HENWOOD & DANCEY PTY. LTD. GEELONG

AVIATION SAFETY DIGEST

DEPARTMENT OF
CIVIL AVIATION

No. 30 JUNE, 1962

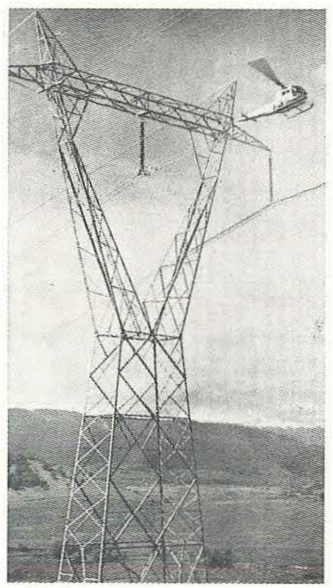
AVIATION SAFETY DIGEST

No. 30 JUNE, 1962

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

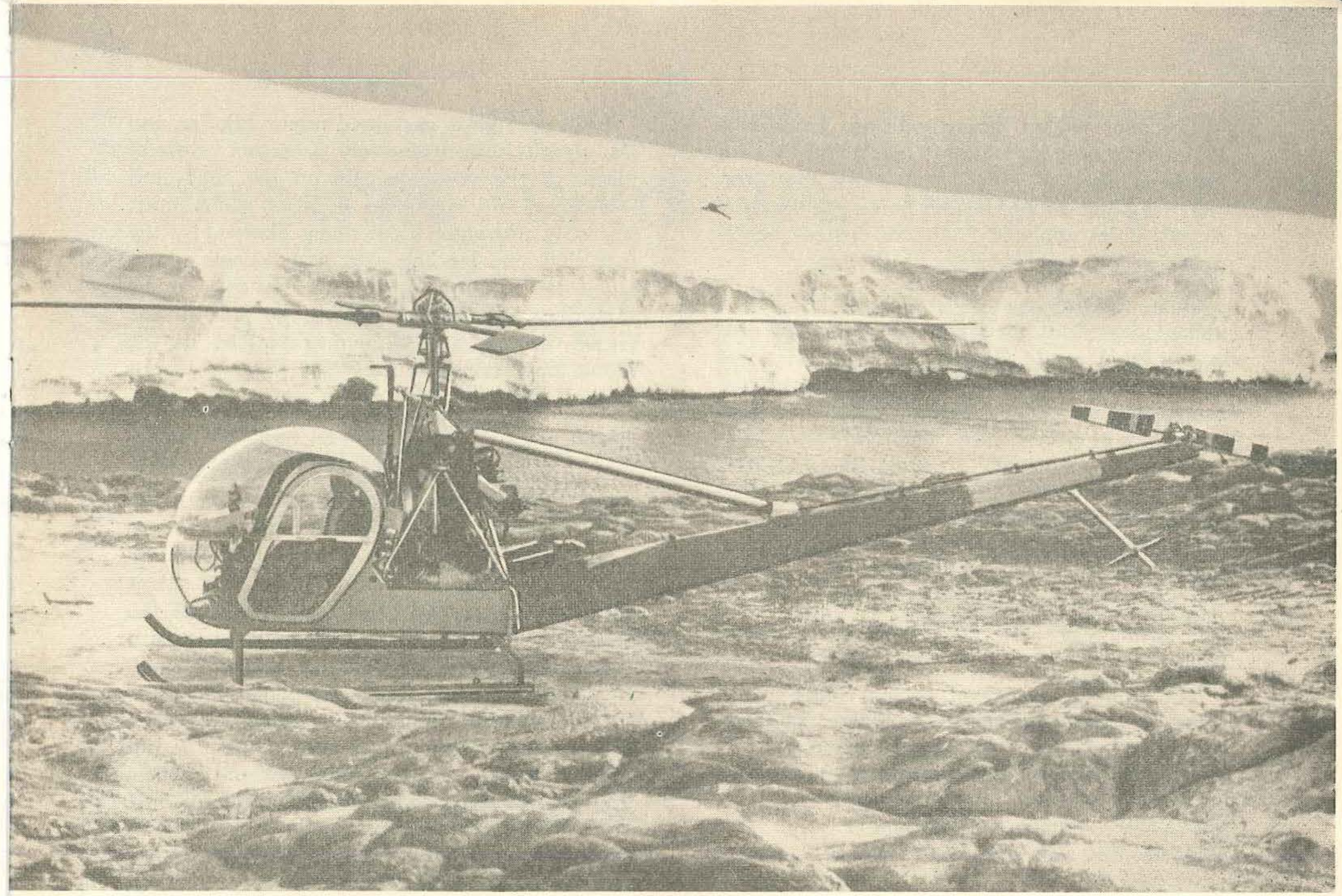
Contents

Helicopter Hazards in the Antarctic 1
Check That Breather Pipe 2
Operating Limitations are Important 3
Boeing 707 Overshoot at London Airport 4
That Vital Fuel Again 7
Weight Versus Lift, Waiwhiu Valley, North Auckland 8
Helicopter Icing, British Columbia 10
Switch Off Before You Step Out 10
Costly Carelessness 11
Passage Barred 11
Seeing the Shear 12
Which is Which! 16
Your Pre-flight Check can be a Life-saver 16
Loss of Control in Extreme Turbulence, Lasqueti Island, British Columbia 17
Lack of Crew Co-ordination precedes Constellation Disaster, Richmond, Virginia 18
The Pay-off 22
A Stitch In Time 23
An Expensive Oversight 24
Design Note : Surface Controls — Pulley Installation



Helicopter on patrol of State Electricity Commission of Victoria power lines.

Commonwealth of Australia



HELICOPTER HAZARDS IN THE ANTARCTIC

On 13th February, 1960, two Hiller helicopters attached to the Australian Antarctic base at Wilkes set out in company for the Hatch Islands, a small group situated close to the shore at a distance of approximately fifty miles from the base. Each aircraft carried a passenger, one of whom was to carry out geological work and the other to take an astro fix to determine the exact position of the islands.

The weather was fine and the wind calm at departure and, apart from a generator failure in one of the aircraft, the first stage of the flight to South Vanderford Glacier was uneventful. After the aircraft had been refuelled from a fuel dump which had been set up on the glacier the flight was resumed.

During take-off there was a surface wind of 30 knots which increased to 45 knots as the aircraft approached the cruising altitude of 2,000 feet. As the flight progressed the wind strength increased further and reached a speed in excess of 60 knots when the aircraft were over a group of small islands within four miles of the destination. At this point one aircraft commenced to descend with the intention of attempting to land, but, upon reaching a height of 500 feet, severe turbulence was encountered and extreme difficulty was experienced in controlling the aircraft.

It was evident that a landing on this group of islands was not possible, therefore the other aircraft continued on to the Hatch Islands to see if the conditions there were more favourable, but if anything, they proved to be worse. In the course of the descent similar turbulence was encountered and at a height of ten feet there were wind gusts of an estimated strength of 75 knots.

The pilot judged these conditions prohibitive to landing and the aircraft was climbed to a height of 500 feet and flown towards the mainland ice shelf which at this particular location sloped at an angle of 25 to 30 degrees before dropping 100 feet vertically to the sea.

Upon arriving over the edge of the shelf a violent downdraft together with trubulence was encountered and although full power was applied, the aircraft entered a rapid and sustained descent. This confronted the pilot with the choice of either flying the aircraft away from the shelf in an attempt to avoid the downdraft but with the possibility of being forced down in the sea or alternatively, to remain above the shelf with the almost certain prospect of a forced landing on the ice. Since immersion in the sea would prove fatal due to the extremely low temperature the pilot decided to remain over the shelf.

The aircraft continued to lose height until it was apparent that an accident was inevitable, whereupon the pilot executed a controlled crash on the ice, rolling the aircraft just before impact.

Both occupants sustained minor injuries and the aircraft was extensively damaged. Several pieces of the wreckage slid off the shelf into the water and the main body of the aircraft was only prevented from doing likewise by the fact that one landing skid had become firmly embedded in the ice at impact. In spite of the conditions the other aircraft landed at the Hatch Islands and the crew assisted in the rescue operations.

The accompanying photograph shows the rescue aircraft on the ground and the precarious position of the wrecked helicopter (background) on a steep icy slope leading to a 100 foot cliff falling sheer into the sea.

Although it may be unlikely that you will be engaged in any Antarctic flying, this accident should serve to illustrate the severity of the downdrafts which occur with the passage of a strong wind over undulating or broken terrain. In certain types of flying, particularly agricultural, the flight should be planned to avoid possible downdraft areas and if this is not possible, allow sufficient safety margin to offset the loss of height which is likely to occur.

