Number 97 1977

AUSTRALIAN DEPARTMENT OF TRANSPORT

AVIATION SAFETY DIGEST

Special Reference Edition - Part 2

AVIATION SAFETY DIGEST

CONTENTS Number 97 1977

Aviation Safety Digest is prepared in the Air Safety Investigation Branch and published for the Department of Transport through the Australian Government Publishing Service, in pursuance of Regulation 283 of the Air Navigation Regulations. It is distributed free of charge to Australian licence holders (except student pilots), registered aircraft owners, and certain other persons and organisations having a vested operational interest in Australian civil aviation.

Aviation Safety Digest is also available on subscription from the Australian Government Publishing Service. Enquiries should be addressed to the Assistant Director (Sales and Distribution), Australian Government Publishing Service, P.O. Box 84, Canberra, A.C.T. 2600.

Change of address: Readers on the Department's free distribution list should notify their nearest Regional Office. Subscribers should notify the Australian Government Publishing Service.

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Printed by Ruskin Press, 39 Leveson Street, North Melbourne, Victoria.

Note: Metric units are used except for airspeed and wind speed which are given in knots; and for elevation, height, and altitude where measurements are given in feet.

Recommended Retail Price: $0.50

WE CAN ALL BE PROFESSIONALS.

What is it that can spell the difference between a safe, efficiently conducted flight in a light aeroplane, and one that ends in damage, expense and red faces all round, without actually becoming a catastrophe?

Although they are seldom spectacular enough to attract much publicity, accidents in this category are surprisingly numerous by comparison with those of more serious consequences. In fact, for every fatal general aviation accident in which an Australian registered aircraft is involved, there are some 11 other accidents of varying severity.

It may well be asked why so many flights which begin full of promise and good intentions, end so ignominiously in this way. The unpalatable truth is that, flying training aside, the standard of ability amongst many pilots leaves a great deal to be desired and that far too many seem to exhibit a distressing lack of airmanship. Paradoxically, the accident record for flying training, when compared on an hours-flown basis, is better than that for private and business flying. A newcomer to the industry might be pardoned for imagining the opposite would be true!

This surprising finding perhaps provides the key to the situation. One of the difficulties with private and business flying is that, while airmanship is a quality that is more often caught rather than taught, many pilots, once they have satisfactorily completed their flying training and have been issued with their licence, go their own way and their flying is only rarely subjected to any form of check or revision training. As a result, bad flying habits can form and develop undetected until they culminate, if not in something more serious, then at least in an expensive mistake.

All pilots of course, regardless of their class of operation or category of licence, carry a heavy responsibility for the safety of their operations but nowhere does this devolve more personally than upon a private pilot operating quite independently of any form of supervision. The manipulative skills and operational practices of pilots who fly commercially are normally subject to the surveillance of a chief pilot or to some other form of training and checking organisation. But the private pilot, particularly one who operates and flies his own aeroplane, has no such yardstick by which he can regularly measure his performance.

How then can such a pilot ensure that his airmanship and flying ability is maintained at a proper standard? Before anything else can be considered, it is essential that he develop the faculty for objective self-appraisal and self-discipline which will enable him to adopt for himself, standards and requirements of the type imposed upon professional pilots.

Next, he must keep himself thoroughly conversant with all aspects of his operations and responsibilities. This is straightforward enough, provided that he will take the trouble to do it, as all such information is issued to licence holders in the form of AIP's and the VFG, maps and charts, AIC's and Notams. This published data is further supplemented by operational and weather briefings, available on request at Air Traffic Control and Flight Service Units.

Thirdly, the pilot must ensure that he knows the aircraft type he is flying and knows what its limitations are. This is admittedly not so much of a problem with owner-pilots today, but amongst those who hire the aeroplanes they fly, it is perhaps here as much as anywhere else, that well-intentioned but ill-informed pilots unwittingly get themselves into difficulties. Typical examples are mismanagement of the aircraft's systems, particularly the fuel supply, or attempting a take-off or landing in a field that is too small for the performance of the aircraft. All this information however, is contained in the owner's manual and flight manual for the particular aircraft, and if pilots made themselves thoroughly familiar with the contents of these publications, the possibility of accidents resulting from lack of knowledge of their aircraft would be greatly lessened. It is possible that aircraft hiring organisations are not always above criticism in this regard. In some cases, there appears to be little provision for pilots to study beforehand the flight manual of the aircraft they intend to fly, and the availability of adequate aircraft handling notes is sometimes less than it should be.

The fourth requirement of the good private pilot is to know and to be able to recognise his own limitations, in the fields of both manipulative ability and operational judgement. Confidence of course is a very desirable attribute in a pilot, but over-confidence can lead to all manner of difficulties and dangers, as should be evident from some of the accidents referred to in this issue of the Digest. A proper estimate of one's own limitations is not in any sense an admission of inadequacy, but is only a sensible and realistic attitude that can enable one to say 'no' when faced with pressures, of one sort or another, to continue into a situation that could obviously endanger the aircraft and its occupants.

The fifth point concerns flight preparation and planning. If some of the Department's investigation files are any guide, some pilots seem to have developed a fine contempt for flight planning, apparently regarding it as so much wasted time. The fact of the matter is that accident case-histories have shown time and again that lack of proper planning can lead to disaster. Indeed, it is not only the actual weather briefing and flight planning in the briefing room that pays dividends in safety; the same principle applies to all aspects of flight preparation, from acquiring details of fuel supply arrangements at the distant aerodrome at which it is intended to land, to ensuring that there is suitable accommodation for the passengers. Unrelated though some such matters might seem to be to actually flying an aeroplane safely, they have sometimes been the reason for continuing a flight beyond what was prudent in terms of daylight or remaining fuel. In summary, it would be difficult to express the case for preparation more succinctly than does ANR 231(1) when it says that 'Before beginning a flight, the pilot in command shall study all available information appropriate to the intended operation . . .'

Lastly, the private pilot must be particularly on his guard against the temptation to give way to any form of cavalier conduct at the controls of his aircraft, either for the benefit of his passengers, or for those watching from the ground. This impulse, if yielded to, can completely undermine and negate the whole umbrella of safety which the pilot might otherwise have succeeded in developing in respect of the flight. Even in the most favourable situation, conduct of this sort can only lead to ill-considered judgements and actions. And while such aeronautical behaviour may impress some of his audience if he gets away with it, the type of impression it makes on most mature people is not the sort any responsible pilot would relish.

There is little doubt that if these measures could be taken to heart by private pilots generally, there would be an immediate and lasting improvement in the safety standards of this class of general aviation operations. Does it all sound too stiff and dull to be regarded seriously? It is asking no more of the private flying fraternity than is expected of professional pilots every day of their working lives! There is no valid reason whatever why all pilots should not set their sights on a professional standard of airmanship and ability. And this need not be limited to actual flying activity; it can be reflected in countless other ways. Things such as the pilot's personal bearing and behaviour, his relationship with briefing officers and other airport staff; his concern for the comfort of his passengers and their enjoyment of the flight; even the way he taxis and parks his aircraft and the condition in which he leaves it, all of which help to engender an overall mood of professionalism.

Pilots whose aim is excellence in their art will find in the long run that there is far more satisfaction to be had in building a solid reputation for a skilled professional-type performance, than there ever can be in the cheap substitute offered by sporadic indulgence in irresponsible, if spectacular, exhibitionism.

LOW FLYING

- it's just not worth the risk!

'Unwarranted Low Flying', 'Collision With Ground or Water'.

These ominous-sounding statements happen to be but two of the headings under which the Department's accident records are coded for statistical purposes. Though highly necessary for the study of safety problems as a whole, it has to be admitted that cold statistical data is usually an extremely dull way to begin presenting an argument. But in this case, the two headings quoted provide a most apt description of an accident pattern that has been repeated time without number, throughout the history of aviation. And as a perusal of past issues of the Aviation Safety Digest shows all too well, general aviation in Australia has been no exception to this trend. It is clear from this that some pilots, perhaps particularly those whose overall experience is low, need constantly reminding of the unpleasant and frequently grim realities that lie behind the cold statistics.

No one who is truthful and who knows anything at all about aeroplanes, would deny that low flying is thrilling. In fact it is just because it is so exhilarating, so utterly 'out of this world' compared to our normal earth-bound existence that, of all the temptations associated with the freedom of flight, it is perhaps the one to which new pilots are most susceptible. To this must be added the fact that such pilots do not always appreciate the risks they may be taking — dangers that might be quite obvious to those who can look at the situation with the benefit of hindsight, either their own or what they have learned from the mistakes of others.

It has been said that there are two danger peaks in a pilot's life. One is when he has flown about a hundred hours and thinks he knows all there is to know about flying. The other comes when he has about three hundred hours and **knows** he knows all there is to it! It is only much later when he has a couple of thousand hours that he realises he will **never** know all there is to know! Certainly, as experience has shown over and over again, aviation seems to have an inexhaustible supply of unpleasant surprises for those who persist in 'bending' the rules. For the rules, after all, are no more than a legalisation of what aviation has learnt over the years in the hard school of experience. Those who treat the rules in this way are very unwisely ignoring what countless thousands of flying hours have shown to be necessary for the protection of life, limb, and aircraft.

To put it in another way, there is much truth in the trite old saying that 'there are old pilots and bold pilots, but no old bold pilots'. Older pilots (in terms of experience, not necessarily years!) **do** appreciate the risks which, for reasons of inexperience, lack of knowledge or understanding, or simply rashness, are not always understood by those who are newly licensed and perhaps still revelling in their new-found sense of freedom and accomplishment. The net result is that the same sorts of accidents occur again and again.

It is just for these reasons that our enthusiasm for flying, especially when it is new-found, needs to be tempered with an informed self-discipline. It is not easy to put old heads on young shoulders, but if the experiences of those who have learned their lessons the hard way can be passed on to pilots who haven't been around the industry long enough to accumulate this sort of wisdom for themselves, many lives could be saved, not to mention valuable aircraft.

Accumulated experience shows that the majority of low-flying accidents fall into one of four categories:

- Beat-ups — usually of a building or a vehicle occupied by someone well-known to the pilot, to whom he cannot resist demonstrating his prowess. The end result is usually a collision with some obstruction — such as a tree or a power line — which the pilot has not seen because he is concentrating on his admirers and not on where he is going.
- Stall turns or, probably more accurately, wing-overs, conducted at minimum altitude, again usually for the benefit of admirers watching from the ground. Though highly spectacular if got away with successfully, such manoeuvres leave absolutely no room for error. What is more, the consequences of error in these circumstances are nearly always final. This is another form of low flying exhibitionism in which exuberance usually outweighs judgement, skill and common sense.
- Message dropping: In this case the pilot is usually full of good intentions and not simply showing off — though he may well be glad of the opportunity to justify some otherwise-forbidden low flying. In order to position the message cannister accurately, he has perhaps descended to a height at which the normal obstructions around country buildings — trees, poles, wires, etc., begin to present a hazard. And the stage is finally set for a disaster when the pilot concentrates his attention on the people waiting to pick up his message, instead of on the demanding task he has set himself in flying so low. As in the case of the beat-up, the result is often a collision with one of the surrounding obstructions.
- Circling at low level to observe something on the ground: A real trap for young players, especially in high wing aircraft, when the pilot is trying to keep the object in sight throughout the turns. The more he tries, the more the wing tends to obstruct the view, so the tighter and tighter becomes the turn. At the same time, instead of giving his flying the high degree of concentration the situation demands, the pilot is paying more and more attention to the object under surveillance. The final result is a loss of control, either from a stall, or from simply falling out of the excessively steep turn which has probably by this time become unbalanced through lack of attention. Accidents of this type have occurred during shark spotting operations, when almost the whole of the pilot's concentration has been on the sharks in the water. Similar ones have also occurred during cattle mustering operations at low level.

The special dangers of encountering wires while low flying has already been dealt with at some length in 'Wires Are Where You Find Them', in Aviation Safety Digest No. 96. For this reason, there is no need to dwell further on this particular danger, except to say that in the beat-up and message dropping categories of low flying accidents, wires cause a high proportion of the casualties.

The actual circumstances of all the accidents that have resulted from unauthorised low flying and been reviewed in the Digest over the years it has been in production are far too numerous and repetitive to describe in full again. However, the following comments selected from past issues, together with the accompanying photographs, provide an insight into the ongoing nature and extent of the problem. Though most of the accidents themselves are past history now, the remarks which they generated are as pertinent as ever:

- Concerning an accident to a Tiger Moth, which stalled while making a steep climbing turn close to the ground: 'It is difficult to avoid the conclusion that the manoeuvre was undertaken solely to impress the watchers on the ground.'
- On a Chipmunk accident, in which the aircraft struck a hard-to-see dead tree while beating-up a farm house: 'It had been the practice of this pilot over the past 18 months to beat-up this same farm house. Undoubtedly the pilot realised that beat-ups of this nature are dangerous but, as he frequently engaged in such flying, he had apparently adopted the motto, "It can't happen to me".'
- Of another Chipmunk, which flew into a power line while engaged in unauthorised low flying: 'ANR's do not prohibit low flying, but they stipulate the conditions under which low flying shall be conducted. The purpose of imposing such conditions is simply to protect lives and property. These conditions are often disregarded with unfortunate

results. Regulations aimed at the protection of life and property cannot be set aside without exposing someone to very grave risk.'

● About an Auster, which struck a tree while the pilot was dropping a message: 'The message fell midway between the house and the tree. As it was dropped from a low height, its position indicated that the pilot would have been occupied with the dropping action until less than two seconds before the aircraft struck the tree.'

● Of a Tiger Moth, which flew into trees while the pilot was attempting to drop a letter to a friend on the ground: 'As happens in so many of these escapades, the pilot, at a critical stage of his low pass, diverted his attention from the flight path to watch his admirers on the ground. As a result, he did not see the trees until too late to avoid them.'

● Of yet another Chipmunk, whose pilot was attempting a stall turn at a height of about 300 feet while 'farewelling' a group of friends at the aerodrome of departure: 'The lesson was learnt the hard way. This is your opportunity to learn it the easy way.'

