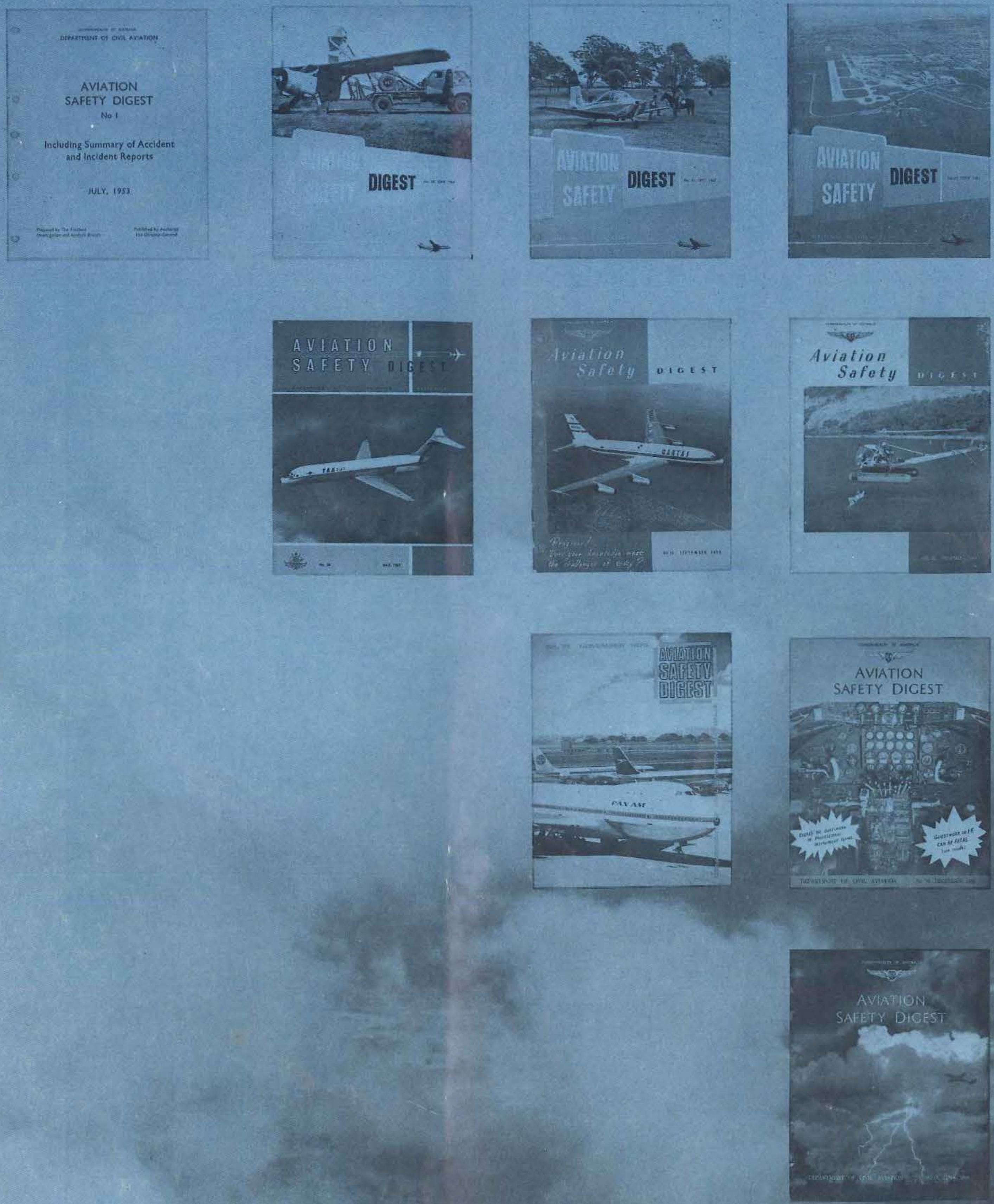

Department of Transport - Australia

103/1978

Aviation Safety Digest

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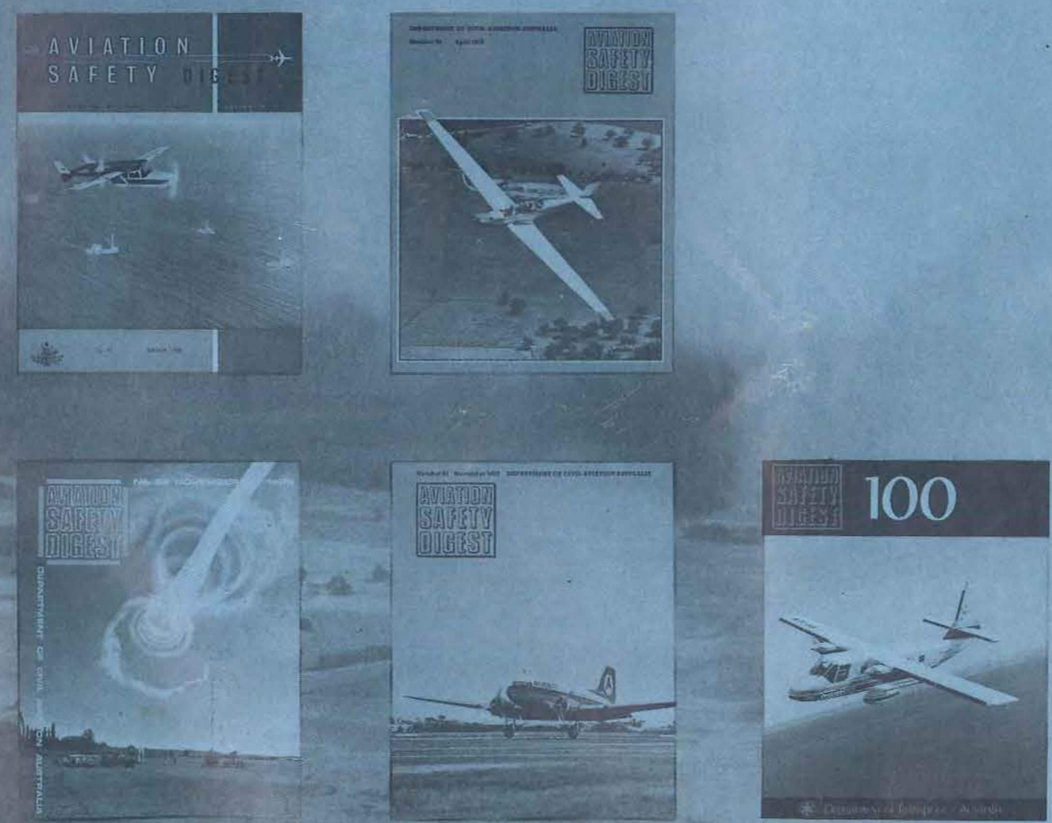

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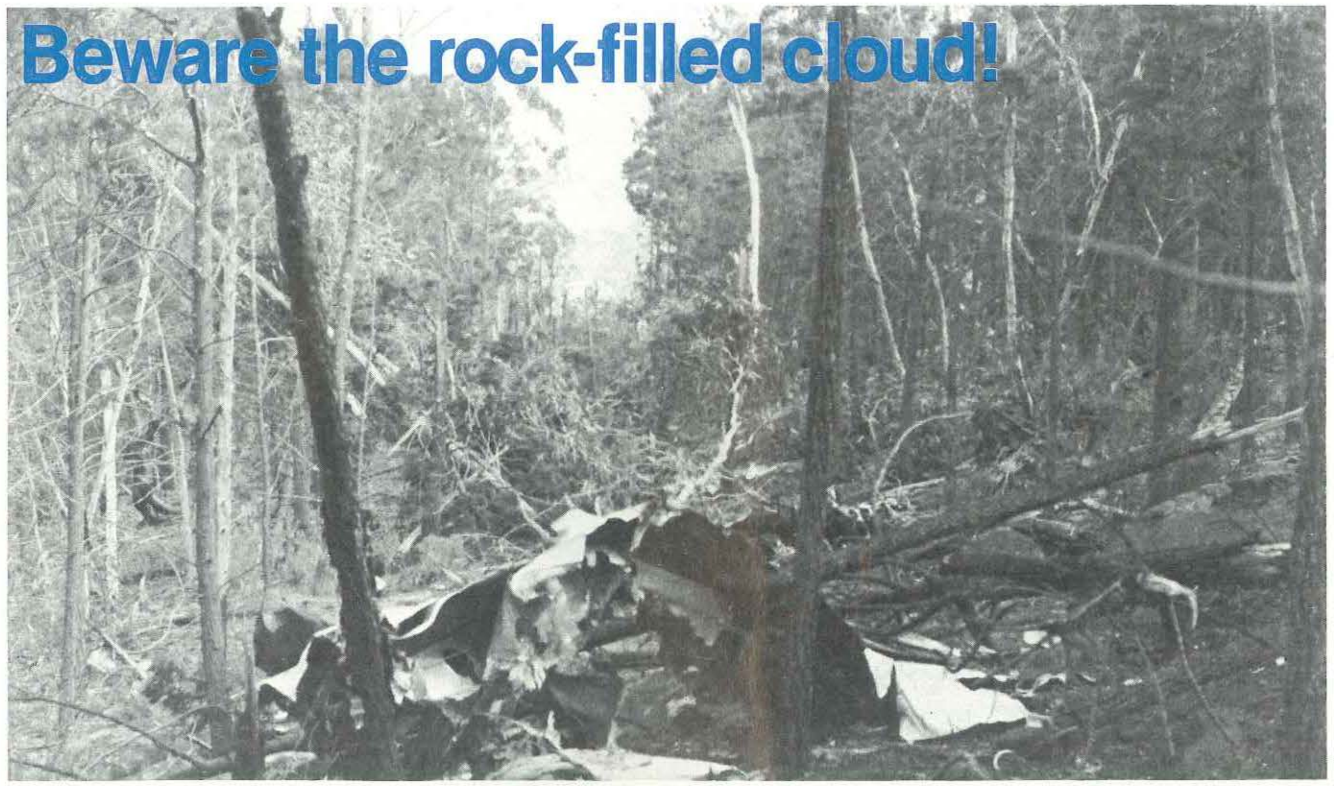
Editor's note:
In response to many requests from readers an index has been prepared for Digests 1-100 and is included in this issue. The list provides reference to subject matter by articles but is not exhaustive. Space has been provided for personal notes so that readers may list particular points of interest.

Beware the rock-filled cloud!



The pilot and owner of a Cessna 182 resided on a grazing property situated in flat, open country. The area restriction on his private licence had been lifted for about 12 months and his total flying experience amounted to some 140 hours. He held no instrument rating and most of his private flying had been carried out in the area in which his property was located.

The pilot had arranged to fly to a town some 520 kilometres distant in order to attend a cattle sale and, soon after daylight, telephoned the appropriate Briefing Office and lodged a flight plan for both the outward and return legs of the flight, nominating a SARTIME of 1800 hours. He was briefed on the area meteorological forecasts which predicted scattered stratus cloud with a base of 2000 feet, broken cumulus cloud with a base of 4000 feet and a visibility of 40 kilometres reducing to 5000 metres in rain showers.

With two passengers on board the pilot departed at 0720 hours and at about 0755, landed en route at another property to pick up a third passenger. Prior to this landing the pilot reported he had encountered light fog in the circuit area. The aircraft departed again at 0809 hours but though the flight plan indicated the pilot's intention to cruise at 5000 feet on this leg, he reported position on track at 0834 hours at an altitude of 1500 feet. No further communications were received from the aircraft. Some 50 kilometres beyond the town over which the pilot reported his position, the terrain rises into a series of small ranges with isolated spot heights to an elevation of 1800 feet.

At about 0840 hours an aircraft was seen and heard flying in this area at a very low height and heading towards hilly terrain surrounding a mountain which rises to 1671 feet. There was extensive low cloud in the area at the time and the tops of the nearby hills were obscured. The aircraft subsequently disappeared from view into the cloud.

When nothing was heard from the pilot by the expiration of his SARTIME, search and rescue action was commenced and, at 1120 hours the following day, the burnt-out wreckage of the aircraft was located on a slope of the mountain about 70 feet below its top. All four occupants had been killed.

Flying virtually right on track, the aircraft had initially struck trees, then a rock shelf, on the steep mountain slope while in a wings-level, climbing attitude, heading in the direction of the planned destination. Detailed examination of the wreckage did not reveal anything to suggest that the aircraft was incapable of normal operation prior to the accident.

The question which this accident raises is why the pilot found himself in the situation in which he and his passengers lost their lives.