CHECK THAT BREATHER PIPE

Recently a Cessna 170 aircraft had to make a forced landing because of engine failure. Fortunately, nobody was injured and the aircraft was undamaged. The subsequent investigation revealed that the engine had failed because of loss of lubricating oil.

How did this loss occur? Simply, the crankcase breather pipe was partially blocked. This overpressurised the crankcase and forced the oil level dipstick from its position and allowed the engine oil to spew from the crankcase.

The engine in the Cessna 170 is one of the Continental 0-300 series and the crankcase breather pipe is of an irregular shape and is difficult to clean thoroughly as the heaviest carbon deposits collect in the section which runs horizontally along the cylinders. Apparently in this case the pipe had not been cleaned properly at the last engine overhaul.

The dipstick on this particular model engine involved in this incident is normally located in position by a rubber "O" ring seal. During their normal operational life the "O" rings have a tendency to harden and lose their elasticity and it is then possible for the dipstick to be dislodged from its normal position by excess crankcase pressure. Later model O-300 engines have a modified dipstick which incorporates a spring locking device.

It is clear from this experience that the engine breather pipe should not be ignored when overhauling an engine and that it is essential for the pipes to be properly cleaned out. An oil leak from around the dipstick may be a sign that the pipe is partially or completely blocked. Check the "O" rings on the dipstick at regular intervals and, if the seal appears to have lost its elasticity replace it. A more reliable safeguard would be to fit (at the earliest opportunity) a dipstick having a spring lock. The few shillings spent so doing could save your life.

OPERATING LIMITS ARE IMPORTANT

During a flight in a Cessna 172 a student pilot found that the flaps were difficult to operate. After landing the starboard wing was found to be distorted with the skin on the lower surface torn from the rivets at the rear spar. Inspection by an engineer revealed that the starboard inner flap track had been subjected to excessive loading resulting in buckling of the rear spar web to which the track bracket is attached. It was also found that the inboard lower surface of the starboard flap had distorted to the extent that in the "flap up" position the trailing edge of the flap was approximately half an inch above the level of the centre section fairing.

The student pilot had been authorised to practice stalling, steep turns, steep gliding turns and forced landings. The subsequent investigation showed that the probable cause of the damage was that during some stage of flight the flaps were lowered at speeds in excess of the maximum permissible for this operation or that speeds in excess of the maximum were flown whilst the flaps were still extended.

As a result of the findings on this incident, and also of exhaustive tests carried out by this Department into the stalling and spinning characteristics of Piper PA-22, Cesna 150, 170 and 172 aircraft, it was decided to modify the Private Pilot Licence training syllabus for these and other similar aircraft by deleting the spinning requirements and amplifying the stalling sequence. In the modified requirement, which is already in force, the following manoeuvres are to be demonstrated by the instructor and the pupil must be competent to repeat the manoeuvres without assistance from the instructor.

(i) Stalling without power, without flaps and with flaps set in varying degrees. Recoveries to be made both with and without power.

(ii) Stalling with power set to simulate powered approach conditions. This is to be practised with varying flap settings. Recoveries to be made with the application of power.

(iii) Stalling as in (i) i.e., no power and varying flap settings, but in this exercise the nose of the aircraft is to be raised high enough to produce a positive wing drop. Recoveries to be made both with and without the use of power.

(iv) Stalling as in (ii) i.e., with power set and varying flap settings but in this exercise a turn is to be initiated just before the stall, the turn to be made using excessive rudder. Recoveries to be made with the application of power.

Both the Cessna and Piper series of aircraft are extremely reluctant to spin and their docile characteristics are appreciated by all private owners. Any aircraft can "bite" if sufficiently abused and, since gross mishandling of the Cessna and Piper is more likely to produce a spiral dive than a spin, due to their fairly clean aerodynamic design, high speeds can be attained very rapidly. Manoeuvres performed at an excessive speed can impose excessively high loads upon an aircraft and with fixed pitch propellers the R.P.M. may reach intolerable limits and present a serious risk of engine failure.

You are urged to familiarize yourself with the operational limitations which have been placed on the type of aircraft you intend to fly. To exceed them is to invite disaster as testified by the fate of many pilots who, either through ignorance or carelessness, have done so.

Boeing 707 Overshoots at London Airport

(Summary based on the report of the Ministry of Aviation, U.K.)

At 1138 hours on 24th December, 1960, a Boeing 707 arrived at London at the conclusion of a scheduled flight from Chicago. The aircraft made a precision approach radar descent to land on runway 23 left. The point of touchdown was nearly half way along the runway, and as the captain was unable to bring the aircraft to a stop on the remaining length of runway, it ran on to the grass surface beyond the end. The main landing gear units collapsed and the aircraft was extensively damaged. None of the passengers or crew was injured.

FLIGHT

The aircraft departed from Prestwick on the final leg of the flight at 1042 hours. A descent was made from Flight Level 180 to 60 in the Watford holding pattern after which the aircraft was positioned with the assistance of London approach radar for a precision approach radar (P.A.R.) talk down onto runway 23 left. At this time the following local weather was broadcast by approach control; surface wind 260° at 5 knots, vis. 1.5 miles in mist, 6/8ths cloud at 500 feet, 8/8ths cloud at 1,500 feet.

When the aircraft had descended to 2,000 feet the landing check was completed and 40° flap selected. The airspeed index setting pointers were set to the correct V ref. figure of 132 knots and both pilots' altimeters were set to the appropriate QNH value. Upon interception of the $3\frac{1}{2}$° glide path talk-down was commenced. The captain was advised that the wind was westerly at 5 knots. According to the captain the aircraft broke cloud at about 1,500 feet and the approach lighting came into view. During the P.A.R. talk-down the flight path deviations were of normal proportions, the greatest being 100 feet above the glide path when at a distance of 2 miles from touchdown. The captain has stated that he maintained an airspeed of 142 knots between the time of breaking cloud and being at a height of 300 feet. At 300 feet full flap was selected and, according to the captain, the speed was gradually reduced to 132 knots over the runway threshold. The first officer believed that the speed when passing over the threshold was about 142 knots. The aircraft crossed the threshold between 35 and 50 feet above the surface and tyre marks on the runway indicated that it touched down when it was nearly half way along the runway. There was no bounce and the captain closed the throttles. The spoilers were then fully extended and reverse thrust on all four engines was applied at about 50% power. Just before the First Officer called out "100 knots" the captain commenced to apply the brakes. Cancellation of reverse thrust was initiated at 100 knots and the wheel braking was then progressively increased. According to the captain the landing had appeared normal to him up to this stage and he had no doubt that the aircraft would stop within the remaining runway length. He said he continued to increase pressure on the brakes until the pedals were at full travel but the braking effect appeared to be far less than normal. The brakes were released and re-applied several times but with no appreciable effect. He did not detect the normal brake pedal kick-back so he switched off the anti-skid device and re-applied the brakes. By this time it was evident to the captain that the aircraft would not stop before reaching the end of the runway so be attempted to steer the aircraft through a right hand turn of about 100° on to runway 33 left which has its beginning at the end of runway 23 left. After an initial change in direction the aircraft commenced to skid to the left and crossed the end of the runway on a heading approximately at right angles to its original direction. After skidding a short distance on the grass surface the main landing gear collapsed and the aircraft came to a standstill. At no stage during the landing run was the brake hydraulic pressure observed by any of the operating crew nor were the emergency brakes operated. The crew immediately shut off engine power, the fuel supply and the electrical services. The passengers and crew were evacuated by way of the inflatable shutes and emergency exits.

(All times herein are G.M.T.)

INVESTIGATION

The captain and first officer held airline transport licences and were both endorsed for Boeing 707 aircraft. The captain's flying experience amounted to 15,805 hours of which 202 hours were flown in this type aircraft. The first officer had a total of 4,550 flying hours.

Runway 23 left is 7,734 feet long and there is no slope. The Precision Approach Radar glide path angle for this runway is $3\frac{1}{2}$ degrees and the touchdown point is 900 feet from the outer boundary of the perimeter track or 800 feet beyond the runway threshold. The surface was moist to the extent that a squeegee effect was discernible in the tracks made by heavy aircraft. The first touchdown marks made by the subject aircraft were approximately 3,500 feet from the runway threshold and were astride the centre line. These marks showed the characteristics of wheel spin-up which included light fresh rubber smears. The wheel tracks were traced to the end of the runway. Fresh rubber smears 15-20 feet in length indicated that the anti-skid system was inoperative during the latter part of the landing run.

The aircraft came to rest on a heading of 350°M approximately 50 feet beyond the end of the runway. The two main landing gear units had collapsed sideways to starboard causing associated damage in the wheel-bays and at the side-strut attachments. The port engines had become detached from their mountings. Three small punctures were present in the underside of No. 1 (port wing) tank which were made when No. 1 engine was torn away and rolled under the mainplane. It was noted that a considerable amount of fuel had drained out. The emergency air brake selector was wire-locked to the OFF position and the emergency air brake pressure was 1,100 p.s.i. The anti-skid switch was at the OFF position.