● Concerning a Cessna 172 which crashed into the sea while circling sharks at low level: 'This and other accidents show quite definitely that low-level spotting operations can be fraught with danger if a safe height is not maintained.'

● Of a second Cessna 172 which crashed while its pilot was attempting to demonstrate low level stall turns to members of an aero club: 'Good airmanship, caution, and adherence to safety regulations are necessary ingredients of a safe operation, and accidents of this type invariably point to omissions in these areas. This accident is no exception and others follow the same pattern.'

● Of a Cessna 175 which dived into the ground while making an extremely steep low level turn over a house: 'There is an all-too-familiar ring about the aircraft's flight behaviour up to the final dive and impact — it has all been said before in almost identical words.'

● Of a Victa Airtourer, whose pilot failed to see a power line in his path while beating-up a friend driving a tractor: 'The accident is another sad example of a pilot failing to appreciate that regulations are framed to prevent such accidents, as well as failing to recognise that his skill was not commensurate with his own estimate of his ability.'

● And finally, concerning a Cherokee which crashed in the course of a beat-up over a country town: 'Whether the pilot was attempting a stall turn, or simply lost control at the top of a steep climb, there can be no doubt that the height at which he was flying, gave him no chance of recovering control before the aircraft struck the ground. In fact, from the time the aircraft approached the town, the flight can only be regarded as a gross display of irresponsibility, with no regard to airmanship, regulations, or the safety of other persons.'

It is well to reflect that the unfortunate pilots involved in these accidents were probably little different from the majority of us. Whatever our temperament, most of us who fly light aeroplanes are sooner or later faced with the temptation to indulge in unauthorised low flying for the thrill or sense of adventure it provides, or to 'play to the gallery' by attempting impressive feats of manipulative ability at low level. The 'wing-over' or stall turn type manoeuvre following a low run in front of an audience seems to have a particularly fatal attraction. Unfortunately, as has been pointed out before, the desire of those who yield to this temptation is not always matched by their skill or judgement.

Many of these accidents too, are tragic illustrations of the particular danger inherent in low flying when it is based on spur-of-the-moment decisions, taken without regard to the careful planning that is so vitally necessary to safety when flying low. Again and again this factor can be seen to nullify and destroy in moments, all the advantages and 'inbuilt' experience inherent in long-established safety precautions and operational procedures. Adequate planning and preparation is of course the essence of safety in all aspects of flying, but nowhere is this more true than with operations close to terrain or obstructions. This is borne out by the degree of care that agricultural pilots need to exercise to ensure that their spraying or spreading runs are conducted safely. In fact case-histories on file in the Department show beyond doubt that pilots inclined to spur-of-the-moment decisions are frequently accidents going somewhere to happen.

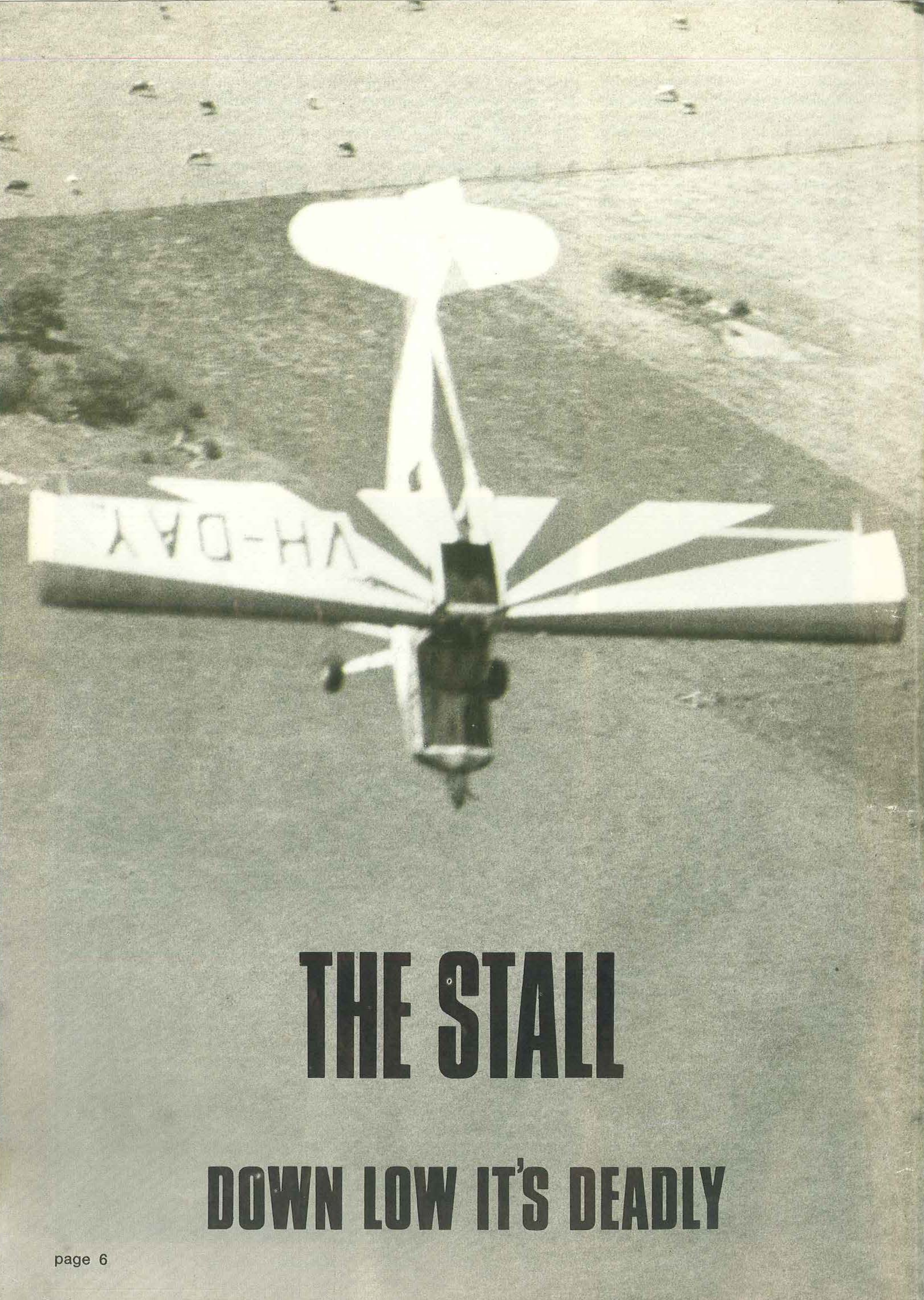
Perhaps one of the most tragic aspects of the type of accidents under discussion, is that they frequently lead to fatal, or at best permanent injuries, not only to the pilot concerned, but also to innocent passengers who have entered the aircraft at the invitation of the pilot, doubtless with every confidence in his ability and judgement. The fact that this trust was misplaced is usually of little solace to the individual concerned or to his bereaved relatives — the distinction of becoming another significant statistic in the Department's accident records is poor compensation for a pilot's failure to recognise the weight of responsibility placed in his hands by virtue of his command of the aircraft.

It is perhaps significant that the majority of the pilots involved in the accidents referred to, though properly qualified for the category of the flight in which they were engaged, had less than 200 hours experience. As we have already seen, it is at about this stage of his flying career that a pilot, having learnt to fly with confidence, tends to think he knows all the answers, and is particularly susceptible to the 'It can't happen to me' philosophy. He is thus tempted to **excuse his own flying standards in** words such as 'Rules were made for the obedience of fools and the guidance of wise men', never questioning that he could be in any but the latter category.

This type of thinking cannot be refuted too strongly. It has no place in aviation and one has only to watch the most experienced professional pilots to see that this is a fact accepted by those most qualified to judge. Logically, if pilots with such a wealth of experience cannot afford to depart from accepted operational standards, how much less can the pilot with only a hundred hours or so? Indeed, it is perfectly clear that no pilot, however competent he is, can expect to operate with any assurance of safety if he chooses to act less than responsibly by disregarding or departing from the very standards and procedures that many years of hard-won aviation experience have shown to be necessary. Thus, no matter how innocuous a particular situation may seem when one is tempted to 'bend' the regulations to make a low pass of one sort or another, it is simply not worth the risk involved. For whether the indulgence happens to be the result of a spur-of-the-moment decision, or the culmination of a history of increasingly flamboyant flying behaviour, the final result is the same. It may seem pompous and bureaucratic to keep pointing out that accidents would not happen if aircraft were not flown below the minimum statutory height requirements. But the fact remains that the only way in which pilots can be certain of avoiding hard-to-see obstructions on the ground, is to maintain sufficient clearance from them to provide an adequate margin of safety. The whole intent of Air Navigation Regulation 133, in specifying 500 feet as the minimum height at which an aircraft may fly in normal circumstances, is to provide a buffer against the unexpected and unforeseen which seems to occur so often in aviation.

For this reason, the better pilots are not those who beat-up buildings, land off stall turns or indulge in low flying to impress their friends. Rather they are the ones who get on with their jobs quietly but efficiently, assessing situations constantly and avoiding whatever risks they can. In this way they earn for themselves **real** reputations as pilots.

In a few months' time, will the Aviation Safety Digest have the distasteful task of writing up another tragedy that has resulted from unauthorised low flying? The answer to this question is literally in your hands!



THE STALL

DOWN LOW IT'S DEADLY

A study of a number of accidents that have occurred in Australia and overseas, many of them fatal, suggests that we would all do well to take a fresh look at what happens to stalling characteristics under different conditions of flight.

The most common reason for loss of control in the accidents studied was an inadvertent stall followed by a spin. And no doubt there have been many other loss of control situations in which a recovery in the nick of time has narrowly averted their inclusion in the Department's accident statistics.

The sheer number of light aeroplane accidents that have resulted from incorrectly executed turns at low height, suggests that some pilots take too many liberties with their aircraft, or may have forgotten some of the factors that can cause an aeroplane to stall during a turn.

It is when these two effects are combined that the stalling speed increases most significantly, and it is in relation to these flight circumstances that there is the greatest need for more knowledge. For example, in some types of aeroplanes, in a moderately banked turn at high gross weight, it is possible for the stalling speed to be as much as 50 percent higher than it would be in straight and level flight, at light weight.

First of all, what is a stall? It is an aerodynamic condition in which an increase in angle of attack of the wing produces no additional lift and results in the normally smooth flow of air over the upper surface of the wing breaking down into turbulent flow. For any particular wing form and regardless of airspeed, this will always occur at much the same angle of attack.

In some of these cases there have been other contributory circumstances, but nearly always the accident could have been avoided if the pilot had displayed a more thorough knowledge of the factors governing the aircraft's capabilities in various conditions of flight. The fact is that accidents resulting from inadvertent stalls are nearly always preceded by low level turns which have been either excessively steep, or have been carried out at too low an airspeed. And time and again these manoeuvres have been attempted in circumstances clearly indicating that the pilot did not appreciate the degree to which the aeroplane's stalling speed can increase with an increase in either the aircraft's gross weight or the load factor (i.e. the 'g' loadings encountered in flight).

Relationship Between Stalling Speed and Gross Weight

Airspeed and angle of attack are the two principal factors governing lift (apart from lift augmenting devices and power) over which the pilot has control. Thus, if the airspeed is reduced, the angle of attack must be increased and vice versa, to maintain a constant value of lift. The stalling speed for any given weight and power setting, is the speed at which the wing has reached its critical angle of attack. If, at this point, the gross weight were to be increased, any attempt to provide the lift required to support this additional weight by further increasing the angle of attack will result in a stall. At this critical angle of attack therefore, the additional lift can only be obtained at an increased airspeed which then becomes the stalling speed for the higher weight. Thus, when either the gross weight or the load factor is increased, the wing will still stall at the same angle of attack, but at a higher airspeed.

The figures in Table 1 show the increase in stalling speed for various percentages of increase in gross weight for an aeroplane having a stalling speed of 50 knots at an initial weight of 2500 kg.

Relationship Between Stalling Speed and Load Factor

We see that the increase in stalling speed, even with substantial increases in aircraft weight, is relatively small. But when we come to stalling speed increase in balanced turns, we see that we are dealing with a very different situation. In this case, the increase occurs at a very much greater rate which, in very steep turns, can result in a stalling speed greater than the maximum level speed of the aircraft.

We can gain a better appreciation of the mechanics of these accidents by briefly looking again at the aerodynamic forces involved in turning an aeroplane.

To make an aeroplane turn, a force must be applied towards the centre of the turn required. To impose this force, the total reaction must be inclined from the vertical towards the centre of the desired turn so that its horizontal component provides just enough force to make the aeroplane turn and keep it turning. This is known as centripetal force and its magnitude varies with the weight and speed of the aircraft and the radius of turn.

In a correctly balanced turn, the inclination of the total reaction is produced by banking the aeroplane as shown in Fig. 1. OW represents the weight of the aeroplane, and OL the lift it develops. The lift component is

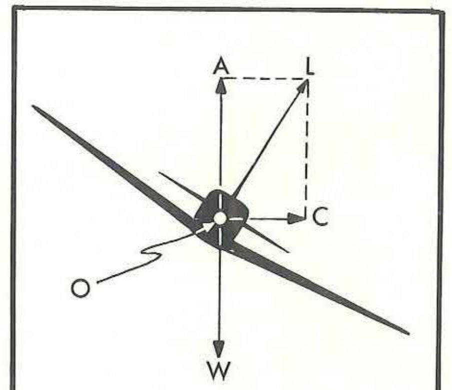


FIG. 1.

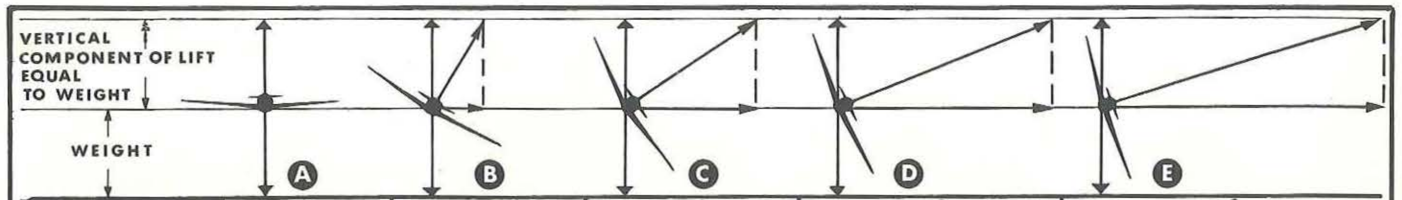
of course vertical in straight and level flight, but now is inclined to the vertical at the angle of bank. The vertical component OA of OL, balances the weight of the aeroplane, while the horizontal component OC of OL provides the necessary centripetal force.

