot is to be commended for landing as soon as possible and resolving the matter, thereby releasing SAR services which might have been required elsewhere for a real emergency.

A technical investigation showed that the interference stemmed from the strobe light's power supply. The power supply incorporates a DC-DC high voltage converter, and if a fault develops in the converter it may allow high frequency harmonics to be radiated, thus causing radio interference. This will be modulated at the converter switching rate and can appear similar to an ELB signal.

Note that to date this interference has been associated only with the HF radio. Pilots who experience the phenomenon should take action, consistent with safe operations, to rectify it as soon as practicable, as it could unnecessarily divert SAR services ●

The maintenance release

Complete and successful maintenance of aircraft depends heavily on flight crew. Their advice at the termination of a flight can be vital to the safe completion of the next one. Pilots have quite specific responsibilities in respect of airworthiness requirements and they have a right to know the detailed airworthiness status of the aircraft they are flying. The maintenance release is the means by which this information is communicated between the flight crew and the maintenance organisation.

The maintenance release is, in effect, the cornerstone of the airworthiness system; however, a lack of understanding by pilots of its use has been noted during inspections of aircraft and associated records. One of the basic misconceptions is that the maintenance release is an airworthiness document rather than an operational document, a misconception perpetuated by some operators who do not permit pilots to endorse the maintenance release with defects. This attitude to the use of the maintenance release has probably stemmed from the fact that the requirements relating to its issue and use are specified in Air Navigation Orders Section 100.5.1, particularly Appendix 5. This ANO contains airworthiness requirements for general aviation aircraft and is distributed to all LAMEs and maintenance organisations. It is only made available to pilots on request; consequently, unless a pilot receives clear instruction during his training on this facet of airmanship he may continue his flying career relying on hearsay in the use of this important document.

Turning now to the actual document, the maintenance release is divided into three parts which, in combination, provide the pilot with all the information he needs to be assured that all necessary maintenance has been carried out. It also provides maintenance personnel with details of any work required and when it has to be done.

Part One is concerned mainly with routine maintenance:

- It certifies that all routine maintenance has been completed.
- It specifies the period of validity of the maintenance release (normally 100 hours or 12 months).
- It records any inspections or maintenance tasks required during the period of validity of the maintenance release, such as oil changes, airworthiness directives, time expired components etc.

Part Two provides the pilot with a means of reporting defects and shows him whether previously reported defects have been rectified. An open entry in Part Two does not necessarily mean that the aircraft should not be flown, but more on this later. It also provides the pilot with a history of defects on the aircraft for the period of validity of that maintenance release. It is worth stressing at this point that a pilot is required to enter defects in the maintenance release.

Part Three provides a record of the hours flown and certifications for the daily inspections carried out. The record of hours flown is necessary to keep a check on the currency of the maintenance release and to show when maintenance called up in Part One is due. It is a requirement that flying hours be entered at least at the end of each day's flying for that aircraft. Except when carried out by the pilot-in-command (other than a student pilot) a certification is required for completion of the daily inspection. ANO 100.5.1 specifies the classes of persons who may make the certification.

Pilot responsibility

The pilot's responsibilities with regard to aircraft serviceability and the maintenance release can be divided into before and after flight requirements.

Before flight, the pilot should:

- Obtain the maintenance release and check that it is current, i.e. that the period of validity, in either hours flown or elapsed time, has not expired. This he does by checking the expiry date and time in service shown in Part One and comparing the latter with the aircraft progressive total time in service in Part Three.
- Examine Part Two for endorsements and check that the certification clearing any endorsement is appropriately signed and authenticated with a licence number. However, as mentioned earlier, the presence of an open endorsement does not necessarily ground the aircraft. Air Navigation Orders, supplemented by the aircraft Flight Manual, list the aircraft equipment requirements for various flight categories and classes of operation. An endorsement affecting any of those items or the airworthiness of the aircraft must obviously be cleared before the aircraft is flown; but there are often unserviceabilities which do not affect either the airworthiness of the aircraft or the mandatory equipment requirements. For example, an endorsement placing the ADF unserviceable does not prevent the use of that aircraft for VFR flight by day.
- Check for certification of the daily inspection in Part Three.
- Ensure that the maintenance release is carried on the aircraft.

After flight, a pilot's attention to detail in completing the maintenance release is critical, not only to the accuracy of the engineering recording system, but also to the airworthiness of the aircraft. His responsibilities in this regard have been mentioned earlier but their importance justifies some repetition and further discussion. The two main areas of action are:

- Recording flight time.
- Endorsing aircraft defects on the maintenance release.

An accurate record of hours flown is essential to preserve the integrity of the maintenance system. It is a requirement that flying time should be entered at least at the end of each day on which the aircraft is flown. This allows the engineers to monitor maintenance requirements against time in service, and enables pilots to ensure that those requirements have been satisfied before they accept an aircraft for flight.

A more exacting responsibility from a day-to-day airworthiness viewpoint is the requirement to endorse aircraft defects on the maintenance release. Failure to exercise this responsibility can result in corrective maintenance not being carried out, thus putting the next pilot to fly the aircraft at risk. The ANRs are quite specific in this regard and there is no concession or exception to this requirement for a normal maintenance release, i.e., when a pilot considers there is a defect, or when he becomes aware of a defect, he must enter on the maintenance release an endorsement signed by him setting out the particulars. Simply telling someone about the problem or leaving a note on a piece of paper are not acceptable alternatives. However, this does not mean that a pilot should not discuss a defect with an engineer or perhaps with a more experienced pilot before making an entry. Inexperienced pilots particularly should be encouraged to do so. But remember, if a defect is not entered there is no guarantee that it will be picked up during routine maintenance — and there can be no valid criticism of the maintenance personnel for failing to do so.

To summarise, complete and successful maintenance depends to a large extent on information entered on the maintenance release at the termination of a flight. Pilots have quite specific legal and moral responsibilities in this regard and should, in their own interest, strive to achieve thoroughness and accuracy in their use of this important document.

This extract from an incident report is an illustration of the foregoing comments:

> On return from a local flight I complained to a LAME of difficulty in locking the pilot's seat and of a sticky altimeter. I did not enter these defects in the maintenance release.
>
> One week later when I again hired the aircraft I noticed that the seat problem had not been rectified, but in another position the seat seemed to be secure so I continued with the flight. Just after lift-off, the seat lock gave way and the seat moved to the rear causing me to lose control of the aircraft. It was some time before I regained sufficient control to climb away and by then I was several degrees off runway heading.
>
> At this point I elected to climb out to 2000 feet to regain my composure. I flew in the general area for about an hour before I felt calm enough to attempt a landing. During this time I again tried to ascertain whether the seat was secure and it did appear to be so.
>
> I made a normal circuit entry and all appeared to be well until I was lined up on final. Then, when I leaned forward to select flap, the seat moved with me and appeared to engage a slot with a loud 'click'. Soon afterwards, when I applied some rudder during the flare, the seat again gave way and slid to the rear. I was unable to reach the rudder pedals and again lost control of the aircraft. It ended up off the side of the runway on the grass, fortunately undamaged.
>
> On returning to the operations room I placed the aircraft unserviceable in the maintenance release for the seat and several other defects. The LAME came in and I described the problems to him as well. His only response was that on no account was a pilot to write anything on the maintenance release without an engineer's permission ●

'Wadaya mean the gizmo's broken, write anything on that bit of paper and you'll be broken too!'

Haste and lack of systems knowledge lead to gear-up landing

When established on downwind at his destination the pilot of a PA28R-200 selected gear down for landing. He heard the pump motor operate and felt the aircraft respond to the drag and trim change as the gear went down, but he did not get a down-and-locked indication. With the cause of the problem not obvious, and being unsure of the gear position, he wisely went around from final for another approach. When established on downwind he again tried to extend the gear, but without apparent success. With last light approaching, he decided to continue and make what he feared would be a gear-up landing. It was!