No defects were discovered which could be associated with any reduction in the braking effectiveness.

The target threshold speed for the aircraft at the landing weight of 85,405 kilos was 140 knots and the maximum threshold speed was 155 knots.

A profile reconstruction of the aircraft's descent path during the P.A.R. talk-down is included at page 6. Calculations made on a basis of the time taken between the radar ranges show that the average ground speed of the aircraft between the $4\frac{1}{2}$ and $\frac{1}{2}$ mile ranges was approximately 160 knots. Bearing in mind that the wind between 1,000 and 2,000 feet was 230°/10 knots and the surface wind was 240°/4 knots it would appear likely that the aircraft's airspeed was about 10 knots higher than the ground speed during most of the approach.

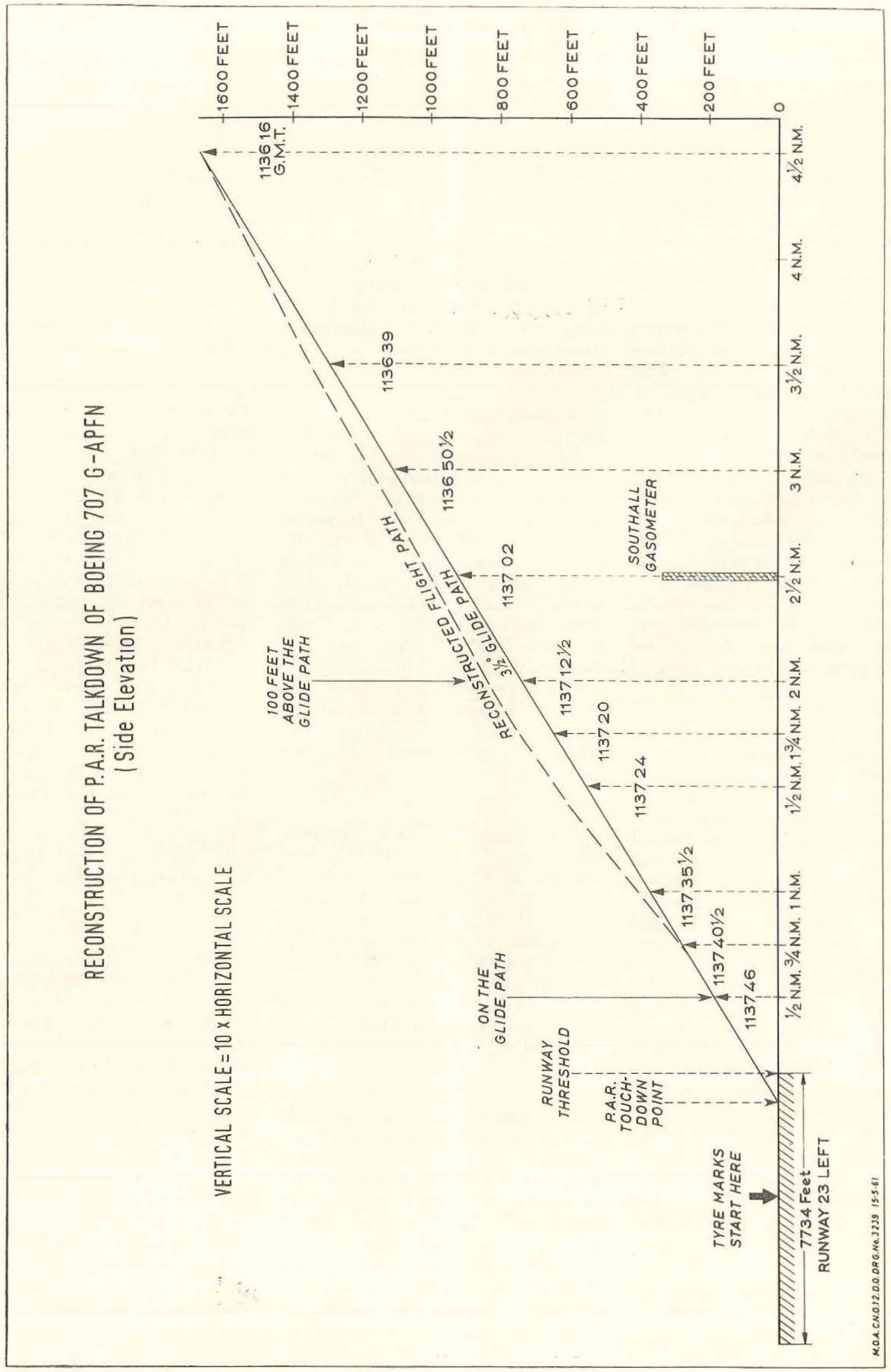
The captain's evidence that the airspeed of the aircraft during the approach was 142 knots is not consistent with this analysis of the P.A.R. talk-down, nor is it possible to reconcile the aircraft's touchdown position, nearly half way down the runway, with his belief that he crossed the threshold at 35-40 feet at an airspeed of 132 knots.

In considering a possible reason why the approach and threshold speeds were too high it is necessary to examine the relationship between the glide path angle and the approach speed in light wind conditions. If the glide path angle is steeper than normal the resultant rate-of-descent will be greater than normal; also in conditions of no wind the rate-of-descent will be greater than when there is a strong headwind. When these factors are acting in combination higher rates-of-descent will result.

To flare the aircraft from a given height an increment of lift coefficient (CL) is required which is proportional to the square of the rate-of-descent. It is therefore essential to ensure that an adequate margin of lift capability is available to achieve the flare successfully, subsequent to a high rate-of-descent. One method of doing this is by approaching the flare at an airspeed higher than the target threshold speed. It is probable that the experienced pilot will instinctively adjust the airspeed in relation to the rate-of-descent but as the amount of the increment of speed is a matter of fine judgement and the consequences of underestimating it can be more dangerous than the consequences of overestimating it, the pilot may tend to err on the safe side and select a speed that is too fast rather than too slow.

The instructions contained in both the Flight Manual and the Operations Manual state that upon touchdown the spoilers should be fully extended, then the wheel brakes should be applied at the same time as the nose wheel is being lowered on to the runway.

During the landing reverse thrust was applied at about 50% power and its cancellation was initiated when the first officer called "100 knots." Full advantage was not taken, therefore, of the available retardation effect resulting from reverse thrust.



Maximum reverse thrust should have been used and maintained until an airspeed of 90 knots was reached whereupon the reverse thrust should have been regulated to prevent engine surge and controllability difficulties. At a speed of 60 knots reverse thrust should have been cancelled. When it became clear that the aircraft would not stop before reaching the end of the runway it is considered that reverse thrust should have been reapplied regardless of the airspeed limitations.

The wheel brakes were operated after reverse thrust had been applied, and the speed was just above 100 knots. They were applied and released several times both with and without anti-skid control selected. There is no evidence from the runway marks, the tyres or from the strip examination of the brake assemblies that the brakes did not operate normally during the landing run. It is probable that less efficient braking resulted from the captain's action of switching OFF the anti-skid switch. When he had the impression that there was no retardation from braking effort it is considered that the emergency brakes should have been used although it seems unlikely that this would have prevented the aircraft overrunning.

CAUSE

The Captain carried out the final stage of the approach to land at too high an airspeed. As a result the aircraft touched down too far along the runway and failed to stop within the remaining length.

THAT VITAL FUEL AGAIN

Early in 1961 a Piper Pawnee aircraft was engaged in a superphosphate spreading operation over hilly terrain in Gippsland, Victoria. At the conclusion of a day's operation fuel was added to the tanks until a total quantity of twenty gallons was shown on the aircraft's fuel gauge. After the refuelling the aircraft was taken up on a short flight of ten minutes duration.

On the following morning the pilot although not qualified to do so, carried out the daily inspection and then flew the aircraft to the agricultural strip from which operations were to be conducted that day. The duration of this flight was eight minutes.

The spreading operations were then commenced and, over a period of between 110 and 120 minutes, 23 flights were made. When turning at the end of the first run on the 24th flight the engine lost power and the pilot dumped the remaining superphosphate.

As there was no favourable forced landing area available to him, he attempted to land the aircraft up the steeply sloping sides of a nearby hill. The approach was misjudged and the aircraft struck the ground 500 feet beyond and 100 feet below the crest of the hill after which it swung through 90 degrees before coming to rest in a creek bed 120 feet from the point of initial impact. The aircraft was extensively damaged but the pilot was unhurt.

After the accident the aircraft's fuel system was found to contain insufficient fuel to allow satisfactory operation of the engine. It was established that there could not have been any significant loss of fuel by leakage or any other means either before or after the accident. When operating at 75 per cent power the Piper Pawnee consumes nine gallons of fuel per hour, and on the assumption that the engine had been operated at a mean of 75 per cent power since refuelling, it is estimated that the aircraft would have used twenty gallons of fuel which was the total quantity initially carried.