The pilot's instructor told the investigators that, in his view, the pilot was often pressed for time but that, though he was a confident person, he would 'give a flight away' if after departure he found the weather was unsuitable. The instructor could recall several instances where he had received telephone calls from the pilot to advise that a flight had been abandoned because bad weather was encountered after departure.

On the other hand the holder of a private licence who knew the pilot well told the investigator that in his opinion the pilot tended to be over-confident in his approach to flying and took unnecessary risks. He recalled several occasions when the pilot had landed after last light and when he had flown in cloud.

The combination of the two factors of a pilot being 'pressed for time' and subsequently being caught in deteriorating weather is a common one in the circumstances leading to fatal accidents, particularly in private flying. In the case of this accident it has not been possible to establish whether the combination again existed but the clear message from the known circumstances leading to the accident suggest that it happened in this way ●

Wear your seat belt the right way

— Buckle by your side
— Belt not twisted
— Fastened firmly

Seat belts are required to be worn during certain phases of flight, so most people do. But for full value you have to wear the belt the right way.

Ten years ago, all new types of aircraft imported into Australia were required to be fitted with seat belt systems that restrained the upper part of the body. In 1971, the requirement was extended to types already in Australia for which installation schemes existed and in 1973 Australia became one of the first countries in the world to implement a plan to fit upper body restraint harness to the front seats of all general aviation aircraft. British and American authorities have since introduced parallel requirements.

The effect of this harness on accident statistics has not yet been fully assessed, but there is no doubt that it has been beneficial. It seems however, that in at least some cases the full benefit has not been obtained because the harness was either improperly fitted, or was incorrectly adjusted.

Lap belt position

For the lap belt to be fully effective it needs to act on the basic structure of the human body and is best positioned on the hip bones, thus transferring the belt loads to the bony skeleton of the body and holding it firmly in the seat. Impact loads transmitted by a poorly positioned belt can cause serious internal injuries. Most modern aircraft are so equipped that the lap belt is always correctly positioned but on older aircraft it may be necessary to adjust the anchorage points to achieve the optimum positioning.

Buckle position

The positioning of the buckle on lap-sash belt combinations should be such that the sash crosses diagonally from the outboard shoulder to an attachment point as low on the inboard hip as possible. This diagonal configuration places the body's centre of gravity inside the triangle formed by the sash and lap belt. The body is thus prevented from rolling out upon forward impact. Positioning the buckle towards the front of the body increases the possibility of 'fallout' from the sash as well as the risk of injuries caused by the buckle itself. It also has the undesirable effect of pulling the lap belt upwards. Later style seat belts have the buckle position fixed, but on aircraft with an adjustable belt attached to the buckle, the belt should always be adjusted to ensure the buckle is at the side of the hip — not across the stomach.

Effect of slack

Tests have shown that if a seat belt is slack on impact the deceleration forces acting on the body are greater than those affecting the aircraft. The body keeps moving until the slack is taken up, but then must stop in a lesser distance than with a properly adjusted belt. Thus to minimise the risk of injury the seat belt must be fastened firmly.

Inertia reels

Generally, inertia reels are essential if the pilot is to have unrestricted access to the full movement of all controls while maintaining the protection of upper body restraint. The additional cost of an inertia reel is relatively insignificant when the advantages over a fixed three point harness are considered. Ensure that the inertia reel is operating correctly by removing any twists from the shoulder strap and checking its functioning with a sharp jerk on the belt.

Loose clothing

On aircraft fitted with a full shoulder harness of the type which has a buckle secured in the locked position by a lever and a spring ball, pilots should ensure that loose clothing cannot catch the lever and unlock it, particularly during negative 'g' manoeuvres. When flying such aircraft pilots should wear short-sleeved or close-fitting shirts.

Fastening your seat belt

Firstly, ensure the buckle of the lap belt is by your side, not across your stomach.

Next make sure the straps are not twisted, then fasten the belt.

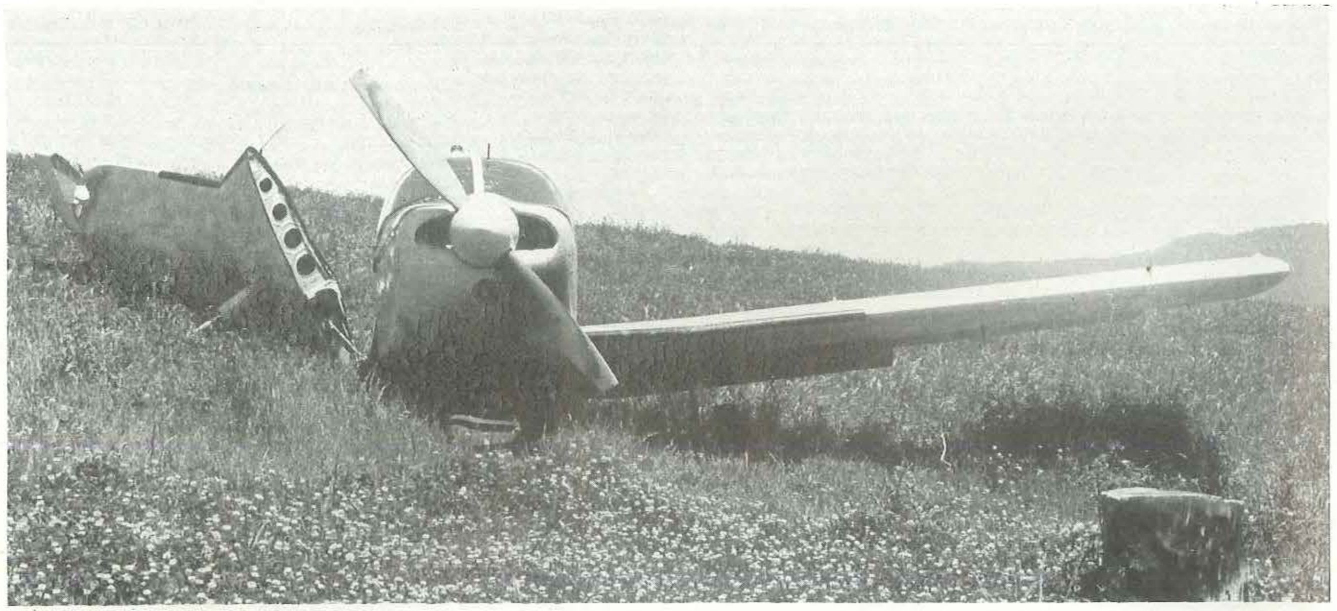
Now tighten it — as firmly as possible, allowing for comfort.

Remember — try to position the belt below your stomach and the buckle right at the side of or below your hip joint. This will help to avoid injury caused by compression of the abdominal area in the event of an accident.

Think of your seat belt as your life belt . . . and wear it the right way ●

Are you ready for take-off?

The pilot of the PA28-235, shown below and opposite, certainly was not! While taking off from an unsuitable area, the aircraft struck a parked car. The pilot was fortunate to escape serious injury.



In the period 1970-1975 inclusive, 249 Australian aircraft were involved in take-off accidents. Thirteen of these were fatal and altogether 27 people were killed in them. These 13 fatal accidents represent 11 per cent of the total fatal general aviation accidents that occurred during the six year period.

By comparison, accident statistics released by the National Transportation Safety Board in the United States, show that in the period from 1970 to 1974, take-off accidents represented 12 per cent of all fatal general aviation accidents in America.

A feature of the general aviation take-off accident situation is the high ratio of fatal accidents to total accidents. Both in Australia and America, the ratio of fatal accidents to total accidents in the take-off phase, is more than twice the ratio of fatal to total accidents during approach and landing.

About half the Australian accidents were simply the result of inadequate flight preparation — a disturbing situation because the pilots concerned could have taken time to analyse the conditions and study the various factors affecting the take-off before their aircraft left the ground. This does not just mean that take-off accidents are attributable to negligence and carelessness on the part of the pilot. Rather in simple terms it means that the accidents occur because pre-flight preparation is not put into its proper perspective — that the solution to the problem lies in good pre-flight planning habits, better awareness of the potential hazards, and an appreciation of the capabilities and limitations of the aircraft type. Traditionally, pilots tend to emphasise the planning of the en route approach and landing phases of their flight; they study the weather at the destination, the route to be taken, the en route and terminal facilities, applicable altitudes, the en route weather, and fuel consumption, but very often too little thought and preparation is given to the actual take-off.

In an attempt to ascertain whether the problem existed 'across the board' in general aviation, or whether it was endemic to particular types of operations and/or pilot groups, we programmed our computer to disgorge the relevant data. This covered all types of accidents in all categories of general aviation flying that had occurred between the time power was applied for take-off and the first power reduction after take-off. Records of hours flown in the various kinds of flying were factored into the data to obtain an approximate number of take-offs against types of operations and classes of pilot licences. The results obtained were surprising to say the least!

The least number of take-off accidents occurred in flying training. The rates were about the same for dual and solo training and were extremely low — one accident per half-million take-offs. Flying training thus accounted for only about seven per cent of the take-off accidents.

The next lowest rate was in charter/commuter type operations flown by commercial pilots. This group accounted for about 12 per cent of the take-off accidents at a rate of one accident per 60 000 take-offs.

Agricultural flying was the second worst grouping, and accounted for 26 per cent of the accidents at a rate of one per 40 000 take-offs.

The doubtful honour of the highest rate of take-off accidents went to private/business operations flown by both private and commercial pilots. Private licence pilots flying in private/business operations were involved in 39 per cent of the take-off accidents, whilst commercial pilots were involved in 12 per cent. The frequency of take-off accidents in this grouping was one per 20 000 take-offs — a rate no less than 25 times more frequent than for student pilots engaged in solo flying training!

For those among our readers who are mathematicians, the missing four per cent of the accidents involved pilots without any licence, or fell into some category which became insignificant in the overall picture.

Private and commercial pilots involved in private/business operations accounted for 123 of the 249 take-off accidents. They were involved in 42 collisions with objects during take-off, 11 stalled, 21 had problems with engine operation, 11 over-ran, 13 ground looped, on seven occasions the landing gear collapsed, and there were 18 other accidents of miscellaneous type.

The real significance of these figures lies in the circumstances in which the accidents occurred. Of the 42 collisions, nearly all were with objects aligned with the take-off path and occurred because the strip used did not meet the basic requirements of an authorised landing area — no obstructions on or over the landing area. Half the engine problems were associated with fuel management, and mainly involved water in the fuel and/or insufficient fuel. Six of the ground loops occurred because the pilot selected an unsuitable take-off path. In all, at least half the accidents in this group could have been prevented before the pilot entered the cockpit — to put it in a nutshell, by giving a bit of attention to the job in hand.

So next time you call 'ready' at a controlled aerodrome, or give yourself a take-off clearance at an uncontrolled aerodrome or authorised landing area, be sure you have considered all the factors which could jeopardise the safety of your aircraft and its occupants. Ask yourself have you:

- Properly refuelled your aircraft?
- Made sure it is safe for flight?
- Checked the suitability of the take-off area?
- Checked that the load is within limits — and is tied down?
- Considered the wind, weather and density height?
- Ensured there is adequate fuel on board and selected the correct tank?
- Checked for carburettor ice?
- Mentally prepared yourself to deal with any emergency that could turn a simple take-off into a disaster?

To sum up — are you really 'ready' for take-off?

An accident report revised

Although this article concerns a heavy multi-jet transport aircraft, the factors that led to the accident are applicable to all IFR operations.

Aviation Safety Digest No 93 contained a condensed version of the National Transportation Safety Board (NTSB) report concerning the crash of a Boeing 707 on final approach to Pago Pago International Airport. About 18 months after the release of the NTSB report the Airline Pilots' Association in America petitioned the Board to reconsider the probable cause of the accident.

As a result of the petition, the Board reopened the accident investigation because of knowledge gained through other accidents after the original investigation. The aircraft's flight data recorder (FDR) data, the cockpit voice recorder (CVR) data, and the aircraft's engineering performance data were re-evaluated extensively to determine more conclusively the effect of the existing environmental conditions on the pilot's ability to stabilise the aircraft's approach profile. Following the re-investigation the NTSB released a revised report which supersedes and replaces the original.

The aircraft was making an ILS approach at night to a runway equipped with high intensity lighting, a medium intensity approach light system and a two-bar VASI. The approach was over water until five kilometres from the runway threshold. About three kilometres from the threshold the approach path crosses Logotala Hill, which is 399 feet above mean sea level. The terrain under the approach path slopes downhill from Logotala Hill to the runway.

The aircraft struck the ground 1200 metres short of the runway and was destroyed by impact and fire. Of the 101 occupants only five survived the accident and one of these, the third officer, died later.

