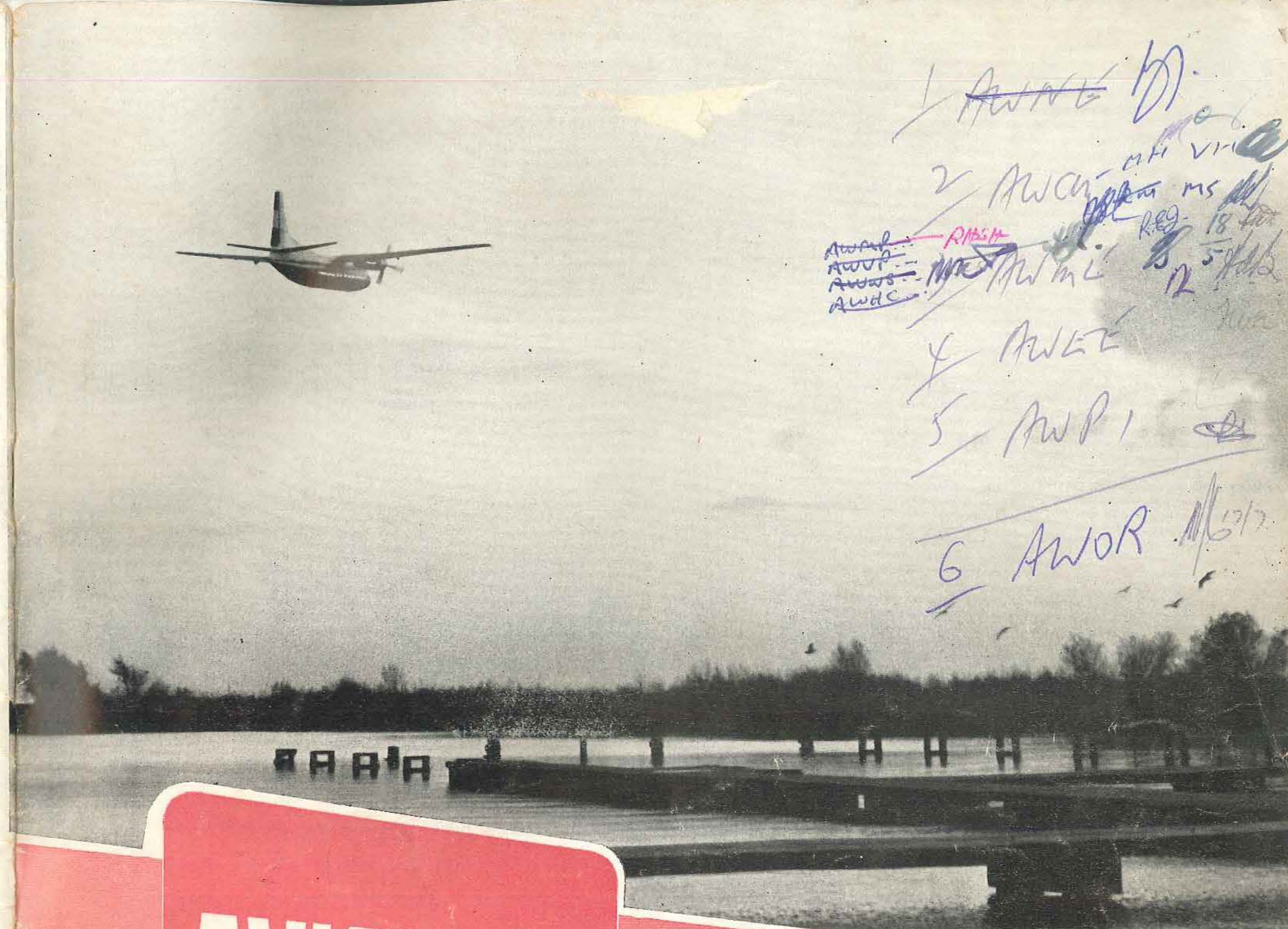
PRINTED BY HEDGES & BELL LTD.



AVIATION SAFETY DIGEST

No 25, MARCH, 1961

DEPARTMENT OF CIVIL AVIATION

AVIATION SAFETY DIGEST

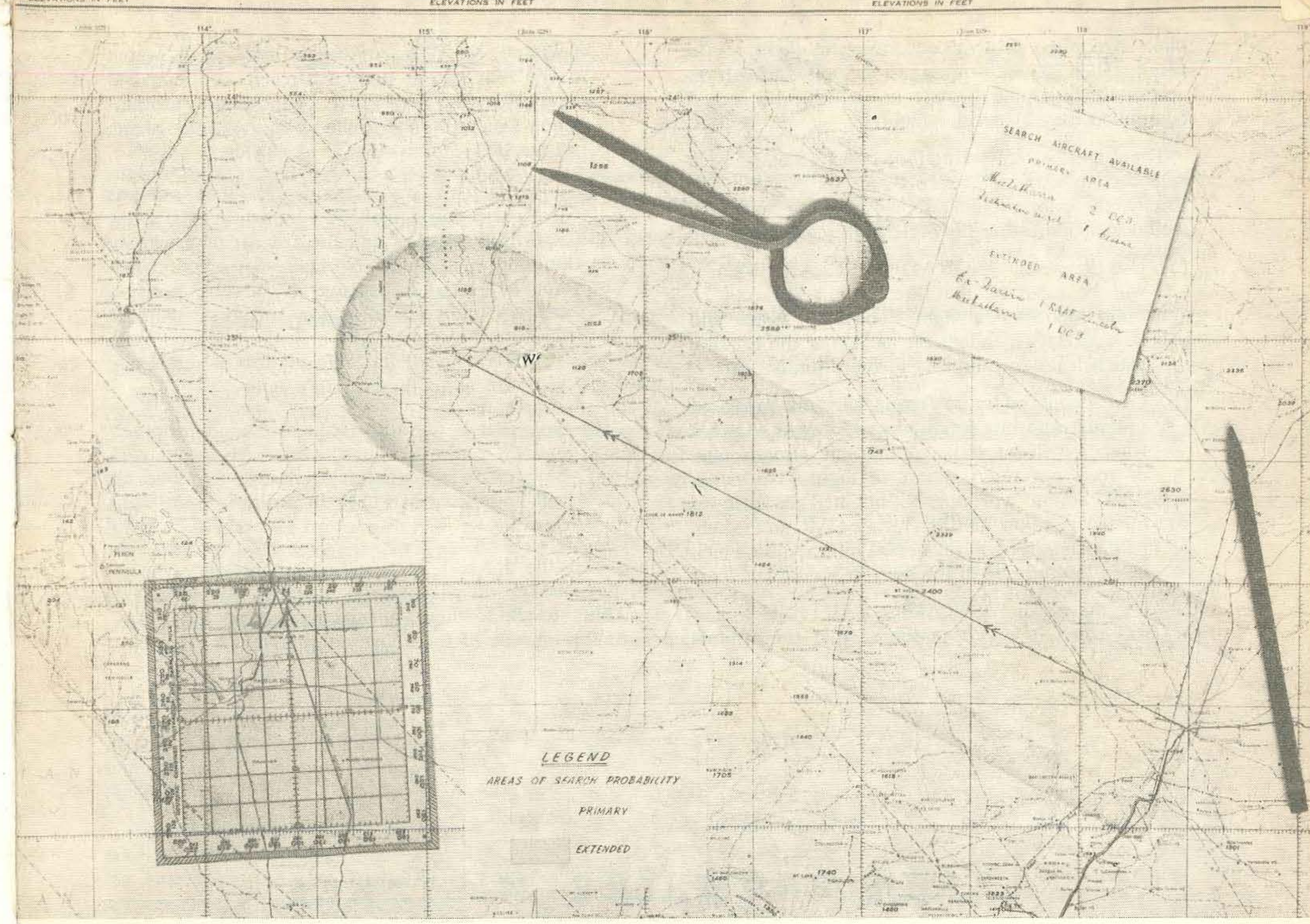
No. 25 MARCH, 1961

Prepared in the Division of Air Safety Investigation
Department of Civil Aviation

Contents

A DCA Fokker Friendship over Holland prior to delivery.

Commonwealth of Australia



MISSING —
BUT NOT LOST

Our Search and Rescue service works on the principle of "when in doubt — check". In Search and Rescue, to check, means to declare at least the UNCERTAINTY PHASE and to make every possible move to determine whether or not all is well with the aircraft and its occupants. This usually involves special efforts by a multitude of willing helpers. Not only do we use our own aeronautical communications links and the public telephone system but in addition we make checks through such as the aeromedical, bush-fire, police, army, air force, and railway communications networks. No communications channel is left untapped.

Despite the fact that for one reason or another most SAR actions are borne of false alarms there has never been the slightest hesitation on the part of anyone to do their best until such time as all doubts have been cleared. On the other hand, of course, this places on the aviation industry as a whole a burden which highlights the need to limit these false alarms wherever reasonable measures make it possible to do so.

During the past twelve months there were well over 1,000 false alarms involving SAR. In many cases it was found that they were caused through misunderstandings as to the precise information the pilot is required to give concerning his flight. As a result, the ground organisation was unable to accurately determine the extent to which SAR should be applied for a particular flight.

The Light Aircraft Handbook has recently been amended to clarify the procedure to be followed. Briefly, the pilot should adopt one of the following methods of indicating his SAR requirements:—

(a) Use the words "NORADIO, NOSAR" when it will be assumed that the aircraft will not be radio reporting in flight. The SAR watch will be entirely dependent on incidental information which leads to doubt as to the aircraft's safety.

(b) Give details of radio frequencies and proposed in-flight reporting followed by the word NOSAR when it will be assumed that the aircraft may or may not radio report in flight. Normally, SAR action will not be initiated because of missed position reports; rather SAR action will be dependent upon incidental information which leads to doubt as to the aircraft's safety.

(c) Use the words "NORADIO, SARTIME so and so" when it will be assumed that the aircraft will not be radio reporting in flight. SAR watch will be dependent upon non-receipt of the arrival report by the SARTIME or incidental information which leads to doubt as to the safety of the aircraft.

(d) Give details of radio frequencies and proposed in-flight reporting followed by SARTIME when it will be assumed that the aircraft may or may not report in flight. Normally SAR action will not be initiated because of missing position reports; rather SAR action will be dependent upon non-receipt of the arrival report at SARTIME or incidental information which leads to doubt as to the aircraft's safety.

(e) Give details of radio frequencies and proposed in-flight reporting when a full SAR watch will be provided; among other things SAR action will be taken when in-flight position reports are overdue.

In the interest of avoiding unnecessary inconvenience to all who help us everyone should do his best to limit these misunderstandings by clearly adopting one of the above alternatives.

LEARN FROM THE MISTAKES

. . . of others, you won't live long enough to make all of them yourself.

About 10 minutes after take-off on a cross-country flight, the pilot radioed the tower and requested clearance to enter the traffic pattern and land. He stated he was returning because of bad weather along his intended route. The flight was cleared to land and, shortly thereafter, the aircraft was observed to pass the approach end of the runway with gear and flaps down. About this time the pilot reported his aircraft was picking up ice and he requested a 180-degree turn-back for a landing. Shortly after the pilot was issued a clearance for a missed approach, the aircraft was seen to enter a left turn in a nose-high attitude. It then stalled and fell off into a steep nose-down diving turn into the ground. The pilot and two passengers were fatally injured.

Investigation disclosed weather at the time of the accident was: Ceiling 3,000 feet; Visibility 4 miles; Temperature 33°F., with light rain and fog. It also disclosed that the terminal forecast for the area included freezing precipitation for the afternoon period and that all pilots who had been briefed were alerted to the possibility of icing. The aircraft was not equipped with de-icers.

Probable Cause:

(a) Judgment of the pilot in taking off into reported icing conditions.

(b) Failure to maintain sufficient flying speed with ice accumulation on the aircraft.

(Extract from Flight Safety Foundation Bulletin)

Ice on Wings — Take-off Doomed

With the approach of winter the circumstances which led to this accident should provide a timely reminder of one of the particular hazards which will soon be encountered again. The aircraft involved was engaged on a lime spreading operation and was being flown by a pilot who had over 4,000 flying hours which included extensive experience in agricultural operations and on the particular aircraft type.

On the night before the accident the aircraft had been parked in the open and exposed to light rain followed by a severe frost which had combined to leave a coating of ice on all the upper surfaces of the aircraft. During the pre-flight inspection, which was carried out in the half-light shortly after dawn, the pilot noticed what appeared to be a thin layer of rime ice on the wings. Without ascertaining the extent of the deposit, he decided that it was unnecessary to remove it before flight.

According to the pilot, in the take-off which followed soon after his inspection, the aircraft accelerated normally, but upon reaching the unstick speed, felt very heavy and was reluctant to leave the ground. He attempted to dump the lime when it was apparent that the aircraft would probably not become airborne before reaching the end of the strip but it was slow to discharge and, although the aircraft rose a few feet, it failed to maintain height. The tailwheel then struck the boundary fence causing the main wheels to settle back on to the ground and, after running through another fence, the aircraft came to rest at a point 920 feet beyond the end of the strip.

Immediately after the accident the pilot again examined the mainplanes and found that beneath the rime ice there was a layer of clear ice a quarter of an inch thick. This increased to half an inch in thickness where water had dripped down from the four wing-to-fuselage struts.

Disregarding the effects of the ice, the aircraft should have required a distance of only 1,050 feet to attain a height of fifty feet whereas there was 1,195 feet of strip available. The weight of the ice was estimated to be 250 pounds and, even taking into account this increase in all-up-weight, the aircraft should have been at a height of fifty feet upon passing over the end of the strip.

The exact amount by which the ice reduced the lift due to disruption of the airflow cannot be accurately determined but the performance of the aircraft indicates that this effect, together with the weight of the ice, had at least doubled the distance required for the take-off. Even at a much lower weight it is doubtful if flight without the assistance of ground effect would have been possible.

The weight of ice was not significant in this accident and it is important to appreciate that even a thin film of ice or frost is sufficient to cause a very serious deterioration in lift because of the change in the aerodynamic shape of the wing.