The pilot did not check the fuel contents before take-off on the final flight and, apart from noticing that the fuel gauge showed empty immediately following the loss of power, the last check he could recall having made was when the gauge showed ten gallons several flights prior to the last.

The pilot was relatively inexperienced both in the type of flying and on the type of aircraft, having flown a total of only 59 hours on agricultural operations and 61 hours on the Piper Pawnee. In addition, he had not completed the full agricultural pilot training course.

Although inexperience might be an acceptable excuse for shortcomings in manipulative skill it is no let out for fuel mismanagement of this nature.

WEIGHT VERSUS LIFT

FATAL AGRICULTURAL ACCIDENT AT WAIWHIU VALLEY

NORTH AUCKLAND, N.Z.

(Summary of a report by the Air Department, New Zealand)

On 22nd October, 1961, a Piper PA18A dived into the ground from a low level on a steep slope, during top dressing operations at Waiwhiu Valley, North Auckland. The pilot was killed instantly.

On Saturday, 21st October, 1961, the pilot and his loader-driver were engaged on topdressing. Operations began at 1500 hours and finished about 1830 hours, during which time some 20 tons of superphosphate had been spread.

The following morning, operations commenced at 0520 hours. By 0650 hours 22 runs had been completed in good flying weather and without incident or mechanical trouble. The pilot then rested for 10 or 15 minutes, during which time he himself put some fuel in each tank of the aircraft.

Two further runs with a 7 cwt. hopper load were then made successfully but on the next one, the loader-driver had the impression that the aircraft was flying lower than usual. It flew over the strip towards the dressing area on a constant heading with the engine running quite normally but descending. The loader-driver and another witness both saw the aircraft pass over a small intervening ridge on an unaltered heading and just prior to disappearing from view, it entered a steep dive. An immediate search revealed the wrecked aircraft standing almost vertically, nose down on a reciprocal heading, in manuka bush on the steep face of a hill.

Nothing was found in the wreckage of the aircraft or in the examination of the engine to suggest any defect or malfunction of any kind.

The hopper was found approximately two-thirds full of superphosphate and some residue of this material lay in the immediate vicinity of the wreckage. The hopper release mechanism and the hopper mouth were too badly damaged to provide any useful evidence.

The propeller showed evidence of having been under power at the time of impact and no pre-impact malfunction or defect was apparent.

A quantity of fuel remained in each tank.

Overall damage was consistent with the aircraft having struck the ground at a speed of 60-65 m.p.h.

INVESTIGATION

On the morning of the accident, the pilot made 22 topdressing flights prior to the refuelling break. The pilot spoke of no difficulties and was apparently satisfied with the progress being made. After refuelling, two further flights were made without incident.

On the third flight, both the loader-driver and the farmer on whose property the aircraft crashed observed that the aircraft was flying over the strip into the dressing area at a lower height than had been the practice hitherto. The fact that the aircraft was flying in a power-on shallow descent caused the farmer some concern.

The loader-driver believed that during this run he saw superphosphate emerging from the aircraft but the farmer was not sure on this point. The fact that the wrecked hopper contained a large amount of superphosphate indicated that only a small quantity, if any, had been released prior to the crash. It was therefore apparent that the flow of superphosphate during the last dressing run was much less than normal. Neither witness at any time observed a hopper flow which would indicate that the pilot had attempted to jettison his load.

There is a possibility that the aircraft was being flown in an inadvertantly overloaded condition. The weight of the aircraft with pilot, hopper load and oil was 2,128 lb. The maximum permissible all-up weight, according to the certificate of airworthiness, was 2070 lb. Even without fuel, therefore, the aircraft was being flown on every flight in an overloaded condition.

It was ascertained that the pilot customarily filled both tanks brim full when refuelling. Total fuel capacity of the aircraft was 30 imperial gallons. If, whenever it was refuelled, the tanks were filled to capacity, the aircraft would make its first flight after refuelling with an overload of 274 lb.

Prior to the accident the pilot himself refuelled the aircraft. There is no evidence to show how much fuel was added to each tank during the refuelling break at 0650 hours. Neither is it known whether the tanks were completely filled at the end of the previous day's work. It has therefore been necessary to calculate the weight at the time of the last take-off under the least prejudicial circumstances. The pilot added some fuel to each tank after he had completed 90 minutes' flying on the morning of the accident. This could indicate that he may have planned to refuel at 90 minute intervals and that he was deliberately carrying a restricted fuel load. In 90 minutes flying time the engine would consume 12 gallons of fuel and the pilot would necessarily provide a small reserve as well. If that reserve amounted to 3 gallons for each tank, a total of 18 gallons would be required to meet the planned refuelling program suggested. The accident occurred after the aircraft had made two flights during the course of which 3 gallons at most would be consumed. That being the case, the aircraft would have taken off on its last flight with a total of 15 gallons in the tanks. The all-up weight for the last flight would then have been 2,236 lb., representing an overload of 166 lb.

As the aircraft had made 24 successful sorties in an overloaded condition, it is logical to assume that some additional factor existed on the fatal flight. This additional factor could have been created by increased overload, brought about by failure to discharge the complete contents of the hopper on the previous flight and in loading a further 7 cwt., the additional weight would have been sufficient to materially affect the performance of the aircraft. This situation has been the cause of a number of accidents and near accidents in the past. The texture of the superphosphate found in the hopper after the accident supports this possibility. It was found to be of a consistency which did not flow freely through the fingers and was capable of being compressed into soft lumps. Such a condition would also account for the failure of the load to jettison in what must obviously have been a critical situation. Moreover the pilot's preoccupation with the probable attempt to jettison could also be an explanation for his flying the aircraft directly towards a steep slope and thus into a position from which he could only escape by a steep turn or an attempt to climb over the ridge. Either of these manoeuvres if performed by an inexperienced pilot in such a situation would inevitably result in the stalling of the aircraft.

In this case the pilot was inexperienced not only in the total hours flown but in agricultural operations. Furthermore, this was the first time he had operated without supervision in hilly country. There can be little doubt that this inexperience played a major part in the accident and points once again to the necessity for thorough and specialized agricultural flying training and close supervision for some time thereafter.

The pilot was in good health and cheerful spirits on the morning of the accident and a post mortem examination revealed nothing which would point to the possibility of physical incapacity in the air.

CAUSE

The accident was caused by a loss of control at a height which did not permit the regaining of control before the aircraft struck the face of a steep slope while auto-rotating to the right.

Helicopter Icing

BIG INTERIOR MOUNTAIN, BRITISH COLUMBIA

(Extract from Report of Department of Transport, Canada).

When taking off from a drilling site situated at an elevation of 5,850 feet on Big Interior mountain in Canada, a helicopter crashed out of control into the snow following a loss of engine R.P.M. The accident occurred as the helicopter was entering translational flight from the hover.

At 0750 hours, Pacific Standard Time, the helicopter had taken off from a mining camp at an altitude of 3,800 feet to carry a 350 pound load of timber to the drilling site. Light cloud was encountered during the flight.

After landing the engine was set to idle at 1800 r.p.m. and the carburettor hot air control adjusted to a position which the pilot estimated would provide an inlet temperature of between 32 degrees and 35 degrees Fahrenheit. The outside air temperature was 20 degrees Fahrenheit.

The pilot assisted in the unloading of the timber then re-entered the cockpit and increased the engine power to 3100 r.p.m. He attempted to apply maximum carburettor heat however the linkage had frozen and the selector could not be advanced beyond the two thirds hot position. He tested the engine, which appeared normal with the exception of the carburettor inlet temperature which remained in the vicinity of 27° Fahrenheit, and then commenced the take-off.

After the accident an accumulation of ice was noticed on both the cold air intake and the one main rotor blade which was still largely intact.

The conditions were conductive to the formation of airframe icing, thereby accounting for the ice at the cold air intake and possibly allowing ice to form on the inlet air filter thus imposing a further restriction to the flow of cold air to the carburettor. Another possibility considered was that the limited amount of hot air available may have only raised the inlet air temperature into the critical range for the formation of ice inside the carburettor.

The ice on the rotor blades could have formed either when flying through cloud on the previous flight or during the period of five or six minutes when on the ground during the unloading. The effect of the ice on the rotor blades would be to induce a stall and if this did in fact occur, the resultant increase in aerodynamic rotor drag would have contributed to the loss of engine r.p.m. which preceded the accident.

It was concluded that the accident was caused by stalling of the rotor blades together with a loss of engine power which was possibly due to carburettor icing.

A deposit of ice, even in the form of frost, on the aerofoils of an aircraft can seriously retard the generation of lift. Although most pilots are aware of this they may not fully appreciate that a helicopter's rotor blades are similarly effected and certainly to no lesser degree.