Tests and research

Flight recorder data/aircraft performance data analysis

Measured values of the flight data recorder parameters were analysed along with engine thrust values determined from a spectrographic study of the cockpit voice recorder tape and the aircraft manufacturer's data on performance. The purpose of this analysis was to determine the magnitude of the winds along the flight path and to construct a flight profile which would relate the aircraft's position during the final minute of flight with the ILS glide slope and the corresponding VASI indication.

Determination of winds encountered

The aircraft's performance capability for a given set of conditions (including weight, configuration, thrust, airspeed, and altitude) is described by a specific plot of vertical speeds versus longitudinal accelerations. When the values for the aircraft's rate of altitude change and rate of airspeed change at a given instant were not compatible with the calculated theoretical performance capability, the differences were attributed to external forces on the aircraft which were produced by changes in the vertical and horizontal components of the wind.

Although the total effect of the wind could be determined by these analyses, the exact combinations of vertical and horizontal wind components which the aircraft encountered could not be determined precisely.

The thrust which would have been required for the aircraft to have achieved level flight with a constant indicated airspeed was also calculated for each of the environmental conditions encountered.

Determination of flight profile and relationship with ILS glide slope and VASI indication

The flight profile of the aircraft, i.e. its altitude versus distance from the runway threshold, was determined for the last minute of flight using airspeed and altitude values from the FDR. The values were used both uncorrected and corrected for the apparent errors evident from impact site elevation and CVR callouts. The calculations were performed assuming both a 15 knot constant headwind and a headwind which varied between zero and 35 knots (the maximum wind speed indicated in meteorological reports) in accordance with the wind accelerations determined in the described wind analysis.

Analysis

The captain occupied the left hand seat and was flying the aircraft. The third officer acted as co-pilot because the first officer had laryngitis. The first officer occupied the jumpseat.

The CVR readout and an interview with the co-pilot established that the runway was in sight when the aircraft was about 15 kilometres from the runway threshold. The co-pilot commented five times during the approach, after the aircraft was within 14 kilometres of the runway threshold, that he had the runway or the runway lights in sight. There was no indication that any of the navigational aids or the aircraft instruments were faulty.

The aircraft descended about 500 feet below the published minimum glide slope intercept altitude of 2500 feet before the glide slope intercept point was reached. This placed the aircraft 180 feet below the final approach fix (FAF) altitude of 2180 feet. These altitudes are confirmed by a CVR comment, 'Two thousand', made about 1.5 seconds before the FAF callout. The Board was unable to determine the reason for this deviation from approach procedures.

At FAF passage, i.e. the seven DME fix, the co-pilot's navigational receiver selector switch should have been changed from the VOR position to the ILS position; however, this was not accomplished. If the change had been made, as good practice would indicate, the co-pilot could have monitored the approach more efficiently and his navigational display would have been ready for crosscheck by the captain or crossover in case of failure of the captain's instruments.

As the aircraft approached the glide slope, it continued through and above it as the captain started the descent. The glide slope was intercepted as the aircraft passed through about 1000 feet. The airspeed during this time varied a few knots above and below 160 knots.

From this point on during the approach, the FDR information showed that the aircraft flight path was not compatible with the aircraft performance which would be expected in stable air. The differences can be attributed to external forces acting upon the aircraft, such as wind changes or rain drag. Analysis has shown that maximum density rain could produce an increase in drag forces which would equate to a −600 fpm change in descent rate. Statements by the co-pilot and the surviving passengers however, refute any claim that the aircraft encountered such heavy rain before impact. Therefore, the difference between expected and recorded aircraft performance was more likely caused by the winds.

Analysis of the wind changes needed to produce the recorded aircraft performance

The FDR data analysis indicated that the aircraft encountered gusty wind conditions with a predominantly increasing headwind and/or an updraft about 50 seconds before impact. The influence of this wind condition persisted for about 25 seconds. The Board believes the windshear was caused by the outflowing winds from the rainstorm over the airport as they were affected by the upsloping terrain around Logotala Hill. The windshear was evident by a sharp increase in airspeed and shallowing of the descent path resulting in the aircraft going above the glide slope. The airspeed at this time was still about 160 knots. The sound spectrogram of the CVR showed that at this time the thrust was reduced, apparently to correct the high and fast situation.

As the aircraft passed Logotala Hill, it apparently came out of the increasing headwind or updraft condition and the positive performance effect was lost. It then encountered a wind which produced a small negative performance effect. The thrust was well below that normally needed for a stabilised approach and, about 16 seconds before impact, the aircraft started a rapid descent of about 1500 fpm.

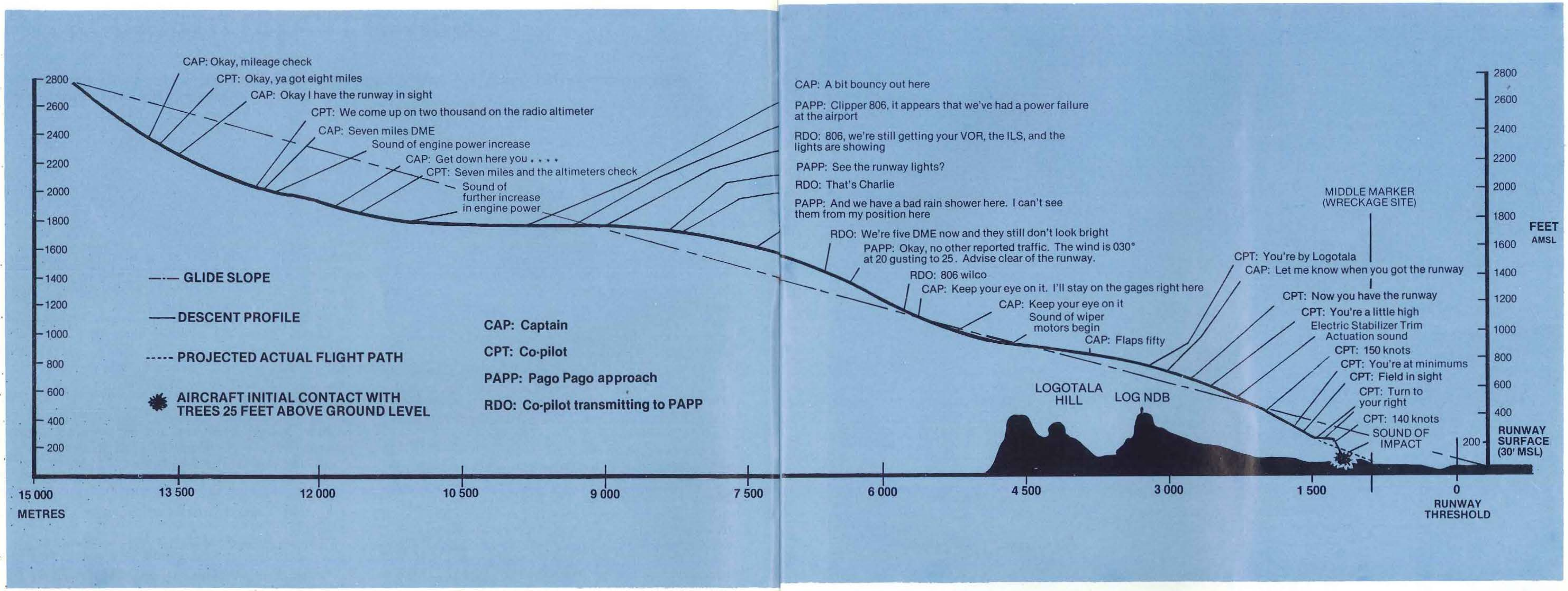
It was concluded that the captain recognised the initial effect of the windshear condition and acted to correct the aircraft's flight profile by reducing thrust, but he did not recognise the second effect as the windshear condition changed. Consequently the aircraft with low thrust responded to the changing wind by developing a high descent rate. The captain had at least 12 seconds in which he could have taken action to arrest the descent in time to prevent the accident. Adequate thrust was available but the necessary pitch attitude and thrust changes were not made, indicating that the flight crew was not aware of the high descent rate and the impending crash.

When the sink rate increased, the captain was probably looking outside the aircraft and not flying by reference to the flight instruments. At about this time the aircraft was over an area devoid of lights (known as a 'black hole'), a heavy tropical rainstorm was over the airport and moving towards the approach end of the runway, and the first officer had called the runway in sight.

The circumstances of several other accidents which have been investigated by the Board indicated that the transition from instrument flight to visual reference for vertical guidance is the most critical portion of the approach, particularly if the transition is initiated prematurely. Dynamic changes to the aircraft's flight profile often go unrecognised. In this accident the heavy rainshower ahead of the aircraft probably caused visual cues to diminish to the extent that the increased sink rate would have been extremely difficult, if not impossible, to recognise.

The VASI was operating during this approach but there was no way to determine if the crew could have seen it continuously because of the heavy rainstorm that was moving across the airport. As the rain moved towards the aircraft's approach path it most likely obscured each pair of runway edge lights progressively until the VASI disappeared from the flight crew's sight.

It is likely that the flight crew did see and use the VASI at some time during the approach, particularly after the co-pilot's report that the aircraft was '. . . a little high'. The most likely reference for his statement of the aircraft's vertical position would have been the VASI, because he had not changed his No 2 navigational receiver selector switch to the ILS frequency. Therefore, ILS information would not have been displayed on his instruments. To obtain this information, other than visually, he would have had to look 'cross-cockpit' at the captain's instruments to determine that the aircraft was high. In the last few seconds, the co-pilot would have had to look back into the cockpit to ascertain that the aircraft was at the minimum altitude at an airspeed of 140 knots and advise the captain.



Even had the captain been observing the VASI as the aircraft descended below the glide path, his attention to the indications and his reaction to an unsafe red/red signal would have had to be rapid and decisive in order to prevent impact.

The flight profile analysis showed that the aircraft was about 178 feet above the trees and descending at 25 feet per second when the red/red VASI indication should have been seen by the crew. Allowing one second for the captain to introduce a control movement, the aircraft would then have lost about 80 feet of altitude before the descent was arrested. This assumes a very positive level-off manoeuvre where the aircraft is rotated to a 1.5g load factor. The captain would have had to recognise and start responding to the situation within about 2.5 seconds of the red/red VASI presentation in order to miss the trees by about 235 feet. Slower recognition time or a less positive level off manoeuvre would have resulted in impact with the trees. The Board believes that 2.5 seconds is marginal for the perception of the change in VASI indications and the initiation of appropriate response by the captain.

The Board considered another factor could have supported the captain's visual indications that he need not apply power to reach the runway or to arrest a high rate of descent. The heavy rainstorm which was moving towards the aircraft could have caused a shortening of the pilot's visual segment — that distance along the surface visible to the pilot over the nose of the aircraft. This can produce the illusion that the horizon is moving lower and, as a result, is often misinterpreted as an aircraft pitch change in the nose-up direction. The natural response by the pilot would be to lower the nose or to decrease, not increase, power.

While conceding that the environmental circumstances at the time of this accident were unfavourable, the Board concluded that the accident could have been avoided had the crew recognised, from all available sources, the onset of the high descent rate and taken timely action. The Board is, therefore, concerned about crew procedures relative to altitude awareness and required callouts. If the crew had been completely aware of the aircraft's altitude, they should not have accepted a glide slope intercept 500 feet lower than the published altitude; they should not have accepted an altitude 180 feet lower than that altitude prescribed for the FAF crossing; and the pilot not flying should have made altitude warning callouts. The co-pilot did make an altimeter check about 2.4 minutes before impact, but he said nothing about actual altitude. About three seconds after the co-pilot's comment, the captain made an unintelligible remark which might have been a recognition of the aircraft's lower-than-prescribed altitude because, five seconds later, the sound of a power increase could be heard on the CVR.

Perhaps even more important than altitude awareness in this accident was awareness of increasing sink rate. Company procedures required that the pilot not flying the aircraft call out sink rate when it exceeded 800 fpm. An analysis of the approach to Pago Pago showed that the 3.25 degree glide slope would require a descent rate slightly less than 800 fpm with an indicated airspeed of 135 knots in zero wind conditions. In this case, 135 knots was the reference speed (Vref) for the approach. Using the company procedure of adding only half the steady wind velocity to Vref, the required descent rate would be less than the rate required for zero wind since the ground speed would be affected by the total value of the steady wind velocity. Any additional speed margin to compensate for wind gust velocity would have had the effect of increasing the ground speed and thereby increasing the required descent rate. Such rates however, would still be less than 1000 fpm even with a 35 knot gust margin.