In the analysis of this accident, it became clear that it contained some valuable safety lessons. Unfortunately, the pilot's recollection of what he did and what actually happened was such that a detailed factual reconstruction of the occurrence was not possible. However, to illustrate the importance of having a thorough knowledge of an aircraft's systems and of calmly and methodically following operating handbook instructions in an emergency, a discussion of known events based on the pilot's recollection of his actions and on the landing gear system design is offered. It should, however, first be noted that no fault was found in the landing gear system after the accident. All the evidence suggested that it should have worked as advertised, and that it probably did.

The aircraft is fitted with an hydraulically actuated gear extension/retraction system powered by an electrically driven pump. It is controlled manually by the gear selector switch or automatically extended by an airspeed/power/altitude sensing circuit. Gear position is relayed to the pilot by three green down-and-locked lights, a yellow in-transit light just below the glare shield and a red gear-up light, also just below the glare shield, which illuminates if manifold pressure is reduced to about 14 inches of mercury or less with the gear not down and locked. This light also illuminates when gear extension takes place with the normal selector switch in the up position and when the gear is selected up while the aircraft is on the ground.

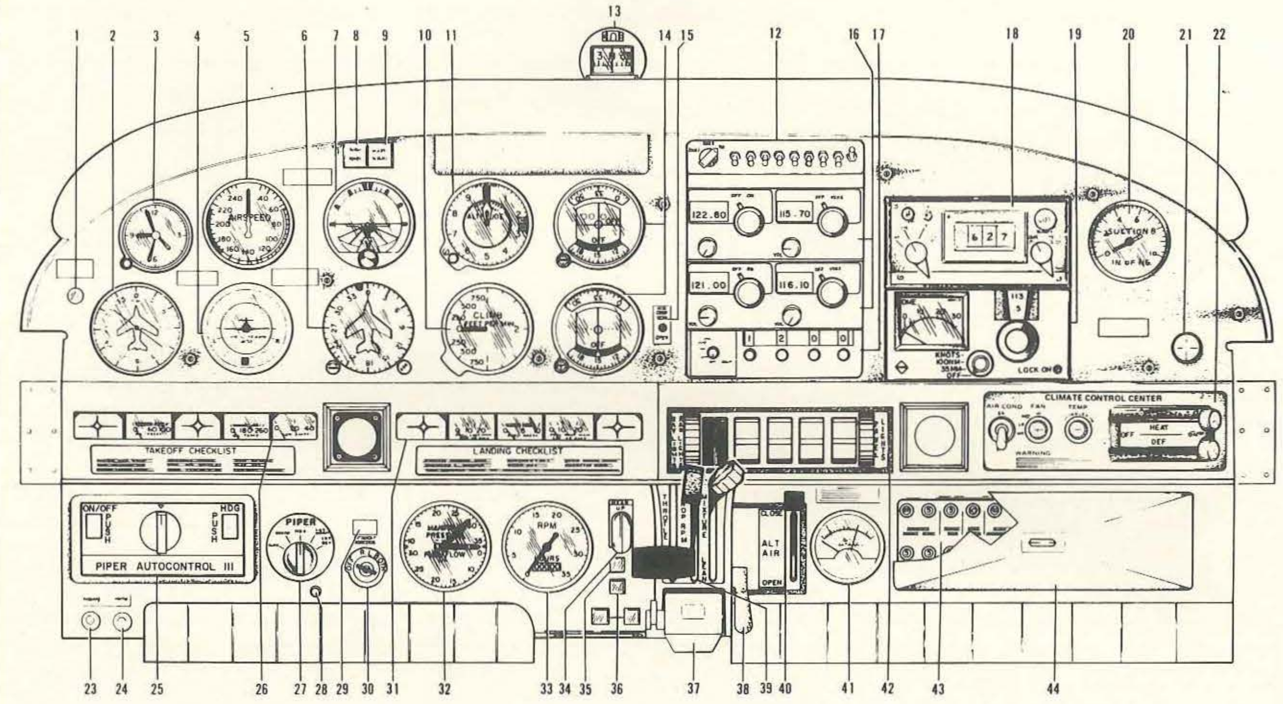
The automatic extension system lowers the landing gear regardless of the gear selector switch position at speeds between about 75 knots and 90 knots, depending on power setting and altitude. However, the pilot can override this system by placing the dual-purpose emergency extension/override lever in the override position. The landing gear system then functions as a conventional system controlled only by the gear selector switch. A yellow 'Auto Ext Off' light, immediately below the gear selector switch, flashes continuously when override is selected.

During a flight the day before the accident, the pilot was unable to retract the gear after take-off until he selected override. In the absence of any evident malfunction of the system the most likely explanation is that his airspeed at the time was below the automatic gear extension speed. The gear retracted normally after take-off the next day and, similarly, functioned normally when extended before a landing for fuel, and when retracted after the subsequent take-off.

On arrival at his destination just before sunset, the pilot joined the circuit and selected gear down. He heard and felt all the normal indications of gear extension and saw the in-transit light illuminate and then extinguish, but he could not discern any illumination of the green down-and-locked indicator lights. After checking that the panel light switch was off (the green lights are dimmed when the panel lights switch is on) he applied full power and went around. Climbing away with two stages of flap selected to keep the speed down he selected gear-up, but did not perceive any indication of gear movement. He then 'cycled the gear switch' during the climb and again on downwind with no further indication. The actual selections he made could not be determined — but when the aircraft landed the gear was up, the override lever was in the override position and the gear selector was up.

Concerned about the fading daylight, the pilot had not taken time to calmly and rationally go through either the normal or emergency extension procedure laid down in the operating hand book. No doubt he was confused about the absence of lights on the first attempt, but from his description of events and ground witness evidence, the gear was almost certainly down then. However, the investigation did not conclusively determine why the lights did not illuminate. One possibility is that they were illuminated but dimmed. The pilot may have only checked that the panel light rheostat was rolled off without actually ensuring the on/off switch was through the spring loaded detent and in the off position.

The absence of a gear down indication and the approaching darkness undoubtedly placed this pilot under stress and led him to make a hasty decision to land without thoroughly examining his situation. He decided when on downwind the second time that he would not have sufficient time to go around from that approach and still land in daylight. At that time, however, last light was still about 13 minutes away. Ironically, had he approached the situation more methodically and got the gear down again, he may well have seen the green lights on his second attempt: the sun had by then gone down, and the indicators, even if they were dimmed, may then have been visible.



1. STALL WARNING INDICATOR
2. ADF INDICATOR
3. CLOCK
4. TURN INDICATOR
5. AIRSPEED INDICATOR
6. DIRECTIONAL GYRO
7. ATTITUDE GYRO
8. GEAR "UP" WARNING LIGHT
9. GEAR "IN TRANSIT" LIGHT
10. VERTICAL SPEED INDICATOR
11. ALTIMETER
12. AUDIO SELECTOR
13. COMPASS
14. OMNI & GLIDE SLOPE INDICATOR
15. AIR COND. INDICATOR LIGHT
16. TRANSCEIVERS
17. TRANSPONDER
18. ADF
19. DME
20. SUCTION GAUGE
21. CIGAR LIGHTER
22. HEATER/DEFROSTER CONTROLS
23. MIKE JACK
24. PHONE JACK
25. AUTOPILOT
26. ENGINE INSTRUMENT CLUSTER
27. OMNI-COUPLER
28. NAV SELECTOR
29. PITCH CONTROL
30. MAGNETO & STARTER SWITCH
31. FUEL GAUGES
32. MANIFOLD PRESSURE GAUGE
33. TACHOMETER
34. GEAR SELECTOR
35. GEAR OVERRRIDE LIGHT
36. GEAR POSITION LIGHTS
37. MICROPHONE
38. FRICTION LOCK
39. THROTTLE QUADRANT
40. ALTERNATE AIR CONTROL
41. EGT GAUGE
42. INSTRUMENT PANEL LIGHTS
43. CIRCUIT BREAKER PANEL
44. CIRCUIT BREAKER COVER

In his haste the pilot also forgot to avail himself of other assistance that was available in the aircraft; one of his passengers was a private pilot with experience on this aircraft type. However, the passenger was unaware of the situation until touchdown. The pilot had not commented on his problems because he did not want to alarm his passengers.

Functional tests made on the landing gear during the investigation failed to reveal any significant abnormality and the system operated normally in all modes. The only discrepancy found was in the adjustment of the gear-up indicator micro switch; the throttle had to be fully closed to operate the red gear warning light and the gear warning horn.