Prior to this accident this pilot did not appreciate these facts. Here is your chance to have the benefit of his hazardous and embarrassing experience. **REMEMBER! A take-off should never be attempted when the wing is coated with ice or frost.**

CONSIDER THE RISK

The question of just what discrepancies on an aircraft should be considered "safety of flight" gripes and cause to "down" the aircraft has long been a matter of discussion. No doubt this discussion will continue because individual opinions are bound to vary. However each pilot should carefully consider both the known and possible requirements of his flight prior to accepting an aircraft with known discrepancies.

Investigation of a recent fatal accident indicated that the pilot attempted a cross-country flight with his Tacan equipment, compass, and fuel transfer system inoperative. Obviously, this placed great additional demands upon the pilot even before take-off.

Many modern aircraft are designed with multiple systems, one to back up the other in case of trouble; therefore the question of exactly which systems are considered primary flight systems is largely dependent upon the type aircraft and mission to be flown. Again however, careful consideration of the possible demands of the planned flight will often offer logical guidelines. A sound understanding of the aircraft's systems is as necessary to thorough flight planning as an adequate weather briefing.

Altogether too often personal pride plays a large role in deciding just what discrepancies a pilot will accept. With the advent of our more complex modern aircraft, the often quoted phrase, "I can handle it", is out of date. The professional pilot of today, with his aircraft's limitations and capabilities, and a sound flight plan before him, has revised it to read, "Can I handle it".

(Extract from "Approach", 1960)

Cautions and Considerations

re

WINTER OPERATIONS

(Extract from Flight Safety Foundation Bulletin)

Flight Control Hazards and Protection from Icing

Accident and critical incident reports reveal that many private and professional pilots may not be aware of the many ways in which icing can seriously affect the pilot's ability to maintain flight control during instrument flight. It is also known that many operators are unaware of the kind and amount of protection needed to cope with light, moderate, or heavy icing conditions.

External icing (impact, rime, clear, etc.) is most probable when flying in air with visible moisture (cloud, drizzle, rain, or wet snow) and at temperatures from 32°F. to 20°F. Even in air temperatures as low as —30°F., there are many known cases of encountering heavy icing when flying in such supercooled moisture conditions. Depending upon the degree and form of moisture present, and upon the air temperature, ice accretions on an airplane's wing and other external surfaces may form slowly or with alarming and dangerous rapidity.

Internal carburettor system icing is most likely to occur in temperatures between 40°F. and 60°F. but can occur in air temperatures as high as 90°F. It is not necessary to have visible moisture present for this type of icing. The particular temperature range and the degree to which a carburettor is subject to icing is dependent upon its particular design and installation. For this reason, the pilot should refer to the airplane manufacturer's manual on the operation of the engine for detailed information on how to cope with carburettor icing. However, there is one aspect of carburettor icing that has been revealed in more recent accident and incident reports that will be covered below, namely, high altitude carburettor icing.

General aircraft operators must rely upon the U.S. Weather Bureau's forecasts and reports to predict icing conditions ahead. The definitions of these conditions as used by that Bureau are as follows:

LIGHT ICING.—An accumulation of ice which can be disposed of by operating de-icing equipment, and which presents no serious hazard. Light icing will not cause alteration in speed, altitude, or track.

MODERATE ICING.—An accumulation of ice in which de-icing procedures provide marginal protection; the ice continues to accumulate, but not at a rate sufficiently serious to affect the safety of the flight unless it continues over an extended period of time.

HEAVY ICING.—An accumulation of ice which continues to build up despite de-icing procedures. It is sufficiently serious to cause marked alteration in speed, altitude, or track, and would seriously affect the safety of the flight.

Flight Hazards from Icing

The basic and critical icing hazards in flight are as follows:

1. Icing of outside pitot/static pressure sources and venturi units.

(a) Erroneous airspeed, altimeter and rate of climb indications. Whenever the pitot or static air pressure sources or lines freeze fully or partially, the airspeed, altimeter, and rate of climb instrument indications will no longer be correct. This grave situation can cause the pilot to exceed the airplane's limitations unknowingly, to break up the airplane in flight, or to fly unknowingly into the ground.

(b) Erroneous direction and attitude indications. Those airplanes that utilize an outside venturi unit to provide power for vacuum driven gyros, and which are not located within the engine's exhaust gases, are very susceptible to ice accretions on the venturi tube. This in turn reduces the vacuum and the gyro will no longer give accurate attitude or direction indications.

(The pilot must have at least one properly functioning gyro instrument to maintain flight control on instruments.)

2. Accumulation of dangerous ice loads on the wing and tail surfaces.

This situation changes the airflow and reduces the available lift while increasing the load the wing has to carry. It can also jam flight control surfaces if the build-up occurs near hinge points or between fixed and movable flight surfaces. In extreme cases, the combined effects of ice load and loss of lift will force a plane down. Further, the wing will stall out at considerably higher than normal stall speeds.

3. Accumulation of ice on propeller surfaces.

This situation creates a serious vibration problem and a loss of propeller effectiveness. The first indication to the pilot of propeller icing will be cycles of increasing vibration, followed by a sudden vibration increase as the ice from one propeller blade breaks free, followed by a period of vibration-free operation after all ice is thrown free from both propeller blades. The situation also causes a decrease in airspeed at a constant altitude and throttle setting. On multi-engine airplanes, the pilot may hear chunks of ice impinge on the side of the fuselage as they break free of the vibrating propeller blades.

4. Carburettor icing and air intake clogging.

Either condition results in loss of power. Carburettor icing is more difficult to control at high altitudes. This is because the available heat to cope with any icing is considerably less at altitude than at sea level for airplanes with non-supercharged engines. A sea level engine can only develop approximately 75% power with full throttle at 8,000 feet. Available carburettor heat may be reduced to an even lower percentage of that which would be available near sea level.

Carburettor air intake icing is usually the result of snow or sleet impinging on the intake screen. Such an ice build-up starves the engine for air. Carburettor air must then come from some alternate protected source to maintain power.

5. Windshield icing.

The loss of windshield visibility from icing is most hazardous to the pilot when attempting an approach and landing. An openable window to see forward or a means for de-icing the windshield is needed to provide the necessary forward vision at such times.

6. Radio and pitot mast icing.

Ice build-up on these masts can create air disturbances and bending loads for which they may not have been designed. If so, the mast may bend or break off. The pilot will then be without radio or have erroneous airspeed/altimeter/rate-of-climb indications. It is also possible for the "run-back" from a heated pitot tube to freeze and cause an ice build-up on the mast that can adversely affect the air flow functioning of the pitot and static pressure system.

There are also two other possible icing hazards, namely; impact or runback freezing of (a) the controls for the carburettor air preheater and the throttle, and (b) a fuel tank vent becoming clogged with ice which would in turn cause fuel starvation. Fortunately, these two hazards do not seem to materialize very often. Frequent checking of the throttle and heater controls for freedom of movement is a method of knowing that they remain operative. If fuel starvation does occur from vent icing, switching to an alternate tank may provide power for a limited time, or if a common vent line is accessible to the pilot, it may be possible to sever it to provide an emergency vent.

Equipment Protection

To be able to cope with inflight icing situations, the pilot should have operative equipment on the airplane as follows:

1. vital instruments (speed, altitude, direction, attitude).
   - (a) An airspeed pitot tube heater and an alternate static air source for the airspeed/altimeter/rate-of-climb indicator system.
   - (b) Heat from engine exhaust pipe(s) impinging on any venturi tube(s) used to supply vacuum power for air operated gyroscopic instruments or, an alternate vacuum source that is power driven. (One vacuum and one electrically driven gyroscopic instrument provide equally effective and excellent protection against malfunction of any type.)
2. Inflatable wing and tail surface boots or a heat duct de-icing system for flight surface protection.
3. Alcohol slingers or electrically heated boots for propeller surface protection.
4. A carburettor air preheater device and a sheltered alternate air intake source for the carburettor.
5. Alcohol or a heat system to de-ice the windshield, or an openable forward window that cannot freeze shut, to protect forward vision.

6. Alcohol, inflatable boots, or electrically heated boots for pitot and radio masts that may be susceptible to ice build-ups, for protection of the navigational radio aids and the airspeed/altimeter/rate-of-climb system.

Temporary preflight protection of external surfaces from possible inflight icing can also be provided by application of one of the commercial anti-ice preparations. When applied to wing surfaces, windshields, propeller blades, etc., in accordance with the manufacturer's instruction, a pilot may expect the airplane to stay free of any serious ice build-up for a reasonable period of time on the surfaces so protected. However, the protection is temporary, and the pilot should not expect protection beyond the period of time the manufacturer specifies for his product.

Operational Practices

As can be readily seen, icing protection is needed for all of the above areas that are vital for maintaining flight control in any actual icing condition while flying on instruments. The degree of protection is dependent upon the amount and rate of ice accretion with which the de-icing or anti-icing equipment can cope. At best, the de-icing equipment that is usually provided on current models of non air-carrier airplanes cannot be expected to cope with heavy or prolonged moderate icing conditions. The latter can be expected to tax the equipment beyond its capacity.

Thus, pilots of airplanes which are equipped with all of the above de-icing provisions should always strive to avoid heavy and moderate icing conditions. If heavy icing is encountered unexpectedly or unavoidably, prompt action must be taken to get into more favourable flying weather conditions. To procrastinate or delay such evasive action, accident investigation reports show, is to invite a loss of flight control and with very little, if any, warning.

Should a pilot find himself in icing conditions without full de-icing equipment, his primary concern should be to use the equipment he has and to get to non-icing air as quickly as is safe. The following basic operational practices or flying habits should be observed:

Avoiding Conditions Conducive to Icing

Monitor closely all weather reports in the vicinity, paying close attention to temperatures at the ground and any reported or forecast icing condition aloft. A 3°F. to 4°F. temperature drop per 1,000 feet above the ground may be used to approximate temperatures at flight altitude above ground stations, if unknown.

Monitor closely the outside air temperature gauge for temperatures favourable to external icing.

Follow a plan of safe evasive action which utilizes the following principles:

(a) In clouds not near a cold or warm front, a lower altitude — if altitude permits — is usually warmer and any accumulated ice will melt. A higher altitude is usually colder and the visible moisture will likely be in a frozen state which cannot cause any further ice build-up. Any accumulated ice will gradually sublimate (vaporize) when getting into dry colder air.

(b) In freezing precipitation near a warm front, a higher altitude will usually be warmer (warm air usually overruns cooler air near the ground). If at sufficient altitude, it may also be possible to descend into warmer air near the ground with non-icing conditions.

(c) In clouds or precipitation near a cold front, advantage may be taken of the difference in temperature ahead of and behind such a front and the tendency of the cold mass of air to wedge under the warmer air ahead of the front. Thus going towards a cold front in temperatures conducive to freezing, a higher altitude will likely avoid icing both ahead and behind the front.

Flight speed and attitude indications should be closely watched and double checked. Cross checking the artificial horizon or attitude gyro instrument with the airspeed indicator and the altimeter, is a means of making certain that ice is not affecting the accuracy of airspeed/altimeter/rate-of-climb indications. Maintaining a basic attitude is essential to avoidance of a stall or excessive flight speeds. Cross checking an electrically operated gryo's indications with those of a vacuum operated gyro is also a check on the accuracy of their indications.

Note: At least five cases are known involving three current makes and models of multi-engine airplanes in which the airspeed/altimeter/rate-of-climb indications became dangerously in error due to rain and moisture freezing in flight as the airplane climbed into freezing temperatures. In another known case involving another multi-engine model that had a modified pitot mast installation, an ice-build-up on the pitot/static head mast caused dangerous airspeed/altimeter/rate-of-climb indications from the disturbed airflow effects on the static pressure opening.

Emergency Icing Conditions

If an ice load is accumulated that makes climbing to a higher altitude difficult or maintenance of altitude impossible, an emergency descent is mandatory and flight control must be maintained with primary emphasis given to airplane attitude and keeping a safe flight speed above the airplane's higher stall speed with such an ice load. If a landing is necessary, such speed must be maintained to touchdown.

In an emergency while flying on instruments, the pilot should rely on:

(a) The attitude or artificial horizon gyro instrument to avoid a disastrous dive or stall;

(b) The turn indicator, directional gyro, and attitude gyro to keep the airplane from entering a disastrous spiral; and

(c) Breaking out the glass in the altimeter or rate of climb instrument to get an emergency alternate static source which will give approximate altitudes, rates of climb or descent, and airspeed indications when the normal static pressure source has frozen.

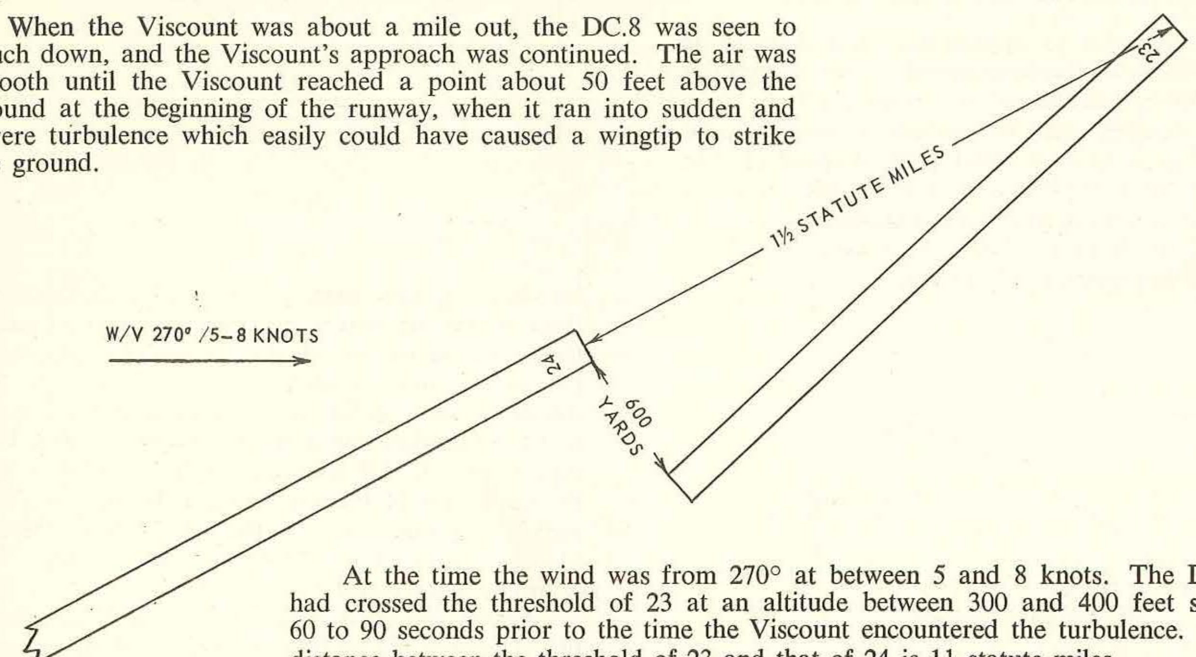
Note: This will only be true in unpressurised aircraft.