The captain was attempting to maintain an approach speed of 150 knots. If the anticipated headwind dissipated to zero, the descent rate required to maintain position on the glide slope would have been 880 fpm, still less than the 1000 fpm maximum. Nevertheless, according to procedures, a callout should have been made which might have alerted the captain that the actual winds differed from those reported.

The FDR data showed that the aircraft's rate of descent increased to about 1500 fpm at least 15 seconds before impact. Again, there were no callouts and the evidence indicated that the captain did not recognise or react to this increased sink rate in a timely manner. The Safety Board believes that, had he done so as a result of a callout by one of the non-flying crew members, the accident could have been avoided.

The Board also believes that flight instruments are more reliable indicators than the senses of the pilots, especially during that portion of the approach when the aircraft is close to the ground and when the visual cues are sparse or diminishing. In severe windshear conditions, the flight director must be used in combination with other flight instruments such as the raw data indications. In the final 15 seconds of this approach, the rate of descent must have averaged considerably more than the 1000 fpm recommended maximum and the raw data glide slope needle must have shown that the aircraft passed through, then below, the glide slope.

Probable cause

The National Transportation Safety Board determined that the probable cause of the accident was the flight crew's late recognition of, and failure to correct in a timely manner, an excessive descent rate which developed as a result of the aircraft's penetration through destabilising wind changes. The winds consisted of horizontal and vertical components produced by a heavy rainstorm and influenced by uneven terrain close to the aircraft's approach path. The captain's recognition was hampered by restricted visibility, the illusory effects of 'black hole' approach, inadequate monitoring of flight instruments, and the failure of the crew to call out descent rate during the last 15 seconds of flight ●

Would you swing the propeller this way?

This article describes the correct way to hand-start an aircraft; however, careful consideration should be given to the need to do so if a pilot is confronted with this situation. Ensure that all possible alternatives such as obtaining engineering assistance, using another aircraft, delaying the flight, etc., have been considered before undertaking this not-so-simple procedure. It may be the first link in the inevitable chain of events leading to an accident!

The pilot of a Cessna 182 had hired an aircraft from a training school at Essendon for a pleasure flight, staying over-night at a Western Victorian town. Before departing from Essendon with his three passengers the pilot had to hand start the aircraft because it had a flat battery and there was no spare available.

On completion of the travel flight which included a delay on the ground en route because of weather, the pilot made one local flight. The engine was successfully started on two occasions using the starter motor as the battery had recharged sufficiently in flight. The aircraft remained over-night at the country aerodrome.

On the following afternoon the pilot and passengers boarded the aircraft for the return flight. When he tried to start the engine, the pilot found the battery was once again flat. He checked the parking brake was on, the ignition was off and the throttle was set about one centimetre open for starting. Leaving the cockpit he positioned the propeller at the top of the stroke then returned to the left hand cabin door and turned the ignition to 'Both'.

The three passengers were still on board the aircraft when the pilot swung the propeller and the engine started. The aircraft immediately started moving forward and the pilot ran to the left hand door and struggled into his seat. He was unable to stop the aircraft before the left wing struck a small shed, causing the aircraft to veer sharply left. The propeller slashed through a barbed wire and picket fence and some old corrugated iron gable markers.

After the engine stopped the uninjured occupants had to vacate the aircraft by the right hand door because the buckled wing had jammed the left door shut.

Subsequent investigation of the accident revealed that the pilot had been shown, some time during his training, how to hand start an aircraft but he was unfamiliar with the applicable safety precautions. The brakes were serviceable and it was concluded that because of his slim build, the pilot had been unable to apply the parking brake firmly. Wheel chocks were not used during the hand start.

In a more recent accident in Western Australia, the pilot of another Cessna 182 suffered severe injuries and the four passengers on board the aircraft were fortunate to escape serious injury when it bolted after the pilot hand started the engine. Inadequate provision had been made to prevent the aircraft moving forward.

Despite the reliability of modern aero engines, pilots may from time to time be faced with the need to hand start an engine because of a flat battery or a malfunctioning starter motor. In many late model aircraft however, the propeller may not necessarily be positioned on the crankshaft for convenient hand swinging and, if the pilot has not been properly trained in hand starting techniques the stage is set for disaster.

In the case of an aircraft that always has to be started by swinging the propeller, pilots accept the correct starting procedure as an integral part of the overall operation and proper safety precautions are observed as a matter of course. But for those pilots who normally start aircraft by 'turning a key', it seems that, either through lack of proper instruction, ignorance of procedures or even plain carelessness, hand starting attempts result in disproportionately more accidents than for pilots regularly flying aircraft types that have to be started by hand every time.

The following summary of procedures and considerations covers the major points in the normal hand starting sequence. While not exhaustive, the list provides for most light aircraft engine installations:

Preparation

- Firmly apply the parking brake;
- chock the wheels;
- have the pilot's seat occupied by a qualified pilot or approved person;
- remove or tuck away tie, remove watch, loose jacket or coat, any rings — in fact anything that might become entangled in the propeller or hinder movement;
- establish clear communications with the person at the controls.

Practising the hand start

- Set the engine with magnetos off, fuel off, mixture idle cut-off and throttle closed;
- face the plane of the propeller;
- ensure the ground is firm and not slippery;
- place one or both hands on the trailing edge of one of the blades;
- stand so that the swing will tend to carry the body away from the propeller;
- position the propeller blade for a comfortable swing against compression;
- make a smooth stroke through compression, pulling the hands down and away as the movement is completed, and simultaneously stepping back from the propeller arc;
- select the most favourable position of the propeller and practise the hand swinging technique best suited to the particular installation.

Starting the engine

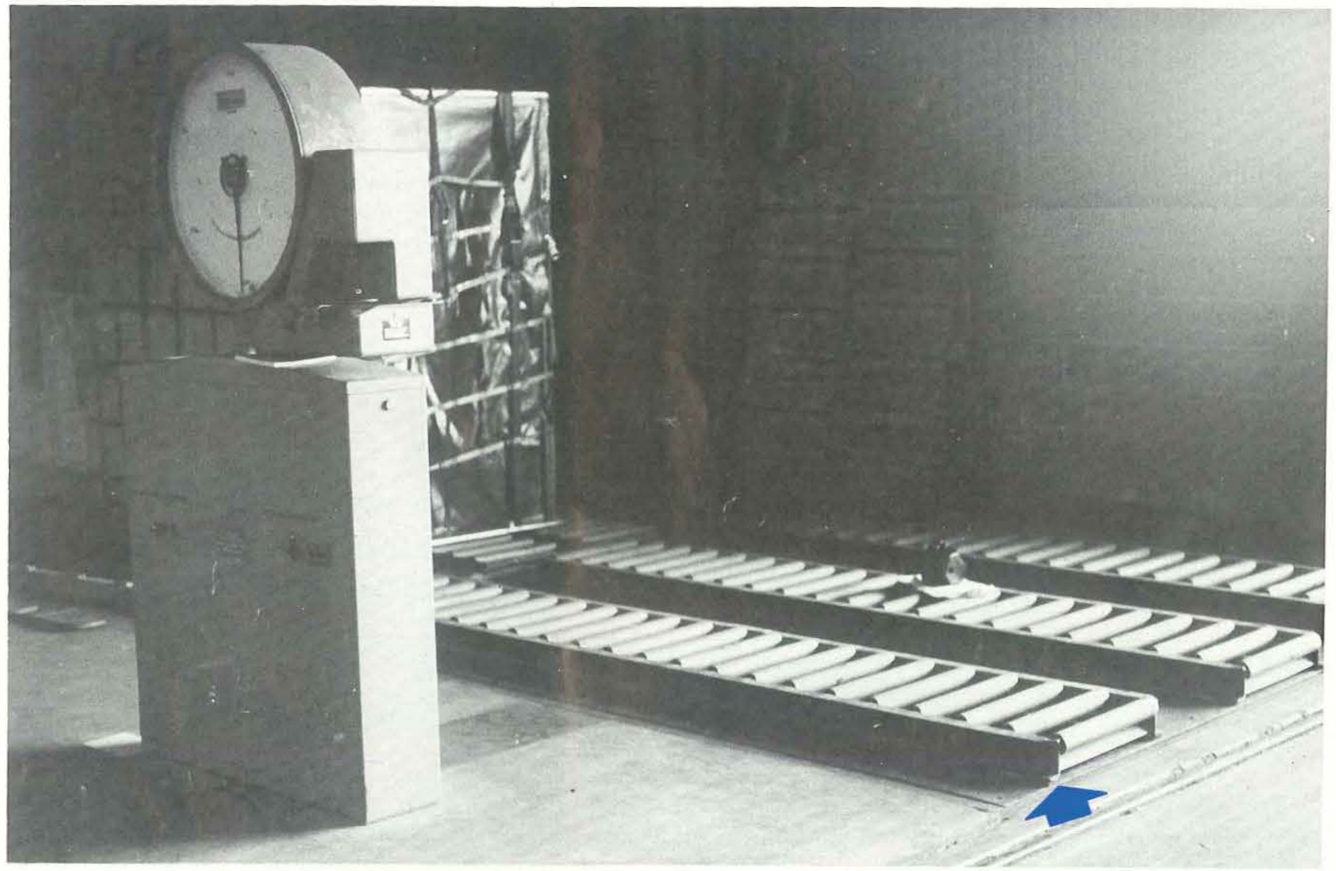
- Fuel on;
- battery master switch on;
- prime the cylinders — throttle, mixture and boost pump as required;
- throttle closed, then set for a normal start — but not open more than five millimetres;
- throttle friction nut tight;
- magnetos as recommended for handstarting;
- swing the propeller using the procedure practised.

It is essential that the propeller always be regarded as live — never stand in, or pass through, the propeller arc. It must also be remembered that with an impulse magneto even the slowest movement can cause a primed cylinder to fire. Therefore even when turning the propeller slowly for correct positioning, the techniques adopted when actually attempting a start must be used.

In an emergency, when the engine has to be started without a pilot or an approved person at the controls, the following considerations should be observed:

- Have the passengers leave the aircraft — better to brief them properly and have them board again after the engine has been started than risk having them in a runaway aircraft;
- align the aircraft so that it cannot become airborne — being stopped by a ditch is preferable to having the aircraft become airborne unmanned;
- consider attaching ropes to the chocks so they can be pulled clear of the wheels from inside the cockpit;
- remember that the throttle need only be partially open to give enough power for the aircraft to jump the chocks;
- consider attaching a line from some fixed point to the throttle to ensure the throttle will be closed if the aircraft moves forward;
- consider tethering the aircraft to some heavy or fixed object using the **rear** tie-down point, but do not forget to undo it! ●

Good show all round



An Electra freighter had been loaded at Melbourne for an early morning flight to Launceston. The load in the aircraft was mostly contained in nine cargo igloos and the total weight of the cargo was documented as 13 658 kilogrammes. The load sheet for the flight indicated a ramp (taxi-ing) weight of 45 204 kg; the maximum permissible ramp weight is 51 390 kg.

At 0318 hours EST the aircraft taxied from the freight terminal for the departure runway. While taxi-ing, the flight crew checked the on-board Weight/CG computer in accordance with the cockpit checklist. This computer calculates gross weight and centre of gravity from the hydraulic pressures in the three undercarriage oleo struts. The readings obtained were corrected using the data correction card kept on board the aircraft and the crew reached the conclusion that the aircraft was about 1600 kg above the documented weight. The captain elected to return to the hangar and advised ATC accordingly.

After the Electra had been loaded the loading crew had proceeded to other duties. The senior clerk in charge of the loading went to inspect some other igloos and discovered that the wind had blown away the marking tabs from three of them. He arranged to have them reweighed and on completion of this task found them to be substantially heavier than records from their previous weighing showed. The reweighing was conducted on a set of mechanical scales.

The senior clerk realised that the igloos in question had been weighed initially on the automatic electronic scales and that four of the igloos on board the Electra had also been weighed on those scales. Suspecting an error in the weight of the load on the departing aircraft, he contacted Melbourne operations to have the aircraft recalled. Melbourne Tower advised the flight crew who had already elected to return to the hangar for a check of the loading. Reweighing the aircraft load on the mechanical scales revealed the total weight to be nearly 2000 kg more than documented. Thus, though the maximum take off weight had not been exceeded, the zero fuel weight was 664 kg above the limit and the aircraft would have been overweight for landing.

Subsequent investigation of the automatic weighing system uncovered a fault in one row of the roller conveyor. A clamp was missing and had allowed the rollers to move sideways slightly. They were resting on the base of the scales so that instead of the full weight of the load being on the weighing platform, part of it was supported otherwise. Consequently the indicated weight was less than the actual weight.