When the operation of the system and the indicator light dimming circuit was demonstrated to the pilot at the completion of the tests, he agreed that in all probability the gear had been down and the lights dimmed on that first approach.

The scene was set for this accident when the pilot had difficulty getting the gear up after take-off the previous day. Unable to analyse the occurrence because of inadequate knowledge of the landing gear system, he was left with some doubts about its serviceability. Then, when faced with an apparently abnormal indication the next day he was probably mentally tuned to accepting that a gear system malfunction actually existed. However, at that stage the accident was not inevitable: it only became so when the pilot, in a stressful situation, was impelled to act in haste without fully considering his options ●

Pilot contribution

An account of an incident between a Cessna 172 and a Fokker Friendship at an uncontrolled aerodrome.

It was approaching 1700 hours on a Sunday afternoon, and I was about to fly to a town 68 nm from my base. Because I had done this flight numerous times and had 1300 hours flying experience in this area I planned to conduct the flight NOSAR NO DETAILS.

When I arrived at the airport a large storm was building up to the south west and west, but the weather was perfectly clear to the east, the direction I was to travel. The wind was 30 knots from the south west, straight down Runway 06-24, the cross strip. I untied the plane after carrying out the pre-flight inspection and commenced taxying, realising that I had only a few minutes to be airborne before the approaching storm would close in, possibly for some time. I also realised that it was the time the Sunday afternoon Fokker normally came in, but there was no sign of the agent at the airport so I assumed that it had either been and gone or was running late, which meant I might meet it at my destination.

I had always got on well with the Fokker pilots, and found it easy to maintain separation, normally offering to keep clear for their benefit, even in situations where I had priority.

I called on VHF and advised 'any traffic' that I was taxying for Runway 24 for my destination. There was no reply.

I did my normal lookouts, and as I was about to enter Runway 30 to back-track I saw the Fokker on the downwind leg for Runway 12 at circuit height.

I presumed it would only confuse him if I called again, since I knew my departure on 24 with subsequent left turn would have me well out of his way for his landing or overshoot on 12, or his circling prior to landing on any other runway. The Fokkers very rarely used 06-24.

As I commenced my take-off run on 24 I saw that he was on final for 12. Because of the proximity of the storm by this time, I turned left onto the crosswind leg of my departing circuit at a height of about 300 feet, about half way down the runway.

I looked behind at this point to see if the Fokker had landed, and to my horror saw him a half mile behind me at my height (about 500 feet AGL), and heading the same direction.

I immediately altered my heading 20 degrees to the right, assuming he would turn left rather than right, and descended to 400 feet AGL until subsequently I saw the Fokker about normal circuit height, a couple of miles away, and still in the circuit area. I then climbed to 3000 feet and continued to my destination. Again, I had not called the Fokker whilst the above eventuated. My main concern was to maintain separation myself and not to confuse him, but I did wonder if he had sighted me at any stage.

Ten minutes later I heard Flight Service (58 nm from the departure aerodrome) call the Fokker to see if he was in VHF range. He replied that he had been circling for 10 minutes due to crosswinds in excess of his maximum.

I heard no further radio communications at all from the Fokker until his VHF taxying call on departure.

I spoke the next day with the airline agent, who had arrived at the airport as I was taking off. He said the Fokker abandoned his approach on 12 and that he was convinced the Fokker was going to leave wheel marks on the roof of my Cessna. He asked the Captain when he finally landed had he seen the lighty that took off. He hadn't.

I was upset at having such a close shave, and gave the whole incident much soul searching. In retrospect I should have tried to establish contact with the Fokker when I first sighted him, but in view of the approaching storm, my concern to get airborne, and his obvious concern to land, I felt it wisest not to confuse the situation. Also, since he had not answered my earlier call I felt there was a chance he may not answer again. Furthermore, the cross-wind at that point of taxying was so strong that I needed both hands for operating the ailerons and throttle for control of my aircraft.

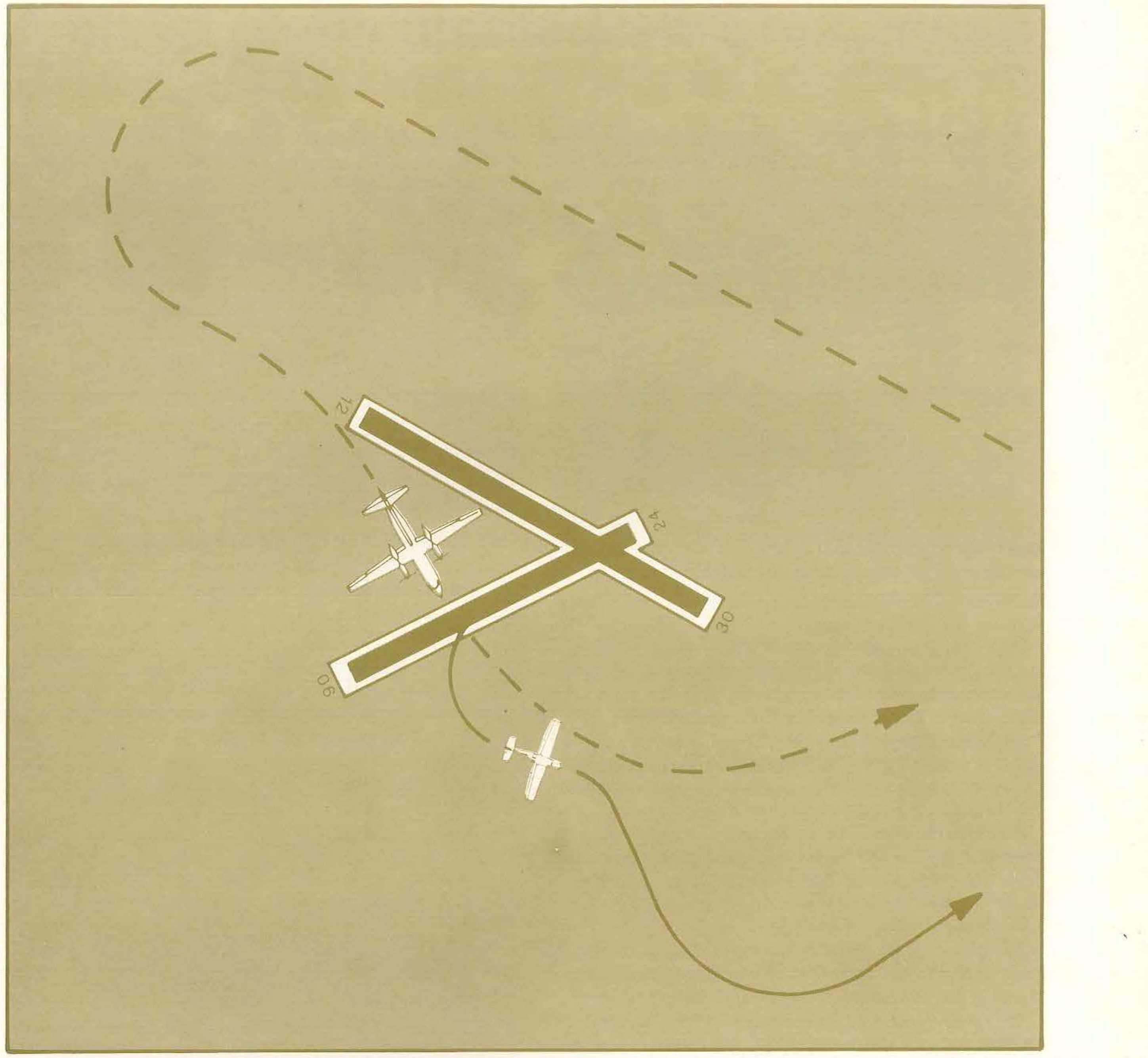
I did not put a 225 in. I felt that perhaps I should have, but I did not wish to harm a Captain's career. Also, Fokker Captains, as indeed all RPT pilots, have always been most helpful with relaying radio messages. Indeed, I have found them to be more 'brother pilots' than some GA pilots are. I had no wish to 'dob' one in, and have pleasant memories of hours spent in Fokker jumpseats. I deemed an article in *Aviation Safety Digest* would do far more good, assisting all Fokker Captains to play their part in maintaining separation from light aircraft, and assisting us bush pilots to do our bit in keeping clear of the big ones.