In summary, pilots should avoid all heavy and moderate icing conditions, proceed with caution into areas where light to moderate icing is forecast, and should not engage in any instrument flight in air conducive to icing without having full de-icing equipment for the items vital to the maintenance of flight control. The vital areas of concern are : (1) speed, attitude, direction instruments that are dependent on the pitot/static pressure systems and venturi gyros, (2) wing and tail surfaces, (3) propeller surfaces, (4) carburettor air fuel mixture and air intake, (5) windshield forward visibility, and (6) any radio or pitot tube masts that may be seriously affected by any ice build-ups.

Turbulence while Landing

Before turning on final for Runway 23, the captain of a Viscount was warned by A.T.C. of the presence of a DC.8 doing circuits and landings on the new Runway 24. Runway 24 lies starboard of 23, with its threshold level with and about 600 yards from the far end of 23. The angle between 24 and 23 brings the centreline approach to 24 about over the threshold of 23. See sketch below.

When the Viscount was about a mile out, the DC.8 was seen to touch down, and the Viscount's approach was continued. The air was smooth until the Viscount reached a point about 50 feet above the ground at the beginning of the runway, when it ran into sudden and severe turbulence which easily could have caused a wingtip to strike the ground.



At the time the wind was from 270° at between 5 and 8 knots. The DC.8 had crossed the threshold of 23 at an altitude between 300 and 400 feet some 60 to 90 seconds prior to the time the Viscount encountered the turbulence. The distance between the threshold of 23 and that of 24 is 1½ statute miles.

(Extract from Flight Safety Foundation Bulletin)

What Do You Know About Landing?

(Extract from Flight Safety Foundation Bulletin, November, 1960)

An analysis of accident statistics, together with intensive international research aimed at the development of more precise landing distance requirements, has emphasized the importance of knowing the significance of the various factors, such as wet surfaces and incorrect approach speeds, in relation to landing safety.

It is significant that an analysis of overrun accidents indicates that in most cases, the accident resulted from a combination of excessive speed and a slippery runway surface. In many instances the landing distance available was, even allowing for the slippery surface, theoretically more than adequate. It is probable, therefore, that a more accurate knowledge of the adverse effect of a slippery runway surface and excessive speed and the correct technique required to reduce landing roll under these conditions would have prevented these accidents.

The Mechanics of the Landing Roll

The first point to appreciate, when considering the mechanics of the landing roll, is that the greater part of the roll is covered at a relatively high speed. This is because, when the aircraft is slowing down, the time spent in each equal band of speed (100 to 90 knots, 90 to 80 knots, etc.) is roughly the same, but the distance covered is proportional to the mean speed of the band (95 knots, 85 knots, etc.). This is shown diagrammatically in Fig. 1.

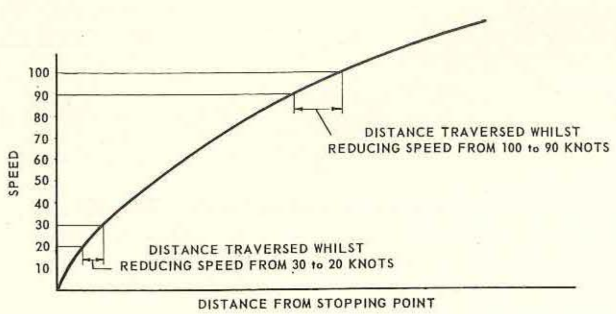


Fig. 1

The Effect of Wing Lift

During the landing roll the aircraft is retarded by aerodynamic drag and the use of brakes. The aerodynamic drag, excluding that due to the propellers, varies as the square of the airspeed. The lift from the wings is also proportional to the square of the airspeed. Thus, at the higher speeds, the weight on the wheels is considerably reduced, as shown in Fig. 2. However, for a given coefficient of friction

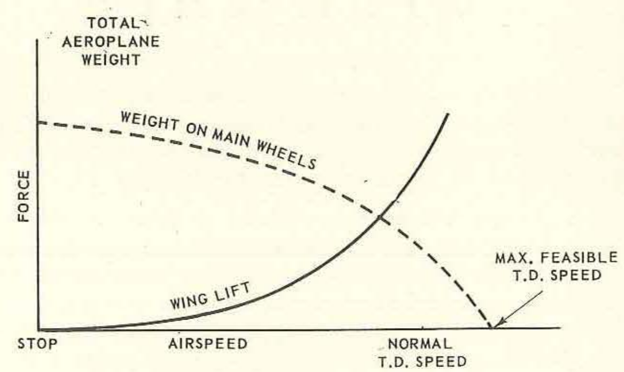


Fig. 2.

between tyre and runway, the maximum retarding force which the brakes can provide is proportional to the weight on the wheels (in modern aeroplanes the brakes are sufficiently powerful to lock the wheels at most speeds on a wet surface). It follows that the retarding force of the brakes is reduced at high speed. If, for convenience, it is assumed that the coefficient of friction between the tyre and the runway remains constant, the relative contribution of aerodynamic drag and braking drag to the total retarding force would be as shown in Fig. 3. Since, in practice, the effect of speed is normally to reduce the coefficient of friction, as explained below, the retarding force is, in most cases, still further reduced at high speeds.

The original article based on a pamphlet entitled "Landing Technique and Safety", issued by the then Ministry of Transport and Civil Aviation, appeared in "Air Clues", a monthly publication of the Royal Air Force.

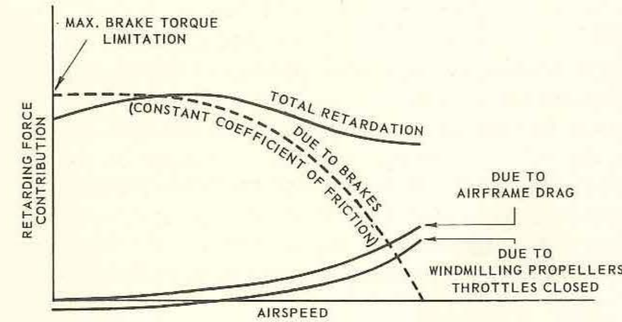


Fig. 3

The Effect of Speed on the Coefficient of Friction

In Fig. 4 the variation of the coefficient of friction with speed is shown. It will be seen that, except in the case of icy surfaces, it decreases as speed increases, the effect being particularly marked on wet surfaces. This is believed to be due to the fact that, as speed increases there is less time for the water between the tyre and the runway surface to be squeezed out and hence a larger proportion of the weight on the wheel is carried, in effect, on a film of water. This effect can be reduced by drainage channels, such as grooves in the tyre tread or a rough granular surface on the runway, but may be increased by the presence of grease, such as is

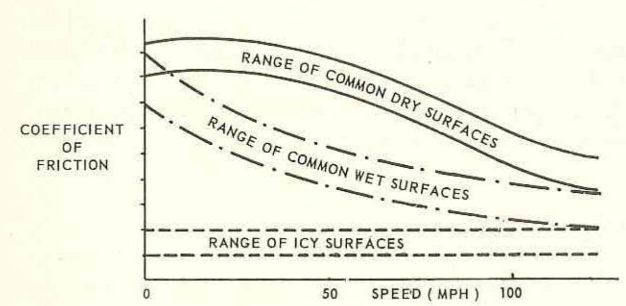


Fig. 4

exuded by certain runway material. The reasons for the apparent reduction in the coefficient of friction at high speeds on dry surfaces are more complex and less readily explained. In the case of wet ice the coefficient of friction is practically constant but, with dry ice at temperatures near freezing point, it may actually fall as speed is reduced and the ice has more time to melt under pressure of the tyre.

Summary

The typical variation of retardation with speed, taking all the above factors into account, which can be achieved on a landing is shown in Fig. 5. The airborne portion from the threshold is shown as a

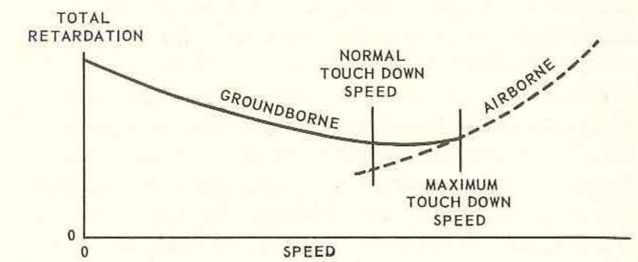


Fig. 5

broken line and the ground portion as a solid line. The retardation is the total retardation taking into account the effects already described and assumes a wet surface and normal, as distinct from emergency, technique for stopping in a short distance.

The important points to note are that:

(a) if the aeroplane is held off the runway and touched down below the normal speed, there is a loss in retardation because airborne retardation is considerably lower than that which can be achieved on the ground, and

(b) the retardation which can be achieved at high speeds is appreciably smaller than at low speeds.

It will be recalled that the larger part of the landing distance is covered at high speed. It follows from (b) above that quite a small gain in retardation at touchdown speed, such as may be obtained by reducing to a minimum the period of hold-off and braking immediately on touchdown, can result in a substantial reduction in total landing distance and can be worth more than a large improvement in retardation at low speed.

OPTIMUM TECHNIQUE

In general, the best technique for stopping an aeroplane in the shortest distance is to touch down at the earliest practicable moment after crossing the threshold with as much weight as possible on the main wheels and to apply maximum braking immediately.

(This does not, of course, imply that the threshold should be crossed with less than a safe margin of height.) Even on an extremely slippery surface such a technique, if the aeroplane characteristics permit its proper implementation, will give better results than reliance on ordinary "aerodynamic" braking down to a low touchdown speed or to a low nose-wheel lowering speed. It has been explained that most of the landing distance is covered at a fairly high speed and that, although the retardation from the wheel brakes is poor at high speeds, the increase so provided over that obtainable with air drag alone is valuable. Where the aeroplane is fitted with propellers which can be reversed or which produce high aerodynamic drag after touchdown, the importance of not delaying the touchdown is considerably increased as these devices are most effective at high speeds and should not be used before touchdown except in extreme emergency and even then only with the greatest care. As regards high aerodynamic drag before touchdown it should be noted that propeller discing drag is frequently controlled by an undercarriage switch and cannot, therefore, be used before touchdown.

Factors Limiting Early Use of Brakes

With non-automatic brakes, which are still fitted to most aeroplanes, it is easy to burst tyres if the brakes are applied at high speed on a dry or "patchy" runway. On a really slippery runway, however, the risk of bursting tyres is small and, subject to the maintenance of directional control, it is generally preferable on this type of surface to lock the wheels if there is any serious doubt about ability to stop within the runway. It should, however, be noted that there is some evidence that the improvement in braking on an icy surface from sanding of the surface is less with a locked wheel than with a rolling wheel. Although the coefficient of friction is at its highest when the wheels are nearly but not quite locked, it is impossible to maintain this condition with an ordinary braking system and any attempt to do so may result in reduced braking efficiency. (On some other types of aircraft the brakes may tend to fade towards the end of a long run if used hard from touchdown. For such aircraft it is difficult to give guidance on the best technique and this must be established by experiment or from experience.) Consideration of such factors as avoiding wear on the brakes and tyres will, of course, influence technique in day to day operations. It is stressed that departures from the best technique for stopping in a short distance are only admissable if the distance available under the prevailing conditions is clearly not critical.

Methods of Increasing the Weight on the Wheels (Aeroplanes with Nose Wheels)

In the case of aeroplanes with soft nose wheel suspensions it is advantageous to push the control column forward as soon as the nose wheel is on the ground. This increases the weight on the wheels and also increases the directional control of the nose wheel which can be useful when landing on a slippery runway in a crosswind since it reduces the need for differential braking, use of which decreases the total retardation available. Care should, however, be taken when using such a technique to avoid the situation arising in which the reduction in wing lift is offset by excessive transference of weight to the nose wheel and tailplane.

The use of reverse pitch, by disturbing the flow over the wing, provides a most effective way of getting weight on to the main wheels, even if only idling power is used. In that case the elevators should be used in accordance with any instructions for minimizing control snatch. There is, in any case, little to be gained from using the elevators to put the weight on to the main wheels once the propellers have gone into reverse.

Use of Wing Flaps

Unless overriding circumstances, such as unusual weather conditions or such special features of the aircraft as interconnection of the throttles and flaps, make it unwise or impossible, full flap should be applied well before crossing the threshold both in the interests of permitting a lower safe approach speed and reducing the float if the energy at the threshold should prove to be too high. In this connection it should be noted that flap handling practice in the air ought to remain consistent, as experience has shown that larger variations of approach speed occur where the flap handling is varied with the prevailing conditions. The optimum point for the application of full flap naturally varies with the type of aircraft because of differences in the sensitivity to the use of full flap.

Relaxation in Non-critical Conditions

It is noteworthy that most landing accidents have occurred in conditions which were not theoretically critical, even though in some cases adverse factors, such as gustiness, wet runways (the most common) or poor visibility, were present. There is evidence to suggest that lack of adherence to the best technique in non-critical conditions was an important factor in a significant proportion of these accidents. This may arise because pilots do not appreciate the magnitude of the adverse effect of such factors as wet runways. In this connection it is interesting to note that in recent years none of the accidents due to overrunning on landing in United States' air carrier operations appear to have occurred on dry runways. It should be borne in mind that a runway which may be appreciably longer than the required minimum may prove inadequate if the correct technique is not employed. As a good general rule, unless the runway is patently much longer than will be required, the aeroplane should always be handled, at least down to the point of touchdown, as if the aerodrome were critical. However, this does not imply that a reduction in target threshold speed or height below the normal safe and comfortable minima is acceptable. Fig. 6 illustrates this point and also shows the penalty incurred by the use of "aerodynamic" braking, i.e., holding the nose wheel high instead of lowering it and applying the brakes.