It would be pure conjecture to try and estimate the duration of the fault existing in the scales or the number of aircraft which might have been loaded incorrectly as a result. Fortunately on this occasion the aircraft involved was equipped to detect such an error in the loading and the diligence of the flight crew in so doing is to be commended.

Had this incident involved an aircraft not fitted with a Weight/CG computer, the prompt actions of the senior loading clerk, although initiated following a chance event, would have prevented a serious overload situation being undetected ●

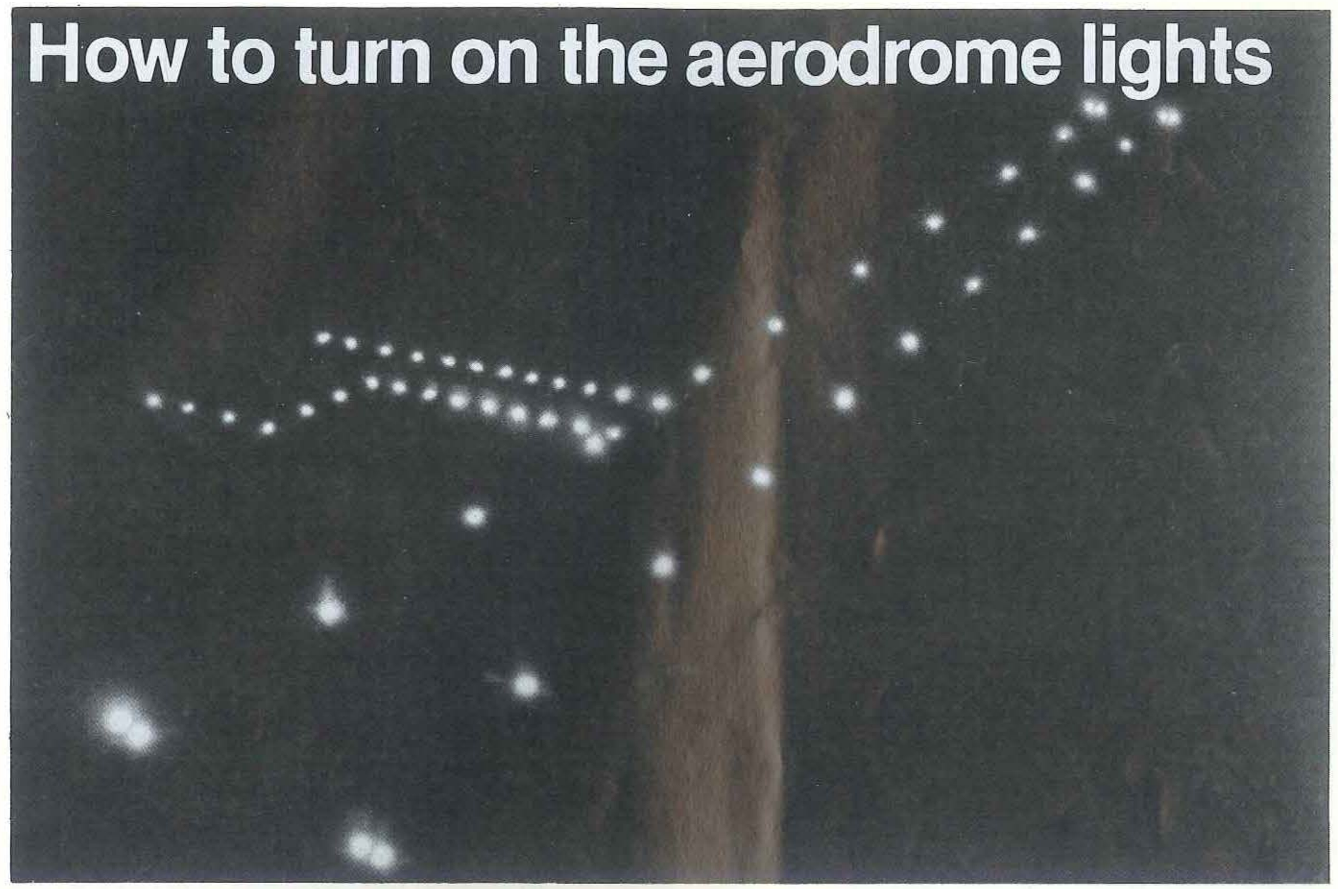
Index to Aviation Safety Digest 1 - 100 (1953—77)

References in this index are to articles, rather than to specific mention of the subject on particular pages. Where the reference is in italics, the article is a general one on that topic, otherwise the reference is to an occurrence or pilot contribution in which the subject was involved as a major factor.

Listings are in the following form: D27-3, 25, 29.
The number following D is the Digest issue, the numbers following the hyphen are page numbers in that issue where the reference articles begin. The example given refers to Digest 27 and articles beginning on pages 3, 25 and 29.

Notes

How to turn on the aerodrome lights



During the last two years VHF-activated runway and associated aerodrome lighting has been introduced at a number of licensed and government aerodromes throughout Australia. There are now about 30 installations listed in the Aeronautical Information Publication (AIP) and the Visual Flight Guide (VFG). As widespread as the use of the equipment is becoming, a recent incident report concerning a Night VMC flight in New South Wales revealed that the pilot, who held a Night VMC rating, did now know how to operate the lighting. While this knowledge is primarily of interest to pilots holding Night VMC and instrument ratings, it may also be of use to the VFR pilot who finds himself in an emergency situation requiring a landing after last light or in extremely hazy and dark conditions.

The lighting is operated by a transmission on a discrete VHF frequency from an aircraft within 15 miles of the aerodrome and above 1500 feet AGL. With the appropriate frequency selected, three transmissions of approximately three seconds duration spread over a period of not greater than 25 seconds will activate the lighting for 60 minutes. Each transmission activates a code element after approximately one second but cancels that element after five seconds. Three complete code elements within 25 seconds will activate the lights. For this reason it is important to limit each transmission to approximately three seconds. The system may be activated/re-activated by the appropriate transmission from an aircraft on the ground or in flight. Flashing white warning lights, located near the terminal building, indicate the last 10 minutes of the 60-minute cycle and, unless re-activated, the aerodrome lighting will extinguish.

There are a number of operational requirements associated with use of the system and it is not intended to specify them in this article. It is intended, however, to acquaint readers with applicable documentary references so that they may increase their knowledge of the facility. (References quoted below were current at the time of preparation of this article.)

The system operation was described in Central Office Class II Notam 7/1977 which is valid until inclusion in the AIP and VFG. The Notam also contains the operational requirements concerning the use of VHF-activated lighting.

The eleventh edition of the VFG produced in 1977 contains two applicable references. At page 177 in the Night VMC Procedures Section is a detailed description of the system, its activation and the applicable operational requirements. At page 117 in the Flight Planning section is a list of aerodrome lighting facilities including those equipped with VHF activation. The information contained on this page was updated recently by Notam CO 10/1978.

The AIP contains a similar list of aerodrome lighting facilities and alternate aerodrome requirements in the RAC/OPS Operational Requirements section. Detailed operating instructions will be included but, until they are, AIP users should refer back to Notam CO 7/1977.

As further aerodromes are equipped with the lighting, Class 1 Notams will be issued on completion of installation commissioning and AIP/VFG lists will be amended accordingly. Activation frequencies will also be progressively published on landing charts and in the AIP and VFG aerodrome directories.

All pilots are advised to read the above references and take particular note of those aerodromes equipped with VHF-activated lighting located in their normal area of operations. Knowledge of the correct way to operate the system may benefit you if the lights are required in a moment of stress ●

Take notice of empty fuel gauges

We all know how inaccurate fuel gauges can be; however, when they show empty do not take a chance as the pilot of this Cessna 150 did!

The pilot of a Cessna 150 had planned to fly from Kalgoorlie to Jandakot, W.A., accompanied by a passenger. The flight was to be carried out over two days, with a landing at a country town en route and an overnight stay. The pilot's flight planned time interval to the first landing point was 144 minutes and he had calculated the aircraft's endurance as 225 minutes, using a fuel consumption rate of 22.7 litres per hour for the 85 litres of usable fuel available.

Departing Kalgoorlie, the pilot climbed to 3000 feet where he levelled off and set 2500 RPM for the cruise. He leaned the mixture by pulling out the control knob until the RPM dropped, then pushed it in again about half-way. The flight was apparently uneventful and the aircraft landed at its destination for the first day 155 minutes later, having taken 11 minutes more than the flight planned time interval.

The pilot and passenger went about their business and next day, about 1630 hours, the pilot telephoned Jandakot to obtain a weather briefing and lodge a flight plan. His estimated time interval to Jandakot was 37 minutes. The pilot did not have the aircraft refuelled, nor did he physically check the tank contents.

After take-off, the pilot climbed to 2500 feet and, on levelling off, noticed the fuel gauges were showing just above empty. The needle on the left gauge was moving, indicating there was some fuel in that tank, but the right gauge did not appear to move at all. The pilot knew from past experience that this gauge tended to stick, so he continued on towards Jandakot.

About 28 minutes after take-off, the aircraft was overflying a large water reservoir when the engine misfired twice, then lost all power. The pilot carried out his emergency drills, but the engine did not pick up. He transmitted a Mayday call, and began looking for a place to put the aircraft down.

The reservoir is surrounded by forest and the only area that appeared suitable for a forced landing was the sloping bank just above the water line. The pilot selected a stretch of ground that seemed to be the least obstructed and, just before touch down, turned off the fuel, and the master and magneto switches. He went to lower the flaps, but they would not extend without electrical power.

The aircraft collided with the steeply sloping bank at about 70 knots, the port wing tip striking the ground at the base of a tree stump. Slewing to the left, the aircraft came to an abrupt halt only 10 metres directly up the sloping bank, extensively damaged. The pilot and passenger escaped with only minor injuries.

During a detailed examination of the aircraft at the accident site, a total of 5.1 litres of fuel was drained from the tanks and lines. This was 8.1 litres less than the normal quantity of unusable fuel. The line to the carburettor and the carburettor itself contained only a few drops of fuel.

Immediately before the aircraft took off from Kalgoorlie the day before the accident, the fuel tanks had been filled to over-flowing. Some time after reaching top of climb, the pilot said he leaned the mixture by pulling out the mixture control until a drop in RPM was indicated on the tachometer, and then pushed the control half way back into the panel, plus 'a little bit more'. This technique however, would be of doubtful value and, in all probability, the aircraft was operating with virtually a full-rich mixture. On the flight to Jandakot, the pilot did not attempt to lean the mixture at all.

Though the pilot had planned for a fuel consumption of 22.7 litres per hour, a subsequent check of the aircraft's records established that its average fuel consumption was 24.1 litres per hour. The total engine operating time after refuelling at Kalgoorlie was 195 minutes, giving an overall consumption for the two days flying of 28.6 litres per hour, or 5.9 litres per hour more than the figure the pilot had used when planning the flight.

Shortly before landing at the end of the first day's flight, the passenger had in fact drawn the pilot's attention to the fuel gauges. The right gauge was indicating empty and the left gauge nearly empty. The pilot replied that the gauges were unreliable and that the flight plan calculations showed they had sufficient fuel to reach Jandakot next day. Later, the pilot explained he did not refuel before taking off for Jandakot because he had left the fuel carnet card behind in Kalgoorlie. No dipstick was available and the pilot did not look inside the tanks because, he said, even if he looked in, he could not estimate how much fuel was there. But even if the pilot had simply added the actual flight time of 155 minutes from Kalgoorlie to his estimated 37 minutes for the flight to Jandakot, he would have seen that he did not have the required 45 minutes reserve — even if the aircraft had achieved a consumption rate consistent with his planned endurance of 225 minutes.

The accident site was only 26 kilometres from Jandakot and it would have taken only another 11 minutes for the aircraft to have reached its destination. It is ironical that, if as little as 10 litres of fuel had been added before the aircraft took off, the accident would probably not have occurred. Though fuel gauges may not always be accurate to close tolerances, empty indications for both tanks surely cannot be ignored! ●

The last gasp!

A Cessna 182 landed at Mackay, Queensland, after a flight from Archerfield, and requested clearance to cross the intersecting runway ahead. It was cleared to do so and instructed to turn off at the first taxiway. But a couple of minutes later the tower controller saw that the Cessna had still not crossed the runway and, as there was another aircraft on final for the runway on which the Cessna had landed, he repeated the clearance. The controller then noticed that the Cessna's engine had stopped. The pilot advised that he was trying to restart it. The aircraft on final was instructed to go around.