Comment

This account of a close encounter tells its own story, but three points are worthy of comment.

First, the pilot's decision not to submit a 225. This precluded an investigation of the incident, thereby denying the opportunity to learn why the broadcast system failed to work.

Contrary to the pilot's suggestion, the air safety incident reporting system is not a vehicle for 'dobbing other pilots in'. The objective of air safety investigation is to promote aviation safety through the identification of unsafe conditions and procedures: it is not to apportion blame or liability.



With that comment made, we express our appreciation to the pilot for submitting this report of his experience for publication in the *Digest*. First-hand accounts of incidents and experiences such as this one are always superior to any admonitions made with the benefit of hindsight from the comfortable seclusion of an office.

The second point concerns the actions of the F27 pilot during the period he was holding. It is probably fair to say that most amateur pilots look to the professionals for guidance, if only through example. Consequently, to circle for ten minutes and then land without making one broadcast of intentions is hardly a good example for an RPT pilot to set.

Our contributor commented in his covering letter that he hoped this article would get the message to the RPT pilots that they should not be afraid to use their radios and talk to the 'bushwackies'.

The third relates to our contributor's concern that to call the F27 pilot during the encounter would have confused the situation. As he said in retrospect, he should have tried to establish contact when he first sighted the F27.

Attempts at establishing communications are unlikely to cause confusion, whereas reliance on assumptions will almost certainly do so, or worse, result in the development of a situation in which a pilot takes inappropriate action or is forced to modify his operations at a critical stage because he does not know the other pilot's intentions.

And a final thought — RPT pilots, without a doubt, appreciate the gestures shown by the many GA pilots who give way in consideration of tight operating schedules. But when you are extending that courtesy, do tell the other pilot what you are doing. Without communication the gesture may be interpreted as indecision ●

Engine fire during start

The pilot's report stated: *On request from the owner, I was positioning the aircraft for refuelling. It was very difficult to start — the outside air temperature was minus one degree Celsius and the battery was sluggish. After numerous attempts to start the aircraft I considered that I may have overprimed the engine. I shut down the electrical system, selected full throttle and lean mixture, and waited for a couple of minutes before attempting a 'hot' start. The engine backfired, ran for a couple of seconds then stopped. I tried one more start before noticing smoke coming from the front of the aircraft. I immediately shut down the electrical and fuel systems, grabbed a fire extinguisher and, with the aid of a mechanic from a nearby maintenance facility, extinguished the fire. The aerodrome fire service attended. Damage was restricted to minor burning of the fibreglass around the exhaust system outlet.*

Subsequent investigation of this incident included discussion between the investigator, the owner and the pilot, and reference to the Pilot's Operating Handbook for the aircraft type and the Operator's Manual for the engine.

Describing his technique of starting the engine, the pilot said that he made two or three strokes of the manual primer before attempting the start but the engine did not fire. He then pumped the throttle a couple of times and tried starting again, without success. He tried again and then stopped to let the engine 'settle'. After several more pumps of the throttle he tried to start the engine and it backfired. He tried yet again and during this attempt noted what he thought was steam coming from the engine cowl. He initially believed it was steam because he had washed the aircraft down to remove the frost.

As the cloud of white vapour continued to rise he realised it was serious, shut down the systems and exited from the cabin with the fire extinguisher.

The pilot later emphasised that when he used the throttle for priming he did not use full strokes but only about three-quarters of the full throttle movement. He added that, during his training at the local aero club, he had been taught to use the throttle rather than the normal primer. He believed this teaching was prevalent amongst instructors.

Reference to the appropriate manuals would have provided the pilot with the correct procedures to follow. In this case the aircraft was a Piper PA-28-181, fitted with an Avco Lycoming 0-360 engine.

The Normal Procedures section of the Pilot's Operating Handbook provides the following expanded checklist for engine starting:

STARTING ENGINE

(a) **Starting engine when cold**

Open the throttle lever approximately ¼ inch. Turn 'ON' the master switch and the electric fuel pump.

Move the mixture control to full 'RICH' and engage the starter by rotating the magneto switch clockwise and pressing in. When the engine fires, release the magneto switch, and move the throttle to the desired setting.

If the engine does not fire within five to ten seconds, disengage the starter, prime the engine and repeat the starting procedure.

(b) **Starting engine when hot**

Open the throttle approximately ½ inch. Turn 'ON' the master switch and the electric fuel pump. Move the mixture control lever to full 'RICH' and engage the starter by rotating the magneto switch clockwise and pressing in. When the engine fires, release the magneto switch and move the throttle to the desired setting.

(c) **Starting engine when flooded**

The throttle level should be full 'OPEN'. Turn 'ON' the master switch and turn 'OFF' the electric fuel pump. Move the mixture control level to idle cut-off and engage the starter by rotating the magneto switch clockwise and pressing in. When the engine fires, release the magneto switch, advance the mixture and retard the throttle.

If the Pilot's Operating Handbook does not contain the full details, e.g. priming, then refer to the engine manufacturer's Operating Manual which in this case states:

STARTING PROCEDURES

The following starting procedures are recommended; however, the starting characteristics of various installations will necessitate some variation from these procedures.

Note: Cranking periods must be limited to ten (10) to twelve (12) seconds with a five (5) minute rest between cranking periods.

a) **Carburetted engines (cold).**

(1) Perform pre-flight inspection.
(2) Set carburettor heat control in 'OFF' position.
(3) Set propeller governor control in 'FULL RPM' position (where applicable).
(4) Turn fuel valves 'ON'.
(5) Move mixture control to 'FULL RICH'.
(6) Turn boost pump 'ON' (where applicable).
(7) Open throttle approximately ¼ travel.
(8) Prime with 1 to 3 strokes of manual priming pump or activate electric primer for 1 or 2 seconds.
(9) Set magneto selector switch (Consult airframe manufacturer's handbook for correct position).
(10) Engage starter.
(11) When engine fires move the magneto switch to 'BOTH'.
(12) Check oil pressure gauge. If minimum oil pressure is not indicated within thirty seconds, stop engine and determine trouble.

Note: If engine fails to achieve a normal start, assume it to be flooded and use standard clearing procedure, then repeat above steps.

b) **Carburettor engine (hot)** — Proceed as outlined above omitting the priming step.

The reader will now realise that as well as risking a serious fire by using incorrect priming techniques the pilot could have caused a failure of the starter motor by exceeding the recommended cranking periods. Compliance with this requirement would have allowed time for the excess fuel collected from over-priming to have cleared from the engine.

(cont'd on page 15)

A chain of circumstances

After landing I taxied the Shrike Commander into the dispersal area with the landing lights on and noticed the refueller standing by the fuel outlet with the unit opened and the refuelling hose out. The visibility at the time was poor due to rain and also, as was later determined, the overhead flood lights were unserviceable. The aircraft was positioned alongside the unit with the right-hand side nearest to it, as the fuel inlet is on this side. I switched off the landing lights approaching the unit to avoid dazzling the refueller.

After shutting down both engines, and before we had alighted from the aircraft, the refueller had set up his ladder and was extending the hose for refuelling. As he obviously needed no assistance, I disembarked my passengers and helped them with their baggage to the terminal and out of the rain. On entering the terminal, I noticed that my returning passengers also had a large quantity of baggage; therefore I assisted them to carry and load it onto the aircraft. By this time the refuelling had been completed and I checked the fuel level in the tank to be sure it was actually full.

It was raining at the time and, having checked the fuel level, I did a fuel drain and returned to the terminal where I signed the fuel docket and checked the quantity taken. This amount was what I expected. I then loaded the passengers and eventually commenced a take-off.

During the take-off, I detected a slight, variable, asymmetric sound from the engines and although the gauges appeared normal I abandoned the take-off from about 75 knots. I ran the engines up to 1800 RPM to check their performance. The gauges and sound were normal. Suspecting that a small amount of water could have possibly caused the engines to act as they did I lined up for another take-off, this time applying full power whilst holding on the brakes and closely monitoring the engine performance. They did not give full power so I terminated the flight. While taxying back to dispersal it occurred to me that, when checking the fuel tank contents, the fuel smell was turbine fuel and not avgas but, at the time, this had not registered. A subsequent check of the fuel docket confirmed the error.