Take the opportunity of learning from this pilot's lack of foresight. Even if you are a little behind schedule on some frosty morning, take sufficient time to ensure that all aerofoils are free of ice, otherwise you may become involved in a similar and equally unnecessary accident.

Switch Off Before You Step Out

Irrespective of the motor car act or the traffic laws, it is safe to say that in normal circumstances, few responsible citizens would leave their motor car parked unattended with the engine running.

Incredible as it may seem, reports have recently been received of an increased tendency for pilots of light aircraft to leave their aircraft unattended while parked on apron areas with the engine/engines running, wheels not chocked and often with passengers on board.

Apart from violating Air Navigation Regulations, the danger potential in leaving an aircraft with the engine running unattended, should be obvious. Little imagination is needed to visualize the consequences which could follow in the wake of an aircraft rolling under power, with or without passengers and without an authorised person occupying the pilot's seat.

Apart from the risk to life or limb the pilot's action might well be judged as negligent and his liability for third party damages could easily equal or exceed his life savings.

Costly Carelessness

Most business aircraft operators pride themselves at being good housekeepers. Their hangar areas are neat and clean; their offices are orderly, and their aeroplanes shine like the new silver dollars you don't see much of any more. Occasionally, however, a weary worker will let his weariness get the better of him . . . and then carelessness slips in. Here are a few instances that suggest a periodic check on the housekeeping in the hangar or service operation you rely on wouldn't be wasted.

CASE 1: During a maintenance check a pilot found a flashlight lying across the control cables, and a loose bolt that eventually would have bound the controls.

CASE 2: While cruising at 9,000 feet a loud report was heard.

Investigation revealed a small hole in the fuselage under the flight deck. After landing at the destination airport, several other holes were found in the fuselage, in addition to nicks and gouges in two prop blades of the starboard propeller and a dent in that engine's cowl. Later investigation revealed one handle of a pair of pliers behind one of the holes in the fuselage, and this handle fitted the hole exactly. Somewhere along the line a serviceman evidently had left pliers lying on the engine and vibration had caused them to fall, bouncing into the propeller, and shattering. The pieces were thrown into the fuselage by the spinning prop.

CASE 3: En route, the aeroplane's right engine suddenly lost all oil pressure.

The engine was feathered and a single-engine instrument landing was made at the first available airport. The engine screen was removed and found completely covered with a coating of oil-soaked fibrous material. The sump plug was removed and more fibrous material found. Eventually, the trouble was tracked down; a shop towel was found partly in the oil intake line and partly in the oil pump, thus restricting the oil flow from pump to engine.

One of these three instances occurred as a result of a lapse in the home hangar of the aeroplane; the other two were the fault of slips traced to en route service operations.

Obviously, that old rule of check and double-check belongs in the maintenance end of the business as well as in the flying end.

(Extract from Business Pilots Safety Bulletin)

PASSAGE BARRED

In June, 1961, a private pilot was engaged on a VFR flight in a Dornier DO27 single engined aircraft from the coastal aerodrome at Madang to Goroka—elevation 5,140 feet situated in the New Guinea highlands.

Such a flight calls for a mountain crossing involving peaks rising to nearly 12,000 feet above mean sea level. In clear weather it is possible to navigate visually through one of the several gaps in the mountain range as low as 6,500 feet above mean sea level.

At the material time, cloud had built up covering the mountain range and the gaps referred to, but in the valley where Goroka is situated, the cloud was 4/8ths at 2,500 feet above aerodrome level.

The pilot gave a position report by radio indicating that the aircraft was at the Bena Gap on the top of cloud at flight level 130. This was the last transmission received from the aircraft and it failed to arrive at Goroka.

Approximately 1¾ hours after receipt of the last radio transmission from the aircraft an aerial search located the wreckage at an elevation of 8,800 feet on the slopes of the mountain range six miles on the Madang side of Goroka. A ground party which was directed by air to the accident site later confirmed that the pilot was killed in the crash and the aircraft destroyed by impact forces and fire.

Examination of the wreckage did not reveal any pre-impact defect in the airframe and indicated that the engine was capable of developing normal power immediately prior to the accident. It was concluded that the probable cause of the accident was that the aircraft was flown without adequate visual reference when operating over mountainous terrain.

COMMENT

When undertaking a flight in which you are restricted to visual flight rules, ensure that at all times you avoid flying in weather which does not meet the standards laid down for visual meteorological conditions and when descending at your destination, ensure that you avoid any situation which may cause you to inadvertently lose visual contact with the terrain or other obstructions in the vicinity.

SEEING THE SHEAR

(Extract from Pilots Safety Exchange Bulletin)

(This article from the U.S.A.F.'s "Aerospace Safety" magazine, is an adaptation of an airline technical bulletin, with additional source material from Boeing and Air Force publications).

Starting his final approach at about 1500 feet, a pilot finds himself heading into a stiff wind. Because the wind provides a substantial part of the necessary airspeed, he throttles back his engines. Suddenly, a few hundred feet above the ground, the wind dies. Only a fast increase in power prevents the airplane from stalling and crashing.

Right ?

Or is this right ? Starting final into a stiff wind the pilot finds he has to carry extra power to bring his plane up to the runway. Suddenly, a few hundred feet from the ground, the head wind dies out. Only a fast decrease in power prevents the aircraft from overshooting.

Or how about this version ? Starting final into a stiff wind the pilot finds he has to carry extra power to maintain a normal glide path toward the runway. Suddenly, a few hundred feet from the ground, the wind dies. Only a fast increase in power prevents the aeroplane from stalling and crashing.

If there is any doubt in your mind as to which of the three cases above is correct (or if there is no doubt, but you are wrong), read on. There are things you should know about wind shear.

Normal Glide Path

Figure 1 illustrates a normal glide path profile with a 3 degree glide path from the glide slope unit crossing the outer marker at 1000 feet. This gives a glide slope distance of 3.14 nautical miles from the outer marker to touchdown point. For our typical case we have chosen headwinds of 20 knots at 1000 feet and 10 knots on the surface. Speed selected is 140 knots over outer marker, tapering to 120 knots at touchdown. These conditions are considered typical and will be used as standards for analysing abnormal wind conditions in later examples.

From Figure 1 we can compute that the elapsed time from outer marker to touchdown in this case is 1.64 minutes, which results in an average ground speed of 115 knots and an average rate of descent of 610 feet per minute. Also, normal airspeed deceleration from outer marker to touchdown is 20 knots and the ground speed deceleration in this case is 10 knots. The change in ground speed becomes a very important consideration when analysing abnormal wind shear conditions because it involves the problem of rapidly accelerating or decelerating an aircraft mass of up to 150 tons during the landing approach.

Tailwind Approach

In Figure 2 we consider an abuormal tailwind approach in which a 40 knot tailwind exists at the outer marker with a zero surface wind. As can be computed in this case, the average ground speed from the outer marker to touchdown is 150 knots, which results in an elapsed time of 1.24 minutes and an average rate of descent of 800 feet per minute for a precisely executed approach. Comparing this example with Figure 1, we see that while the airspeed is decelerated 20 knots in both cases the ground speed in the latter case must be decelerated 60 knots in a faster time than the 20 knot deceleration in the normal approach of Figure 1. This is the root of the problem, for whenever the wind environment changes faster than the aircraft mass can be accelerated or decelerated, the wind variations must be reflected by changes in airspeed. In the tailwind situation depicted in Figure 2, should the pilot be unable to decelerate his aircraft in the faster time required, he would find his airspeed had increased, very likely he would have gone above glide path in an effort to hold desired airspeed, and he would have to go around. (Assuming of course, he wisely resists the temptation to land long). One more point, the more gradual the shear the more likely the pilot is to be able to decelerate to remain on glide path and at desired indicated airspeed.