The angle of bank required in a sustained balanced turn is governed by the aircraft's speed and the radius of turn. Increasing the speed or decreasing the radius of turn requires an increase in the angle of bank with a consequent greater rate of turn. Conversely, a decrease in speed or an increase in radius requires less bank, thus giving a lesser rate of turn.

It will be obvious from Figure 1 that as the bank is increased, so of

Table 1

Aeroplane Wgt (Kg)	2500	2625	2750	3000	3250	3500
Percentage Increase in Wgt	—	5	10	20	30	40
Stalling Speed in Knots	50	51	52	55	57	59
Percentage Increase in Stalling Speed	—	2	4	10	14	18



BANK	0°	30°	60°	70°	75°
LOAD FACTOR	1·0	1·15	2	2·9	3·86
STALLING SPEED	60knots	64knots	85knots	102knots	118knots

FIG. 2.

course must the total lift produced by the wings be increased to maintain height. The resulting increase in dynamic load will therefore cause an increase in stalling speed. Thus one of the essential facts of flight that should always be to the fore in the mind of a pilot is that **the stalling speed increases in a turn.**

Simultaneously with this, the airspeed tends to decrease, because of the greater drag resulting from the greater angle of attack required for the increased lift. By increasing power at the commencement of a steep turn however, this tendency can be offset in proportion to the amount of power applied.

But by how much does the stalling speed increase in a turn? The answer to this question can only be expressed mathematically: It increases as the **square root** of the load factor, the factor by which the lift has to increase in a balanced turn compared to the lift required for straight and level flight. This is clearly illustrated in Fig. 2. In (c) with 60 degrees of bank, the wings are producing **twice** as much lift as they were at (a) in straight and level flight. The stalling speed in straight and level flight is 60 knots, so with 60 degrees of bank, the stalling speed will be

$$60 \times \sqrt{2}$$
$$= 60 \times 1.414$$
$$= 85 \text{ knots}$$

Notice that in (e) of Fig. 2, with a load factor of 3.86, i.e., with the wings producing nearly **four times** as much lift as in straight and level flight, the stalling speed is nearly double its basic value, and as the angle of bank steepens further, the rate at which the stalling speed increases in a balanced turn rises very rapidly. At 80 degrees of bank it would be 144 knots, at 81 degrees, 150 knots, and at 82 degrees it would have risen to 162 knots! The accident to the ultra-light aircraft referred to in the summary that follows is a particularly interesting example of this effect. This particular ultra-light aeroplane cruises at 66 knots. Its normal stalling speed is only about 28 knots, yet it was stalled during a steep turn because the stalling speed had become equal to the speed at which the aircraft was flying. It will be obvious from all this that **an aircraft flying at low speed can tolerate only a relatively small angle of bank before the onset of a stall.**

The danger of losing control is increased if the aircraft should drop a wing while flying close to the stall with the wings at a large angle of attack, as represented by the point X on the lift curve in Fig. 3. As the wing drops, the angle of attack of the down-going wing is increased, while that of the up-going wing is decreased, as shown in Fig. 4. The result is that the aerodynamic condition of the up-going wing has come back to the point Z on the lift curve, while that of the down-going wing has moved past the stall to the point Y. Note that the up-going wing is now producing more lift than the down-going wing. This condition will tend to make aircraft continue rolling towards the down-going wing. The down-going wing also now has a greater angle of attack which causes increased drag. This produces a yaw towards the down-going wing. The continuation of these effects is the incipient stage of a spin. This needs to be recognised and corrected early in its development, otherwise a fully developed spin may result.

An additional hazard is always present during a steep turn if the pilot's attention is distracted, a likely possibility if the aircraft is being flown at low level. (See 'Low Flying — It's Just Not Worth the Risk!', page 2). Because of the inherent directional stability of the majority of light aircraft, the nose will always tend to drop towards the lowered wing. If this is allowed to occur unchecked, the aircraft will enter a spiral dive.

Other Factors Which Affect Stalling Speed

Turbulence: Up-draughts in turbulent conditions can change the direction of the airflow relative to the wing and precipitate a stalled condition.

Wing Damage: Any damage or irregularity, particularly on the wing upper surface, may precipitate a general flow breakdown, inducing a stall at a lower angle of attack and at a higher airspeed than would otherwise occur.

Ice and Frost: Like any wing damage, ice or frost on the wings can greatly reduce lift and increase the stalling speed. In cases where the accumulation of ice is extensive, the resulting increase in gross weight will increase the stalling speed even further. This latter situation is not often a problem in Australia's mild winters, but even a light coating of frost on the wings can seriously affect an aircraft's take-off performance.

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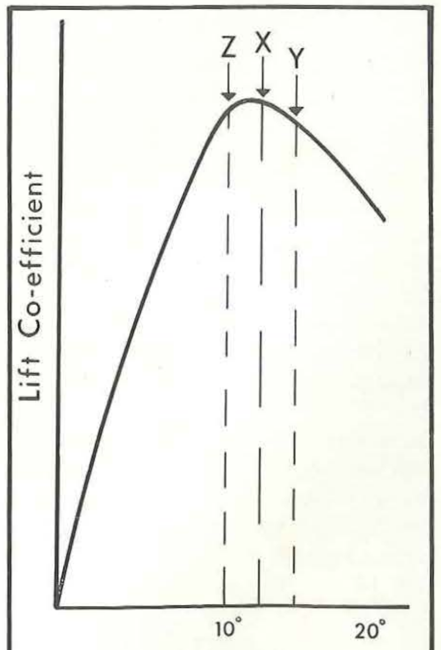


FIG. 3.

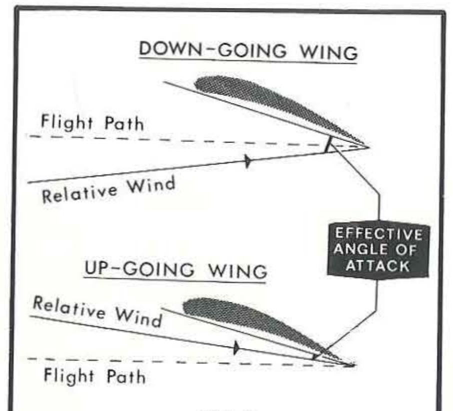


FIG. 4.

All that has been said so far in this discussion is effectively illustrated by the summary of some typical stalling accidents in Table 2.

It is important to note that in all these cases the pilots, no matter how expert their recovery techniques might have been, had no hope of recovering control of their aircraft in the very limited height available.

* * * * *

Pilots who doubt the validity of all that has been said need not be surprised if they one day find themselves in the process of adding to the Department's stall-spin accident statistics. The best possible insurance against this risk is a sound knowledge of all the factors which can lead to these accidents, and for this reason pilots should ensure that they:

- Are familiar with the aerodynamics of stalling.
- Thoroughly understand the operational limitations of their aircraft, and that they are able to recognise the symptoms of impending loss of control.
- Do not fly their aircraft to its operational limits unless they are practised in recovery from loss of control situations and have ample height in which to effect such a recovery.
- Fly close to the ground **only** when absolutely necessary and then strictly in accordance with regulations and specified requirements.

Those who feel that their knowledge and practice of some of these points is a little 'rusty', would do well to discuss them in detail with an experienced flying instructor. Some revisionary dual flying with an instructor, during which the operational limitations of their aircraft can be demonstrated, would be better still.

Pilots who, for any reason, **have** to operate their aircraft close to the ground, should be especially conscious of these operational limitations. They should also remain constantly alert for any indication that these limitations are being approached.

All too frequently throughout the history of aviation, pilots have found themselves in trouble when their attention has been divided between flying their aircraft and looking at something on the ground — especially if this has been the result of an irresistible, spur of the moment, urge to demonstrate their flying ability to lesser mortals watching from below. The modern light aircraft is usually very docile to handle in normal flight, even at the stall. This is especially so in the circumstances in which a stall is usually demonstrated — with the aircraft only lightly laden. But, like a good number of its aeronautical ancestors, it can still become a killer if control is lost at low altitude. An unnecessarily steep turn at low level, particularly if the aircraft is carrying a capacity load and the pilot's attention is being diverted at the same time, is simply inviting a disaster of this sort.

Table 2

Aircraft Type	Height	Attitude of Aircraft
Ultra-light	50′	Stalled in 80° banked turn
PA-23	200′-300′	Stalled in turn at slow speed during approach to land
DH-82	500′	Stalled in 60° banked turn
Auster	100′	Swung on take-off and stalled in subsequent turn
Victa	200′	Stalled during unauthorised low flying
C-172	30′	Stalled after overshoot during attempted precautionary landing
DHC-1	80′	Pilot attempted very steep turn with full flap and half power to align aircraft for landing
PA-25	50′	Stalled during turn at low speed after take-off
PA-24	250′	Stalled during unauthorised low flying
C-150	<400′	Stalled during cattle mustering at low level
C-172	70′	Stalled after take-off in gusty cross-wind
PA-28	200′	Stalled during attempt to turn back to aerodrome after engine failure
C-206	200′-300′	Stalled during steep turn while attempting to turn back after engine malfunction.

SECURE THAT OIL CAP!

Before beginning a cross-country flight from Sydney to an aerodrome on the western side of the Great Dividing Range, the pilot of a Cessna 210 carried out his daily inspection while he waited on the apron for the refuelling tanker. When it arrived, one attendant set about refuelling the aircraft while the other proceeded to top up the engine oil. The attendant omitted to bring a funnel, and because the filler neck is located some four inches below the top of the cowling, the pilot refused to allow him to pour the oil in without one. The pilot re-checked the oil level and after finding it adequate, told the attendant that he would not require additional oil.

Turning then to the other attendant who had finished the refuelling in the meantime, the pilot climbed up to see that both fuel tank caps had been properly secured before checking the tanks for water. By the time the pilot had done this, both the engine oil cap and the oil filler access panel in the engine cowling had been replaced, but because the men were now urging him to sign for the fuel, he didn't re-open the cowl to check the security of the oil cap.

As soon as the tanker had driven away, the pilot climbed aboard, started the engine and taxied out. The run-up was normal, and he took off, but at about 200 feet, oil streamed from the engine cowling and over the windscreen. The pilot turned back and landed, taxied in, and opened the cowling to inspect the engine. The oil cap was loose.

The hour that it took to clean up the mess probably seemed a high price to pay for the few seconds saved in the pre-flight inspection. But how incomparably higher it could have been if the oil cap had come off a little later!

This incident happened because the pilot was distracted while carrying out his pre-flight routine. It is a well-substantiated fact that interruptions of this sort during vital routine 'drills' and checks, both on the ground and in the air, have helped to set the stage for many an aircraft accident. A strict personal rule not to allow your attention to be diverted at such times, and not to be 'steam-rollered' into interrupting your set routine, makes for safer flying.

Safety is paramount — lesser things can usually wait a minute or two.

CROSSWIND LANDINGS

What are your crosswind landings like?
To many pilots, even quite experienced ones, the prospect of a crosswind landing remains something of a secret fear — something to be ignored most of the time in the pious hope that if ever they have to make a 'maximum effort', they will be able to cope — somehow!
This article encourages pilots to face this situation, explaining what is involved and enjoining practices which will enable crosswind difficulties to be accepted with confidence and skill.

Arriving over a country aerodrome, the owner-pilot of a newly restored vintage aircraft estimated from the windsock that the wind was blowing from the east at about 10 knots. Anticipating that these conditions would produce only a slight crosswind component on the 12 duty strip, the pilot decided to practise some crosswind landings and carried out a circuit and approach. After touching down, the aircraft bounced, but when the pilot saw that it was not drifting, he decided to continue with the landing and applied power to cushion the descent. But as the aircraft touched down again, the port wing suddenly lifted and the aircraft swung rapidly off the strip into a cultivated area in the middle of the aerodrome. Unable to check the swing, even with full rudder and aileron, the pilot opened the throttle to go around but, realising the swing had progressed too far, promptly closed it again. As the aircraft skidded downwind, the port wheel dug into the soft earth, one of the undercarriage bracing struts collapsed, and the aircraft pitched forward on to its nose and overturned, coming to rest on its back. It was subsequently determined that, at the time of the accident, the wind was indeed blowing from the east but was gusting to about 25 knots, producing a crosswind component in excess of the maximum permitted for the aircraft type.

Admittedly, such aircraft are not easy to handle in a crosswind, and it may seem a little unfair to select an accident like this as an example of mis-managing a crosswind landing in a light aeroplane. However, the Department's records show that the sort of problems experienced in this case are by no means confined to earlier types of aeroplanes, and that crosswind landing accidents are continuing to occur in many modern light aircraft, despite the inherent directional stability of their nose-wheel undercarriages.

Typical of these is an accident involving the pilot of a Cherokee. Arriving over his destination, which had only a single, sealed east-west runway, the pilot circled the aerodrome twice while he assessed the wind strength and planned his approach. As it turned out, the wind, a southerly of about 10 knots, was blowing virtually at right angles to the runway, and as it did not particularly favour either direction, the pilot eventually decided to land into the east.

Encountering turbulence generated by the gusty, crosswind conditions on final approach, the pilot maintained a speed of at least 75 knots until he had crossed the threshold. After rounding out however, the aircraft floated for over 300 metres before touching down on the main wheels. The nose-wheel quickly dropped to the ground and, still at high speed, the aircraft skipped three or four times before settling on to the ground. Almost immediately the nose-wheel began to oscillate and the aircraft swung rapidly to starboard under the influence of the crosswind until it was heading towards the edge of the runway. The pilot attempted to regain directional control but the aircraft left the sealed surface and headed directly towards two cone markers on the boundary of the flight strip. Though he was now pressing hard on the left rudder pedal, the pilot was unable to check the swing and the aircraft smashed through the markers into a bank of soft sand. The nose-wheel broke off, and the aircraft came to an abrupt halt on its nose, extensively damaged.