In addition to all the other factors included in his report the pilot stated that there was a forecast for possible fog at his destination from about the time he was expecting to arrive there.

A contributing factor not included in the pilot's report was that the refueller on duty was a relief operator who was unfamiliar with this type of aircraft and did not see the fuel placard on the wing.

This incident is a classic example of how a number of factors may come together during the development of an incident or accident. To quote but a few of the factors which arose during this incident:

- It was night time, raining, and the flood lights were unserviceable . . .
- The pilot assumed the refueller knew what he was doing because of an appearance of efficiency . . .
- The refueller did not check the pilot's requirements even though unfamiliar with the aircraft . . .
- The pilot became heavily involved in non-operational matters, a common situation in this type of operation . . .
- Etcetera . . .

The pilot is to be commended on electing to abandon the take-off when he detected a problem with the engines and in terminating the flight when the subsequent ground run proved unsatisfactory. If he had not done so the final outcome may well have been tragic.

We can be sure that this pilot now has a good appreciation of the subtle way in which circumstances can combine to produce a serious problem — perhaps a major accident. It is hoped that every one of our readers will also be helped in the recognition of similar factors when they appear on the scene from time to time ●

* * *

Engine fire during start *(cont'd)*

The rules are simple — if you want to learn the correct way to operate your aircraft and its equipment refer to the appropriate manuals produced by the manufacturers; if compliance with their recommendations does not work, then it is time to see your maintenance organisation ●

Cockpit etiquette

by Arnold Reiner (courtesy Flight Crew)

This is not about co-pilot deference to the captain or captain's condescension to the co-pilot. This is about survival through respect.

A BAC 1-11 with 73 passengers on board landed long and sped off the rollout end of the runway at flying speed! When the dust settled, one passenger was seriously injured and the aircraft was substantially damaged. The captain never considered a go-around. In contrast, according to the National Transportation Safety Board report, the co-pilot considered a go-around many times and tried to warn the captain in subtle ways such as mentioning the possibility of a strong tailwind and the slowness of the flap extension. The first officer's remarks did not make a dent in the captain's resolve to land the aircraft regardless of speed and remaining runway length. The co-pilot might just as well have not been there.

Following take-off and climb to about 1500 feet, a B747 banked steeply and dived into the sea at an airspeed in excess of 300 knots. Investigating authorities determined that the captain's attitude director indicator had malfunctioned in a way which did not display a warning flag. The captain followed the gyrations of the failed indicator and flew into the sea while the first officer attempted in a marginally coherent way to draw the captain's attention to the two good horizon displays in the cockpit. The co-pilot was cited for his lack of assertiveness while the captain was faulted for relying excessively on one cockpit instrument.

A B727 crashed on landing during a low visibility approach. One person died and 32 were injured when the plane landed long and fast and the captain attempted a go-around after being committed to a full stop landing. The NTSB report cited the co-pilot for not being outspoken enough when the flight was conducted in a careless or dangerous manner. The report continued, 'Pilots-in-command should foster an atmosphere in the cockpit which permits constructive advice and positive recommendations for change where safety is involved'.

The reality is that captains, even well meaning ones, do not always foster 'an atmosphere of constructive advice and positive recommendations'. Such behaviour sometimes encourages co-pilots to take great pleasure in watching captains err — at the risk of all on board. Recently, a B707 first officer related a story about a captain who tried to turn off too soon after landing on a slippery runway. To hear the first officer tell it, the captain's ego was as big as the aircraft. When it became apparent to the first officer that the captain was attempting to negotiate the rapidly approaching taxiway at an excessive speed, he said to the captain, 'You're not going to make it'. The statement was repeated several times — each time strengthening the captain's resolve to accomplish the feat. The co-pilot was right. As the aircraft slid into the watersoaked grass between the runway and taxiway, the first officer's final banter was, 'You didn't make it'. The co-pilot related the story with triumph, unaware that he played a hand in the incident.

What's the answer? How does a captain accept the honest concerns of a young co-pilot — or an old co-pilot? And what will foster a spirit of teamwork and co-operation in the co-pilot? The answer is respect. Respect for the other's knowledge and concerns. Co-pilots do not have to be high time veterans to know when the captain misreads the descent minima, hears a clearance incorrectly or fixates on the runway while sink rate doubles or airspeed deviates excessively from normal. As a rule, co-pilots don't like to be constantly told how to fly and captains don't like to be 'advised' too frequently when their technique deviates from the norm. After a while even the most obtuse pilots develop a certain tolerance for the non-standard and know to hold their tongues lest the working environment becomes intolerable. With this in mind, when a warning or cautionary remark is made by either crewmember, each owes it to the other to consider its worst implications. Words must be chosen carefully or they may be misinterpreted. On the other hand, subtle hints not directed at the root of concern may be misunderstood and ignored. The BAC 1-11 co-pilot's hints about excessive speed for the flap setting and high tailwind made no impression on the captain as he bore in toward the runway at an impossible landing speed. Comments must be made in a positive manner and should relate directly to the concern, possibly containing direction, e.g. 'Go around, we are too fast'.

Even though progressive companies require their crews to call out significant deviations from normal flight profiles and speeds, helpful, precisely worded statements defining danger are what the pilot doing the flying needs. Tactfully beating around the bush at critical periods in the flight, as we have seen, is not an effective approach to a life and death situation. On the other hand, captains and co-pilots must accept a warning for what it is and be prepared to act upon it ●

Just before rotation, during take-off at Hobart Airport, the nosewheel of the B737 struck a hare which was hopping across the runway. Fortunately the aircraft was not damaged.

The pilot filed a 'mid-hare collision' report ●

Observe your authorisation limits

Have you ever been tempted to go below your authorised minimum height during a practice forced landing? The pilot involved in this accident did.

The two occupants of the aircraft were trainee commercial pilots, each with about 135 hours flying experience. The pilot in command had been authorised to conduct practice instrument approaches to a nearby NDB and, with the exercise completed, was returning to base when his companion suggested that they make a practice forced landing. The pilot agreed and the throttle was closed. He then carried out the appropriate checks and set up an approach to a paddock in the training area. When established on final he recognised that he was undershooting and decided to continue with the approach to see whether he would have reached the paddock. At a height of about 40 feet and about 100 metres short of the paddock he realised that he was very close to the ground and rapidly opened the throttle — the engine did not respond. A second attempt achieved the desired result but by then the aircraft had hit power lines, which the pilot had not seen. Trailing three lengths of cable, the aircraft stayed airborne but would not climb. The pilot commenced a left turn to avoid trees and silos, but after turning through 180 degrees the aircraft touched down. Realizing that further flight was impossible the pilot closed the throttle and managed to stop the aircraft without incurring any additional damage.

Both pilots were aware that they were not authorised to go below 500 feet AGL. The pilot in command pressed on out of curiosity. His companion went along without comment and said later that, although he was concerned, he was also curious as to whether they would have reached the paddock.

These two were lucky. Others have not been so. Authorisation limits are imposed for good reasons, and the charred and bent ruins of many an aircraft attest to the dangers of violating them ●

The power lines struck by the aircraft, replaced by the time the photograph was taken. Direction of approach is arrowed and the aircraft is circled at left of the photograph.

The aircraft as it came to rest. Broken power lines are shown wrapped around the left undercarriage, rear fuselage and right stabilator.