The techniques recommended in this paragraph are believed, in the light of existing knowledge, to be the most suitable for general application. The special characteristics of a few types of aeroplane may call for different techniques, however, particularly in unusual operating conditions.

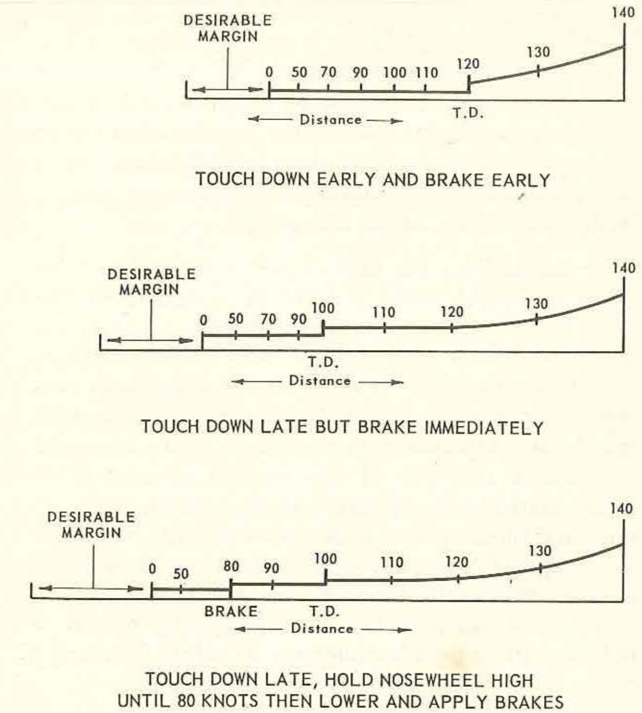


Fig. 6

Total landing distance of a typical aeroplane from an approach speed of 140 knots, showing the effect of different techniques.

Note:

1. Figures represent speed in knots.
2. The "desirable margin" is the extra distance required with the particular technique to ensure that the theoretical risk of over-running is not greater than 1 in 100,000, taking into account such factors as variations in the runway coefficient of friction and errors in the approach speed.

THRESHOLD SPEED AND HEIGHT

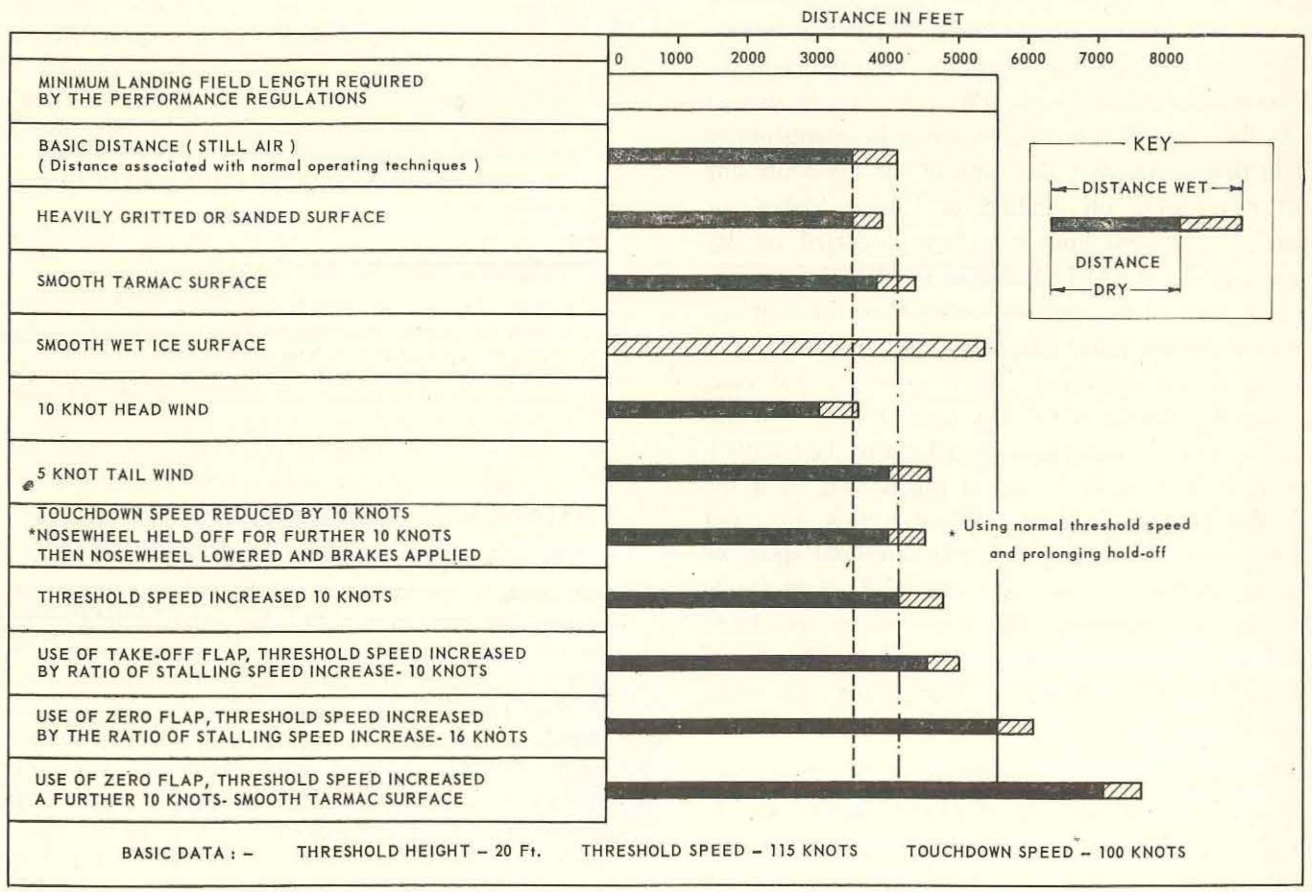
The statistics collected for both United Kingdom and foreign operators suggest that the average (i.e., strictly the most commonly occurring) height of the wheels and speed over the threshold are of the order of 20 feet and 23 knots above the power-off stalling speed in the final approach configuration. Wind, turbulence, handling characteristics of the aircraft, and so on, may cause noticable variations from the above values. It is believed that the techniques used by pilots and represented by the above threshold crossing heights and speeds have been largely chosen intuitively. Until further research is made and more becomes known on the relationship between safety and final approach technique, it is not possible to say whether the technique now being employed by pilots is, in fact, the safest for the currently available landing distances. However, there is evidence that the use of techniques which result in threshold heights and speeds appreciably below 20 feet and Vs1 plus 23 knots is likely to result in undershoot or heavy landing accidents, particularly in the case of the larger aeroplanes.

In emphasizing the importance of using a suitable target threshold speed, it must be remembered that there may be need to vary the target approach and threshold speeds with weight. The landing distance regulations in force for most British aeroplanes presuppose that the target approach and threshold speeds are adjusted with weight so as to represent a constant multiple of the stalling speed. From recent statistics it appears that, in general, pilots do not vary these speeds with actual weight, but select those appropriate to the aircraft's average landing weight. Where the landing weight is restricted to a value substantially below the average by reason of field length, it is advantageous to adjust the target speed accordingly. There is, however, evidence that in some cases, possibly due to the use of constant approach power settings regardless of weight, the threshold speed is increased as weight is reduced. This can result in the aeroplane taking a longer distance to land at low weights than at high weights.

Effect of Various Techniques and Conditions on Landing Distance

This table shows the effects of various techniques and conditions on the landing distance of a modern transport aircraft equipped with a nose wheel landing gear, four piston-driven non-reversing propellers, and non-automatic brakes of average power. The minimum landing field length shown at the head of the table is a civil criterion.

While the existing mandatory minimum landing distance requirements aim to make some provision for different surface conditions, this can only be achieved within certain limits. It follows that the pilot or operator must take special measures to ensure safety where extreme conditions are known to exist. For example, if a flight is planned to an aerodrome where wet ice conditions are liable to exist, an additional margin of distance above the mandatory minimum will usually be required if adequate safety is to be ensured. Similarly, when the runway surface is wet and only the mandatory minimum landing distance is available, it will be necessary for the pilot to abandon an attempt to land if his height and airspeed at the threshold are appreciably in excess of those intended. It is again emphasized that each knot of excess airspeed has, in the case of a typical large piston-engined aeroplane, about the same effect on landing distance as 10 feet of excess height. They both add about 1.8 percent to the total landing distance.



This table shows the effects of various techniques and conditions on the landing distance of a modern transport aircraft equipped with a nose wheel landing gear, four piston-driven non-reversing propellers, and non-automatic brakes of average power. The minimum landing field length shown at the head of the table is a civil criterion.

Wing Commander Spry sums up

The most striking conclusion of this report is the fact that any landing which does not begin with the correct height and speed at the threshold is likely to become an accident. It states that most overruns are caused by excessive speeds on wet or slippery runways, whereas approaches which are just a little too low or slow are likely to lead to undershoots or heavy landings, it further points out that an important factor in many landing accidents is departure from the best technique when conditions are not critical. The inference which is drawn is obvious: the safe practice is to handle the aircraft to the point of touchdown in all cases as though the landing conditions were critical. That means accurately.

The landing run will be extended by holding the aircraft off the ground, or by maintaining a nose-high attitude during the landing roll, because the aerodynamic drag provides a smaller retarding force than that of the brakes when the weight of the aircraft is on the main wheels. Therefore, to stop in the shortest possible distance, the aircraft should be flown smoothly on to the runway at the earliest practicable moment, and the maximum braking force applied at once, with as much of the aircraft's weight as possible on the main wheels. But don't run away with the idea that you are supposed to slam the brakes on like that every time; it only applies to times of emergency when the risk of tyre bursts is acceptable.

The pamphlet mentions the danger of relying on a power setting rather than an accurate airspeed on the final approach, because this practice can lead to excessive landing speeds at low all up weight. It was stressed in the early paragraphs that the greatest part of the landing run takes place at high speed, when the braking efficiency is reduced both by the effect of wing lift and by the lower coefficient of friction (especially on water), and it follows that an excessive landing speed only aggravates this difficulty. In heavy aircraft, remember, every extra knot or 10 feet in height at the threshold means an increase of about 1.8 percent of the landing run, which means that an excess of ten knots will add about 270 yards to a 1,500 yard run on a dry runway.

Finally, it certainly seems that we have reached the stage when we must carefully consider runway conditions and facilities as well as the weather at the destination when planning flights. If the runway length is marginal when conditions are good, we must be prepared to think again when any adverse conditions are known to exist.

FULL — OR IS IT?

In attempting to locate the cause of an indicated loss of hydraulic oil soon after take-off the engineers concerned were unable to locate any signs of leakage. As the addition of only one quart of oil appeared to completely refill the system it was concluded that the direct reading quantity indicator was unserviceable. On the subsequent flight the system quantity reading fell to zero during gear retraction. Again it was necessary to resort to emergency procedures.

Further inspection located a leak from a cracked coupling nut in the undercarriage line. It also disclosed that the strainer in the reservoir filler neck had become clogged with foreign fibres and this restriction prevented the oil from passing through the filter at the normal rate and thus caused the engineer to assume that the system was full when oil was added. The oil leak discharged into the slipstream and for this reason was not readily apparent.

It seems clear that a little time spent in investigating the reason for the discrepancy between the direct reading gauge and the apparent fullness of the reservoir would have revealed the faults in the system. This incident also highlights the importance of cleanliness in handling hydraulic fluids.

Power Cables Arrest Helicopter

At approximately 1045 hours E.S.T. on 13th March, 1960, a Bell 47J helicopter collided with power cables crossing the Melton Reservoir, 16 miles west of Melbourne Airport, and plunged into the water below. The helicopter was substantially damaged and three of the four occupants died in the accident, the fourth occupant being seriously injured.

At the time of the accident the helicopter was being positioned at the Melton Reservoir for the conduct of joy-rides in conjunction with an aquatic carnival.

THE FLIGHT

The helicopter departed Melbourne Airport at 1025 hours with two Company employees and one non-paying passenger aboard in addition to the pilot. The destination was an alighting area adjacent to the retaining wall of the Melton Reservoir. It is apparent that the helicopter arrived in the area of the reservoir after an uneventful 20 minute flight at an altitude of approximately 500 feet. The sole survivor of the accident reports that the helicopter appeared to be operating quite normally during this flight.

The reservoir was approached from the north in a gradual descent over relatively flat open country. The water level at this time was low, and since the reservoir lies in a narrow defile, the water itself did not come into view until the helicopter was quite close to it. The survivor estimates that the altitude at this time was some 100 feet above terrain. The reservoir was intercepted some ¾ mile upstream of the retaining wall and the pilot continued the descent and commenced a gentle turn to port, presumably with the intention of making a low run over the water towards the area where the public enclosure and alighting area were situated. Just as this descending turn to port through some 90 degrees had been completed the helicopter came into contact with a power transmission line which crossed the reservoir and the flight path at approximately right angles (see sketch).

One of the steel power cables was pulled from its supporting poles but did not break. The helicopter was apparently jerked to an inverted position after which it spiralled into the water and sank immediately. A number of eye-witnesses reported that the tail-rotor assembly separated from the helicopter and at least one occupant left the helicopter before it entered the water. The sole survivor does not recall how he escaped from the helicopter but he believes that he was still in the cabin when it entered the water. Soon after he found himself on the surface of the reservoir, he was picked up by a powered boat.