Planning Ahead

Planning for a crosswind landing, as with any other type of landing, should begin well in advance of the actual approach and touch down. Correction for drift in the circuit is quite different to that normally required, and allowance for it must be made early to avoid distortion of the circuit pattern. Special care is needed on the downwind leg to ensure that the aircraft tracks parallel to the intended landing path and thus maintains the correct distance from it. The pilot also needs to remember that ground speeds on crosswind and base legs will be different to those he is used to, and he should be prepared to begin the turn on to final approach earlier or later than usual, depending on the wind direction, in order to roll out of the turn correctly lined up with the runway.

The Approach

As most pilots will recall from their student days, a good approach makes for a good landing, and a good approach rarely follows a poor circuit. This is especially so in crosswind conditions where any error in assessing drift in the circuit or on final approach will make judgement more difficult and only increase the chances of a poor or misjudged landing.

There are two fundamental methods of compensating for drift during an approach to land out of wind —

- By heading the aeroplane sufficiently into wind to counteract the drift and, with the wings level, tracking or crabbing along the intended landing path.
- By lowering the up-wind wing and, holding on opposite rudder to stop the turn, side-slipping the aircraft sufficiently to descend in line with the landing direction.

Of these two techniques, the crabbed approach is the more straightforward method of compensating for drift. Once a crab angle sufficient to cope with the conditions has been established, aircraft handling, at least up to the point of touchdown, is quite straightforward and similar in all other respects to a normal approach.

In the case of the side-slipping technique however, there are several important considerations to be taken into account. In many aircraft types, flight manual requirements prohibit extended side-slips with low fuel quantities because of the danger of uncovering the tank outlets and causing engine failure from fuel starvation, a situation which could be extremely embarrassing at low height! In some aircraft too, side-slipping with flaps extended beyond a particular setting is not recommended because of the possibility of shielding the tail surfaces from the air flow and producing a sudden nose-down pitch which could be difficult to correct close to the ground.

Yet another and perhaps not quite so obvious shortcoming of this type of approach is the possibility of 'running out of control'. In a very strong crosswind, considerable into-wind aileron and a correspondingly large rudder deflection may be necessary. In these circumstances, there may be insufficient control travel remaining for the pilot to right the aircraft should an exceptionally strong gust or unexpected turbulence cause an upset near the ground.

Touchdown

During a crosswind landing, the wind force acts over the entire side area of the aircraft and tends to push it towards the downwind side of the runway. This force is proportional to the square of the crosswind velocity; thus, in a 10 knot crosswind, the side force on the aircraft would be quadruple that produced by a five knot component. Generally, the centre of pressure of this crosswind force acts aft of the centre of rotation (the main undercarriage), so that a yawing moment which tends to make the aircraft weather-cock into wind is usually produced.

Undercarriages are not designed to withstand heavy side loads, a fact brought home only too clearly by accidents such as those described at the beginning of this article. It is imperative therefore, that the aircraft is not permitted to contact the ground while drifting, and that at the moment of touchdown it is aligned with the runway.

As in the case of the crosswind approach, there are two basic methods of counteracting drift at the point of touchdown. Both are simply extensions of the techniques already described. If the crabbed approach is used, the touchdown technique consists of flaring the aircraft in the normal way, with the drift correction still applied and then, as speed diminishes and the aircraft begins to settle towards the runway, smoothly but firmly applying rudder to yaw the aircraft into line with the landing path just before it touches down. As the aircraft is straightened in this way, opposite aileron should be used if necessary to keep the wings level.

Despite the obvious advantages of the crabbed approach, this exercise of 'decrabbing' immediately before touchdown calls for a very high degree of skill and judgement. The pilot must resist the temptation to align the aircraft with the runway too soon or, though still pointing in the landing direction, it will quickly commence drifting towards the downwind edge of the runway. Any attempt at this stage to re-align the aircraft by making a co-ordinated turn into wind will almost certainly result in it striking the ground whilst drifting downwind. Conversely, if the pilot waits too long to straighten up, the aircraft will touch down at an angle to the runway, subjecting the undercarriage to the very loads which the exercise is intended to avoid. And even if the pilot has correctly judged his height above the runway and he starts to reduce the crab angle at what he estimates to be the right moment, he may still find himself in difficulties. Decaying airspeed during the hold-off might well have reduced rudder effectiveness to the point that, even with full pedal deflection, there may be insufficient control available to yaw the aircraft into line before the wheels touch the ground.

By contrast with these difficulties, landing off a side-slipping approach does not require such precise judgement or timing. The aircraft is already aligned with the runway and, after what is virtually a normal flare and hold-off, the aircraft touches down without drift on the up-wind main wheel. The fact that the up-wind wing remains lowered also provides some measure of protection against strong sideways gusts.

The Combination Method

The crosswind landing technique which probably gives the greatest degree of control without making unnecessarily high demands on pilot skill is the combination crab-slip method. In this type of approach and landing, the pilot compensates for drift on the approach by crabbing the aircraft into wind and holding the drift correction until after the aircraft is flared for landing. But as the speed begins to diminish and before the aircraft starts to settle towards the ground, the pilot transitions to the slip method by yawing the aircraft into line with the runway while the speed is still sufficient to maintain rudder effectiveness. Then, when the aircraft is tracking straight down the runway, the upwind wing is lowered smoothly to prevent further drift and the hold-off continued until the upwind wheel touches the ground. After touchdown, the aircraft is kept straight by using a combination of rudder and upwind aileron.

The 'crabbed' approach, with the aircraft headed slightly into wind so that its approach path is aligned with the runway.

Directional Control after Touchdown

Maintaining directional control after touchdown in a tailwheel aircraft generally presents no major difficulty provided a wheel-landing technique is used. The aircraft is held straight initially by the careful application of rudder, and then judicious use of brakes as the tailwheel is lowered to the runway. Into-wind aileron helps prevent the upwind wing from rising in a strong gust.

In nose-wheel aircraft however, there are the limitations of nose-wheel steering to contend with. A few modern general aviation aircraft have fully castering, non-steerable nose-wheels, but the great majority have some form of steering system. On some types, the steering is not direct, but is arranged through a spring linkage so that, when the wheel is off the ground and the strut is fully extended, the wheel automatically aligns itself with the centre line of the aircraft. But on most others, the nosewheel is coupled to the rudder pedals by a direct acting linkage so that the wheel turns whenever rudder is applied. It is this arrangement which can lead to handling problems in crosswind landings. For no matter which crosswind technique is used, rudder application (sometimes full deflection) is necessary to align the aircraft with the runway. If the nosewheel is allowed to contact the ground with rudder still applied, the aircraft will immediately swing in the direction in which the wheel is turned, regardless of the wind direction.

A deliberate effort is therefore required to centralise the rudder pedals before the nosewheel touches down, to avoid the onset of an uncontrolled swing and ground loop. Pilots must also bear in mind that a similar manoeuvre could result if, in an endeavour to hold the aircraft on the ground, too much forward elevator control is applied at too high a speed, thus transferring most of the aircraft's weight to the nosewheel. In some instances this could lift the main wheels clear of the runway altogether.

The side-slipping approach. In this case, the effect of the side slip counteracts the drift produced by the crosswind.

General Technique

As a general rule, it is preferable to carry out powered approaches in crosswind conditions. The use of power helps a pilot regulate the rate of descent over a very wide range to compensate for varying wind strengths. It also results in a smaller change in attitude during the landing flare compared with that for a full-glide approach. Furthermore, whenever the wind is strong and gusty, no matter from which direction it is blowing, it is always desirable to use a slightly higher approach speed to provide a greater measure of control and a higher margin above the stalling speed. On the other hand, the use of too high a speed in a crosswind can lead to many kinds of problems. For instance, as the crosswind angle increases, the headwind component decreases until, with a wind blowing at right angles to the runway, the headwind component is reduced to zero. An excessively high approach speed in these circumstances, no matter how hard the wind is actually blowing, will result not only in a significant increase in the landing distance, but also in a much higher ground speed at touchdown which could well lead to handling difficulties in some types of nosewheel aircraft.

Some pilots, in an attempt to offset the crosswind effect, aim to land near the downwind edge of the runway, apparently reasoning that by allowing themselves this additional manoeuvring space, they would have more chance of recovering control should the aircraft start to weathercock into wind after touching down. These pilots however, overlook the fact that, in this situation, it would not take an especially strong gust to blow the aircraft off the runway altogether, possibly into a rough or otherwise unserviceable area. Others, thinking along slightly different lines, plan their approach for the upwind side of the runway, to provide an additional margin should the aircraft begin to drift downwind before the wheels contact the ground. This technique has an in-build snag in that if the aircraft did weathercock after touchdown, the pilot might not have room to regain directional control before it runs off the runway. All things considered, it is far better to adhere to established techniques and to aim to touch down about the normal distance in from the threshold as near as possible to the centre line.

Pilots should at all times guard against the error of touching down first on the downwind wheel. This raises the upwind wing, presenting a large surface area to the wind. Not only does this increase the chance of the aircraft being blown laterally off the strip, but it can induce a rolling motion which, once developed, can be very difficult to correct. A similar effect can be produced if the aircraft touches down near the downwind edge of a heavily cambered surface.

Practice

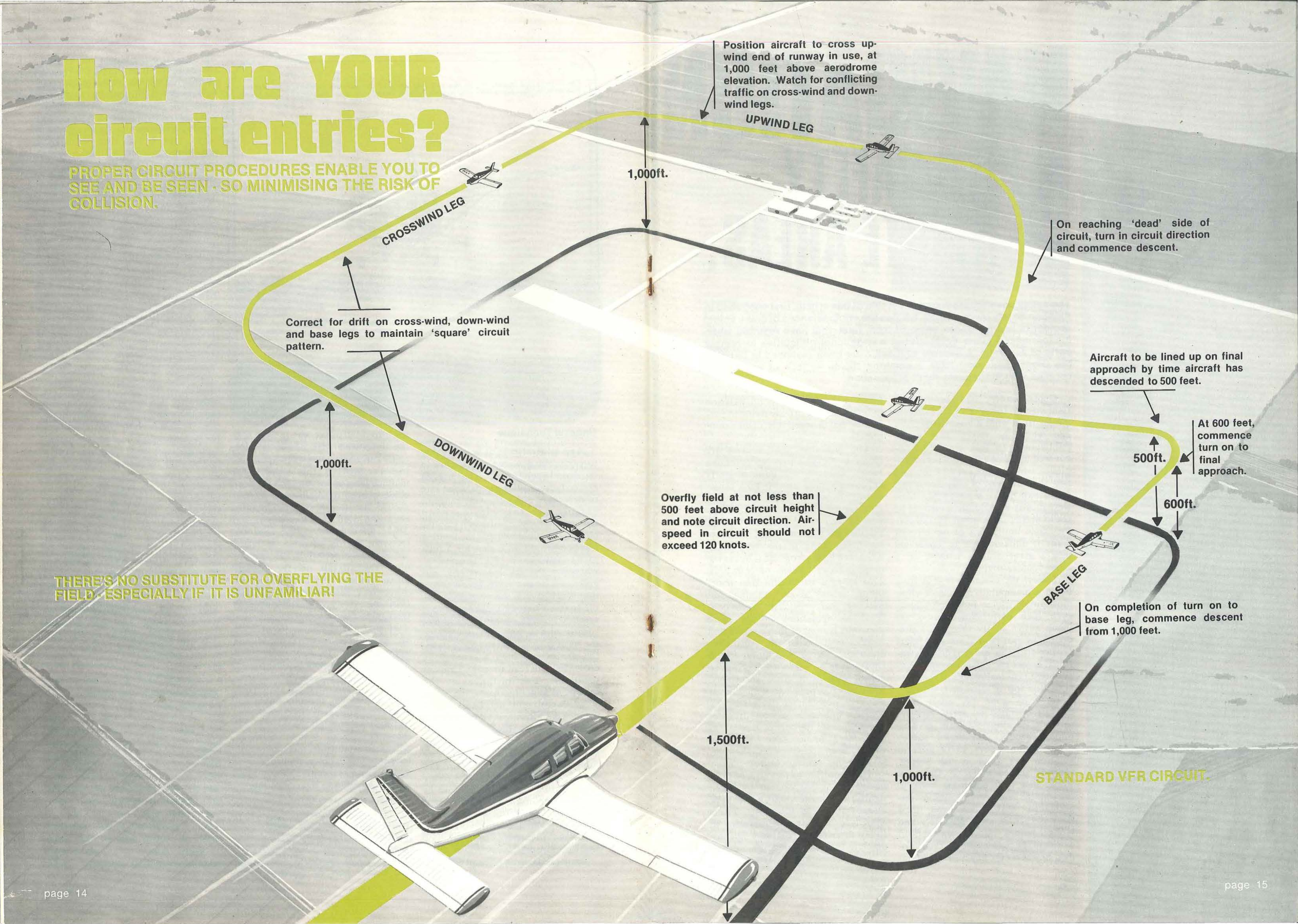
Pilots should be capable of handling a variety of crosswind conditions competently and safely. In addition to operations at major airports where procedures frequently call for landings out of wind, they may be confronted from time to time with unexpected situations such as a temporary obstruction on an into-wind runway or an in-flight diversion to an aerodrome where the wind may be blowing strongly at an angle to the only available strip.

As precise judgement is required to estimate height and drift angle in crosswind conditions, and a high degree of co-ordination is necessary to correctly align the aircraft with the touchdown direction, proficiency in crosswind landings is a skill that can only be maintained by regular practice. Traffic at busy secondary airports does not always permit operations contrary to the normal circuit pattern but frequently, even on the duty runway, there is a small crosswind component which should be properly allowed for. Pilots should use these opportunities to practise and perfect their crosswind landing technique rather than simply ignoring this factor and trusting the aircraft's normally forgiving tricycle undercarriage to cope with side loads and sort out the directional stability problems.