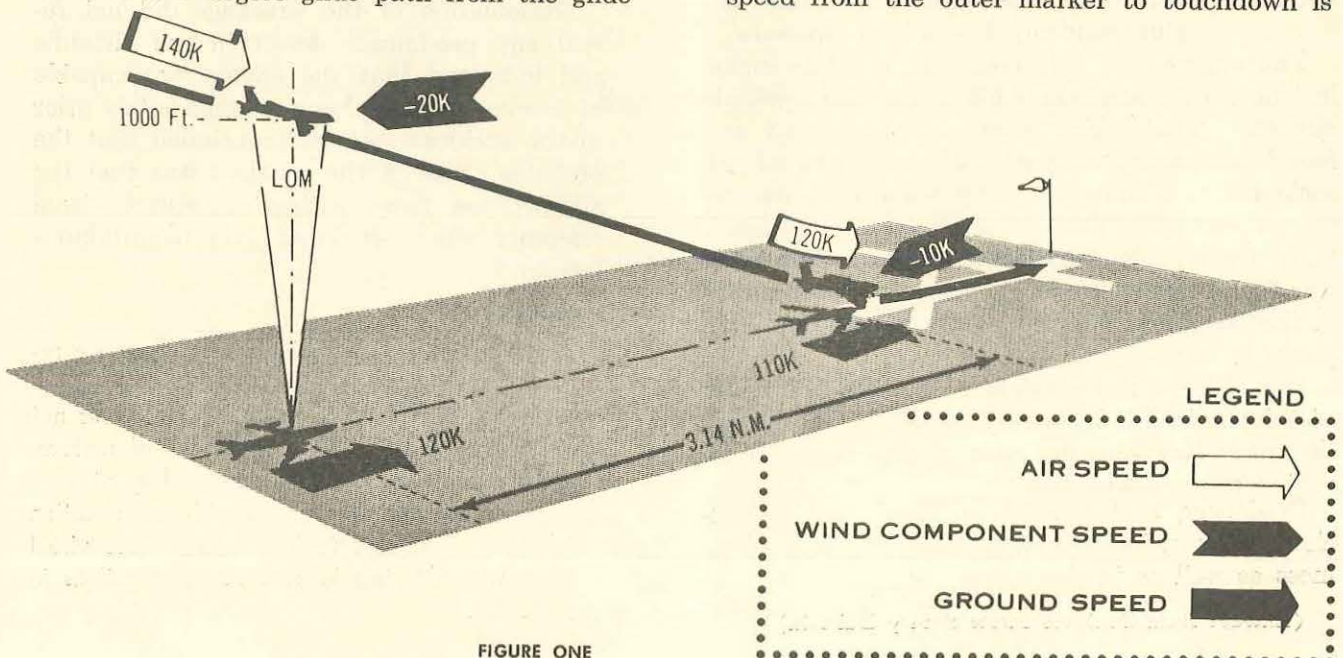


FIGURE ONE

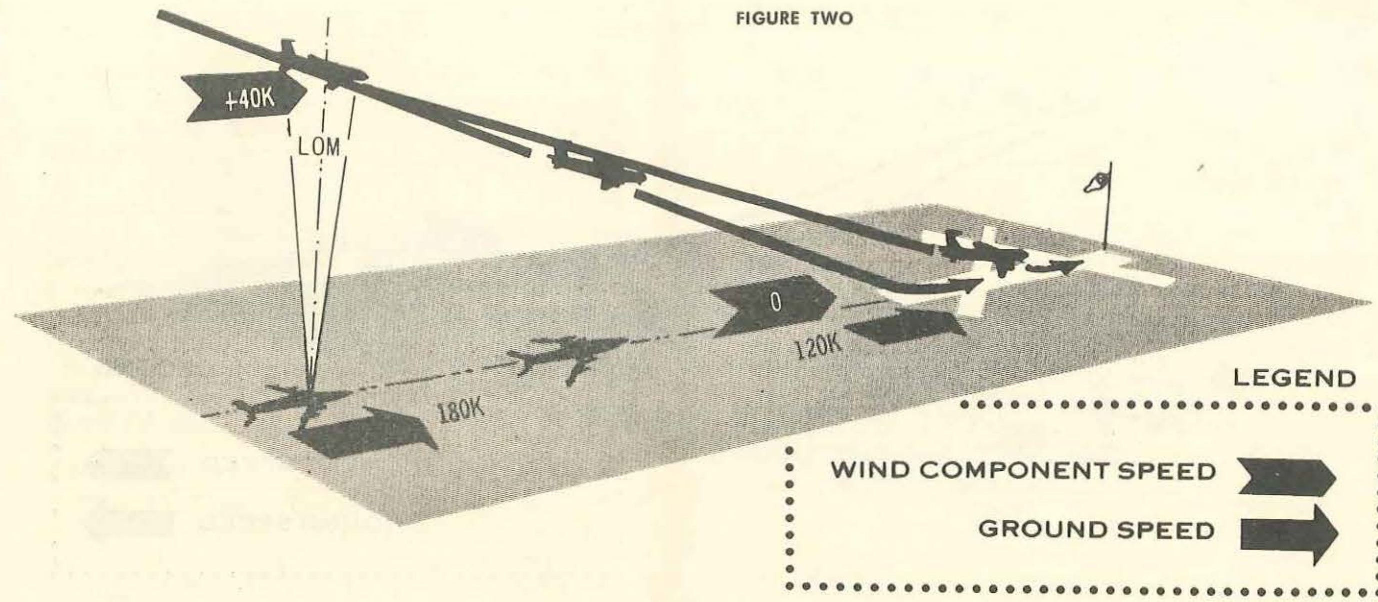


FIGURE TWO

Headwind Approach

In Figure 3 we take up the strong headwind-aloft condition. In this case we have a 40 knot headwind over the outer marker and a zero component on the ground. In this case we find that the average ground speed from the outer marker to touchdown is 110 knots, which results in an elapsed time of 1.7 minutes and an average rate of descent of 580 feet per minute for a precisely executed approach. In comparing this situation with the normal profile approach depicted in Figure 1, we see that in the headwind shear approach the aircraft ground speed must be accelerated by 20 knots during the final approach instead of the normal 10 knot deceleration. Unless this acceleration is accomplished, the aircraft will sink below the glide slope and land short of the runway. Occasionally the shear will not be gradual, but will occur rapidly. If the speed falls below stall speed the aircraft will lose altitude until it crashes or flying speed is recovered. Time required for acceleration to flying speed may exceed that available. To illustrate, following are calculations for a particular aircraft. Conditions are altitude 1000 millibars, power setting constant, air speed 100 knots, headwind 20 knots. When the aircraft is instantaneously placed in calm air the times to accelerate to the indicated ground speeds are :

80 knots — 0 seconds
86 knots — 39.9 seconds
90 knots — 77.5 seconds
96 knots — 175.5 seconds

This computation confirms tests run with a Constellation in stabilized flight at constant altitude near the stalling speed in which it was found that nearly half a minute was required before any noticeable acceleration was observed following application of full power.

It appears that a safe landing speed from a headwind into a calm would be an airspeed equal to at least the stall speed plus the headwind component at approximately 1000 feet above the surface.

Aggravating the seriousness of a sudden decrease in headwind component on final approach is increased drag as angle of attack is increased to lower stall speed, with the possibility of entering the backside of the power curve (more power required to fly slower).

Pilots of propeller aircraft have a considerable advantage due to faster acceleration and a lowered power on stall speed due to increased

FIGURE THREE

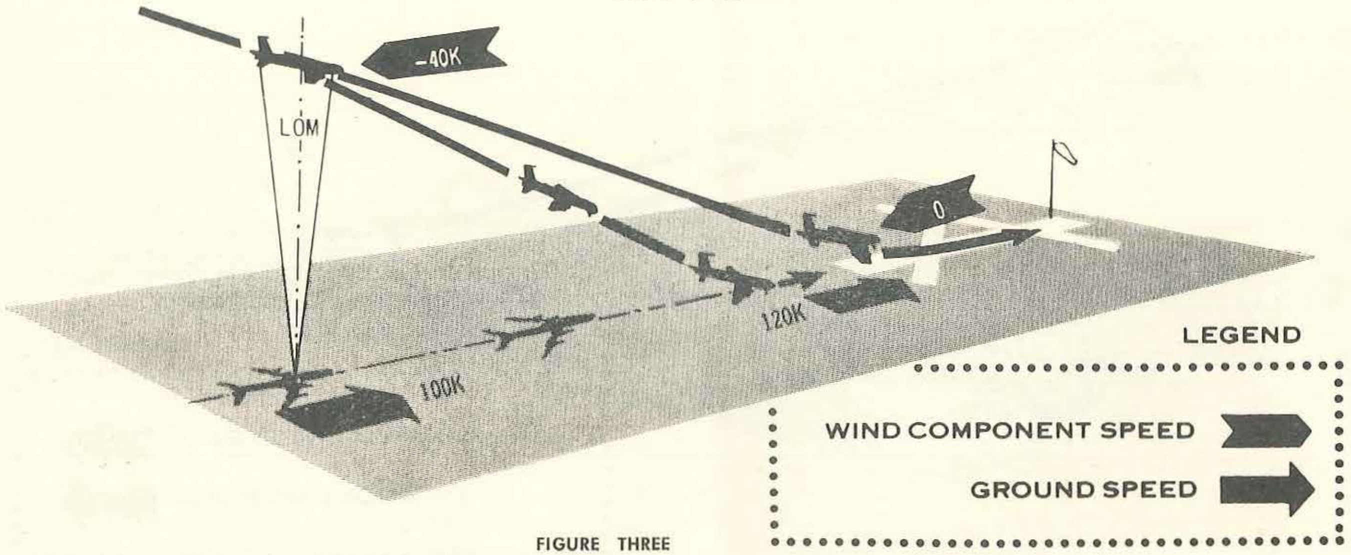


FIGURE THREE

airflow over the wings. Jet pilots must rely on increased airspeed alone.