INVESTIGATION

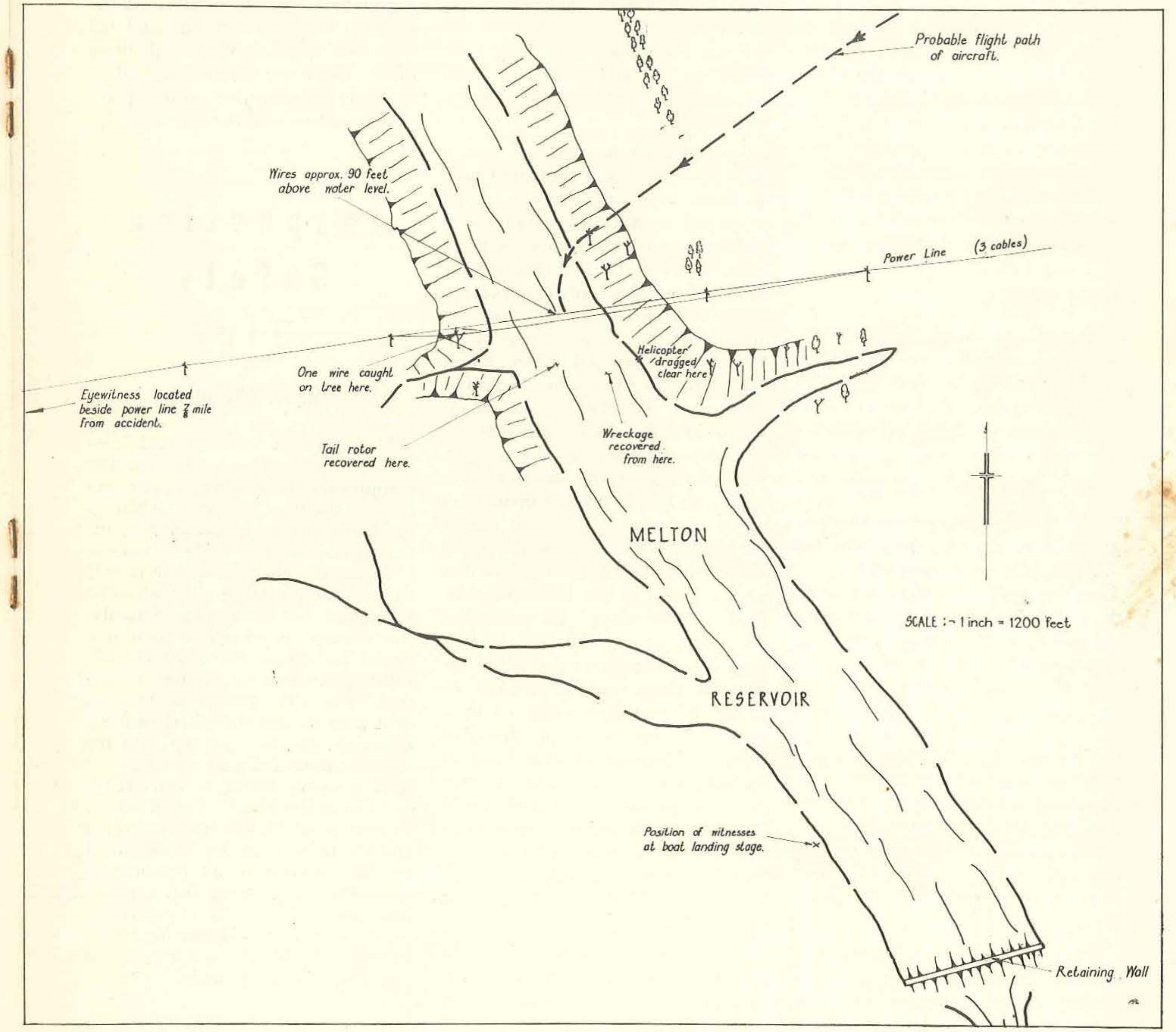
The reservoir is contained in a narrow valley some five miles long by 150 yards wide. At the time and place of the accident the water level was some 80 feet below the level of the adjacent banks. The terrain surrounding the reservoir is flat farming country with areas of sparse timber.

A 22,000 volt three-cable power-transmission line crosses the reservoir from north-east to south-west at a point some 3,300 feet upstream of the retaining wall. It is supported on wooden poles 34 ft. high having a single cross arm and the distance between the poles on each side of the reservoir is 1,380 ft. These poles stand on relatively level terrain surrounding the valley in which the reservoir lies and it is estimated that the power cables at the centre of the span were some 90 feet above the water level at the time of the accident. Although the power line crosses relatively open farming country on each side of the reservoir the poles are not easily distinguishable at any great distance on the northern side because of their colour and the existence of dead trees in their vicinity. Each of the cables consisted of three strands of 18 gauge steel wire twisted to form a cable of some ¼ inch diameter. They would be virtually indistinguishable at any safe distance without reference first to the supporting poles.

One week prior to this accident the pilot carried out an aerial inspection of the particular area having in mind the intended operation there. During the course of this inspection the power cables crossing the reservoir were drawn to his attention and he noted them at least with sufficient care to estimate their height above the water level. It is significant, however, that this inspection was made at a height of some 600 feet above the general level of terrain and the power line poles were not observed until the helicopter was within approximately ¼ mile of them.

The pilot-in-command of the helicopter was 29 years of age and his flying experience amounted to 828 hours on fixed wing aircraft and 988 hours on rotary wing aircraft which included 31 hours on the Bell 47-J type.

The main body of the wreckage came to rest on the floor of the reservoir in some 80 feet of water and approximately 350 feet downstream from the point of collision with the power cables. The wreckage was brought to the water's edge some three hours after the accident. It was then established that all major components of the helicopter were present except for the tail-boom extension, the tail-rotor assembly and port synchronized elevator. Subsequent diving opera-



tions succeeded in recovering the tail-rotor assembly, the port synchronized elevator and shattered fragments of the tail-boom extension casting; thus there was almost a complete recovery of wreckage which was subjected to a detailed examination. No evidence was found of any defect or malfunctioning which might have contributed to this accident. The tail-rotor assembly had separated from the main wreckage when the main rotor blades had struck and severed the tail boom extension as a result of flexing due to the forces brought about by the contact with the wires. The port synchronized elevator spar had failed in the impact with the water and there was clear evidence that the power cable had been in contact with the forward cross bow and the runner on the port side of the undercarriage assembly.

ANALYSIS

A thorough examination of the helicopter structure, and its control systems, the main and tail-rotors and the engine has failed to reveal any evidence of defect or malfunction which might have preceded the collison with the power cable and thus contributed to it. This conclusion is strengthened by the evidence of the survivor, who has said that the helicopter appeared to be operating quite normally right up to the point where there was a violent change of attitude and an immediate spiralling into the reservoir. The other eye-witnesses have introduced no evidence which runs contrary to this proposition. There is no suggestion that the pilot was incapacitated or impeded in any way in exercising normal control and there does not appear to have been any factor present which was outside the control of the pilot and which might have contributed to this accident.

The existence of a power line crossing the reservoir in the near vicinity of the intended operating area was apparently well known to the pilot since he particularly noted it only one week prior to this accident. The question which then arises is whether the pilot saw the power line for any useful period prior to the collision and struck it as a result of an error of judgement in manoeuvring close to it or whether he was unaware that the cables obstructed his intended flight path until the helicopter struck them. No firm conclusion can be reached on this point but it is considered that the weight of evidence points to the probability that the pilot did not see the cables until they were struck by the aircraft or, at least, not until they were so close as to be unavoidable.

It is difficult to imagine that a pilot who had taken particular note of these cables in relation to the projected operation should completely overlook them only one week later. It is possible that, because the supporting poles did not become obvious due to their location amongst trees he made an error as to their position and believed that they were at some other point in relation to his flight path as he approached the reservoir and therefore did not present any danger. The evidence of the survivor indicates that he did not see them from the port side of the aircraft during the approach and he noticed nothing which would lead him to believe that anybody else in the helicopter saw them at any stage. In particular, the pilot gave no indication of looking for or having seen the cables nor was the flight path apparently affected by any knowledge of their presence. The survivor describes how the attention of everybody in the helicopter seemed to be focussed on a water-skier who tumbled into the water just as the helicopter came out over the reservoir. It is possible, therefore, that this occurrence may have distracted the attention of the pilot at this critical stage.

In the circumstances of the flight leading to this accident it is considered that the pilot should have positively established the position of the power line, if necessary by a circuit of the area at a safe height, before any low level operations were conducted. The evidence points strongly to the conclusion that this was not done. In view of the fact that the pilot had seen this power line only one week prior to the accident it must be concluded that this course should have presented itself to him as being a necessary precaution and there is every reason to believe that such a precaution would have quickly established the position of the power line and led to a safe approach to the alighting area. There are times when safety can only be assured by sound planning in advance of the operation.

Inspection Safety Tip

R. D. Chandler

Hand injuries have resulted from two-man inspections of turbine and compressor rotor wheels. This accident usually happens when a mechanic and an inspector are surveying the damage to the wheel. It is a natural tendency for both people to have their hands on the wheel to locate and feel the damage. Usually, the damage is on more than one blade, and one of the observers will rotate the wheel for further inspection. The other person is unaware of it until he sees the wheel turning. Consequently, he ends up with his fingers caught between the stator or turbine casing before he can lift his hand from the wheel. This accident, or near accident, has occurred often enough to warrant its being called to the attention of all persons responsible for making this type of inspection. It can be prevented if only one person will use his hands to rotate the wheel when a two-man inspection is being made.

(Aviation Mechanics Bulletin)

Forward C of G

LOSS OF CONTROL IN HELICOPTER

In the course of a pest control programme in a section of state forest, a Sycamore helicopter was chartered to spray various types of insecticides under test. These operations were being conducted from a level, cleared area approximately 200 feet in diameter with one side giving way to a gradual down-slope which was utilized as a climb out path.

After preparing the aircraft and getting the ground markers into position the pilot commenced the spraying which involved flights of an average duration of 25 minutes followed by similar periods spent on the ground to top up the fuel to 19 gallons and refill the spray tank with insecticide to its capacity of 55 gallons. Following upon one landing, after operating in this manner for a little over two hours, the pilot decided that it was not necessary to refuel because there were twelve gallons remaining and, without stopping the engine, the spray tank was refilled and a passenger taken aboard.

The next take-off was made under clear weather conditions with a light wind of two or three knots. The aircraft rose to a height of ten feet in a normal manner and smoothly entered translational flight. After travelling a few feet it rolled to port and commenced descending until the main rotor blades struck the ground causing the aircraft to overturn and come to rest against a tree.

Both occupants were seriously injured although the pilot was fortunately spared additional and perhaps fatal injuries by his safety helmet which withstood severe impact and crushing forces.

When giving an account of the take-off and the events which followed, the pilot said that he had "run out of stick", meaning that the aircraft could not be controlled even with full movement of the cyclic stick. This lead to an examination of both the loading and the ballast system which is provided for the adjustment of fore and aft trim.

In the Sycamore the ballast consists of $5\frac{1}{2}$ gallons of glycol, weighing sixty pounds. This can be distributed as required between front and rear ballast tanks by means of an electric pump and a selector level which is situated between the two front seats. A contents gauge indicates the amount contained in the front tank.

When the ballasting system was examined the rear ballast tank was found to have been punctured and the lever was selected to the front tank which contained $5\frac{3}{8}$ gallons. Various ways in which the ballast might have entered the front tank after the accident were considered, but it was apparent that this quantity of ballast had been in the front tank during the take-off.

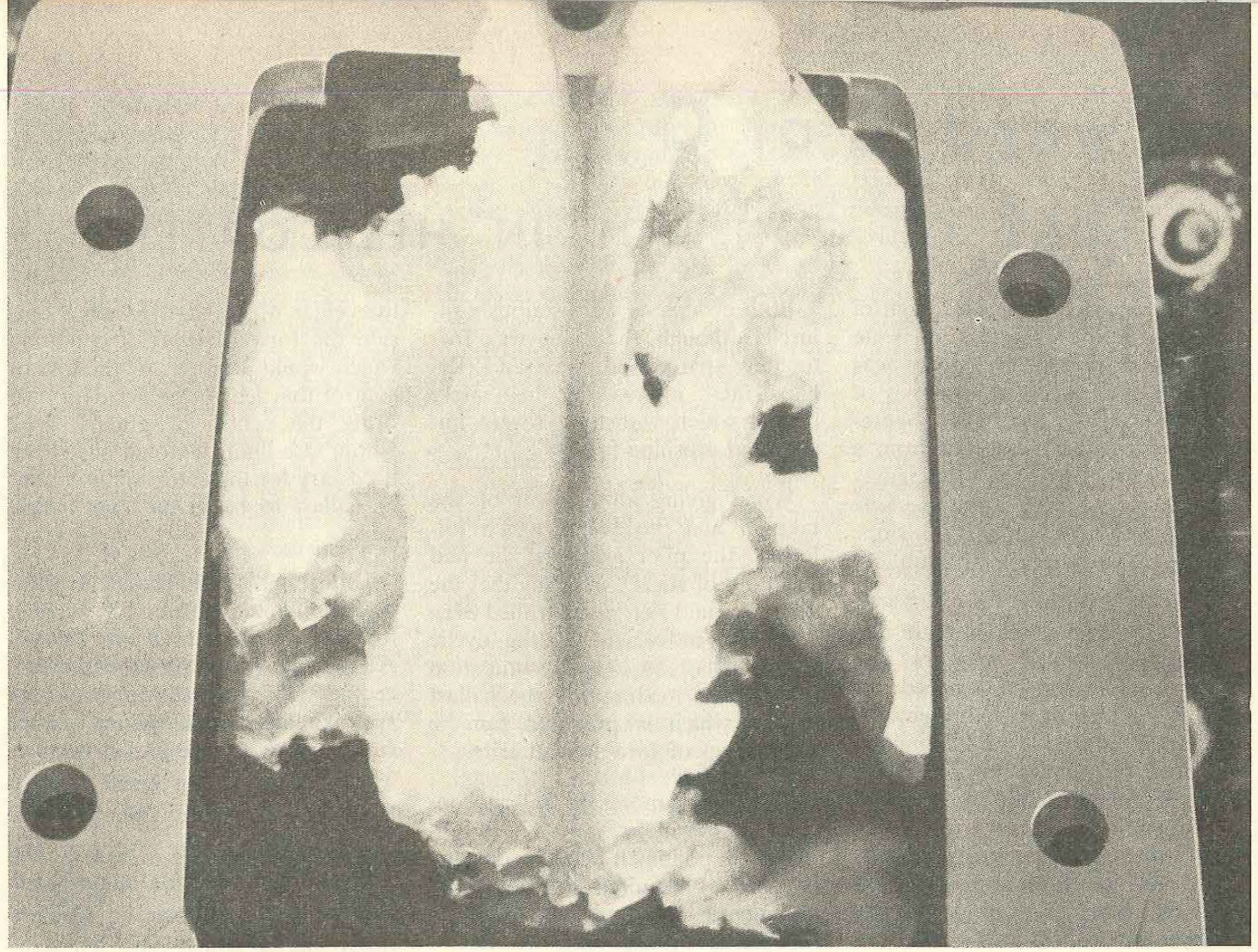
It was computed that the distribution of the load and ballast placed the centre of gravity $4\frac{1}{2}$ inches outside the forward limit, a condition which would account for the loss of control that led to the accident. To bring the centre of gravity back within safe limits it would have been necessary for the entire sixty pounds of ballast to be in the rear ballast tank.