The pilot of the 182 then got out of his aircraft and began to pull it off the runway to one side. He stopped pulling the aircraft short of the intersecting runway but appeared to be about to cross the runway on foot. The aircraft that had been instructed to go around previously was now on final for the intersecting runway and the controller, alarmed and unsure of the Cessna pilot's intentions, asked the Fire Service unit to go to his assistance immediately.

A few minutes later the Fire Service advised that the aircraft had apparently run out of fuel. After being refuelled where it stood, the aircraft was taxied off the runway to the parking area.

It turned out that the pilot had not landed at Rockhampton to refuel on the way to Mackay as he originally planned, and that though his planned endurance showed he should have had sufficient fuel for the flight, he had in fact made a number of errors in his calculations. Firstly, he had omitted to include a figure of 18 minutes in the total time interval. This should still have allowed him to complete the flight with sufficient fuel, though without the required reserve. But as well as this the pilot had used a fuel consumption rate considerably more optimistic than his actual usage. The high fuel consumption rate was caused largely by the pilot's failure to lean the mixture.

The pilot said later: 'I now realise that mixture control is an integral part of flying and also that to plan a flight with only the required reserve is an extremely unsafe procedure.'

Comment

We do not doubt the pilot's good intentions in his implied resolve to carry more than the required reserve for future flights but he seems to have missed the point to some extent. Carrying only the required reserve is not in itself an unsafe procedure, but when the flight is a long one, as in this case, poor fuel management can easily erode the minimum fuel reserves and result in a dangerous situation.

It should also be said that the pilot's movements about the aerodrome after he found he could not restart the aircraft's engine, without advising the tower of his intentions, were both hazardous and disruptive to other traffic. When in doubt, ask for advice! ●

Search and rescue, part 3
The search area

Previous articles on Search and Rescue in Australia dealt with the SAR organisation, its lines of responsibility and its functions. This article describes the procedures and problems associated with determining the area to be searched.

The most difficult problems confronting the SAR Mission Co-ordinator are where to begin looking and how to determine the search area. The answer is in the collation of information on hand or available from a number of sources. This data can vary widely from a Mayday message indicating the aircraft's precise position to information provided by a friend or a relative, which may be vague and completely lacking in detail.

Information used to alert the SAR organisation is obtained from a wide variety of sources and directed to the appropriate Australian SAR authority. When an aircraft is missing, advice normally comes from Air Traffic Control or Flight Service but, on some occasions, such as when there has been no pre-flight notification, it may come from a member of the public.

Recreational boating on coastal waters presents the greatest search and rescue problem in Australia. This is the responsibility of the appropriate State or Territory Police, as is the problem of persons missing on land. Because of the time lapse that is frequently experienced between such a mishap and the commencement of a search, the area to be searched becomes so large that the operation often goes beyond the resources of the State concerned and the SAR responsibility is subsequently handed over to the Commonwealth. It is at this time that the Department of Transport Marine Operations Centre is activated and, if an air search is necessary, the aviation Rescue Co-ordination Centres become involved.

In the case of ships at sea the Marine Operations Centre has both the alerting and SAR operational responsibility. Most commercial ships operating in Australian waters are required to make regular reports through the Australian Ship Reporting System (AUSREP). If a ship's master fails to make a scheduled report SAR action will follow.

When the possibility of SAR action is recognised, a 'SAR Phase' is declared which indicates the degree of apprehension felt for the missing persons. The introduction of this phase always results in the commencement of some search planning, the degree of which depends upon the urgency of the situation.

Once it is established that search action is indeed required, the search is commenced and will continue until such time as all missing persons have been located and survivors rescued, or it becomes evident that continuation of the search with the best available SAR units is unlikely to locate survivors.

Having reached a decision to commence the search, it is essential that a sound plan be prepared. This plan provides the basis for the entire operation and a great deal of expertise and experience goes into developing it.

Planning a search poses five distinct questions:—
- the initial and most obvious is, 'what is the most probable position of the missing persons?'
- next, if their probable location is not known, 'what is the extent of the area in which they could possibly be?'
- then, 'how many and what types of aircraft, boats or land parties are needed to adequately search this area?'
- fourthly, 'what are the best search patterns to be used?'
- and finally, 'how are the available resources to be used most advantageously to adequately cover this area?'

This article deals with the first and second of these questions, the selection of the search area.

Search planning and the size of the area to be covered varies from one environment to another. If an aircraft has crashed on land the factors to be considered in determining the area are the crash position as notified, or the last reported position and the route being flown. An area is then calculated which allows for possible navigational inaccuracies of the distressed aircraft and includes a tolerance which accounts for the same type of inaccuracies affecting the searching aircraft. Readers will be aware that it is strongly recommended that survivors remain at the crash site.

If however an aircraft has ditched at sea, inflated life rafts and jackets will drift rapidly from the point of impact, which is known as the Splash Point (SP). The longer the period of elapsed time, the greater the effect of drift.

Consider the example of a yachtsman who is reported to have been at sea for three months on a two month voyage. If he met with a mishap at the end of the two month period he would have been adrift for one month. If, however, a mishap occurred shortly after the voyage began, he could have been drifting for three months. The resultant search area would be incredibly large.

Let us now consider the ditching of an aircraft a considerable distance off the coast. The SAR Mission Co-ordinator will be given advice of the event within a few moments of the receipt of a distress call. He will act immediately to determine the Splash Point. This becomes the datum for his calculations to establish the search area. The datum will be either the position notified in the distress call or a dead reckoning (DR) calculation based on the last reported position.

If the aircraft fails to transmit a distress call its disappearance will be detected when it misses its next planned position report. Search and rescue action will commence a fixed period of time after the estimated time of arrival at that position reporting point. The Co-ordinator will assume the aircraft to be between its last reported position and its destination. The most probable search area is the section of track between the last reported position and the unreported position. The datum for the search area will then be a DR position calculated from flight plan information.

Figure 1. Calculation of Datum – Sea Search
When the distress position can be positively fixed, the search area becomes a circle based on the datum point. To facilitate aircraft allocation this is boxed-in or squared, as in Figure 2.

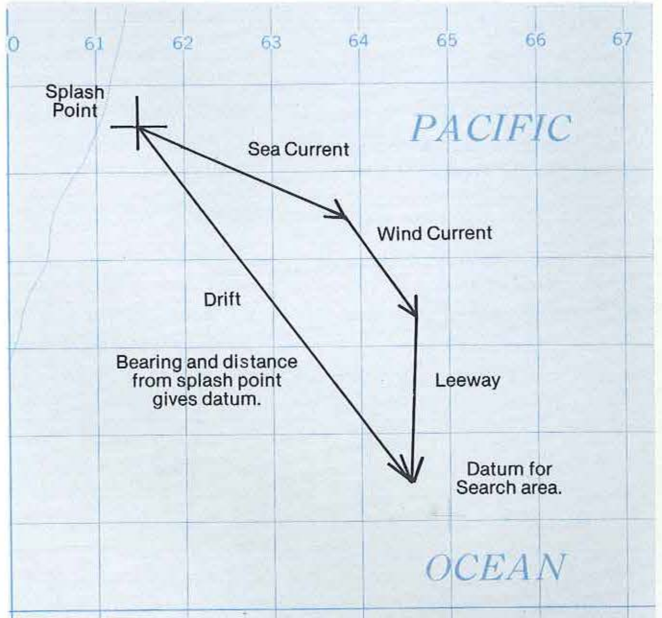
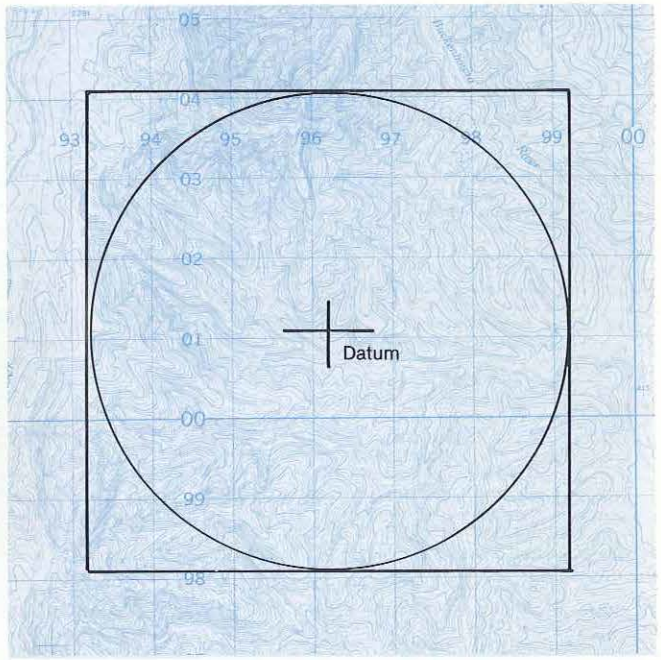


Figure 2. Land Search Area



The possibility of a diversion from track, or of a communications failure which could result in the aircraft actually being beyond the missed position, are considered but do not affect the calculations used initially to determine the search area. These factors become relevant when survivors cannot be located after extensive coverage of the primary area.

If SAR units are available in or close to the search area soon after the ditching, they will be directed along the missing aircraft's track because the life rafts would not yet have had time to drift very far. Unfortunately this is a rare event and a significant time has usually elapsed before aircraft and ships can be alerted, briefed and arrive in the area. By this time the rafts are no longer close to the Splash Point.

The problem then is to determine where they have gone. This problem is compounded as the area is searched without result. If by the second or third day of the search survivors have not been sighted, the drift of the rafts can run into hundreds of miles and the search area becomes greatly expanded, possibly to the point where it is impossible to conduct a successful search.

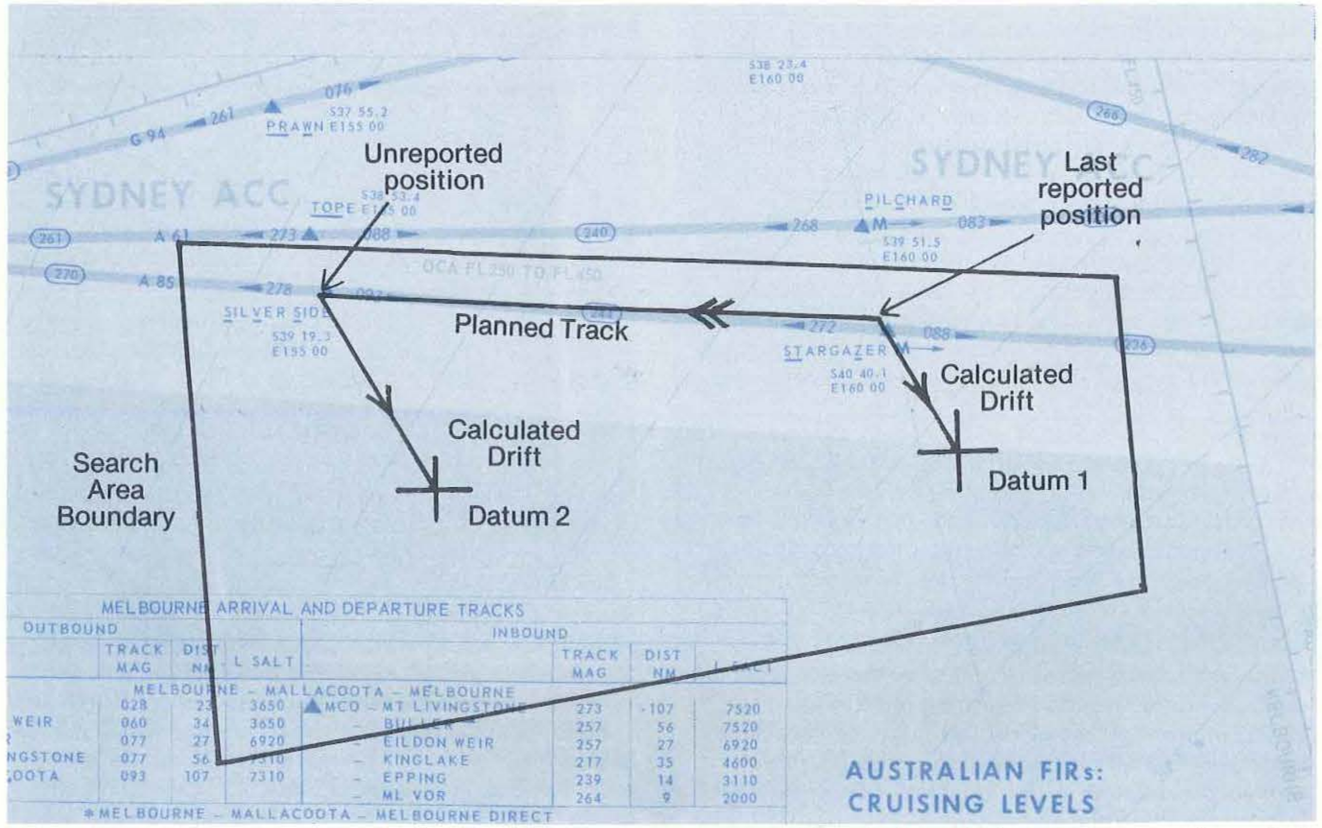
How does one determine the position to which the rafts have drifted? This is affected by three factors — sea current, wind current and leeway. The direction and movement of the life raft drift is referred to as 'set' and is quoted as the direction *towards* which the movement is taking place. For example, a set of 090/15 means moving in an easterly direction at 15 nautical miles per day.