The sudden loss of headwind component can also be disastrous on take off—takeoffs into thunderstorm shear areas have provided several examples of this.

Wind Shear in Turns

The effect of encountering a wind shift during a turn deserves special mention because of the possibility in certain cases of its simultaneous occurrence with other conditions which could compound the hazard. Effects can be: a rapid drop in airspeed; a sudden increase in angle of bank caused by the side component of the new wind environment acting upon the wing dihedral, down drafts. An analysis of meteorological conditions associated with squall lines had led to the conclusion that the simultaneous occurrence of the three hazards could normally be experienced in the northern hemisphere only in the left turn.

Gusty Winds

When winds are gusty the airspeed will vary in an amount equal to the difference between the lull and the peak gusts. For this reason it is wise to carry an added airspeed allowance in a gusty wind condition to help prevent experiencing a dangerously low airspeed. This is particularly important during approaches and when circling due to relatively high drag of an aircraft with gear down, particularly when in a banked attitude. Operating procedures manuals spell out allowances to be made, usually on the order of half the value of the gustiness up to a specified figure.

Vertical Wind Gradient

Due to reductions in wind speeds at lower levels due to surface friction, wind speed gradually increases from ground level up to the gradient level where surface friction is no longer effective. Another characteristic of wind gradient is the change in wind direction at low levels. In the free atmosphere the wind blows approximately parallel with the isobars, the lower pressure being to the left; but, in addition to reducing the wind speed, the surface friction also causes the wind direction below the gradient level to flow somewhat across the isobars toward the lower pressure. As a result, the wind direction usually backs counterclockwise from about 3000 feet to 300 feet, the magnitude averaging 20 to 40 degrees but reaching as much as 70 to 90 degrees in isolated cases. A rule which may help in areas where wind flow is not materially affected by terrain features and obstructions is: When the runway wind is from the right and is nearly a crosswind or has a tailwind component, the gradient wind usually has a stronger tailwind component. An extreme situation of this type in a tight pressure gradient could constitute an abnormal tailwind-shear condition for aircraft using this runway. Similarly, the frictional shift of wind direction below the gradient level also increases the wind shear in a headwind approach. In this case, descent below the gradient level magnifies the decrease in headwind component, which tends to also decrease the airspeed unless ground speed is accelerated to correct for this factor.

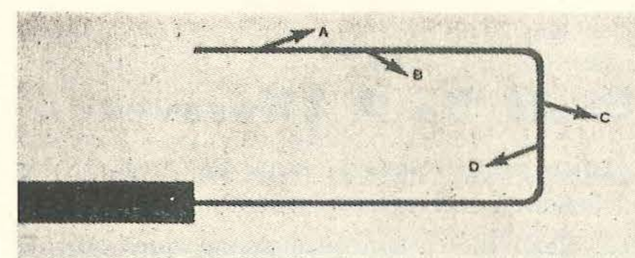
Low Altitude Wind Gradients

Wind gradient effects normally benefit an aeroplane during take-off because as the plane climbs into increasing wind velocity the indicated airspeed increases faster than the aeroplane actually accelerates relative to the ground. Just the opposite occurs on landing. A high level headwind that decreases as the aeroplane approaches the ground causes a decrease in indicated airspeed that could, under certain conditions, allow the aircraft to touch down earlier than expected. As the aeroplane descends to the runway some bleed off in airspeed should be expected. During the last portion of the descent, a pilot should be prepared to add considerable thrust to accelerate the aeroplane in case the airspeed bleed off due to wind gradient is more than expected. A rule of thumb to partially compensate for wind gradient is to add one half the headwind to the approach reference speed, allowing the airspeed to bleed off rather than attempt to hold the approach speed plus the one-half headwind and gust correction factor (maximum of 20 knots total).

Low Level Jet

The low level jet is a phenomenon most common over the flat terrain of the Great Plains that reaches a maximum during the middle of the night. In one reported case at 1700 the wind at 900 feet was 28 mph, at 0300 the next morning it had increased to 67 mph and at the same time the wind speed 30 feet above the ground was 15 mph. Formation of this phenomenon is tied in with nocturnal inversions with wind above the inversion speeding up and giving birth to the jet. This condition, because of its magnitude and occurrence close to the surface, poses a low level shear hazard to aircraft.

FIGURE FOUR



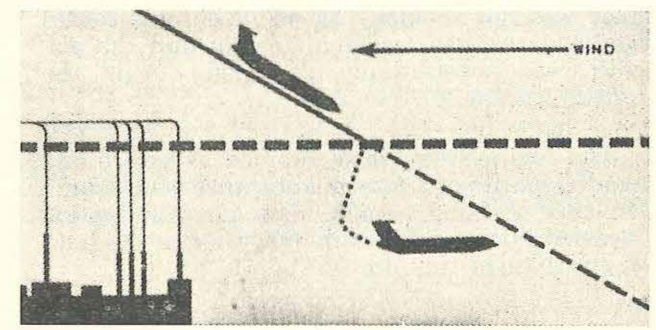
Shear can also be expected from di-urnal cooling. The air close to the ground cools and settles, some fog may form, and about sunrise the upper air starts to move with the result that a low altitude shear—as much as 20 to 30 knots in 200 to 300 feet—results. This shear condition normally dissipates quite rapidly.

Clues

Figure 4 provides an indication of clues to wind shear that the pilot can pick up in the pattern. Assuming a calm, or near calm surface wind, if crabbing as depicted in A or B is necessary, lateral shear can be expected on final. If crabbing is required as depicted in C, a tailwind component is present at pattern altitude and over-shoot problems, as discussed in the section on Tailwind Approach, should be anticipated. If crabbing is required as depicted in D a headwind component is present and a short touchdown potential exists if the gradient is large enough and occurs rapidly during the final approach path.

Shear can be anticipated whenever there is an inversion (Fig. 5). Shear is also a hazard potention with frontal passage and in and near thunderstorms. Severe down drafts associated with thunderstorms warrant delaying take-off or landing when such storms are over or adjacent to the airfield. Shear should be anticipated when taking off or landing over cliffs, water, in hilly terrain and with large buildings or trees adjacent to the runway. Normally, the severity of such low altitude wind shear bears a direct relationship to the surface wind speed. Don't overlook the help you can obtain from the weather forecaster. Check with him before take-off and, when you suspect shear, call him before making your final approach.

FIGURE FIVE



Answers

By now we trust you have figured out which of the three conditions posed in the beginning of this article is correct. Also, you may have done some project thinking and figured out that converse situations could exist. Suppose you have calm air at pattern altitude, but a surface wind. For example, as you start to flare from your calm wind final approach you encounter a 15 knot headwind. Now you have 15 knots more speed to bleed off before reaching normal touchdown speed, and face a go-around or long landing situation. And if the surface wind you encounter is a tailwind . . . you're arrived, ready or not.

Apply wind shear hazard planning for the aircraft you fly. When you have strong surface headwinds reported, aim a bit further down the runway. Ground speed will be less and roll out distance will be shortened. If shear is probable, a rather flat approach has been recommended by some in order to transition the shear area more slowly and allow more time for correction. If taking off into suspected shear, accelerate as rapidly as conditions permit until safely above stall speed.

WHICH IS WHICH!

At the conclusion of an agricultural spraying flight in the Western District of Victoria, the engine of an Avro 643 aircraft lost power on the final approach to land. A successful forced landing was carried out on the strip.

Suspecting the presence of water in the fuel, the pilot made an examination of the fuel system and, although no water was found, he discovered deposits of a foreign substance in the filter. After the filter had been cleaned the engine performed satisfactorily, and it was assumed therefore, that the cause of the loss of power had been found. The operation was then resumed.

One week later, when the aircraft was engaged on a similar operation in the same area but with a different pilot, the engine again suffered a loss of power. On this occasion it occured during the climb after take-off. This pilot was not so lucky as no favourable forced landing area was available to him and the aircraft was substantially damaged during the forced landing.

The fuel system was examined as before and again deposits of a foreign substance were found. On this occasion a more detailed examination revealed contamination in the carburettor bowl in addition to the filter.

The foreign matter in the carburettor bowl had the effect of causing the float needle to stick in the closed position thereby preventing the flow of fuel.

It is distinctly possible that the same condition was the cause of the first forced landing and that the interference was intermittent to the degree apparent in the two events.

To assist in establishing the source of the contamination, laboratory tests were conducted on samples of the deposit, but it could not be identified. It was established, however, that before the first case of loss of power, the aircraft had been refuelled with a pump normally used for chemicals. This pump and the fuel pump which should have been used were of the same type and there was no ready means of distinguishing one from the other and there seems little doubt that the foreign substance was a chemical residue existing in the pump before it was used of refuelling.