Unfortunately, no satisfactory explanation could be found to account for the distribution of the ballast. At the time of landing on the preceding flight, there should have been approximately fifteen pounds in the front tank to achieve proper balance. The pilot could not recall whether he had subsequently calculated the position of the centre of gravity and adjusted the ballast for the new load. Had he done so, however, it is unlikely that he would have intentionally transferred it to the position in which it was found and it can only be concluded that the presence of the entire ballast in the front tank was the result of an inadvertent movement of the selector lever.

It is not possible to say how an inadvertent movement of the selector lever may have occurred. The important lesson in this, however, is to see that the possibility is acknowledged and that the pilot's vital actions and checks are performed in a manner and at a time which provides positive protection.

You can't change the past,

but you don't need to repeat it.



Be Ice Conscious

Basically, a carburettor functions a great deal like the expansion valve in a mechanical refrigerator, with the result that a temperature difference as great as 60°F. can exist between the free outside air temperature and the carburettor-mixture temperature. A carburettor can literally manufacture its own ice — at any season of the year.

Ice can and does result in loss of power and can occur when the free-air temperature is as high as 90°F.

Loss of power due to carburettor icing has exposed the occupants of light aircraft to unnecessary danger and has cost operators many thousands of pounds during the past few years. Despite the increased emphasis placed on this problem by the flying training organisation, we find many light aircraft pilots are still being caught out. Simply, they spring the trap because they either fail to appreciate the wide range of conditions under which carburettor icing can occur, or do not recognise the symptoms in time to take corrective action.

The engine manufacturer has expended a lot of effort, time and expense to design and install a hot air supply to combat ice formation in the carburettor. It is up to you, the pilot, to recognise the conditions under which it must be used. The most important single factor is to be aware of the atmospheric conditions favourable to icing, and thus be on the alert for the operational symptoms in their early stages.

In the following paragraphs we provide you with food for thought as to what happens, why it happens and when it is most likely to happen. A few minutes of your time spent in thinking along these lines as well as revising the operational procedure laid down for each individual aircraft type for which your licence is endorsed may some day save your life, or at least avoid the expensive repairs which frequently follow forced landings.

Three types of carburettor ice can be encountered. They are IMPACT ICE, THROTTLE ICE, and FUEL EVAPORATION ICE.

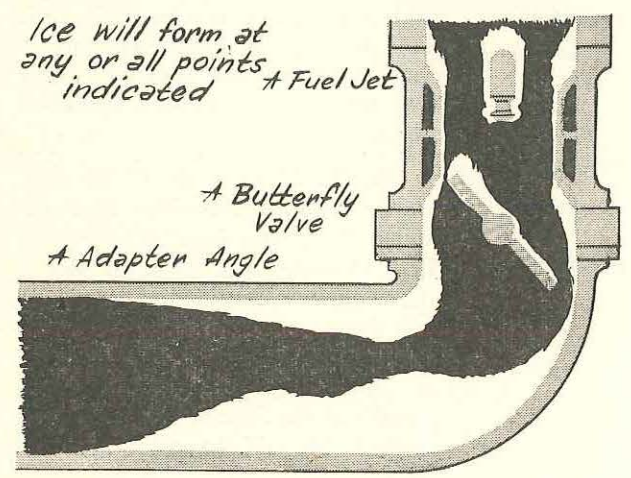
IMPACT ICE is formed by snow, sleet or super-cooled water droplets impinging on surfaces where there are changes of direction in airflow. It includes the ice formed when water strikes surfaces, such as carburettor air intakes, which are below 32°F. Impact ice may seriously affect engine operation where ambient temperatures are below 32°F., particularly if snow, sleet or sub-cooled liquid exists in the atmosphere.

THROTTLE ICE is formed at or near the throttle, particularly when it is in a part closed position, and is due to the drop in temperature which accompanies the reduction in pressure created by the venturi effect. It is formed from moisture particles which freeze outside the airflow boundary layer and are then carried to metal surfaces such as the throttle butterfly by their initial momentum. Comprehensive tests show that throttle ice may form in air temperatures up to about 37°F. Where the air temperature is above 37°F. the cooling effect of the increased velocity alone is insufficient to result in icing.

FUEL EVAPORATION ICING is caused by the vaporisation of the fuel after it is introduced into the intake airstream. The heat required to change the fuel from a liquid to a vapour is supplied mainly by the airstream, with the result that even though the outside air temperature may be well above freezing point, the temperature of the air passing through the system aft of the fuel spray nozzle, and of the surrounding structure, can be reduced to below 32°F. This type of carburettor icing is the most common and it may cause rough running by upsetting the fuel-air ratio, or the mixture distribution through the manifold, as well as engine failure by obstructing the passage of air through the carburettor.

It is possible that all three types of icing will be encountered at the same time, but that arising from fuel evaporation would be the most likely except in extremely cold conditions.

The cooling effect of fuel evaporation within the carburettor will reduce the air temperature by as much as 60°F. As ambient air temperatures above 90°F. are rarely encountered in flight, the outside air temperature factor should be ignored when considering the meteorological conditions likely to produce icing. The only other factor to be considered is the moisture content of the atmosphere. In clear air conditions where the humidity exceeds 70%, or in rain, cloud, fog and some forms of haze, the moisture present can be sufficient to produce a dangerous accumulation of ice. Under these conditions carburettor hot air will probably be required at some stages of the flight, and it may be necessary to clear the induction system prior to take-off. The operational application of hot air will vary with individual aircraft and engines, and a pilot should follow implicitly the instructions contained in the manufacturer's or operations manual. In addition, it is well to remember that under most conditions the formation of carburettor ice is a relatively slow process and it is possible for a pilot not to recognise the early symptoms of icing unless he is conscious of the significance of the meteorological conditions.



Recognition of the symptoms will, we believe, be made easier if it is appreciated that ice in the induction system acts in the same way as closing the throttle. As ice builds up it obstructs the air flow, causing a reduction of power and, with a fixed pitch propeller, a reduction in r.p.m. With a constant speed propeller the reduction of power will not produce this latter effect in the early stages but power and, consequently, airspeed will still be reduced. If the condition is allowed to progress to a point where the power developed is not sufficient to cause the propeller to remain above the fine pitch stops there will be a reduction in r.p.m. even with a constant speed propeller. Irrespective of the propeller installation, a suspected formation of ice can often be detected by increasing the throttle opening. If the throttle movement is sticky or abnormal, or it fails to increase the power, it is a sure sign that ice has formed and the application of hot air has already been delayed longer than is healthy but it is still not too late to apply it.

Frequently pilots fail to recognise icing in its early stages, and increase the throttle opening by slight increments to compensate for falling off of r.p.m. or boost. These are precisely the conditions that lead to maximum ice formation. Removal of ice already formed is best accomplished by use of full carburettor heat. If the pre-heat capacity of the system is sufficient and the remedial action has not been delayed, it is only a matter of seconds before the ice is removed. The pre-heat capacity can be increased by applying more power and closing cowl flaps where they exist in a closable form.

If ice formation is allowed to progress to a critical extent the loss of power may make it impossible to generate sufficient heat to clear the engine. It is for this reason that we have emphasised the need to recognise meteorological conditions favourable to carburettor icing and take early preventive action. **Use heat for prevention — it may not be available for cure.**

MID-AIR COLLISION

Viscount and Lockheed T33

NEAR BRUNSWICK, MARYLAND, U.S.A.

A Viscount 745 airliner and a Lockheed T-33 of the Maryland Air National Guard collided in the air about four miles ENE of Brunswick, Maryland. Seven passengers and the crew of four aboard the Viscount were killed. A passenger in the T-33 was killed, but the pilot, although severely burned, parachuted safely. Both aircraft were totally destroyed.

The collision occurred at an altitude of about 8,000 feet, while the Viscount was descending en route from Pittsburgh to Baltimore. It was operating on an I.F.R. flight plan, but the weather conditions were V.F.R. The T-33 was on a V.F.R. proficiency flight from Martin Airport, Baltimore, Maryland.

Just before the collision the aircraft were observed in the area west of Brunswick, flying parallel easterly courses, with the T-33 some distance behind and to the left of the Viscount. The T-33 quickly overtook the Viscount and made a gentle right turn, during which it struck the forward left side of the fuselage of the Viscount.

Investigation disclosed that both aircraft were operating in V.F.R. weather conditions and it was therefore the responsibility of each crew to provide adequate separation by visual reference.

(Summary based on the Report of the Civil Aeronautics Board, U.S.A.)

(All times U.S.A. Eastern Daylight)

INVESTIGATION

The Viscount was operating a regular passenger flight from Chicago to Baltimore with one stop at Pittsburgh. The aircraft took off from Pittsburgh at 1050 for Baltimore on an I.F.R. flight plan and a clearance was obtained to fly at 11,000 feet. At 1115, the aircraft contacted Washington A.T.C., reporting its position. At approximately 1124 Washington A.T.C. issued a clearance to descend to and maintain 7,000 feet. At 1126, the aircraft reported leaving 10,000 feet estimating Baltimore at 1139. When this report was received, Washington A.T.C. was able to distinguish identification of the flight by radar.

From the recording of communications between Washington A.T.C. and the aircraft, it was determined that approximately 41 seconds after the aircraft reported leaving 10,000 feet it was given a further clearance by A.T.C. to descend to 5,000 feet and to maintain 5,000 feet. The aircraft acknowledged this clearance and reported leaving 9,000 feet. This transmission was made approximately 48 seconds past 1126 and was the last transmission from the flight.

The Washington air traffic controller who was controlling the flight stated that at the time the target was first identified on the radarscope, the flight was proceeding eastward and there was no other traffic noted within 15 miles of it. In addition, no other target was seen in the vicinity at the time of the final radio contact. He said that a few minutes after the final transmission, on one sweep of the antenna he saw a faint return of a target near the Viscount. On the next sweep the target had disappeared and the "blip" which was known to be the Viscount was somewhat enlarged. The controller initiated a call to the aircraft to determine its altitude and to advise of possible V.F.R. traffic but was unable to make contact. The target of the Viscount remained almost stationary on the scope for about a minute and then faded. It was determined that this call was made three minutes and three seconds after the Viscount reported leaving 10,000 feet at 1126.

The pilot of the T-33 had planned several days previously to take another member of the National Guard on a familiarization flight in the local flying area. Just prior to the flight he filed a local V.F.R. clearance and obtained a weather briefing from the U.S. Weather facility at Baltimore Friendship Airport.

After take-off the flight proceeded southward climbing to 3,000 feet. The pilot said the weather briefing he had received before take-off indicated that there would be an overcast at 5,500 feet in the Baltimore area. This was the condition he found. He continued south to about Gibson Island, Maryland on Chesapeake Bay, keeping below the overcast, and then turned to a westerly heading, passing north of Washington and south of Friendship Airport to Leesburg, Virginia.

He could not recall his various altitudes, headings, or speeds because he was not flying a constant course. It was not uncommon for these to vary considerably on a V.F.R. flight. He said the clouds in the Washington area were about 10,000 feet and that at one time he had climbed to about 9,000 feet between Washington and Leesburg. From Leesburg, he proceeded up the Potomac River to Harper's Ferry, West Virginia. He remembered descending from 8,000 to 5,000 feet just prior to reaching Harper's Ferry to allow his passenger to photograph this scenic spot. He also remembered that he had selected 85 percent r.p.m. but could not recall his airspeed. He said he made a left turn around Harper's Ferry at 5,000 feet and picked up an easterly heading, intending to proceed to Baltimore via the Frederick, Maryland area. After straightening out on this course, he began a slow climb, still maintaining 85 percent r.p.m. He did not know his airspeed or rate of climb but did recall seeing the altimeter indicating 8,000 feet. At this point he said, he thought the aircraft exploded. He did not know how he got clear of the aircraft, which was tumbling and afire, but recalled opening his parachute and descending to the ground. In hospital, he learned for the first time his aircraft had been involved in a collision.

The pilot of the T-33 said the weather conditions he had encountered had improved as he proceeded west. Near Washington, the base of the overcast was approximately 10,000 feet. In the accident area there was less than 2/10 cloud coverage and he had remained below these scattered clouds. He said he had not made use of any radio navigation aids, although he was at all times guarding the Martin Tower U.H.F. frequency. The aircraft had performed satisfactorily and no mechanical difficulty was encountered.

He further testified that he did not perform any aerobatics nor did his passenger handle the controls of the aircraft at any time. He stated that he maintained a constant lookout for other aircraft throughout his flight. The windshield and canopy of the T-33 were clean and no distraction or cockpit duties had interfered with his lookout prior to the accident.

Numerous witnesses of the accident agreed that the Viscount was flying straight and level and stated that it was ahead of the T-33 at all times until collision. The T-33 appeared to be travelling considerably faster and overtaking the Viscount from a position behind and to the left. The T-33 was then seen to make a shallow turn to its right during which it struck the forward part of the Viscount. The witnesses said there appeared to be a small explosion when the aircraft hit. After the collision the aircraft separated and the T-33 continued on its original course for a short distance, then exploded. The Viscount appeared to pull up to a near stall, then spin steeply. This spin gradually lessened to a slow flat spin which continued until the Viscount hit the ground. There were light fluffy clouds in the area with the amount of coverage variously estimated from one-tenth to one-fourth of the sky.

At the public hearing a forecaster for the U.S. Weather Bureau testified that the weather reports around the area of the accident indicated that there were approximately two-tenths to four-tenths clouds in the lower levels with bases around 3,500 to 4,000 feet. The witness stated, however, that because of the clearing situation which existed, cloud coverage could vary considerably in a few minutes. It would have been entirely possible for the coverage at a particular time in the area to have been as little as one-tenth to two-tenths.