In most cases the average sea current is obtained by reference to the 'Atlas of Ocean Currents', however, there are many oceanic areas in which there is insufficient current data as yet recorded. Should an emergency occur in one of these areas, a sea current is obtained by plotting a vector average of surrounding known currents. Because this result will not be precise, an additional vector is included. This procedure is known as plotting for minimum and maximum drifts or a 'minimax' plot.

Wind current is the movement of the water generated by wind acting on its surface. This is usually limited to a depth of about 0.6 metres and is directly related to the period of time the wind has been blowing. It will therefore change with varying weather patterns. This current results from wind strength, duration and the area over which the wind is blowing. It eventually reaches a limiting or maximum velocity. The direction of the wind current set is the down wind vector of the surface wind, modified by the effects of 'coriolis force'. This is the force generated by the earth's rotation and causes deflection

Figure 3. Sea Search Area

A typical maritime search area where the Splash Point is not known.



of the ocean surface movement. In the Southern Hemisphere this deflection is always to the left.

Leeway is the movement of an object which is being pushed through the water by local winds blowing against the exposed surfaces of the object which are known as freeboard. The greater the freeboard, the greater the wind effect and consequently the greater the drift. The wind effect is countered by the water drag on the under-water hull and, in the case of life rafts, a sea anchor, if fitted. The water drag varies with the volume, shape, depth and orientation of the section of the vessel under water.

The direction of the leeway vector for life rafts and flat bottom boats is downwind. Other types of surface craft can diverge to either side of the wind vector and the degree of divergence is about 40 degrees for boats, trawlers and ships, and 60 degrees for sailing boats.

The magnitude of the leeway is found by examination of statistics derived from observation of actual leeway rates of various types of craft. These are tabulated in miles per day for life rafts and as a percentage of the average wind speed for other craft. For example, the leeway speed for a large cabin cruiser is calculated as five per cent of the wind speed. Any change in surface wind conditions will affect the leeway and requires the calculation of separate vectors.

Plotting the calculated vector value of these three factors will result in a datum point given as bearing and distance from the SP as shown in Figure 1.

The search areas described above are not necessarily the final areas to be searched. The SAR Mission Co-ordinator modifies the extent of the search area with incoming information. This is particularly relevant to searches in which members of the public are requested, by radio or TV broadcasts, to report either hearing or sighting the missing aircraft or vessel, survivors or wreckage. Each report is carefully evaluated and if assessed as being accurate may assist in determining the route actually taken. This procedure can considerably reduce the area to be searched, thus facilitating more thorough searching by the SAR resources available at the time.

The next article in the series will deal with the selection of search aircraft and the allocation of these to a specific search area ●

The human element

Acknowledgement to the Aviation Safety Letter, Canada, for the following short articles involving various aspects of human factors.

Understanding the 'press-on' mentality

Most mature people have had occasion to ask themselves 'What made me do a thing like that?' Those who emerge unscathed from a close call are probably quite determined never to let it happen again. But it's often a deeply personal matter which some people feel they should keep to themselves, so their press-on experiences aren't of much use to others. Besides, it's difficult to explain the motivation behind their behaviour. For example, the police often get the driver's answer, 'I guess I like to drive fast'. The fact that he is furious at his boss probably wouldn't occur to him.

It takes a lot of deep digging to understand how a pilot's personality influences his decision-making — and it takes experts to do this work. Human factors investigations are the most productive but unfortunately are the most elaborate and expensive. Here's a brief outline of the background work we did in a recent crash which killed a pilot.

The pilot took off in his aircraft one night, encountered low visibility and snowshowers, and lost control. There was no particular urgency for the flight; in fact, it was to be a training hop — his first night cross-country.

To really understand what happened we need to take a closer look at the man himself. He was middle-aged, had flown sporadically for ten years, accumulating about 150 hours. He then purchased a new aircraft and had flown 65 hours in the previous 90 days. He was obviously now an ardent flyer, firmly intent on upgrading his skill.

His instructors knew him as a man who had a 'know-it-all' manner — you couldn't tell him anything. Add to this the fact that his wife was in hospital, apparently with an emotional disorder. Having been denied a night endorsement pending further training, the pilot deliberately attempted his flight without his endorsement and into weather which was obviously unfavourable.

The picture emerges of a man who would let little or nothing stand in his way — not even weather. Taking that attitude into the cockpit is asking for trouble. In this accident, no innocent passengers paid with their lives for the pilot's action — but it does happen . . .

A tragedy in one act

The actors: a young commercial pilot with prospects of an interesting and rewarding flying career, and a friend. The scene: a populated area and a low-flying aircraft. The finale: a crash followed by a fire, a smouldering wreck, and two people dead. Unfortunately it was no play but a live tragedy. The pilot had just completed an intensive six months flying course to obtain his commercial licence.

Why would a young fellow with apparently everything going for him, act in such a way that he and his friend end up as accident statistics? This is a human factors problem for which we have no ready answer. Several witnesses said that the aircraft pulled up sharply, stalled and crashed. It could be that the pilot finding himself lower than he intended, pulled up sharply in an effort to avoid power lines — we shall never know for certain. But, we do know the end result was tragedy!

Eat — and stay alert

Are you one of the estimated three out of four people who skipped breakfast this morning? If you did, you could be a candidate for an accident, according to Dr J. E. Monagle of the Department of National Health and Welfare, Canada.

He points out that your blood sugar after an overnight fast is at a low level when you wake up. In many people this causes morning irritability, irrational emotional responses, grogginess, and confusion. Add to these the effect of sudden stress or emotional reaction, such as rising anger at a rush-hour lane-hopper. This stimulates a sudden release of adrenalin, further lowering blood sugar and increasing your chances of an accident. Dr Monagle cautions that when you're in this state, it's unwise to do things requiring alertness, concentration, mental and physical responses.

Studies at a university add to these facts. Students who didn't have breakfast showed markedly poorer classroom performance. And in London, England, police have noted that traffic accidents happening around 10 or 11 am frequently involve persons who have not eaten, or at least not properly. For example, a sugar/carbohydrate-heavy breakfast can spur an over-release of insulin which drops blood sugar below the no-breakfast level.

While we have no statistics on accidents to non-breakfasted pilots, the points made here apply also to pilots. To be mentally and physically alert, the breakfast should contain some protein — an egg, glass of milk, or even a sausage or some bacon — before that pre-flight ●

Pre-take-off 'lethal' actions

(Pilot contribution)

With over 1500 hours of flying time and a class one instrument rating, I view myself as a careful and relatively experienced private pilot. But my confidence was recently shattered by the following incident which occurred on the 1600-foot airstrip on my farming property which is located on an island in Bass Strait.

My aircraft is a recent model Cherokee 6-300. Very much aware of the shortcomings of operating such an aircraft from a short, bush strip, I am in the habit of making frequent reference to the performance chart prior to departing from the farm. However, on the day of this incident, the conditions were particularly favourable, as the take-off direction was down the slight slope into a light wind, and with four children, three adults and half-full tanks I considered, from experience, that it was unnecessary to consult the chart. (In fact, later reference to the take-off chart indicated that take-off would have been possible under the prevailing conditions at maximum all up weight.) Accordingly, after a careful pre-flight inspection and unhurried pre-take-off checks, I prepared for the usual precautionary style take-off that I employ at this strip. Standing hard on the toe brakes, I opened the throttle fully, checked gauges, released the brakes and the aircraft accelerated down the strip. The acceleration was less than I expected but since the speed was building up and aborting the take-off was then becoming marginal on the downsloping damp grass surface, I concentrated on making the best of the take-off. Take-off safety speed was reached very close to the end of the strip and we were away without further trouble.

I remember thinking to myself that this was a surprisingly marginal take-off in view of the conditions and told myself that I must check the performance charts again at the destination. This proved unnecessary, however, because the explanation for the marginal nature of the take-off became apparent as I joined the circuit at my destination. Commencing my downwind checks, I found to my horror that the parking brake had not been disengaged. There followed a couple of days of rather agonising self-analysis. How could I have so easily endangered seven lives?

A few points emerged which are worth noting for those who operate aircraft, like the Cherokee, which has a parking brake independent of the toe brakes. Firstly, the Cherokee 6-300 has sufficient power to accelerate with the parking brake on. Secondly, examination of the handling notes of all the aircraft I have flown showed that none specifically listed release of the parking brake as part of the pre-take-off vital actions, even though most reminded the pilot to apply the parking brake *before* the run-up. But the main reason for my oversight probably arose from the different nature of operation from this strip, bearing in mind that most of my operations are from major aerodromes. When operating from a major aerodrome, the only times that the parking brake is employed are in the tarmac area and in a holding bay or at the holding point. In the case of this incident, however, the run-up was conducted lined up on the strip itself, a situation in which I would not normally be using the parking brake. Furthermore, my whole attention was devoted to making a perfect precautionary take-off with appropriate use of toe brakes.

From now on, my pre-take-off checks will be ending with '. . . Controls — full and free movement; Clearance; PARKING BRAKE — RELEASED!' ●

'I told Junior to make sure the field was clear'

It was 0630 hours when a commercial pilot was taking off from a property in North Western Australia on a mustering flight. The Cessna 150 was about halfway along the strip when the pilot noticed a kangaroo approaching from the port side on a line of constant bearing. The pilot recognised the pending collision situation and in a snap-second computer-age decision, elected to continue the take-off. The kangaroo's stone-age decision making processes reached exactly the same conclusion and just after the Cessna left the ground, the kangaroo commenced a magnificent jump over the moving aluminium fence which was blocking his way. The fur and bone flying marsupial collided with the fin of the Cessna. The Cessna pilot was able to maintain control of his buckled aircraft and made a teardrop circuit pattern followed by a safe landing.

In the absence of any kangaroo wreckage it must be concluded that he also made a successful forced landing. Despite valiant efforts by the Regional Investigator, the offending kangaroo could not be located to provide his side of the story. It must be also concluded that he has 'gone bush'.

Although this account of an actual recent accident has been treated light-heartedly, the problem of animals on aerodromes makes it essential that pilots take every precaution to ensure the area will be clear during the aircraft's take-off run. It is appreciated that 100 per cent success can never be guaranteed. Perhaps amongst our readers, however, there are some who encounter this problem regularly and have developed safe and sound techniques to overcome it. We would be pleased to hear from them with a view to printing their solution for the benefit of other readers ●

In brief

- At the termination of a navigation exercise, the pilot of a PA28 made an approach to runway 04 into a surface wind of 050 degrees at five to ten knots. As he was about to round out he was distracted by a soft drink can which had rolled off the back seat, under his seat and finished up beneath the rudder pedals. The pilot considered going around but decided against it as he was almost on the ground and was afraid that the can would foul the pedals. Holding slight rudder on to correct for drift, he hooked the can out with his left foot and was bending down to retrieve it when he inadvertently pushed the control column forward. The aircraft's nose wheel struck the runway hard, the propeller was bent and the aircraft bounced back into the air. The pilot applied power to recover from the situation but the aircraft bounced several more times with decreasing severity before finally settling on the ground. The pilot switched off the electrics and fuel and steered the aircraft off the runway. As well as the bent propeller, the aircraft suffered substantial damage to the nose gear assembly.

- A student pilot in a Cessna 150 was conducting practice solo forced-landings in a designated training area situated within controlled airspace. He was commencing each sequence at about 2500 feet and terminating at 400-500 feet above ground level.

  On the fifth sequence, approaching the break-off height with full flap set, the pilot was requested to report altitude and position. He replied giving the required information, replaced the microphone in the holder, applied full power and commenced raising the flap by stages. At this time he received a tower instruction to remain below 2500 feet. He acknowledged the call but did not read back the altitude restriction and just after he replaced the microphone in the holder the tower asked him to confirm 'below 2500 feet'. He looked inside again to pick up the microphone, and later concluded that while doing so he probably relaxed some of the forward pressure he was applying to the control wheel. He says he felt a gust of wind strike the aircraft and on looking outside he found that the aircraft was apparently in a spin to the left. He applied full opposite rudder and some forward pressure to the control wheel, but did not have time to reduce power before the aircraft entered the tops of dense mangrove growth in a 30 to 40 degree nose-down attitude at very slow speed.