Maximum crosswind components are normally specified in the aircraft flight manual. These values are generally based on tests carried out by the manufacturer and represent the maximum crosswind values at which the aircraft has been demonstrated, in dry conditions, to possess satisfactory handling qualities. Such demonstrations are usually conducted by test pilots and the results may well be regarded as being a limitation for the type. Pilots should therefore exercise discretion in strong crosswind conditions to ensure that the operations are confined to crosswinds within their own capabilities, and to accept that this may be significantly less than the crosswind component referred to in the flight manual.

How are YOUR circuit entries?

PROPER CIRCUIT PROCEDURES ENABLE YOU TO SEE AND BE SEEN - SO MINIMISING THE RISK OF COLLISION.



THERE'S NO SUBSTITUTE FOR OVERFLYING THE FIELD - ESPECIALLY IF IT IS UNFAMILIAR!

STANDARD VFR CIRCUIT.

NAVIGATION — KEY TO SAFETY IN REMOTE AREAS.

The safety poster reproduced in the title of this article, first published in Aviation Safety Digest No. 55, typifies the circumstances of many actual accidents and incidents, some of them fatal, that have resulted when inexperienced pilots encountered navigational difficulties in remote parts of Australia. A number of these have been reviewed in detail in the Digest and most have a common theme — lack of experience coupled with inadequate flight preparation.

Cross-country navigation in a light aircraft today is a very different matter from what it was two decades ago when the Digest first began publication. In that era of fabric-covered tail skid and tail wheel aeroplanes, which cruised at 80 knots and had an endurance of only about two and a half hours, a pilot's problems were mostly manipulative ones. If he could master these properly, the performance limitations of his aircraft made it unlikely that he would get into a great deal of trouble on a cross-country flight.

Today, the exact reverse is true. From a manipulative point of view, most single-engine light aeroplanes, even high performance ones, are much easier to fly than their predecessors. But their speed and range is often such that quite minor navigational errors can easily become compounded into major ones if the pilot is not 'on top' of what he is doing.

In years gone by, apart from aircraft operated by aerial medical services, developmental air services, mining groups and aerial survey organisations, very little general aviation was done in the distant, sparsely settled areas of Australia. Those that **were** operating, were in the main, flown by highly experienced 'bush' pilots who knew their particular area intimately and whose names became household words in the regions they served. Today, however, the expansion that has taken place in the general aviation industry, and in private flying in particular, has changed this picture completely.

The fact that light aircraft are easier to fly and have an extensive range, naturally and quite properly encourages their use for long cross-country trips and 'tours'. And the increasing use of light aircraft for business as well as for pleasure, has inevitably led to a great deal more flying being done in the very areas where the light aeroplane is by far the most practical means of transport. This in turn has meant that many pilots, whose flying training and practice had previously been confined to operations in the more populous regions of the southern and eastern portions of the Australian continent, have suddenly found themselves faced with having to cope, often with little specialised training or experience, with the far different problem of navigating accurately in areas where hundreds of miles separate the sort of landmarks and check points they have previously been accustomed to — highways, towns, railways and so on.

The transition to this type of pilot navigation is not one to be taken lightly, as many less wary pilots have already found to their cost. Pilots who have little or no experience in flying in remote areas may not appreciate that the Australian outback is a big country and, though light aircraft navigation in remote parts of the continent is not necessarily more difficult than in our closer settled areas, it is a task abounding in pitfalls for the unwary and the ill-prepared, and by its very nature is far less forgiving.

There are two particular factors which have undoubtedly contributed to navigation problems encountered by inexperienced pilots in recent years. Both relate to pilot attitudes.

Over the past few years, the promotional advertising for some types of light aircraft has fostered the notion that the skills and judgements necessary to fly an aeroplane are little removed from those required for driving a motor car. Unfortunately, amongst some would-be aviators, this seems to have stimulated an 'aerial driver' outlook rather than a proper 'pilot-in-command' philosophy and has done nothing to encourage amateur pilots to aim at professional standards in all aspects of their flying.

The same sales promotional campaigns, in conjunction with the undoubted virtues of the aircraft themselves, also seem to have introduced to the ranks of aircraft owners and pilots, persons who have learnt to fly because it provides them with an efficient means of transport in country or outback areas, but who have no real interest in flying other than this.

Attitudes of this sort are in marked contrast to the emphasis on leadership and enthusiasm, pride in skill and airmanship, and *esprit de corps*, which so characterised the aero club and flying school movement two decades or so ago, when private ownership of aircraft was the privilege of the very few. As a result, light aircraft flying today is much less subject to imposed discipline and far more individualistic in character. It is all the more necessary therefore that individual pilots take care to cultivate in themselves the right attitudes and self-disciplines so necessary for conducting their flying in a sound and safe manner.

The following comments, taken at random from the Department's investigation files, give some idea of the problems that are being encountered in remote area flying:

★ 'The pilot did not positively establish his position in relation to a selected fix point before continuing on to the next fix point'.

★ 'The pilot became lost in a remote area because he did not make adequate preparation before departure, to ensure the safe navigation of the flight'.

★ 'The pilot's navigational competence is obviously suspect, as shown by his failure to use his computer to calculate heading, ground speeds and times, and by his general lack of directional sense. If a forced landing had become necessary, the task of establishing a search probability area would have been made much more difficult because of the poor flight plan lodged by the pilot'.

★ 'The situation in which the pilot found himself is typical of what results from sloppy flight planning and inattention to map reading by an inexperienced pilot operating in a remote area. It could be said that this pilot was a SAR phase going somewhere to happen'.

★ 'The pilot was inexperienced both in flying generally and with the remote area in which he was operating. His aircraft carried no survival equipment, water, matches or survival beacon, and he had set out on the flight without ensuring that his HF radio equipment was serviceable. His flight planning was meagre in the extreme, and made no allowance for wind or for checking the progress of the flight in relation to recognisable landmarks'.

★ 'The procedure adopted by the pilot in following unsealed roads involved substantial deviations from the flight planned track. As this was his first flight to the Northern Territory however, prudence might have dictated following the well-defined Barkly Highway to Tennant Creek, thence the Stuart Highway to Daly Waters'.

★ 'The tendency to deviate from the flight plan with no real justification, instead of sticking to the plan, is something like people lost in a forest going round in circles. Obviously a plan is a plan and it should be adhered to unless a positive fix indicates the aircraft is off track'.

★ 'If ever there was a case to demonstrate that accidents don't "just happen" but are the culmination of a chain of unfavourable events and circumstances, this one does. In this case, the chain was formed by a series of factors which, for the most part, could be listed under the general headings of inadequate flight preparation and lack of planning'.

These case histories, together with other accident and incident report data in the same category, show that there are several common factors contributing to the high incidence of navigation difficulties in the outback. For nearly always when navigational problems develop, the pilot is lacking in overall experience, recent experience or perhaps both. It must of course be accepted that inexperience in either of these areas will inevitably result in some mistakes. After all, this is no more than the price of real experience. But proper flight preparation and a sense of one's own limitations should ensure that such mistakes do not develop into navigational disasters. Clearly, one of the chief weaknesses is lack of real flight preparation — not just simply filling in a flight plan form, but as Air Navigation Regulation 231 on flight planning puts it, '... studying all available information appropriate to the intended operation ...' This of course includes obtaining adequate information on weather conditions, both en route and at the destination, as well as the provision of an 'emergency plan' that will enable the aircraft to safely reach an 'alternate' if things go unexpectedly wrong. Also, if the flight is to be through one of the designated remote areas, it includes making provision for the special requirements concerning the carriage and use of HF radio and survival beacons.

And not only must one's technical competence and knowledge for the task be carefully considered. The flight time limitations laid down in Air Navigation Orders have been devised because experience shows them to be an essential component of safe aircraft operations. There are very sound reasons for them and pilots must remember that, just as a machine cannot function properly if it is not adequately fuelled and maintained, so the human body cannot function efficiently without proper food and rest at the right intervals.

Once in the air, other weaknesses in navigational technique take their toll. Principal among these seem to be inability to map read accurately and failure to appreciate the need to keep a detailed in-flight log. Frequently too, the effect of these inadequacies is worsened by pilots becoming convinced, without any real evidence, that they are in a particular position, and by their becoming flustered, which leads them to make rash, ill-considered decisions.

There is evidence too, that some pilots, when venturing into unfamiliar territory, are reluctant to seek out and to clarify, from Briefing Officers, the very information that might save them from difficulty. This is probably born of a reluctance to admit their lack of knowledge of the area or their unfamiliarity with particular aspects of flight planning, but pilots who feel this way should remember that pride is a quality best forgotten when undertaking flights in the remote areas of Australia.

It has been pointed out many times that the development of an accident is nearly always an evolutionary process. In other words, an accident does not 'just happen', but is usually the culmination of an insidious chain of events or incidents. Nowhere is this more true than with accidents resulting from navigational errors, where the event itself usually develops from seemingly insignificant omissions, errors and misjudgements, which, to the pilot concerned, seemed quite unimportant at the time. Yet with hindsight, it is frequently possible to see that if the formation of that chain could have been interrupted, the accident itself would have been averted.

One almost certain way of interrupting such a chain of events, provided that it is done in time to alter the course of the accident evolutionary process, and which is by far the most effective answer to a pilot's navigational problems when the situation seems to be getting out of hand, is to call for assistance. Over the years, the incident record has revealed instances of pilots having been reluctant to call Air Traffic Control or Flight Service Units when confronted with navigational difficulties. No doubt, the number of such cases is much greater than is revealed. It is clear from the facts surrounding the known cases that the specialist officers on the ground could have provided valuable assistance had they been appropriately alerted. It is equally clear that failure to alert the ground organisation in such circumstances may expose perfectly innocent people to grave danger.

A point to be remembered is that the Department has a policy of granting immunity from disciplinary action to those pilots who, because of navigational or other difficulties, have a need to request assistance from the ground organisation. Certainly, such occurrences will be investigated. But this is done so that the circumstances which lead to the occurrence will be properly understood to the ultimate advantage and safety of users of our airspace.

★ ★ ★ ★ ★

What then can pilots, who are inexperienced in remote area navigation, do to avoid its many pitfalls? As already indicated, the answer lies in adequate flight preparation and in sound in-flight judgement based on that preparation. Obviously pilots who have not done their homework properly for a particular route cannot expect to make the right in-flight decisions when the unexpected occurs.

The advice summarised in the section that follows this article may seem common sense and obvious to most. So it is — but it is also so basically vital to safe cross country navigation that it cannot be repeated too often.

Pilots who follow these rules will greatly enhance their chances of completing their flight successfully and uneventfully. If however, despite all precautions, a pilot does require assistance he will have ensured that the SAR organisation is well informed about his intentions and is thereby able to provide whatever assistance is necessary. On the other hand, if a pilot has been aimlessly following odd roads or tracks without keeping any navigational log, the SAR organisation's task is immeasurably more difficult.

And don't think that because you have made one or two trips in remote areas you will be immune from trouble — it takes a lot of experience spread over different seasons and conditions (summer, winter, drought, particularly favourable seasons for growth and so on, all of which can change the appearance of the country radically) to become an accomplished remote area navigator. The Department's records show that the more experience a pilot has, the more he follows these golden rules.

To disregard any of these factors in the planning and subsequent conduct of a flight, can, as has been proved so many times before, lead to results that are not only tragic, but in all probability permanent. As a qualified pilot, you have the complete trust of your non-pilot passengers and their lives are in your hands. It is a heavy responsibility — see that you are worthy of it.

HINTS ON FLIGHT PLANNING AND NAVIGATION IN REMOTE AREAS

● Plan the flight carefully and unhurriedly, making use of all available information. Ensure that your maps are adequate and that they are current editions. Examine your proposed route, noting landmarks and distinguishing features. Study these and plan to track via clearly recognisable landmarks that you will be able to identify when you fly over them. Also study the features on either side of your planned track so that you will know if you drift off track. Read the advice contained in the front of the Visual Flight Guide — and follow it. Be sure you have the required radio and survival equipment and that it is in good condition — and make certain it includes sufficient water, matches, a torch and a mirror for signalling.

● Make use of the local knowledge of briefing officers experienced in the area, and of other pilots who fly the route frequently. Determine what fix points are the most suitable and obtain all possible information on landing areas along the route. Ensure that this information is as reliable and up-to-date as possible, for non-licensed landing grounds on station properties are sometimes abandoned in favour of new or more suitable sites. As far as practicable, plan your flight over these landing areas. Be particularly careful of unmade roads and tracks as aids to navigation. In the outback, these are changing constantly and in open country new tracks can be formed literally overnight — simply because a vehicle happens to be driven through the area. Remember too that the appearance of the country can alter almost out of recognition with a change in the season, or after good falls of rain.

● Plan to fly high enough to obtain a general picture of the country. There are few airspace restrictions in remote areas and generally when the weather is good and the sky clear, the higher you fly, the easier will be your visual navigation. Remember too that higher cruising altitudes will give a better range of communication on VHF. Cross-country flying in the inland is also much more comfortable when your aircraft can cruise above the convective turbulence layer. But don't allow a cloud layer at a lower level to impede your visual navigation.

● Obtain a thorough meteorological briefing and be particularly wary of areas where visibility may be reduced in dust or haze. Cloud shadows on the ground can also cause visual problems, so flights on days with a scattered cloud coverage require special care. Be willing to delay the flight until conditions improve, if the weather appears marginal or difficult.

● Allow adequate time and fuel, plus reserves, not only for the planned flight, but for any possible alternative action. Carefully consider and decide on alternative plans of action in case selected fix points are not located as expected. If the flight is being made in the latter part of the day, ensure that there is sufficient time to execute the total plan, including alternative courses of action, before dark.

● Fly headings carefully — don't allow the aircraft to wander off track simply through inattention. Check for drift soon after departure and adjust heading as necessary. Continue to check drift and make adjustments to heading at frequent, regular intervals. Don't allow yourself to be distracted from the task of navigating the aircraft, but map read carefully as the flight progresses and know where you are all the time. Where this is not entirely possible because of lack of landmarks, at least know your dead reckoning position all the time. Anticipate fix points a few minutes ahead of ETA — don't just wait for them to 'show up'. Record all headings flown and the times of making changes — in fact form the habit of keeping an accurate running log. In the long run it will pay dividends in the trouble it will save you.