Survey of accidents to Australian civil aircraft 1980

General Aviation operations 1976-1980

	1976	1977	1978	1979	1980
Accidents					
Total	243	221	249	243	253
Fatal	19	19	26	19	23
Aircraft damage					
Destroyed	32	27	49	38	32
Substantial	214	191	199	203	220
Minor/none	0	4	2	3	3
Fire after impact					
Fatal accidents	7	4	10	6	3
Non-fatal accidents	5	2	6	6	7
Fatalities					
Crew	21	18	26	19	20
Passengers	32	20	25	13	36
Others	0	5	6	1	0
Injuries					
In aircraft					
Fatal	53	38	51	32	56
Serious	13	13	31	22	27
Minor/none	543	456	540	440	495
On ground					
Fatal	0	5	6	1	0
Serious	1	5	0	1	0
Minor	0	3	1	0	0
Hours flown (thousands)	1 348.0	1 529.0	1 539.7	1 698.9	1 795.4
Accident rates					
(per 100 000 hours flown)					
Total	18.03	14.45	16.17	14.30	14.09
Fatal	1.41	1.24	1.69	1.12	1.28
Number of aircraft on Register at 30 June	4 280	4 726	5 250	5 847	6 141

Airline operations 1976-1980

	1976	1977	1978	1979	1980
Accidents					
Involving fatalities	0	0	0	0	0
Involving serious injury	0	0	0	0	0
Involving minor/no injury	0	1	0	0	0
Total	0	1	0	0	0
Aircraft damage					
Destroyed	0	0	0	0	0
Substantial	0	1	0	0	0
Minor/none	0	0	0	0	0
Fire after impact					
Fatal accidents	0	0	0	0	0
Non-fatal accidents	0	0	0	0	0
Fatalities					
Crew	0	0	0	0	0
Passengers	0	0	0	0	0
Other	0	0	0	0	0
Total	0	0	0	0	0
Injuries					
Fatal	0	0	0	0	0
Serious	0	0	0	0	0
Minor/none	0	381	0	0	0
Hours flown (thousands)	357.0	360.8	368.2	365.7	377.4
Accident rates					
(per 100 000 hours flown)					
Total	0	0.29	0	0	0
Fatal	0	0	0	0	0
Number of aircraft on Register at 30 June	153	145	136	132	131

Australian legislation imposes a mandatory requirement for the reporting of all accidents and incidents involving Australian civil aircraft. These occurrences are subsequently investigated by the Bureau of Air Safety Investigation for the purpose of preventing further accidents and incidents. Reports are analysed to enable factors to be assigned in respect of each occurrence. Relevant data on the man, the machine and the environment, together with the assigned factors, are then recorded in a computer-based system and used in the accident prevention program.

The Bureau annually produces a publication dealing with statistical analysis of the recorded information on reported accidents. The *Survey of Accidents to Australian Civil Aircraft 1980* was released early this year and is available from Australian Government Publishing Service Bookshops. It contains a large amount of statistical detail in respect of the 1980 accident record, including types of accident, pilot experience, assigned factors and so on, for airline, general aviation and gliding operations.

The *Survey* also contains a section devoted to a review of accident rates and activity data over past years for all categories of airline and general aviation flying, thus giving an indication of the changes which have occurred in flying activity and accident rates over the past ten years.

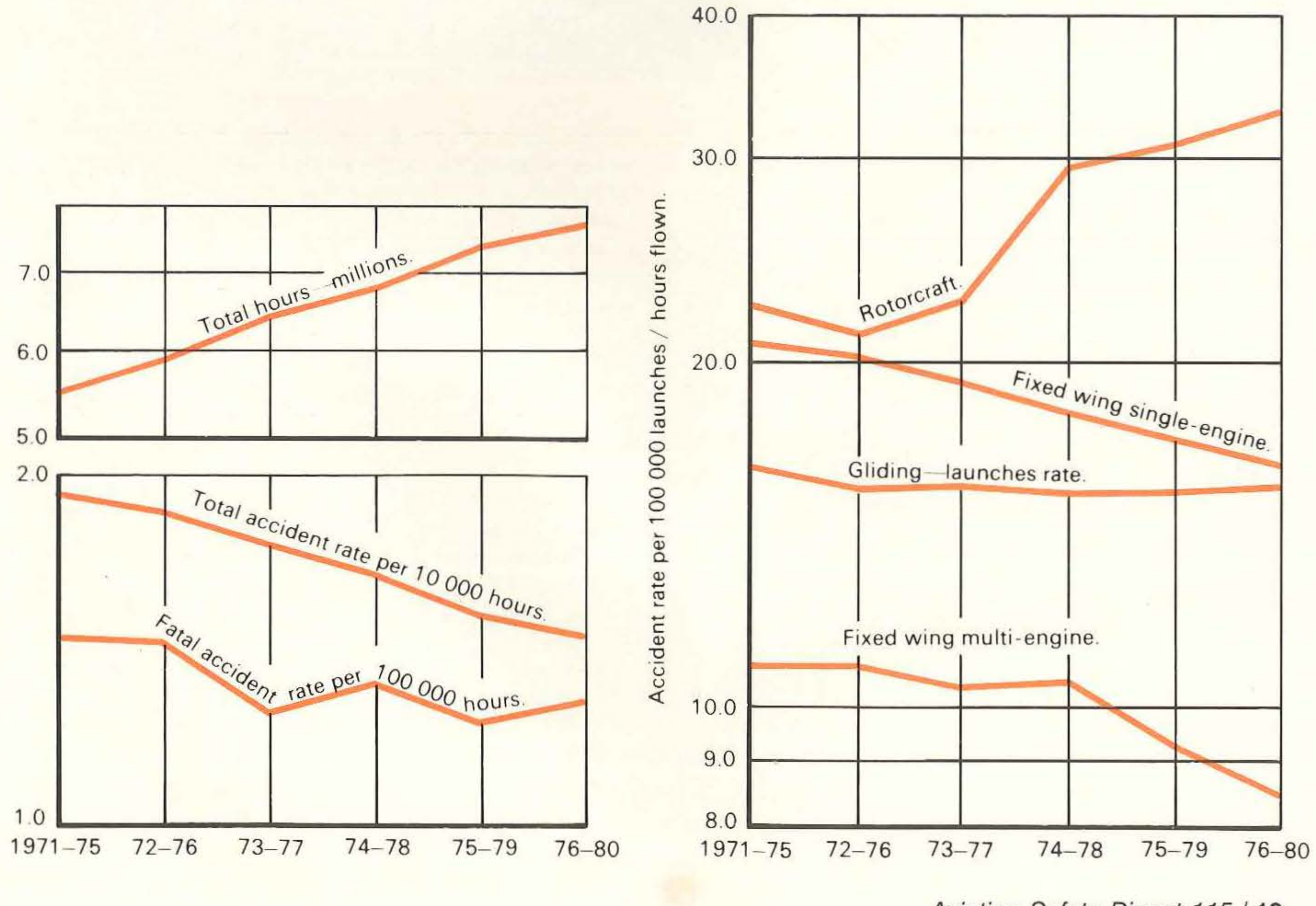
Our readers may be interested to see the graphs and tables presented here, which have been extracted from the 1980 *Survey*. The graphs in particular give a picture of the overall trends in general aviation. Five-year periods are used for trend assessment because there can be substantial random fluctuations in accident numbers from year to year, as may be seen from the tables.

General aviation activity continues to increase at a rate of about six per cent per year and the total accident rate is decreasing at about five per cent per year. Provisional figures for 1981 indicate that the total accident rate trend is being maintained. Obviously some of the effort that is directed to improving aviation safety in Australia is effective.