  The mangroves cushioned the impact and the aircraft travelled only five metres before the nosegear contacted the ground and collapsed. The pilot turned off the fuel and vacated the aircraft but returned shortly afterwards and transmitted a Mayday call. This was received and 15 minutes later the crashed aircraft was located by an F27 which had diverted to the area.

  Comment: Pilots in the early stages of their training learn to develop and establish an awareness of priorities for maintaining safe flight but, occasionally, some pilots place undue priority on radio communications and the acknowledging of transmissions — particularly from air traffic control. They tend to 'drop everything' in their haste to reply fully to a call. The need for communication is important, but the need for a pilot to maintain control of his workload and to ensure safety of flight is more important.

  The transcript of air-ground communications indicated a fairly high concentration of radio transmissions to the aircraft in a very short period, but the tower controller was not to know that the pilot was in a high workload situation. In these circumstances a brief 'STAND BY' in reply to the instruction to remain below 2500 feet would have sufficed. Alternatively, it would have been quite acceptable if the pilot had delayed replying to the tower until he had secured the aircraft in the climb configuration and had then explained the situation. In discussion, the pilot readily agreed that had he delayed answering the tower, until settled in the climb, there would have been no problem.

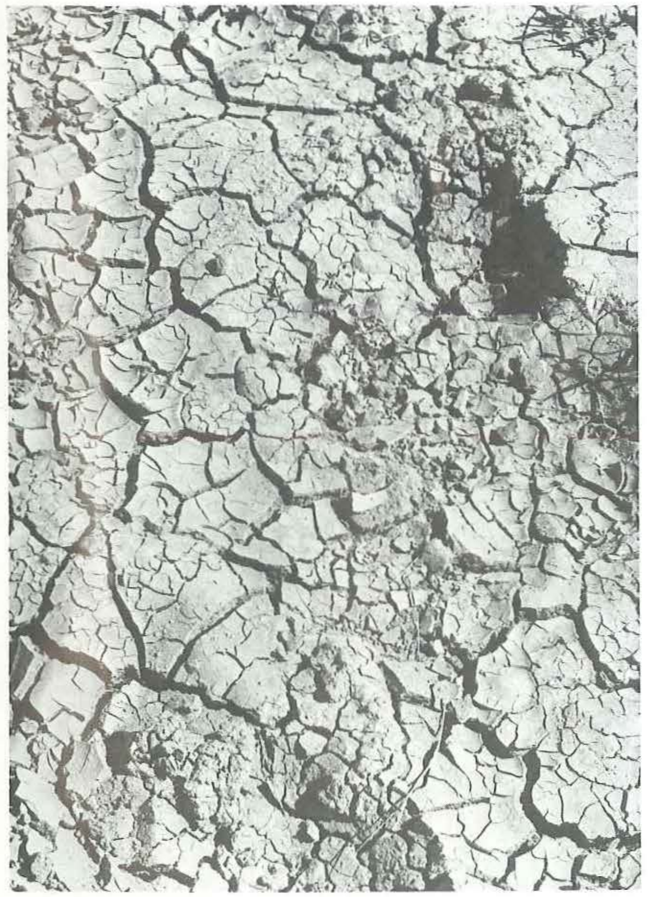
In brief

- During a landing roll on an outlying property strip the nose wheel of a Cessna 182K sank through the surface crust into the soft subsoil and the aircraft nosed over. The property is situated mainly in Queensland but extends into the black soil plains of the Northern Territory. A feature of this black soil is that when drying out after rain has fallen it forms a cracked surface crust but retains a porridge-like condition underneath.

  The pilot's main duties as a flying stockman were to check the security of fences and to maintain an adequate water level in the bore troughs. Landing at individual bores became necessary only when the water level was low and pumping was required. He had been flying the station-based aircraft for six months and was well aware of the characteristics of the black soil patches which were present in many of the bore strips.

  On the day of the accident the pilot was scheduled for a routine bore run. Substantial rain had fallen on the property some 10 days previously, rendering most of the strips temporarily unserviceable. There had been no further rain in the area for several days so, following an aerial inspection, a normal landing and take-off was made at the first bore. On arrival over the second bore the pilot inspected the strip from 500 feet and again from 300 feet and could not see any wet patches which would preclude a landing. The aircraft approached at 60 knots with full flap selected and touched down smoothly in the centre of the strip. As the aircraft was decelerating the pilot raised the flap and was proceeding at about 20 knots when the nose wheel sank through the crusty surface. The aircraft stood on its nose and fell slowly over on to its back. The pilot emerged uninjured.

  In the course of the investigation it was discovered that the aircraft had passed through two patches of black soil before it sank into a larger third patch. It was considered that the precautions taken by the pilot to ascertain the serviceability of the strip were reasonable. Nevertheless, this accident again highlights the problem of assessing strip serviceability from an aerial inspection.



Turbo-charger failure

Many general aviation aircraft are fitted with turbo-charged engines which provide relatively high power in an efficient manner. Because of the high temperatures and pressures produced in the turbine exhaust systems, any malfunction of the turbo-charger must be treated with extreme caution.

A computer read-out of occurrences concerning turbo-charger malfunctions revealed 112 incidents in the last eight years. Of these 10 were attributed to bearing failure, 44 to defective controllers and the remainder to various causes including oil seal failures. There were 31 engine shutdowns, five overheats and one in-flight fire.

Manufacturers' handling notes of many turbo-charger equipped aircraft do not adequately describe the actions to be taken in the event of a turbo-charger failure. Pilots are advised to adopt the following procedures if a malfunction is experienced:

Overboost condition

If an excessive rise in manifold pressure occurs during normal advancement of the throttle (possibly owing to faulty operation of the waste gate):

- immediately retard the throttle smoothly to limit the manifold pressure below the maximum for the RPM and mixture setting;
- operate the engine in such a manner as to avoid a further overboost condition.

Low manifold pressure

Although this condition may be caused by a minor fault, it is quite possible that a serious exhaust leak has occurred creating a potentially hazardous situation. Such a leak might not be visible to the pilot:

- shut down the engine in accordance with the recommended engine failure procedures, unless a greater emergency exists that warrants continued engine operation;
- if continuing to operate the engine use the lowest power setting demanded by the situation and land as soon as practicable to inspect the system.

It is very important to ensure that corrective maintenance is undertaken following a turbo-charger malfunction. After landing, advise a LAME immediately and enter the defect in the aircraft's maintenance release, making particular note of the amount of overboost and its duration. The corrective action taken by the engineer is based on these figures, in accordance with Rolls Royce and Lycoming bulletins. These bulletins, T-107 and 369E respectively, also provide more detailed operational guidance ●

Avoiding a loss of communications

Every year since 1973, general aviation aircraft have been involved in more than 2000 incidents involving communication breakdowns between aircraft in flight and ground stations.

To some, this figure might not seem so bad, considering the volume of general aviation operations now taking place every day of the year. Others would say, so what? It is simply the price we pay for using fairly complex equipment in a sophisticated operating environment.

But though there may be justification for both these views, the majority of general aviation pilots would no doubt agree that because much inconvenience, anxiety, and often expense, results from these incidents, it is in everybody's interests to keep them to an absolute minimum.

One thing must be made clear from the start — it is not being suggested that these incidents are all caused by pilots. In fact up to 60 per cent are the result of factors such as atmospheric interference, equipment failure, and terrain interference. A considerable amount of research is going on into finding ways of overcoming these problems. But still this leaves us with 40 per cent involving the pilot. The following are some of the reasons, as shown by the Department's incident records, for loss of communication when pilots have been responsible:

Incorrect use of equipment:

- radio not switched on
- generator not switched on
- wrong frequency selected
- volume turned down or incorrect use of squelch control
- VHF operated outside range of ground station.

Inadequate flight preparation:

- appropriate route frequencies not fitted
- planning a full-reporting flight beyond usable VHF range without HF equipment
- faulty calculation of SARTIME — insufficent time available to get to a telephone to cancel SARWATCH.

Inadequate reporting procedure:

- failure to report departure
- failure to report en route and arrival
- failure to cancel SARWATCH
- failure to report at nominated position reporting point.

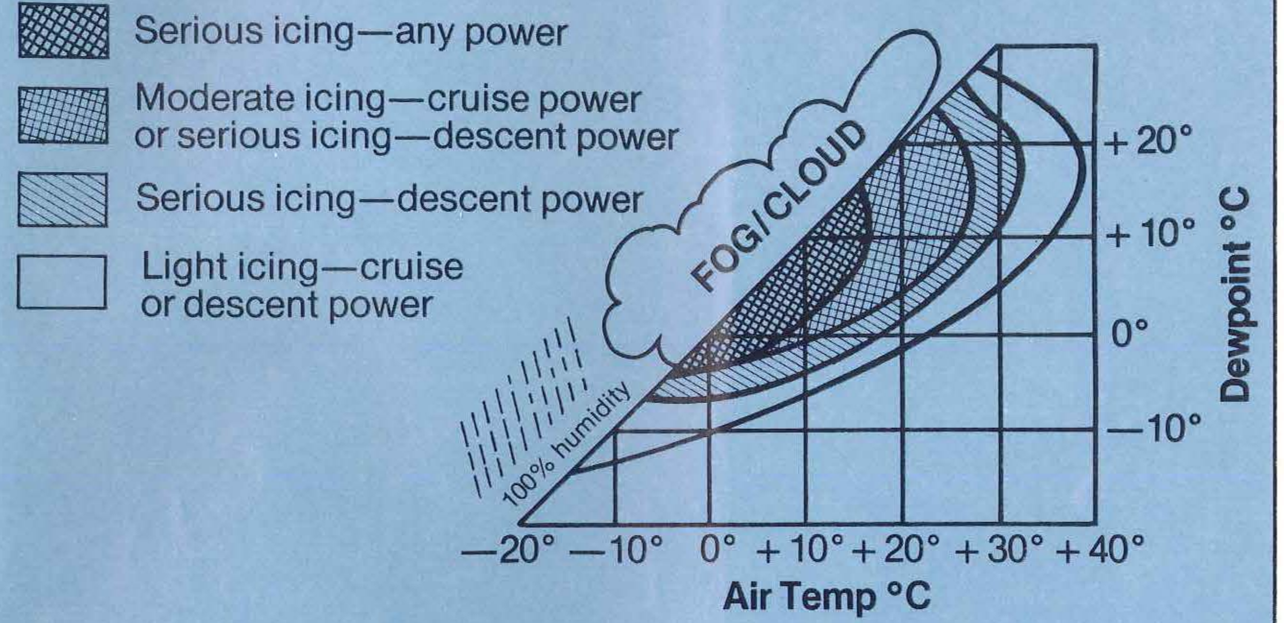
Air traffic clearances not followed:

- failure to follow instructions
- failure to communicate on correct frequency.

With such loss-of-communication incidents occurring at a rate of six per day, it will be readily appreciated that a constant strain is being placed on the resources of the Department's airways operations system. Obviously a little common sense, together with a study of the applicable communication requirements before every flight could greatly reduce the number of incidents in this category ●

Be prepared for carburettor icing

Engine power losses continue to occur as a result of carburettor icing. Ice build-up in the carburettor air intake can gradually choke off the air, enriching the mixture and reducing engine power. Although more prevalent during the winter months, carburettor ice can form at any time of the year if the conditions are suitable. Learn to recognise the situation and be prepared for carburettor icing!



- refer to the chart when flight planning to anticipate carburettor icing
- ensure carburettor heat works during engine run-up checks (initial drop in rpm when heat applied)
- continually monitor engine instruments; loss of rpm (fixed pitch propeller) or decreasing manifold pressure (constant speed propeller) could mean carburettor ice is forming
- apply full carburettor heat early if icing is suspected, and keep it on (the engine may run rough for a short period until the ice melts)
- if the situation allows, lean the mixture carefully, after selecting carburettor heat, to smooth out the engine until the ice melts
- continue to use carburettor heat while the probability of ice formation exists, adjust mixture control accordingly
- several minutes before descent use full carburettor heat at cruise power. Periodically open the throttle during extended low power descent to ensure enough heat is maintained to melt carburettor icing and to keep the engine warm
- if you are unsure about any of the above points discuss them with a suitably qualified person before commencing your next flight.