● If you are unable to locate a selected fix point, immediately commence your planned alternative action. This could entail returning to the last positive fix, or perhaps diverting to some prominent landmark even if some distance away. Be prepared in these circumstances to abandon your original plan for proceeding to your destination, in favour of a destination which is easier to locate and in a more accessible area. Remember to log your headings and to check for drift.

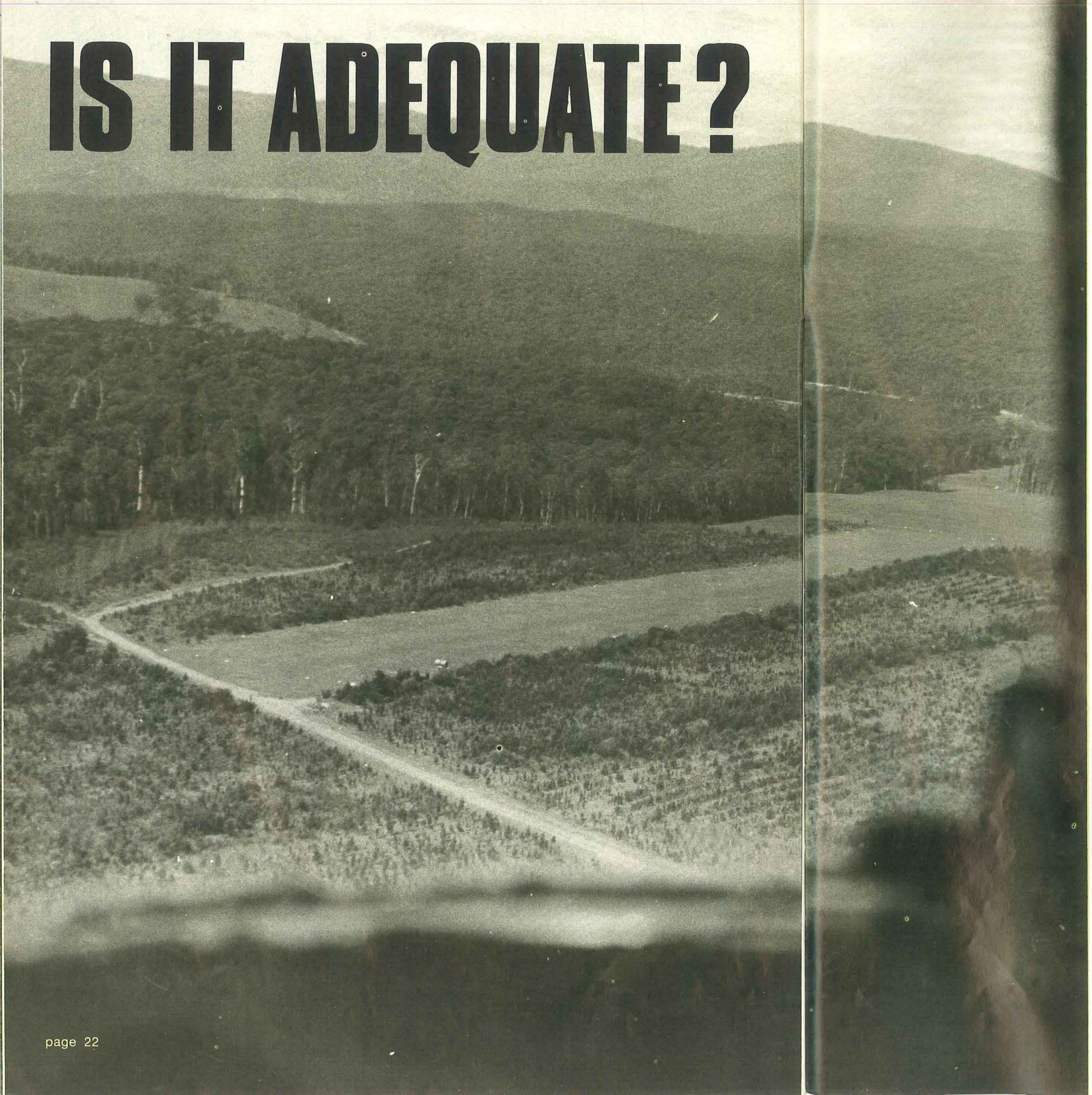
● If you do depart from your original flight plan, notify your new intentions to the nearest Flight Service or Air Traffic Control Unit. If you do become lost, don't allow yourself to become flustered or to become convinced that you must be in a certain position. Instead, keep an open mind and study the surrounding countryside. Advise the ground organisation of all headings and times flown since your last positive fix. This information will enable the SAR organisation, with its up-to-date wind and weather data, to commence a plot of your flight and assist you in establishing your position.

● Lastly, if, despite all these precautions, things go unexpectedly wrong and you are caught with insufficient fuel to reach your destination or a suitable alternative, use your last resources intelligently. Don't wait for the aircraft to run out of fuel before you make a forced landing. Select the most suitable area available to you and put the aircraft on the ground while you still have engine power for a precautionary landing approach — and daylight to see what you are doing. You may damage your aircraft but you and your passengers should be able to walk away from it.

● Having done this, stay with your aircraft. As far as possible maintain a listening watch, operate your survival beacon, lay out ground signals, light fires by night and wait for rescue.

G R E A T   V I C T

IS IT ADEQUATE?



Sooner or later in his flying career, almost every pilot uses a landing area that is neither a Government or a licensed aerodrome. This sort of flying — operations from what are known as 'authorised landing areas' — are everyday events in Australian general aviation. In fact the utility and effectiveness of many charter, business and private aeroplanes, is entirely dependent on this capability.

Yet by its very nature, this is a type of operation which places heavy responsibilities on the pilot. For in such operations it is the pilot, and the pilot alone, who has to ensure that the landing area being used is adequate for the operation both in terms of physical dimensions and surface condition.

The pitfalls of assessing surface condition have already been discussed in Part I of this revisionary Digest material (see 'Have Respect for your Aircraft', Aviation Safety Digest No. 96). It is the matter of determining the dimensional adequacy of proposed landing areas for the prevailing conditions with which we are now concerned. And in the assessment of these aspects, the stakes can be high indeed. The following examples show what we mean:

- While attempting to take-off from a claypan on a station property, a Beech Musketeer failed to become airborne. After using all the available run, the aircraft struck a tree and, still under full power, crashed into a dry creek. The aircraft was destroyed by fire and all four occupants were killed.

The surface of the claypan from which the take-off was being attempted was a dry crust which crumbled under load, allowing the wheels to sink to some extent into the soft earth. The retarding effect of the soft surface would have been about the same as that of long grass.

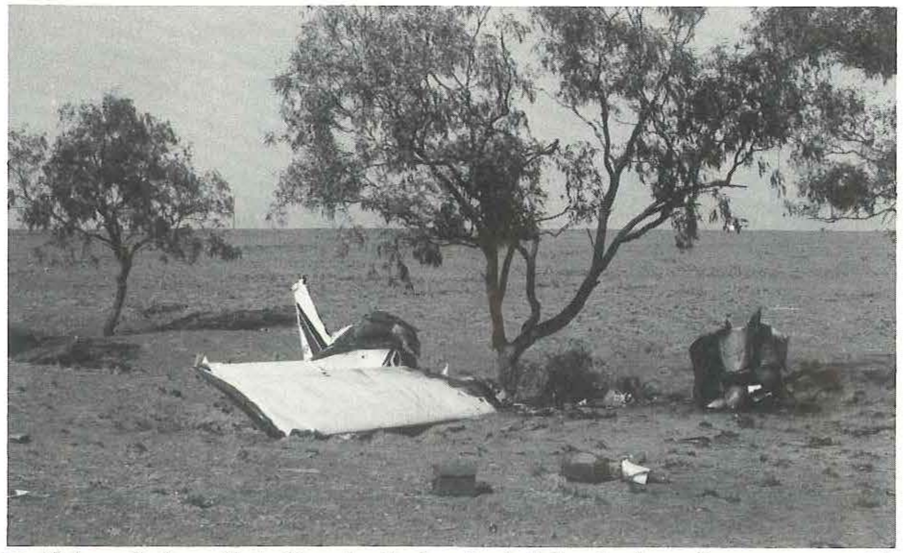
When measured, the length of claypan available for the take-off was found to be only 360 metres. According to the take-off performance chart included in the flight manual for the aircraft, in the conditions of density height and at the weight to which the aircraft was loaded at the time, the distance required for a take-off to a height of 50 feet would have been 640 metres. However, because performance charts are based on operations from a short dry grass surface, additional allowance would have to be made for the soft surface of the claypan. The length of the claypan was therefore hopelessly inadequate.

- Arriving over a 'one-way' agricultural strip at the end of a cross-country flight, the pilot of a Cessna 182 assessed it as being 450 to 600 metres long. The wind was blowing directly up the slope of the strip but, as he estimated it was only about 10 knots in strength, the pilot concluded he would have no difficulty in stopping the aircraft.

After a long final approach, the aircraft failed to settle as expected and seemed to float for almost half the length of the strip before touching down lightly. It did not appear to lose speed and, still rolling fast, careered up the slope and overshot the end of the strip, tore its way through the fence bordering a road and finally crashed head-on into an embankment on the opposite side of the road. The pilot and the front seat passenger were knocked unconscious by the impact and suffered severe injuries, and the two back seat passengers sustained minor injuries. All four occupants suffered skin burns as a result of being showered with aviation fuel from the ruptured wing tank fuel lines, which fortunately did not catch fire.

A major factor in the accident was the pilot's poor assessment of the wind strength. The pilot stated that he assessed the wind from the smoke of a nearby factory chimney and believed it to be about 10 knots. It was clear from other evidence however, including that of a private pilot who owned a property near the agricultural airstrip, that the actual wind strength was of the order of 30 knots. The strip itself fell far short of the minimum requirements for normal category operations and was suitable only for 'one-way' agricultural operations. From fence to fence its overall length was only 470 metres, whereas the flight manual for the Cessna 182 shows that, even in nil-wind conditions, a landing distance of 543 metres is required. The pilot had greatly overestimated the gradient of the strip, and the effect this would have in assisting him to bring the aircraft to a stop. With a 30-knot tailwind, there was absolutely no chance of completing a successful landing.

- At the conclusion of a cross-country flight, the pilot of the Cherokee 180 shown in the picture made a landing on the racecourse of a country town where he had been told 'there was plenty of room for a Cherokee 180'. The landing was une-



ventful and the pilot disembarked two passengers and took off again. After flying to another nearby town and picking up a third passenger, the pilot returned to the racecourse and prepared to land again. During the aircraft's absence however, a light shower of rain had fallen. The pilot made a normal approach to land and, after touching down, applied the brakes. On the wet grass this had little effect and the pilot was unable to prevent the aircraft running into the fence at the upwind end of the landing area.

Reference to the landing performance chart in the aircraft's flight manual showed that a distance of 580 metres was required for a landing on short dry grass. Although the actual length of the area from fence to fence measured 640 metres, a power line 50 feet high on the approach path reduced the effective operational length to only 380 metres.

- The pilot of a Mooney M20 attempted to take-off fully-loaded from a paddock in which the effective operational length of the run he had chosen was 550 metres. After using the full length of the paddock without becoming airborne, the pilot attempted to lift the aircraft over the fence at the upwind end of the paddock. However, the aircraft struck the fence with the undercarriage, and the port wing dropped. The starboard wing then struck a bush, and the aircraft slewed to a stop badly damaged. The occupants escaped without injury. The pilot had not consulted the take-off performance chart in the aircraft's flight manual, which would have shown him that in the prevailing conditions, an effective operational length of 670 metres on short dry grass was required. In any case, because the paddock was covered in long weeds, it is very doubtful whether the area would have met the requirements of an authorised landing area.

- The pilot of a Cessna 172 had flown to visit some friends in the country and had landed his aircraft in a paddock on their property. When he was ready to depart again the next day, the wind was blowing from a different direction and it was necessary for him to select another take-off path. The pilot estimated that he would require at least 610 metres of take-off run, so the property owner drove his vehicle over the paddock in the proposed direction of take-off and determined that more than this was available. After the passengers had boarded the aircraft, the pilot started the engine and taxied downwind preparatory to beginning the take-off run. However, because there was an undulation in the paddock, he lost sight of the upwind fence and he continued taxi-ing downwind only until he believed he had sufficient room for take-off. He then turned the aircraft around and after completing his checks, began the take-off.

The aircraft accelerated normally, but when it reached the top of the rise the pilot sighted the boundary fence not far in front of the aircraft and realised that the distance he had allowed was not enough. The airspeed at this time was a little above 50 knots. The aircraft became airborne, but then sank back on to the ground and struck the fence. The nose leg collapsed and the aircraft skidded to a halt badly damaged. One of the child passengers suffered minor injuries.

Measurements made later showed that from the point at which the pilot had begun the take-off run, the effective operational length was only 440 metres. If he had utilised the full length of the paddock, the distance available would have been in excess of 760 metres.

* * * * *

All these accidents, one of them fatal, the others of varying degrees of severity, occurred because the areas from which the pilots attempted to operate were inadequate for the aircraft type or the prevailing conditions. As it happens, they are but a few examples of a trend that seems to have developed in Australian general aviation in recent years. The problem is not just associated with the physical size of the selected landing area; as we have seen, other characteristics such as surface condition, obstructions, wind, and the pilot's planning of the operation have also played their part. Neither is the problem peculiar to any particular region or class of operation. Charter, agricultural and private aircraft have all been involved.