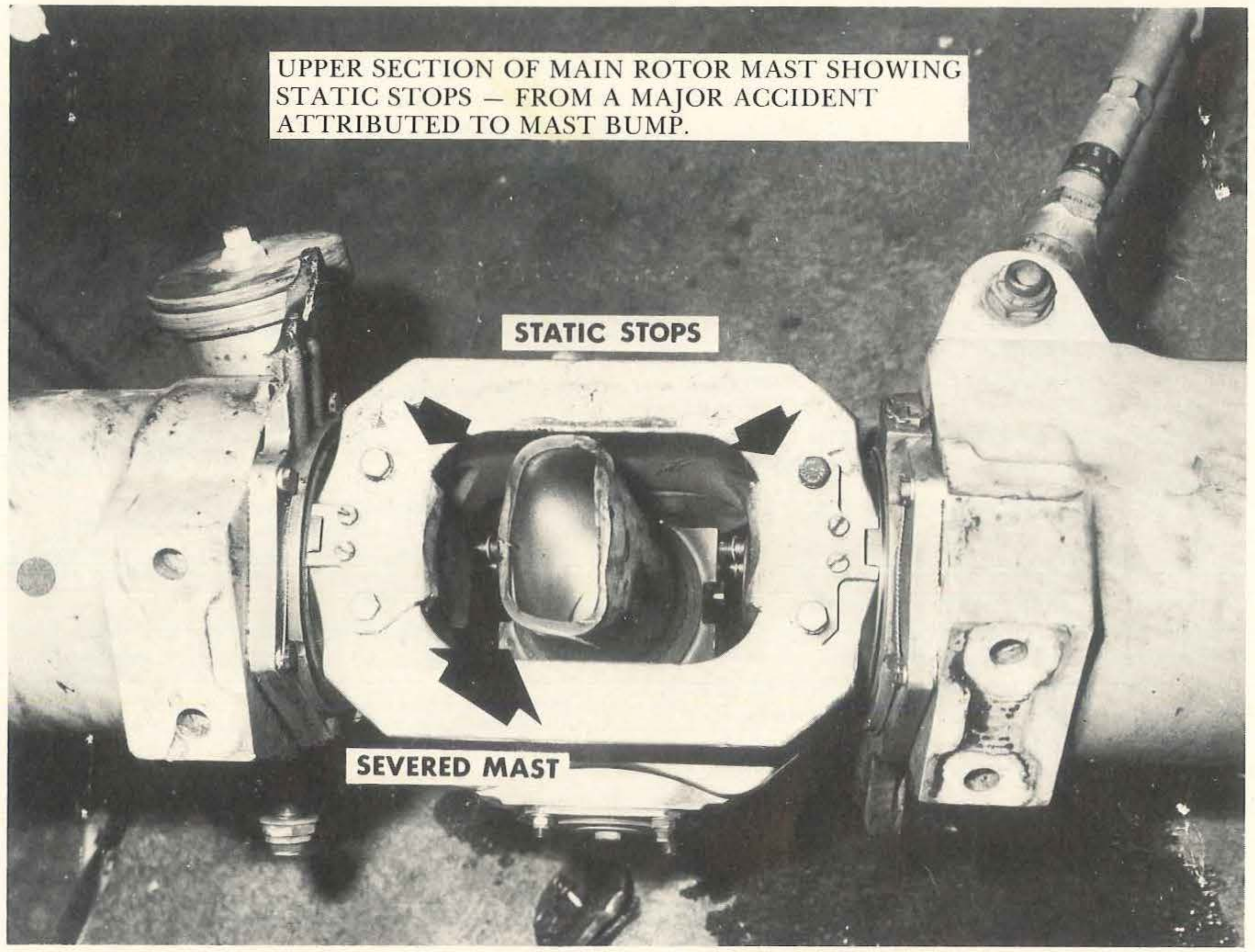
The data refers only to aircraft accidents, the definition of an accident being:

> An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all persons have disembarked, in which
>
> (a) a person is fatally or seriously injured as a result of :
> — being in the aircraft, or
> — direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
> — direct exposure to jet blast.
> *except* when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or
>
> (b) the aircraft incurs substantial damage or is destroyed; or
>
> (c) the aircraft is missing or is completely inaccessible.
>
> Note: An aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located ●

Five year averages of general aviation accident rates

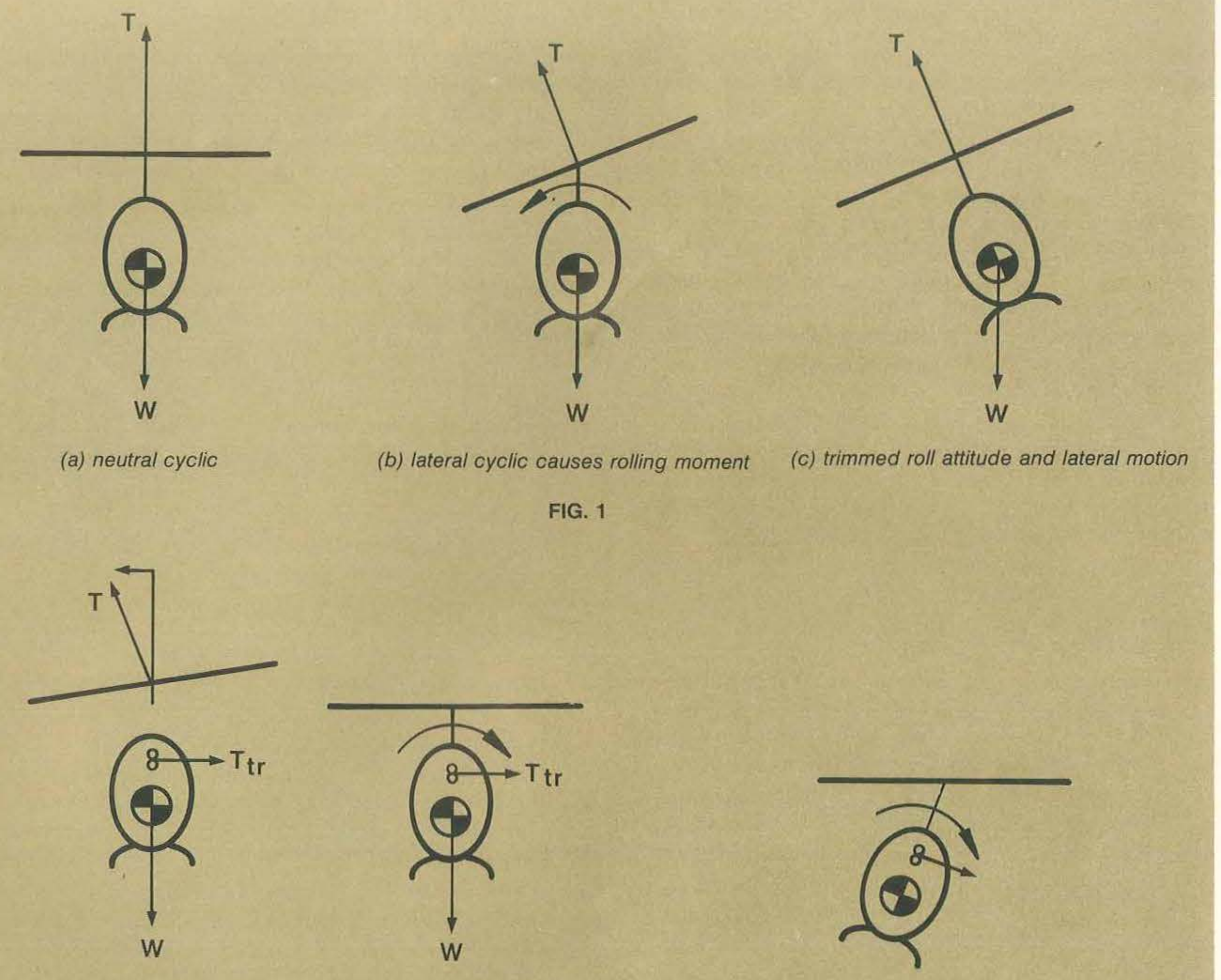


Mast bumping in helicopters



This article was adapted from one originally published in the U.S. Navy safety magazine *Approach*. Mast bumping occurs when the helicopter's main rotor hub contacts and deforms the rotor mast. The next stage is separation of the main rotor mast with catastrophic results. Peculiar to semi-rigid (teetering) rotor systems as fitted to Bell 47, 205, 206, 212, 214 and Hiller 12E, for example, inflight mast bumping has been the cause of more than 50 fatal accidents in the US Armed Forces and two in the RAAF. Fortunately, we have not experienced an accident in Australian civil aviation in which mast bumping has been identified as a contributory factor, but this record should not become the cause of complacency. Mast bumping can be pilot-induced by the use of poor flying techniques and there are about 170 helicopters in Australia embracing the types mentioned above.