The wreckage of both aircraft was widely scattered over an area of about one mile by $1\frac{1}{2}$ miles approximately four miles north-east by east of Brunswick. The main portion of the Viscount broke up and burned when it hit the ground. All four engines and propeller assemblies remained in their approximate proper positions. The Nos. 1 and 2 propellers showed no evidence of inflight impact damage. However, the blades of Nos. 3 and 4 propellers were severely nicked and scratched by inflight contact with metal objects. The fuselage from station 414 aft was severely damaged by ground impact but showed no evidence of inflight impact. However, the fuselage was demolished from station 0 to station 132.

From the widely scattered wreckage of the T-33 it was evident the aircraft disintegrated in the air following the collision. The entire right wing was shattered from the tip inboard and aft to approximately 35 degrees from station 93 at the leading edge. No inflight impact markings were found on the left wing.

All the evidence indicated that the engines of both aircraft were operating normally prior to collision. Maintenance records for both aircraft indicated that they were maintained in an airworthy condition in accordance with applicable regulations. There were no outstanding discrepancies affecting their airworthiness.

A witness for the Civil Aeronautics Administration testified that the primary purpose of the A.T.C. service was to provide for the safe and efficient operation of aircraft operating according to instrument flight rules. In order for him to avail himself of this service the pilot was required to first file an instrument flight plan with an A.T.C. facility. His flight was required to be planned within controlled airspace. He was required to obtain an air traffic clearance prior to taking off and, finally, he was required to adhere to the clearance throughout the flight. It was stated that Washington A.T.C. was equipped with radar which was used to augment the basic non-radar system of air traffic control. If the traffic could be seen and identified on the scope, control could be exercised by radar. If the target failed or contact was lost, control reverted to the basic non-radar system. Radar assisted air traffic control such as that which was rendered between Martinsburg and Baltimore, also provided pilots with advisories on all observed targets. This service was limited by the radar coverage and volume of traffic and workload. In addition, many pilots did not desire the service and requested that it be withheld.

The witness said that because of the poor return from a T-33 type aircraft, it would present a poor target for radar in the Brunswick area below about 8,000 feet. The Viscount under the same conditions, however, being a larger aircraft, presents a good return and would be readily identifiable. Because of this uncertain return from the jet fighter, he doubted that the faint target seen by the controller was from the T-33.

ANALYSIS

It would appear that the faint return on the radarscope followed by the enlargement of the Viscount target seen by the air traffic controller working the flight was in fact the collision. Allowing 10 seconds (one sweep of the radar antenna) for the controller to verify the target first observed and 8 seconds for evaluation and initiation of his transmission, it was possible to estimate closely the time of the accident.

From a study of the inflight damage to the two aircraft, it was determined that initial contact between them was when the nose section of the T-33 right tip tank struck the left side of the Viscount fuselage just ahead of station 132 below the floorline. The Viscount fuselage was destroyed by loads acting from left to right with some indication of an upward component at station 132. Following the initial impact, which separated the nose section from the T-33 tip tank, the main section of tank contacted the Viscount fuselage below the forward entrance door. The next area of impact was between the T-33 wing and the Viscount fuselage, upward and forward of the initial impact area. This destroyed the right wing of the T-33 and shattered the nose section of the Viscount.

The outer portion of the right horizontal stabilizer of the T-33 was destroyed when it struck the upper left Viscount fuselage between stations 198 and 232. Scratches found on fragments of this structure ran aft and inboard at angles of 35 degrees and 45 degrees. The damage to the Viscount was due to forces acting from left to right.

It is significant that the eyewitness' descriptions of the collision are entirely consistent with the inflight damage to the two aircraft. It is believed, from all the evidence, that the Viscount was flying a straight course but descending at a normal rate and at an indicated airspeed of approximately 235 knots; further that the T-33 was flying a straight course which was parallel and to the left and behind the Viscount. Although in a shallow climb of a few degrees its airspeed was higher and it was overtaking the Viscount. A short interval before colliding the T-33 began a normal right-hand turn and continued in this turn until striking the side of the Viscount airliner. Although the T-33 was in a slight climb and the Viscount was in a descent, it is doubtful that the small vertical closure would be perceptible to ground witnesses.

Based on the abovementioned evidence, a study was made of the relative opportunities for the various crew members to see the other aircraft during the 60 seconds immediately prior to collision. At the instant of impact the flight path of the Viscount was assumed to be straight while that of the T-33 was assumed to be in a co-ordinated turn to the right. At an angle of 25 degrees and an airspeed of 290 knots I.A.S. (551 feet per second true), the T-33 would have a radius of turn of about 20,300 feet. To have struck the Viscount at an angle of 42 degrees, the T-33 would have had to have started its turn about 26 seconds before collision from a parallel course about 5,200 feet to the left. The resultant angular relationships of the two aircraft were calculated and tabulated. A comparison of these angles with the cockpit visibility charts for the Viscount shows that the co-pilot could not have seen the T-33 until at the instant of impact. The pilot could not have seen the T-33 until about 26 seconds prior to collision because of the intervening fuselage aft of his left window.

As for the T-33 pilot, there was no obstruction to his seeing the Viscount for well over a minute before collision.

Civil Air Regulations require that all pilots in V.F.R. weather conditions maintain separation from other aircraft visually, irrespective of the type of flight plan or clearance. Overtaking aircraft, whether climbing, descending, or in horizontal flight shall keep out of the way of the other aircraft by altering course to the right, and no subsequent change in the relative position of the two aircraft shall absolve the overtaking aircraft from this obligation until it is entirely passed and clear.

CONCLUSIONS

From all the available evidence it was concluded that the weather at the flight altitude was V.F.R. and that both aircraft would have been free from clouds about nine-tenths of the time without taking any action whatsoever.

It is also evident that the pilot of the T-33 from his overtaking position, had ample opportunity to see the Viscount ahead of him and take evasive action. Had he done so this accident might well have been avoided.

Conversely it is not believed that the Viscount pilot's failure to see the T-33 in the 26 seconds which it could have been seen is evidence of a failure to maintain a normal vigilance.

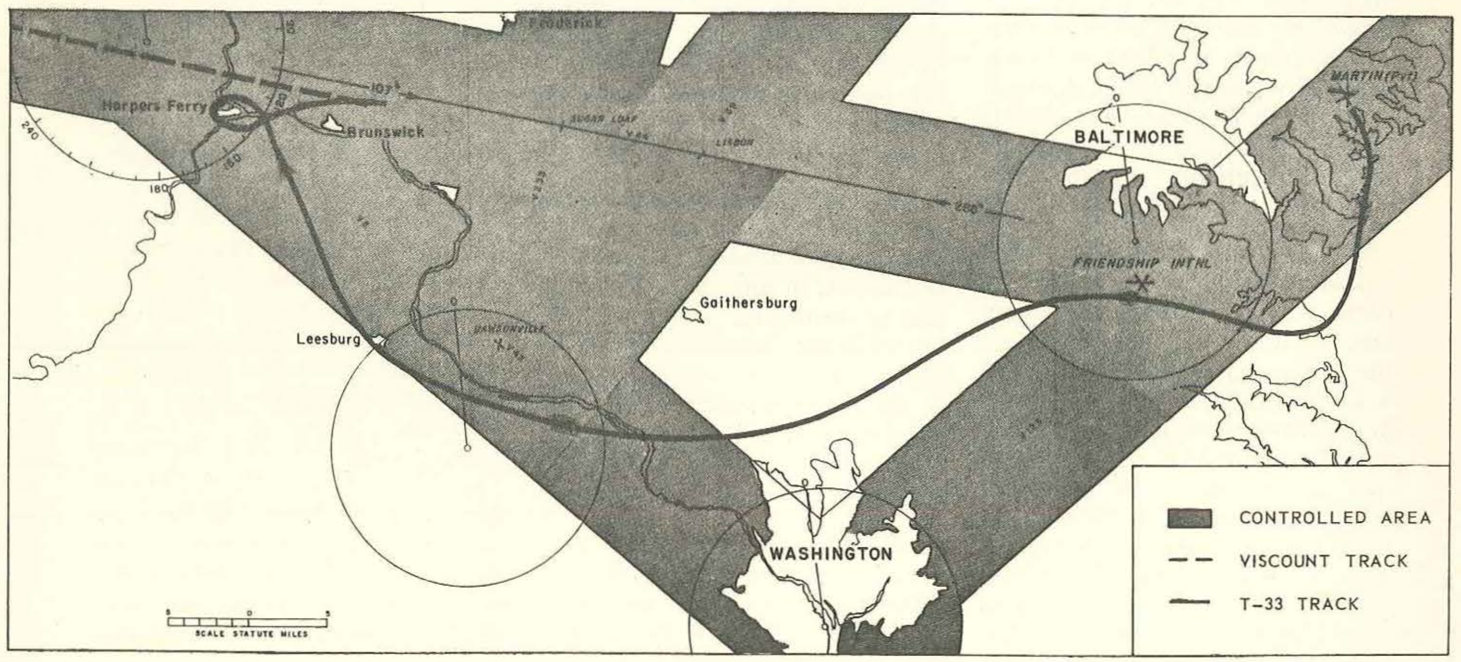
A requirement still exists for the continuation of visual flight rules substantially as contained in the present Civil Air Regulations for the large majority of aircraft operations such as those with which were concerned here. With this, all responsible spokesmen for the principal airspace users, including military and civil, are in agreement. Emphasis must again be made, therefore, on the fact that the obligation to see and avoid other aircraft under visual flight rules conditions constitutes a condition precedent to the use of navigable airspace.

PROBABLE CAUSE

It was determined that the probable cause of this accident was the failure of the T-33 pilot to exercise a proper and adequate vigilance to see and avoid other traffic.

COMMENT

The requirement stated in the final conclusion above should be borne in mind by all Australian pilots when operating in overseas countries where the I.C.A.O. concept of air traffic control is in force. It is particularly important to appreciate that in conformity with this concept there is an obligation on the pilots to see and avoid other aircraft under visual flight rule conditions even when operating in controlled airspaces.



HIGH APPROACH: HEAVY LANDING

RICHARDS FIELD, NEW YORK, U.S.A.

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

At 1520 hours on 14th November, 1957, a Martin 404 aircraft was substantially damaged in a heavy landing at Richards Field, Massena, New York. The two passengers and three crew members were not injured in the accident.

(All times herein are U.S.A. eastern standard)

THE FLIGHT

The flight departed Malone, New York at 1510 hours. The gross take-off weight of the Martin 404 was 35,977 pounds, 8,923 pounds under the maximum allowable. According to the load manifest the load was properly distributed within the centre of gravity limitations. The first officer made the take-off, climbed the aircraft approximately 2,500 feet, and flew it to Massena. The captain from his left seat supervised the flight and performed the duties of co-pilot.

At 1516, when about eight miles east of Richards Field the captain reported the flight's position, then asked for and received landing information, which included the surface wind as "northeast 5 to 10 knots", and the active runway 4 (150 feet wide and 4,000 feet long). The first officer established a downwind leg at 1,200 feet to execute a rectangular left-hand pattern for landing on runway 4.

The flight was viewed briefly by ground observers during the pattern before reaching the final landing approach and it seemed entirely normal. As the aircraft drew closer to the threshold it seemed high and thereafter assumed an abnormally steep descent. As it approached the runway surface the aircraft assumed a flareout attitude; however, the rate of descent continued with little visible abatement. Consequently the aircraft contacted the runway surface with great force at which time the right powerplant separated from the aircraft. The aircraft rebounded and again contacted with great force. It then rolled forward and gradually off the runway to the right. Before stopping it crossed a taxiway and the left powerplant fell free, accompanied by a small fire in the engine and the empty nacelle area.

As the aircraft stopped the captain shut off the fuel and electrical services and ordered the loading ramp lowered. The passengers and crew quickly evacuated by this exit without difficulty or reported injury.

At 1522, two minutes after the accident, weather conditions were reported as: Ceiling 4,000 feet broken, 10,000 feet overcast; visibility 3 miles; haze; wind northeast 6 knots.

INVESTIGATION

Investigation on the scene revealed that the aircraft initially contacted the runway 455 feet beyond the approach end and 55 feet inboard of the right edge. The contact was evidenced by prominent marks from the right main tyres and indentations in the asphalt surface of the runway made by the right main outboard wheel rim. The tyre marks were apparent for the next 36 feet and were in general alignment with the runway heading. Within the tyre marks there were three propeller cuts in the runway made by the right propeller blades. To the left, slightly beyond and parallel to these cuts, were three similar cuts inflicted by the left propeller blades.

Eye-witness observations, crew testimony, and the absence of marks on the runway revealed the aircraft then rebounded and was airborne for the next 580 feet. During this time the right powerplant separated, fell free, and tumbled to the right side of the runway and stopped about 400 feet beyond the initial contact. Tyre scuff marks and additional wheel indentations marked the second runway contact. Thereafter rubber marks showed the path of the aircraft as it rolled gradually toward the right edge of the runway and overran it 1,350 feet beyond the approach end. The Martin continued to a stop at a location 169 feet to the right of runway 4 and 2,350 feet past the approach end. The left powerplant fell off just before the aircraft stopped.

High inertia forces tore out both powerplants. These forces caused the upper engine support struts to fail in tension and the lower struts in twisting and buckling. Fuel and oil which flowed from broken lines was ignited in the case of the left engine, causing the fire which occurred.

The outer skin and internal structure between fuselage station 280 and 311 were cut and torn. This damage was inflicted by the No. 3 blade of the right propeller after the propeller struck the ground and the blade was torn from its hub and hurled into the fuselage.

The front wing spar, including the cap and web, failed at station 120. This damage was the result of deceleration forces imposed on the structure during the severe runway contacts. There was no evidence of material weakness.

Damage found in the left engine nacelle area and to the left wing centre section structure showed the aircraft had rolled over the left powerplant, with some damage in these areas being the result of strikes by the blades of the left propeller.