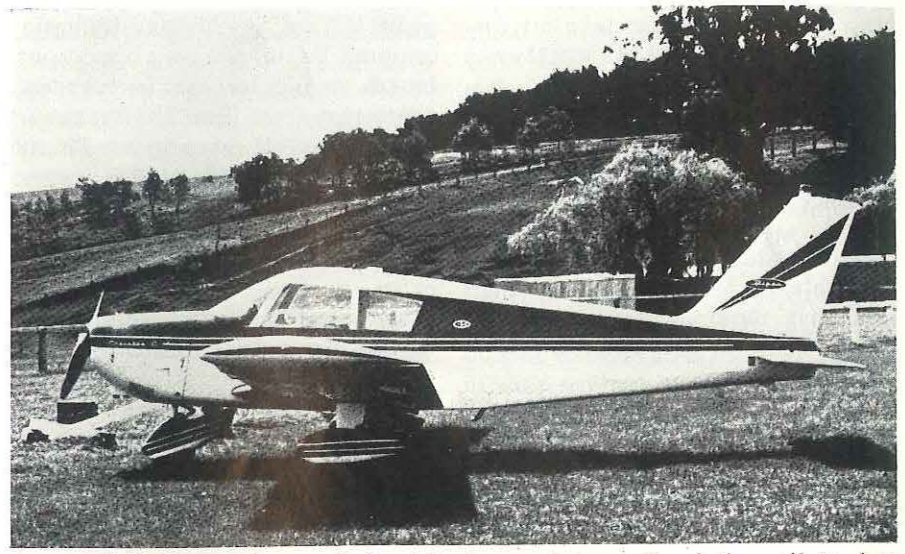
What is the remedy for the shortcomings that are producing all these accidents? The problem itself may be diverse but the solution is

surely very simple. First, a realisation that the modern light aeroplane is not the 'land-anywhere' vehicle some sales brochures would have us believe; then care and common sense in planning such operations, taking **nothing** for granted.

Some pilots for example, seem to think that operations in the country are merely a matter of 'picking a paddock' and all will be well. It is possible that this sort of attitude has grown out of the very ease with which modern tricycle undercarriage light aeroplanes can be handled on the ground, perhaps encouraging pilots to take liberties with these aircraft which would have been unthinkable with the older, more difficult tail wheel or tail skid aeroplanes.

Then too, the increasing use of light aeroplanes as an everyday means of transport, particularly in country areas, seems to have engendered a much more casual attitude to flight preparation in all its aspects. In the minds of some pilots, a flight in their light aeroplane often seems to be equated with a trip in a motor car, for which in the circumstances in which this occurs, it is usually the more desirable alternative.

Unfortunately in many cases, little more thought and preparation is being given to such flights than would be afforded their motor trip counterparts. It is hardly coincidental, for instance, that in every one of the examples mentioned, the area used by the pilot fell short of the length required for the operation as determined from the aircraft's performance charts. These charts are included in the approved flight manuals (not to be confused with the 'owner's manuals' supplied by the manufacturer) issued as part of the Certificate of Airworthiness for **every aircraft. The charts are based**



on actual flight test data and should be used whenever there is the slightest doubt as to the adequacy of the available length in the existing conditions.

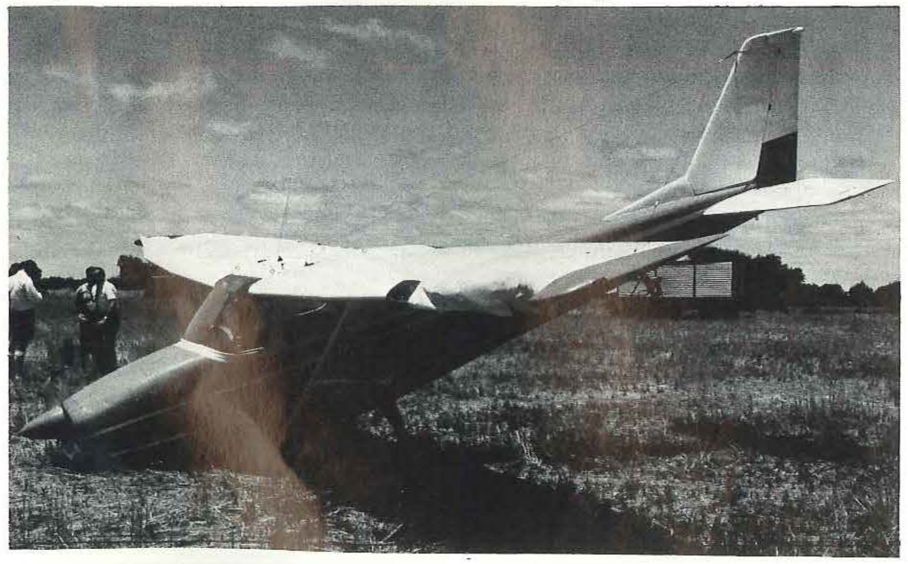
The obvious fact that none of the accidents discussed would have occurred if the areas being used had met the required standard, provides a forcible reminder that today's light aeroplanes, despite their many refinements and the ease with which they can be flown by pilots with comparatively little experience, are still aeroplanes. They are **not** aerial motor cars, however much some manufacturers have tried to persuade the public to the contrary, and their operation is still subject to the same pitfalls that have plagued heavier-than-air aviation from its earliest days. Yet it is perhaps the very publicity associated with sales campaigns of this type that has played a part in the development of some accidents, particularly those occurring on take-off. To illustrate this, let us look at one more example, this time involving a type of single-engined **low-wing light aeroplane well-known to most general aviation pilots, but** which, for reasons that will become apparent, must remain nameless in the context of this discussion:

After taking off from a paddock in a country area where the terrain is about 1000 feet AMSL, the aircraft climbed steeply in an attempt to clear tall trees bordering the boundary fence. It cleared the first line of trees, but then the port wing dropped sharply and the aircraft dived steeply into a heavily timbered area. Both front seat occupants were killed and one of the rear-seat passengers sustained serious injuries.

The weather at the time of the accident was fine with a surface temperature of about 20 degrees Celsius. During the take-off the aircraft would have been affected by a tailwind of some four knots.

Press advertisements for this type of aircraft which had appeared in aviation journals and magazines at the time, had included the unequivocal statement that 'the aircraft takes off in 820 feet' (260 metres). This information was also included amongst other 'performance specifications' in the owner's handbook supplied by the manufacturer.

While it is true that the unfortunate pilot erred in not consulting the approved flight manual performance chart to ensure that his selected take-off path was within the aircraft's performance capability, it is pertinent to ask to what extent the 'facts' contained in the advertisements could have influenced the pilot into believing that the length available at the time of the accident was adequate. In contrast to the advertised figure of 260 metres, reference to the aircraft's take-off performance chart showed that, in the conditions of wind and density height that existed at the time, and at the weight to which the



aircraft was loaded, a take-off distance of no less than 1145 metres was required.

The paddock which the pilot was using on this occasion measured 915 metres from fence to fence, but the presence of trees just beyond the boundary fence in the direction of take-off reduced the effective length available to 550 metres, less than half that required by the performance chart in the existing conditions.

Drastic reductions in effective operational length of this sort, together with the increases in length required in unfavourable combinations of wind, field elevation, temperature and aircraft weight, have contributed to many of the performance accidents that have occurred in past years. For this reason it is worth re-examining some of the factors that play a part in determining the adequacy of an area for both take-offs and landings in a given set of conditions.

Standards for aircraft performance and the physical characteristics of authorised landing areas are of course prescribed to ensure the safety of operations from such areas. The requirements and dimensions for authorised landing areas are contained in Aeronautical Information Publications and the Visual Flight Guide, and it is a pilot's responsibility to thoroughly familiarise himself with these requirements before he operates from such landing areas. As well as defining conditions of strip surface, width and slope, the requirements specify that approach and climb-out areas are to be clear of all obstacles above a gradient of 1:20, or five percent, from the ends of the strip. In cases where fixed obstructions extend above these gradients, the effective operational length of the strip is reduced by an amount that will enable the required obstacle-clearance gradient to be met.

The take-off performance chart, in the aircraft's flight manual, limits the maximum take-off weight to ensure that, for the available effective operational length and in the existing meteorological conditions, the aircraft will be at a height of at least 50 feet as it crosses the end of the effective strip length. From this point on also, the aircraft is required to be able to achieve a gross climb gradient of six percent to ensure that it maintains a margin of clearance above the specified obstacle-free gradient from the end of the strip. Thus, quite independently of any weight limitation imposed by the effective operational length available, the performance chart may also limit the maximum take-off weight to achieve the required climb performance.

As a standard, the climb gradient requirement is specified for zero-wind conditions. A margin of safety exists in these circumstances but other conditions can reduce this margin. In the accident referred to, the pilot took off with a small tail-wind component, apparently under the impression that, as the wind was only light, it would not have any appreciable effect on the aircraft's performance. But although the effect of a tail-wind component is provided for in the take-off performance chart, and may easily be computed by the pilot, it is perhaps not so obvious just to what extent the climb gradient **after** take-off can be affected in these circumstances.

Climb gradient is a measure of height reached in distance travelled. In still-air conditions, the 'air distance' covered to reach a particular height in a normal climb after take-off will of course be the same as the ground distance. If there is a head-wind component, this will reduce the aircraft's ground speed and bring about a corresponding reduction in the still-air distance to reach a given height at the same rate of climb. If it is assumed that the wind velocity remains constant as the aircraft climbs, then the gradient of climb relative to the ground will be greater than the still-air figure by an amount proportional to the strength of this steady head-wind.

Just the opposite occurs during a take-off in tail-wind conditions, the increased ground speed resulting in a longer distance being taken to reach the same height. The actual gradient of climb in this case will be somewhat less than the figure achieved in still-air. If the aircraft's take-off weight has already been limited by the performance chart to meet the six percent still-air climb gradient, or if the aircraft just achieves this figure at an unrestricted weight, then in the more adverse tail-wind situation, the margin of clearance above the five percent obstacle-free gradient from the end of the strip will be reduced. If the tail-wind component is strong enough, the aircraft may even descend in relation to the required obstacle-free gradient. These variations in climb gradient are shown in Fig. 1.

So far, no mention has been made of the effects of wind shear on aircraft climb gradient and only a simplified situation has been considered, such as would exist if wind strength did not alter with height. This of course, never occurs in practice, as wind speed at low level is reduced by friction with the earth's surface. For this reason, wind speed generally increases with height up to the 'gradient level', where surface friction is no longer a factor. A downwind take-off can therefore become progressively more critical as the aircraft leaves the lower levels and climbs into layers of increasing wind strength; the tail-wind component increases as it does so, and with it the distance to reach a given height; i.e. there is a progressive reduction in climb gradient as height is gained. This is illustrated in Fig. 2.

There is yet another way in which tail-wind conditions can adversely affect an aircraft's gradient of climb. In some circumstances, changes in wind velocity with height can be quite severe. If an aircraft traverses such an area of pronounced wind shear and cannot accelerate or decelerate at the same rate as this change in velocity, the wind variations will be reflected in changes in airspeed. A sudden strengthening of a tail-wind component may result in an abrupt loss of airspeed which in turn could place an aircraft critically close to the stall during a climb at low speed after take-off. If the engine is already operating at full power, the only way in which the pilot can accelerate his aircraft in these circumstances is to lower the nose and sacrifice rate of climb. This of course will further aggravate a situation in which the aircraft's gradient of climb has already been diminished by tail-wind effects.

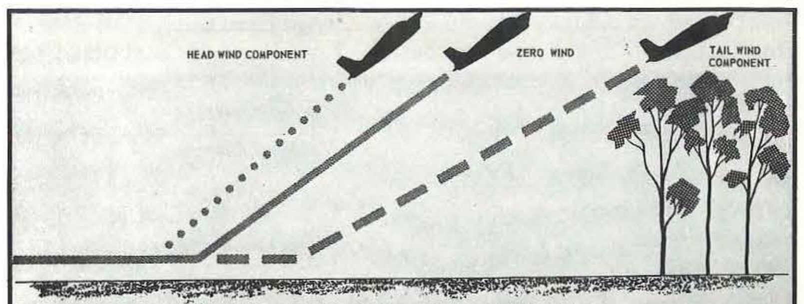


FIG.1. RELATIVE GRADIENTS OF CLIMB IN HEAD AND TAIL-WIND CONDITIONS

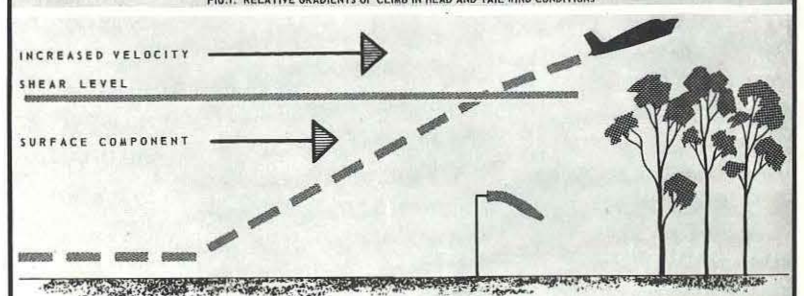


FIG.2. EFFECT OF SEVERE WIND SHEAR ON GRADIENT OF CLIMB IN TAIL-WIND CONDITIONS

Undoubtedly there are occasions when a pilot is faced with a downwind take-off over obstacles such as trees, power lines or rising ground, all of which could pose critical gradient clearance problems. In these circumstances, it is imperative that proper allowance be made for the effect of these obstacles on the operational length of the strip being used, as well as for the increase in take-off distance to 50 feet and the reduction in aircraft climb gradient beyond this point, all of which are vital to the safety of the operation.

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It can now be seen that the overall picture presented by these performance considerations is a vastly different one to that conveyed by the advertisement referred to, as well as by others that have appeared in the aviation press from time to time. It cannot of course be denied that under certain favourable conditions, aircraft **can** 'unstick' in the distances claimed. But there is a lot of difference between 'unsticking' and completing a take-off safely. Also, those 'certain favourable conditions' are not the conditions that prevail over most of Australia for most of the time.

The Department has no alternative but to urge pilots to pay little regard to performance claims published in advertisements and sales brochures for the aircraft they intend to fly, and to reappraise their concept of the aircraft's performance in the light of the information contained in the flight manual approved by the Department. As already mentioned, even the performance figures quoted in some owner's manuals or handbooks should be viewed with caution. The Department has on occasions queried some of these claims with the manufacturers concerned. Regrettably this has had little effect. On one particular occasion a manufacturer explained that their handbook 'uses sales figures' — whatever this might mean!

By referring to the performance charts in the flight manual, preferably as a matter of routine, but certainly whenever there is the slightest doubt as to the adequacy of the proposed landing area, accidents of the type discussed can be avoided.