The problem of mast bumping occurs when the rotor head tilts and contacts the mast; in other words – when the rotor flaps excessively. Generally speaking, flapping amplitudes reach only a very small percentage of the maximum allowed for manoeuvres within the flight envelope. As an example, provided that retreating blade stall is avoided, high forward flight speeds at high gross weights and density altitudes result in flapping angles of approximately 15 per cent or less of the maximum allowable for a typical semi-rigid system. Assuming centre of gravity limitations (forward centre of gravity limits in particular) are not exceeded, gusty conditions can increase rotor flapping by a similar amount. Sudden changes in attitude, as induced by abrupt cyclic input or by mechanical failure, e.g. loss of the tail rotor or engine power loss, can also increase flapping values to as much as 60 to 70 per cent of the limit, and sideways flight to the right at maximum permissible speed will increase flapping similarly. The reason for the last item is that the direction of rotation of the main rotor on these helicopters is clockwise when looking up through the rotor. The most critical manoeuvre in regard to mast bumping, however, is one that generates low g, such as the pushover at the top of a zoom climb. To understand why, think back on your knowledge of helicopter control. If the pilot desires a change in pitch or roll attitude, the primary control is cyclic, which allows tilting of the rotor thrust vector with respect to the mast. As a result, an unbalanced moment is generated about the aircraft centre of gravity and fuselage attitude is changed (see Fig. 1).



(a) neutral cyclic (b) lateral cyclic causes rolling moment (c) trimmed roll attitude and lateral motion

FIG. 1

(a) symmetric 1G flight (b) symmetric zero G flight

FIG. 2

FIG. 3

A more detailed look at forces acting on a helicopter in symmetric, one g and zero g flight is shown in Fig. 2.

Note that in Fig. 2(a) the rotor thrust is tilted slightly left so that the horizontal component of main rotor thrust will balance the tail rotor thrust and provide for lateral equilibrium. In Fig. 2(b) the pilot has induced a condition of near-zero thrust by reducing collective in conjunction with relatively rapid forward cyclic application. Consequently, with no force to balance tail rotor thrust, the result is left yaw, right side slip and, most importantly, right roll – even though lateral cyclic remains neutral.

As the roll accelerates, the tip path lags the fuselage rolling motion slightly, depending on the roll rate and other design characteristics of the rotor. This results in a condition in which the clearance between rotor head and shaft is reduced (see Fig. 3).

This clearance reduction is minor, however, and will not in itself lead to mast bumping. But recall that the aircraft is continuing to roll to the right, despite neutral lateral stick. Instinctively the pilot would counter with left cyclic in order to stop the right roll. Response to the left lateral control will cause upward flapping on the advancing (right hand) side of the rotor disc, thereby further decreasing the clearance between the rotor head and the mast on the retreating (left hand) side. Such an input to a loaded rotor would tilt the thrust vector opposite to the direction of the roll, thereby creating a moment tending to return the aircraft to the proper roll attitude. In the zero or low g condition, however, rotor thrust is virtually non-existent and no restoring moment results from tip path tilt. The unwary pilot, with the instinctive left lateral input, would quickly cause the rotor to contact the mast. The torsional driving load, in conjunction with bending, then causes a mast failure. Need we say more?

How does one avoid this situation? By avoiding low or zero g conditions, of course. However, if you inadvertently find yourself in this situation, how can you make a recovery?

The first concern must be restoration of the thrust vector, i.e. reload the rotor. Once rotor thrust is restored, the pilot will regain normal attitude control through the use of cyclic pitch.

What is the quickest and safest method for

(cont'd on page 22)

Mast bumping in helicopters *(cont'd)*

reloading the rotor system? While both aft cyclic and collective inputs will restore rotor thrust, collective application will also change engine power output. Extensive flight tests have indicated the possibility of rotor under-speeds or gearbox over-torques (depending on altitude) when utilising collective to recover from low g roll. Yaw trim difficulties were also found likely. Aft cyclic application, however, was found to quickly restore control power and decrease right roll rate. Since this method was found not to cause any of the disadvantages of the collective recovery, aft cyclic is considered the best method of thrust restoration. Once thrust is regenerated in this manner, left lateral cyclic may be used in roll recovery without fear of mast bumping. However, it must be stressed that the only safe way to avoid mast bumping and subsequent separation of the rotor head is prevention, i.e. the avoidance of low g situations. The foregoing recovery technique is not instinctive and there is no room for error in its application.

To sum up:

- If low g or zero g is encountered, an uncommanded right roll can be expected.
- The application of left cyclic will not stop the roll, and can rapidly cause the hub of an unloaded rotor to strike, distort and possibly sever the mast, resulting in main rotor separation.
- Rotor thrust must be restored before lateral cyclic effectiveness can be regained.
- Aft cyclic should be used first, to re-load the main rotor.
- Above all, avoid low g situations in teetering rotor helicopters! ●

* * *

Hazardous attitudes

A research team at the Embry-Riddle Aeronautical University in the United States has isolated five accident-inducing 'hazardous attitudes' based upon a study of 600 accidents. The team concluded that the five were a causal factor in 94.6 per cent of the accidents studied.

The hazardous attitudes were identified as:

- Feeling of invulnerability, wrapped around a belief that accidents only happen to others.
- 'Macho' attitude, in which the pilot feels that taking a potentially hazardous course 'will make a bigger guy of me'.
- 'Anti-authority', a defiance of instructions by pilots who dislike being told what to do.
- 'Impulsivity', or acting on impulse in a tight situation rather than reasoning out the best course of action.
- 'Out of control', when the pilot feels that the situation has deteriorated beyond his capabilities and concludes, 'What's the use?'.

When such attitudes crop up only occasionally, pilots can be trained to resist them. When they are compulsive, they may prove to be terminal ●
(Courtesy Flight Safety Foundation Flight Safety Facts and Reports)

Churchill Fellowships

The Winston Churchill Memorial Trust was established in Australia in 1965, the year in which Sir Winston Churchill died. The principal object of the Trust is to perpetuate and honour the memory of Sir Winston Churchill by the award of Memorial Fellowships known as 'Churchill Fellowships'.

The aim of the Churchill Trust is to give opportunity, by the provision of financial support, to enable Australians from all walks of life to undertake overseas study, or an investigative project, of a kind that is not fully available in Australia. This opportunity is provided in furtherance of Sir Winston Churchill's maxim that: 'with opportunity comes responsibility'.

There are no prescribed qualifications, academic or otherwise, for the award of a Churchill Fellowship. Merit is the primary test, whether based on past achievements or demonstrated ability for future achievement in any walk of life. The value of an applicant's work to the community and the extent to which it will be enhanced by the applicant's overseas study project are important criteria taken into account in selecting Churchill Fellows. However, Fellowships will not be awarded in cases where the primary purpose of the application is to enable the applicant to obtain higher academic or formal qualifications nor to those in a vocation which offers special opportunity for overseas study.

Churchill Fellows are provided with a return economy-class overseas air-ticket and an Overseas Living Allowance to enable them to undertake their approved overseas study project. In special cases they may also be awarded supplementary allowances including Dependants' Allowance. Fifty seven Churchill Fellowships were awarded for 1983.

All Churchill Fellows are presented, at an appropriate ceremony, with a certificate and badge identifying them as such. The certificate bestows upon the recipient the prestige of being a Churchill Fellow and, while a Fellow is overseas, serves to open many doors that would not otherwise be opened to a private individual. This could provide an opportunity for a member of the aviation industry to help others in aviation as a result of their endeavour and the assistance provided by a Churchill Fellowship.

Applications

The Churchill Trust is now calling for applications from Australians, of 18 years and over, from all walks of life who wish to be considered for Churchill Fellowships tenable in 1984.

Completed application forms and reports from three referees must reach the Churchill Trust by 28 February 1983.

People wishing to be considered for a Churchill Fellowship should send their name and address now with the request for a copy of the Churchill Trust's information brochure and application forms to: The Winston Churchill Memorial Trust (M), PO Box 478, CANBERRA CITY, ACT 2601 ●

Danger! Aerosol cans do EXPLODE

This pressure can of insect spray exploded when it was left in the closed cabin of a helicopter which was parked in the sun.

The ruptured can made a deep imprint in the metal liner of one of the aircraft's doors before it punched a hole in the windscreen.

CAUTION: Do not expose to heat exceeding 50° Celsius. Do not puncture or incinerate can.

WARNING: The temperature in a closed aircraft cabin can easily reach and exceed the 50° Celsius temperature limitation prescribed to ensure pressure can safety. Temperatures as high as 80° Celsius have been recorded.