Examination showed the landing gear was extended, locked down, and undamaged. The main gear tyres remained inflated; however, areas of flattening on the right outboard wheel rim revealed its tyre had been subjected to maximum deflection, permitting the wheel to contact the runway. Indentation in the runway surface which matched the flattened areas on the rim showed this maximum tyre deflection occurred at both the initial and secondary touchdown points. The nosewheel tyre was blown. The landing gear shock struts were in good condition and properly serviced.

The wing flaps were extended equally to the landing setting, 45 degrees; however, they had received major damage, apparently from contacts with the separated powerplants. The left flap hinges at stations 55 and 120 were sheared from the spar.

As a result of the examination, all damage to the aircraft was determined to have resulted from high inertia forces associated with the hard landing and from contacts between the aircraft and the separated powerplants. Both pilots substantiated this determination by stating that there was no malfunctioning of the aircraft before impact. Describing the severity of the runway contact the captain said it was so hard that he was momentarily stunned.

The captain testified that when he reported in range and received landing information, he recalled the prior landings at Plattsburg and Malone were according to a southwest surface wind, contrary to the reported wind at Massena, "northeast 5 to ten knots." He mentioned this to the first officer. On the downwind leg, however, the captain noted smoke from an industrial plant near the airport which confirmed the Massena wind direction as reported. The in-range checklist was completed and the downwind leg was flown in a normal manner. The aircraft was slowed, after which take-off flap was extended and the landing gear lowered and checked.

The pilots stated that a left turn to base leg was made about 800 feet above the ground and at a normal airspeed of about 130 knots. The captain said that during and after the turn he noted the presence of an overriding wind which drifted the aircraft somewhat closer to the airport. He added that this wind situation was related as a factual observation and not as a factor in the hard landing. Investigation revealed that a southwest wind did exist which was overriding the northeast surface wind. Velocity of the southwest wind was approximately 20 knots above 500 feet.

The pilots said the left turn to final approach was made using a normal bank. It was executed approximately 500 feet above the ground with an airspeed of about 120 knots. Approach flap was added during the turn. On completion of the turn the aircraft was well aligned with the runway. Neither pilot was able to give the distance to the runway; however, at 450 feet above the ground the airplane seemed high in consideration of the distance. The first officer said that at this time he intended to ask permission to go around but, before he had done so, the captain took control of the airplane. The captain said that he felt he should take control but in doing so he believed he could continue and land without difficulty.

The pilot-in-command testified that the technique he employed in continuing was to immediately close the throttles and apply full landing flap with the right hand. Concurrently he applied back pressure to the yoke with his left hand and slowed the airplane to about 95 knots. He stated that it was his intention to slow the airplane, then to lower the nose, getting as much descent as possible over the distance and at the same time increase the airspeed to about 110 knots to assure an adequate airspeed for the flareout and touchdown. Responding to questions, the captain said that his technique resulted in an abnormally steep nose-down attitude and high rate of descent. He stated that without power and in landing configuration he doubted if the airspeed increased for the flareout as he had planned. Consequently, when he began the flareout these factors resulted in the rate of descent continuing with little abatement until the runway was contacted. The captain said that he added some power during flareout but with the runway rapidly approaching, this was psychologically hard to do and for this reason he did not add more. The captain stated that in his opinion it was the technique he employed before reaching the flare-out position that resulted in the hard landing rather than the flareout timing or use of control in the flareout.

The pilot-in-command of this aircraft was 39 years of age and held a current airline transport rating for DC3, DC4, Constellation and Martin 202 and 404 aircraft. His total flying experience amounted to 11,870 hours of which 535 hours had been gained in Martin 404 aircraft. Transition training to the type had been completed 14 months prior to this accident.

Questioned concerning his training to qualify as captain on the Martin aircraft, the pilot-in-command recalled that it included the "high altitude approach". This manoeuvre is one used to descend as quickly as possible over the shortest distance. It would be appropriate during an approach to a runway from a high, close-in position. He said that the proper conduct of this manoeuvre requires slowing the aircraft to 100-105 knots in the landing configuration (full landing flap, and gear extended). It then requires the maximum descent obtainable maintaining the airspeed and carrying no less than 15-18 inches of manifold pressure until reaching the flareout position. The captain said that during training this manoeuvre was demonstrated to him and he had flown it. The captain stated that during the Massena approach he used no power and less airspeed than 100-105 knots, both of which were contrary to the prescribed technique for the manoeuvre. When asked, however, he added that 100-105 knots and 15-18 inches of power had not been indicated as being limits to the manoeuvre.

The Chief of Pilot Training for the operator testified that had the captain used no power and less than 100-105 knots in the high-altitude approach during training, he certainly would have been warned against it. He stated that the company taught the manoeuvre as it was to be executed and described situations where it would be applicable. He indicated that while limits to the approach technique were probably not specifically stated, the attitude of the aircraft and rate of descent obtained as the manoeuvre was taught should prompt the pilot not to go beyond this technique. The Chief of Training said that, nevertheless, since this accident and another nearly identical to it, a decision had been made to publish written material warning pilots against a completely power-off approach. This material, he said, would not only be applicable to the operation of the Martin 404 but to all of the carrier's equipment. He said this material would become part of the flight manual for each type aircraft.

ANALYSIS

It is clearly evident that the principle damage to the aircraft was the result of high forces induced by contacting the runway at an excessive descent velocity. It is equally clear that these forces exceeded the design strength of the aircraft structure. Other damage occurred in the sequence of events when the aircraft passed over and contacted the separated powerplants and when the propellers cut and tore the aircraft structure.

The Board concurs with the pilot-in-command that the technique he employed after taking control from the first officer was faulty and precipitated the hard landing. In consideration of his experience and qualifications he should have realized that a considerably steeper nose-down attitude than normal and an abnormally high rate of descent would result from his technique. Knowledge of an approach maintaining 105 knots and 15-18 inches of power should have indicated to him that an approach resulting from this technique would be undesirable in standard air carrier practice. Further, if the pilot-in-command did not know precisely the approach which would result from this technique, it was unwise to use it.

It is also the Board's view that company training did not fulfil its entire responsibility. The Board realizes that a training programme cannot anticipate and cover every possible contingency or situation. **Nevertheless, it is vital to formalize the safe operational limits of manoeuvres such as the landing approach.*** In this situation, where the limits of airspeed and power retained were most important, they might well have been included as part of the training on the high-altitude approach. The previous accident which occurred under nearly identical circumstances, together with this one, would seem to emphasize the necessity and wisdom for such inclusion. Thus, the material added to the flight manuals cautioning pilots against a completely power-off approach appears to be essential under the circumstances.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the captain's incorrect technique during the final approach which resulted in an abnormally steep nose-down attitude and high rate of descent, the latter not being sufficiently arrested before touchdown.

*** In the Australian view this statement is the very core of the lesson in this and a great many other accidents. It is a concept which, if adopted in relation to all flight phases or manoeuvres, will result in greater safety.**

Mercy Flights

The Royal Flying Doctor Service, the Queensland Ambulance Transport Brigade, the Bush Church Aid Society and the Northern Territory Aerial Medical Services are widely known. Without these highly esteemed and efficient organisations, the people in our outback areas would be deprived of the speedy medical attention now available. Apart from the alleviation of suffering, this prompt medical attention has on numerous occasions meant the saving of a life. It is generally true to say, therefore, that most flights undertaken by aircraft operated by or under charter to these Services are mercy flights, in that they are either directly or indirectly undertaken for the purpose of providing medical attention.

All pilots, however, should particularly note that the term "Mercy Flight" has a different meaning within Departmental requirements. A mercy flight within this meaning is a flight performed under the following circumstances:—

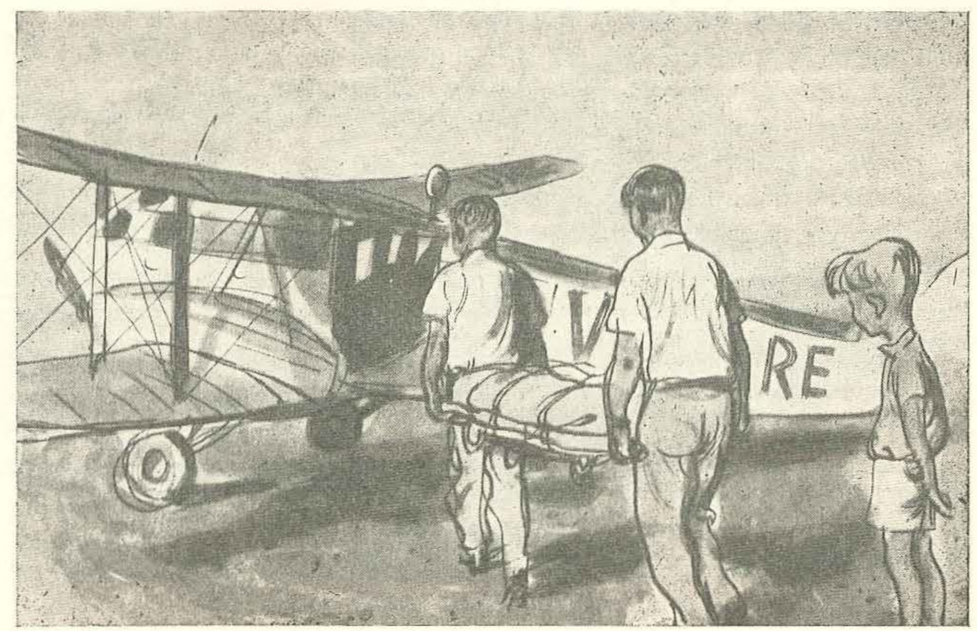
(a) Any urgent medical, flood relief or evacuation flight when there is no satisfactory alternative means of meeting the situation, and

(b) When the operation will take place under circumstances such that full compliance with Air Navigation Regulations and Orders is not possible.

It follows therefore, that a flight engaged on a mission of mercy should not be declared a "Mercy Flight" when there is complete compliance with the applicable Regulations and Orders. It is also of importance for pilots to realize that these flights should **not** be undertaken when:—

(a) The crew and other occupants of the aircraft involved will be exposed to **undue** hazard, or

(b) The relief or rescue can be delayed pending the availability of a more suitable aircraft or more favourable operating conditions.



The appropriate sections of the Aeronautical Information Publication and the Light Aircraft Handbook contain a list of the factors which the pilot should take into consideration in reaching a decision.

Having reached the decision to undertake a "Mercy Flight", the pilot is required to submit flight notification to the appropriate Air Traffic Control or Communications Unit in the normal manner and include the prefix "Mercy Flight". If it is known prior to departure that a flight will constitute a "Mercy Flight" during portion of the flight only, then this should also be stated. If a normal flight develops into a "Mercy Flight", then the pilot should notify the Air Traffic Control or Communications Unit as soon as possible.

On being notified that a "Mercy Flight" is about to commence or develop the Air Traffic Control or Communications Unit will declare the appropriate Search and Rescue phase thereby:—

(a) making available special facilities required for the operation;

(b) maintaining a special communications and navigation watch on the progress of the flight to the limits permitted by available facilities;

(c) assisting the pilot wherever possible with advice and information; and

(d) keeping the pilot informed of any action taken.

Finally the pilot is required to submit an air safety incident report detailing the circumstances of the flight. A report is also submitted by Air Traffic Control.

It is hoped that the foregoing will make clear the meaning of the term "Mercy Flight" as it applies to the Department's requirements, and in this way remove any chance of misunderstandings which could unnecessarily add to the danger potential in these operations.

Swift Rescue

In the SAR operation which followed the loss of power and subsequent forced landing by a helicopter in a remote location in North Western Australia, the initiative and co-operation displayed by those involved was responsible for the crew being rescued in the evening of the same day.

The helicopter, a Bell 47G, had been engaged in an aerial survey project in the Wyndham area and at the time of the accident was on a travel flight from Wyndham to Darwin with intermediate stops at Port Keats and Daly River Mission. A second commercial pilot who was carried on the flight acted as navigator.

The aircraft departed Wyndham at 0530 hours W.S.T. and, at the end of an hour's flight, was in the vicinity of the Western Australia/Northern Territory border cruising at a height of 1,000 feet above the rocky outcrops and timbered gullies of the Weaber Ranges.

When near the middle of the range and approximately 77 miles from Wyndham the engine suffered a sudden and complete loss of power. The navigator immediately sent a distress call, which was received by Wyndham, and the pilot put the helicopter into auto-rotational flight and prepared for the landing. The approach was made down the face of a steep ridge and as the landing flare was commenced above the floor of the gully the main and tail rotors struck trees and the aircraft dropped to the ground. In view of the few seconds in which he had to act, the pilot's selection of a landing area, which was probably the best available to him, and the skill with which he executed the forced landing was largely responsible for the absence of injuries.

Upon receiving the distress call the search and rescue organization went immediately into action. Wyndham acquired the use of a four wheel drive vehicle, and obtained the co-operation of the Police and the Army in organizing a search party.

In the meantime the crew had removed the radio aerial from the damaged tail section and rigged it to a tree and by 0710 hours had established contact with Wyndham and given their approximate position.

It was then arranged that a privately owned visiting aircraft due at Wyndham at 1000 hours, would join in the search and by 1057 hours it had departed carrying an experienced bushman with water and other items to be dropped to the crew.

Assisted by the smoke from a fire which the crew had been asked to light, the helicopter was located at 1150 hours, the supplies were dropped and Wyndham advised.

On the return flight the bushman was left at Carlton Station airstrip where he joined the ground search party and was able to guide them to the helicopter which was reached at approximately 1800 hours that evening. The party then returned to where the vehicles had been left alongside the ranges and, after camping there for the night, the crew were brought into Wyndham at 1130 hours the following morning.

This is a good example of how the skill and intelligent co-operation of a crew coupled with quick action by the ground station and willing assistance from other parties can result in a very smooth and efficient search and rescue action.

Quotable Quotes

Herodotus, a Greek historian who lived some 2500 years ago, made the following statement which is certainly applicable to the management of flight today. Said he,

> "The best man in my belief is he who lays his plans warily, with an eye for every disaster which might occur, and then, when the time for action comes, acts boldly".
> He also said,
>
> "Readiness to listen to good advice comes to much the same thing as being wise oneself".

(Extract from Flight Safety Foundation Bulletin)

Damage to Pavement at one of our International Airports

NOT A PROFESSIONAL TURN: EXPENSIVE TOO!