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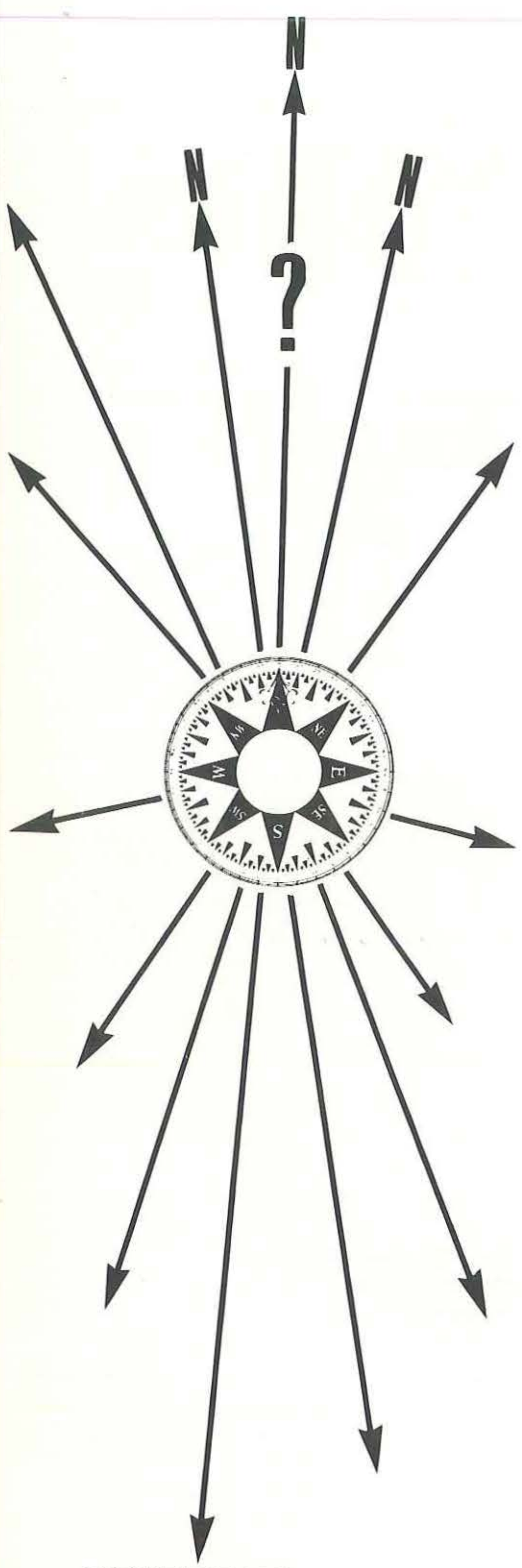
As well as ensuring that their aircraft has the performance to do what is being asked of it, pilots would also do well to see that their own handling techniques leave nothing to be desired and that they have not formed undesirable flying habits since their training days. This latter situation is something of an occupational hazard for owner-pilots who, once they complete their flying training, sometimes operate for years on end without ever undergoing any form of flight check. Pilots who think they may be in this category would only be acting in their own interests by occasionally flying with an experienced flying instructor, so that any bad habits they might have unconsciously formed can be recognised and eradicated. Pilots who submit themselves to checks of this sort are in no sense admitting any lack of ability. Rather, they are only conforming to the established practices of the better commercial operators, all of whom have their own training and checking organisations.

Another difficulty experienced by some pilots involved in accidents on inadequate landing areas is one which sooner or later confronts nearly all general aviation pilots who operate in the bush. There is a tendency which shows itself again and again, for people who do not fly themselves, but who have some association with bush flying, to sadly underestimate what constitutes a 'safe' landing area. In many cases, the word of such people, though no doubt given in good faith, leads pilots into trouble. For this reason it can be quite dangerous to accept a layman's word that a strip or field is 'suitable', and pilots should be especially cautious when they are obliged to operate into any non-licensed aerodrome or landing area about which they have no reliable knowledge. The judgement of distance over extensive areas of flat ground can be notoriously difficult, even for an experienced pilot, and when there is the slightest doubt about it, the distance should be measured. This can usually be accomplished quite effectively using the readings on a car's speedometer.

It is equally important that pilots be able to form a realistic assessment of wind strength and direction before committing themselves to a landing or a take-off. Misjudgement of wind velocity has been a factor in many accidents. There are a number of ways of assessing wind from the air — smoke, windmills, ripples on the surface of dams, etc., but none of them are anything like as reliable as a windsock — the standard form of wind indicator for almost 70 years of aviation! It may not be generally known that windsocks are available from the Department and may be purchased at a number of Government aerodromes.

It has been said before but it bears repeating that, before commiting themselves to a landing on an unfamiliar strip, pilots should take all reasonable steps to satisfy themselves that its surface is serviceable. Obviously, if nothing is to be taken for granted, the surface needs to be inspected by someone who knows what he is doing. Here again, experience shows that opinions from people with little or no knowledge of aircraft operations are of little value. The importance of ground inspections will be apparent to all who have read 'Have Respect for your Aircraft' in Digest No. 96.

Finally, in all operations from authorised landing areas, there is the matter of obtaining the occupier's permission. Some pilots may feel this is merely an irksome legality, but they need to remember that a telephone call to obtain approval will usually assure the pilot of up-to-date information on the strip's condition. Accidents have occurred at otherwise suitable landing areas, simply because the strip was being resurfaced at the time and the pilot did not know it. There is also the point that it is a doubtful advantage to complete a highly successful landing in a farmer's paddock, only to have to contend with the ferocity of a bull, or perhaps to face a prosecution for scaring the owner's prize rams!



COMPASS INTERFERENCE

'Headphones cause control zone penetration!'
Impossible, you say?
Not so. The reason for the penetration was that the pilot had placed a pair of headphones on the coaming above the instrument panel, inducing an error of about 30 degrees in the magnetic compass!

Because of poor visibility, the pilot requested navigational assistance out of the control zone, then endeavoured to locate the reason for the heading error. The problem was solved when he removed the headphones from the instrument panel coaming and the compass swung back to its correct heading. The remainder of his flight was uneventful.

Tests subsequently showed that errors of up to 50 degrees could be induced in the aircraft's magnetic compass by placing the headphones in various positions on the coaming.

This incident is but one of many that have occurred when an aircraft's compass has been affected by some unsuspected magnetic article. Here are two more examples:

- Flying in Papua New Guinea in poor visibility, the pilot of a Piaggio began to have some doubts about his position. After checking track against time intervals and headings flown, he suspected the compass was reading inaccurately. He moved a small electric fan which had recently been installed in the cockpit and found it immediately deflected the compass about 10 degrees. With further movement of the fan, the pilot found it was possible to deflect the compass reading as much as 40 degrees. Because it was impossible to obtain an accurate fix in the existing weather, the pilot climbed the aircraft and set course for his destination by ADF. He landed there 30 minutes later without further incident.

It was found that the fan installation, contrary to requirements, had been carried out without design approval. A compass swing had been carried out after the fan was installed, but this did not show any additional deviation. A check made after the incident however, confirmed that the compass reading was affected when the fan was rotated about its mounting spindle.

- While carrying a spraying machine fitted with a two-stroke motor in the cabin of a Cessna 172, a pilot making a 50 km local flight in the Northern Territory, found he was 11 km off course after flying only the first 30 km. Suspecting the accuracy of the compass, the pilot advised Darwin accordingly and continued to his destination by following a well-defined road which linked the two properties between which he was flying.

After landing, the pilot unloaded the spraying machine, which had been stowed behind the pilot's seat, and found that the compass indication immediately moved ten degrees. Further checks established beyond doubt that the presence of the machine in the cabin had been affecting the compass. To ensure that it was still serviceable however, the pilot left the spraying machine behind and returned the aircraft to Darwin, navigating via a river to the coast and then following the coast to Darwin. Here a compass swing confirmed the readings were in accordance with the aircraft's compass deviation card.

Most small two-stroke motors have magneto ignition, and the principal source of interference in this instance was probably the permanent magnet in the motor's magneto. Quite a number of small machine tools driven by two-stroke motors can easily be accommodated in the cabin of a light aircraft, so there is obviously a continuing potential for incidents of this sórt, especially where light aeroplanes are used for day-to-day work in the inland.

These incidents, which in different circumstances could have had far more serious consequences, are but further variations on the perennial problem of interference to direct-reading compasses caused by magnetic or ferrous metal objects carried in the cockpit. Automatic cameras, exposure meters, electric razors, many of which incorporate permanent magnets in their mechanism, and of course torches and cigarette holders fitted with magnetic 'grips', are some of the items which have caused trouble in the past when they were deposited on that most convenient of places in light aeroplanes — the shelf above the instrument panel. Unfortunately, this shelf is also the area from which the aircraft's compass is most vulnerable to interference.

This most natural of repositories for personal equipment offers a particularly insidious lure for those who carry transistor radios with them in an aircraft. Most types of transistor radios are highly magnetic, whether switched on or off and, if placed in this seemingly ideal position for reception, are almost certain to affect the compass readings to some extent.

Compass interference of this sort was responsible for a very serious incident involving a light aircraft in Africa a few years ago. A pilot, with three passengers on board, was flying a Cessna 182 from Maun, Bechuanaland, to Shakawe, nearly 300 km to the north-west. This part of the African continent is not unlike much of the Australian outback in character. It is rather featureless and dry with high temperatures during the day and its latitude is about that of the Tennant Creek-Daly Waters area in the Northern Territory.

Unnoticed by the pilot of the 182, the passenger sitting in the front seat placed his cigarette case on the shelf above the instrument panel. The cigarette case incorporated a powerful magnetic 'grip' and the effect of this magnet on the aircraft's compass resulted in the pilot flying a south-westerly heading instead of tracking to the north-west. When the pilot finally saw that he was lost, without realising the cause, he turned on to a reciprocal heading on the compass, and attempted to retrace his flight path. Later however, when the aircraft's fuel position became critical, he saw that it was hopeless and he made an emergency landing. The landing was accomplished without injury to himself or his passengers but they were then exposed to extreme heat in near-desert conditions for four days before they were found. The party had little water with them and were in a serious condition by the time they were rescued.

While on the subject of magnetic articles in aircraft cockpits, it is as well to remind readers of an Airworthiness Directive (DCA/General/42, Air Navigation Order Part 105) regulating the location of microphone stowages in aircraft, relative to direct-reading magnetic compasses. This Directive was prompted by the fact that in many aircraft, dynamic microphones have replaced the carbon type microphones which were previously in almost universal use. These dynamic microphones incorporate a permanent magnet which can seriously affect the aircraft compass if placed too near it. The Directive requires all microphone stowages to be at least 38 cm or 15 inches from any direct reading magnetic compass.

It must be remembered too that it is not only magnetic articles that can affect the compass. Any ferrous metal object, such as metal clips on navigation boards, or the ring binders of AIPs can induce errors if placed close enough to the compass.

So when flying cross-country, be particularly careful where you and your passengers put their belongings — it may be good practice to declare the shelf above the instrument panel 'out of bounds to all articles'.

IS YOUR WINDSCREEN CLEAN?

Is a question like this just a case of being over-fussy? Let the reader judge for himself:

- It was soon after first light at a country aerodrome. The pilot of an agricultural aeroplane had finished his daily inspection and was ready to ferry the aircraft to an airstrip for top-dressing operations. He started the engine and let it warm and, after completing a satisfactory run-up, he released the brakes to taxi. The aircraft was facing into the east and the early morning sun made visibility from the pilot's seat difficult. The aircraft had rolled only a few yards when the spinning propeller struck an empty 200 litre drum which had been used for refuelling the night before. The pilot straight away switched off the engine and braked the aircraft to a stop, but both propeller blades were already damaged beyond repair.

When the aircraft was inspected after the accident, the windscreen was found to be extremely dirty. This would have aggravated the blinding effects of the sun, making it almost impossible to see anything from the cockpit while taxi-ing into the east. It was also found that, even if the propeller had missed the 200 litre drum, it would have struck the pumping equipment that had been left in front of the aircraft. The pilot said later that he had noticed the drum and refuelling equipment when he arrived at the aerodrome but, not seeing them after he boarded the aircraft, he thought they were further away and not a hazard.

- At another aerodrome the pilot of a Cessna 180 and his loader-driver arrived early to fly to an agricultural airstrip. The morning was cold with frost on the ground and the aircraft's windscreen was completely misted over. Before starting, the pilot rubbed the mist off a small area of the windscreen directly in front of his seat. The two men boarded the aircraft and, after warming up, the pilot taxied out and began to take off.

As the aircraft gathered speed, the pilot's forward visibility through the small 'hole' on the misted windscreen deteriorated until he could no longer see the strip in front of the aircraft. The pilot realised he was losing directional control and at 40 knots he abandoned the take-off, but the aircraft continued to swing to port and finally ground-looped. The starboard undercarriage leg collapsed and was torn away, and both the starboard wing and the starboard tailplane struck the ground heavily, each being bent badly in mid-span.

Happily, neither the pilot nor his passenger was injured but the accident could obviously have been avoided if the pilot had taken the trouble to clean his windscreen properly before beginning the flight.

- A commercial pilot had been rostered for an urgent charter flight soon after first light.

The aircraft to be used, a Piper Cherokee, had been parked in the open overnight and, when the pilot went to carry out a daily inspection, he found that the aircraft's wings and windscreen were covered with a layer of ice. The pilot tried unsuccessfully to scrape some of the ice off the windscreen, and then decided to taxi the aircraft to the apron to wash off all the ice with warm water. He climbed in, started the engine and let it warm, then began to taxi along the taxi-way, watching the edges of the taxi-way through the storm window on the port side and the open door on the starboard side.

While manoeuvring in this way, without forward vision, the aircraft collided with the tail of another Cherokee parked near the apron. The pilot's aircraft sustained no damage, apart from minor scouring of its propeller blades, but the port tail plane of the other aircraft was literally slashed to pieces by the rotating propeller.

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Some pilots are fastidious in their attitude to windscreen cleanliness and rub them over carefully before beginning each flight. Others are obviously not so fussy and seem to accept that a bit of grime or mist on the windscreen doesn't matter much. If you're in this latter category, watch out that you're not caught out in the same way as these pilots!