This experience has caused the operator concerned to identify items of equipment by suitable marking. Mistakes of this nature are made in every walk of life and there should be no need for costly direct experience before the danger is seen. Make a close examination of your own "household" and you will see similar potential danger awaiting eradication.

Your Pre-Flight Check Could Be A Lifesaver

The following is a condensed version of a recent air safety incident report submitted by a Cessna 180 pilot, with a view to sharing with us a lesson he has learned from this experience:

"In my haste to get started on a travel flight from the coast to a highland aerodrome in New Guinea, I omitted to check the security of the starboard fuel tank cap and cover flap. On my instructions this tank had just been partly refuelled, while I attended to another matter which at the time seemed more important.

During the flight, I noticed a left wing low tendency which I attributed to the full port fuel tank. Consequently, the port tank was selected and most of it's contents used during the flight.

On arrival, I checked and found the starboard fuel tank flap disengaged, the tank cap off and the tank completely drained of fuel.

Fuel gauges had been repeatedly checked during the flight to assess the left wing low tendency. The contents gauge for the starboard tank was showing an erroneous over half-full reading when last checked just prior to the completion of the flight.

The airflow in the region of the open filler hole may have contributed to malfunctioning of the starboard tank gauge."

There is no doubt that this experience has forcefully reminded this pilot of the importance of the pre-flight check. Had it been meticulously performed prior to departure, the unsafe condition which could have resulted in a forced landing in the New Guinea jungle country would have been detected.

Time is important but sometimes the cost of saving it can amount to a life.

Loss Of Control In Extreme Turbulence

LASQUETI ISLAND, BRITISH COLUMBIA

(Summary of the report of the Department of Transport, Canada)

On 20th February, 1961, a Cessna 170B seaplane crashed and was destroyed when it struck the ground in the vicinity of False Bay, Lasqueti Island, British Columbia. The three occupants were seriously injured.

The aircraft departed from False Bay on a V.F.R. flight to Powell River, British Columbia. On completion of a climbing turn to the left at about 400 feet, the pilot continued the flight downwind along the shoreline, at which time the left wing dropped followed by a dropping of the right wing. These oscillations continued despite the efforts of the pilot to regain control, and the aircraft crashed to the ground in an area of tidal mud flats.

The only pieces located away from the main wreckage were the left door and the front engine cowling which were found at the point of initial impact. The fuselage had broken in two, both the wings and the floats were destroyed.

INVESTIGATION

There was no evidence of any fault in the airframe, engine, propeller or controls prior to the accident.

The pilot held a commercial pilot licence and his total flying experience was about 400 hours. He had flown 90 hours on the Cessna 170B and his total seaplane experience was 130 hours.

The terminal weather forecast for Comox (26 miles north-west of the accident site), at the time of the accident was for overcast skies at 500 feet, visibility 4 miles in light rain and fog and the wind from the south-east at 25 gusting to 35 m.p.h. The regional forecast stated the turbulence to be occasionally moderate, briefly severe turbulence in subsidence zones in the lee of Vancouver Island. There is no evidence to show that the pilot was aware of this forecast.

It was established that after take-off under a ceiling of 700 feet the aircraft made a climbing turn to the left through approximately 195 degrees. On completion of the turn the aircraft was flying directly downwind and parallel to the north shore of the bay which was very steep, rising almost vertically to a height of 100 feet from the water. The wind on the water in the bay at the time of the accident was from the south-east at about 15 to 20 m.p.h. but at a height of 200 to 300 feet above the trees and out in the open waters of Georgia Strait, the wind was blowing at 30 to 35 m.p.h.

It was determined by the investigators the following day, under similar wind and weather conditions, that when the wind blows from the south-east at about 30 m.p.h., the air flows downward, spilling off the high ground along the shoreline on the east and north sides of the bay. This was indicated by extensive wind lanes which fanned outwards from the shoreline for a distance of 300 to 400 feet but did not extend out into the centre of the bay. It is believed that the aircraft encountered this turbulent downdraft condition when flying along the shoreline on the north side of the bay.

CAUSE

The probable cause of the accident was a loss of control due to extremely turbulent air.

(All times herein are Pacific Standard)

Loss of Crew Co-ordination precedes Constellation Disaster

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

On the night of 8th November, 1961, a Lockheed Constellation L-049 crashed and burned near Byrd Field, Richmond, Virginia, following loss of power in three of its engines. Seventy-four passengers and three flight crew members died as a result of carbon monoxide poisoning. The captain and flight engineer escaped from the burning wreckage. The aircraft was totally destroyed.

INVESTIGATION

The flight on which the accident occurred originated at Columbia, South Carolina, and was made for the purpose of carrying newly inducted members of the U.S. Army from Newark, Wilkes Barre and Baltimore to Columbia. The flight crew consisted of two qualified captains, one assuming command and the other electing to act as co-pilot; flight engineer, student flight engineer and one stewardess.

The flight departed Columbia for Newark on a VFR flight plan carrying 3,180 gallons of fuel. As the aircraft became airborne the flight engineer noticed a drop on the No. 3 fuel pressure gauge. The captain was not informed but the student flight engineer opened the No. 3 and No. 4 crossfeeds, "to ensure positive pressure on the right side," The fuel pressure drop did not recur and the flight engineer testified that the cross feeds were closed when the aircraft reached its cruising altitude of 9,500 feet.

Flight was routine to Newark where no service or maintenance was performed and evidence was given that 2,300 gallons of fuel remained on departure for Wilkes Barre. At both Wilkes Barre and Baltimore Nos. 1 and 2 engines were shut down while passengers were embarked and Nos. 3 and 4 engines were kept operating. At Baltimore the aircraft returned from the run-up area to the terminal to pick up one additional passenger. On the Newark - Wilkes Barre - Baltimore route segments the aircraft cruised at 4,500 feet on a VFR flight plan. The flight engineer testified that on each take-off, at Newark, Wilges Barre and Baltimore, he opened the Nos 3 and 4 crossfeeds in anticipation of a drop in fuel pressure.

Five minutes after take-off from Baltimore, the co-pilot filed a flight plan for flight direct to Columbia at 4,500 feet, VFR, true airspeed 218 knots, estimated time en route 2 hours 10 minutes with 5 hours 30 minutes fuel on board. The captain in command testified that he flew the entire flight from the left hand seat and that the flight engineer's station was occupied by the student engineer; this was denied by the flight engineer who stated that he had been at the flight engineer's station during take-off from Baltimore.

The Brooke Ommi was passed after the aircraft had reached flight planned altitude and cruise power had been established. Some time after, the aircraft yawed to the right and the fuel pressure warning lights for Nos. 3 and 4 engines came on. The flight engineer immediately assumed the engineer's station which was occupied at this time by the student engineer, and found that No. 3 engine had stopped rotating and No. 4 engine r.p.m. was surging between 1,500 and 2,000 r.p.m. The captain stated that he saw the flight engineer open all four crossfeed valves and check that the fuel selectors were positioned for tank to engine feeding. He further stated that the flight engineer turned on all four fuel boost pumps and advised he was going to try to start Nos. 3 and 4 engines. The captain and flight engineer agreed that, at this time, the fuel gauges were all in a position which indicated fuel, but they could not recall the exact amount.

The captain then told the flight engineer to feather No. 3 engine and concentrate on No. 4 engine which appeared to be partially running. The captain stated that the flight engineer said he was unable to restart No. 4 and was going to try No. 3 and shut down No. 4.

About this time the flight engineer ordered the student engineer to open the midship fuel crossfeed valve. The student engineer returned to the cockpit for a screwdriver and was told by the co-pilot, "Don't open that valve. You have good pressure on 1 and 2; leave it there." With that, the crossfeed valve was not opened although the captain testified that he had known nothing of this and assumed that the valve had been opened.

Attempts to restart Nos. 3 and 4 engines had been unsuccessful, the captain turned toward Richmond to land and the feathering check list was completed. The captain retrimmed the aircraft and got a good speed out of it and the flight engineer reported normal temperatures on Nos 1 and 2 engines. The co-pilot was told to advise Richmond tower of the engine difficulty and intended landing. The stewardess was similarly advised and relayed the information to the passengers over the public address system. As a crash landing was not anticipated no emergency evacuation instructions were given.

The controller at Richmond advised the flight that all runways were available and that the wind was north-north-west at 15 knots with gusts to 22 knots. He requested that the flight advise him on base leg of the runway chosen and asked if standby emergency equipment was desired. The co-pilot replied in the affirmative. The captain testified he had asked the co-pilot to fly the aircraft while he checked the flight engineer's station.

When south of the city the captain advised that they would use runway 33. He said the aircraft was maintaining altitude and had a "healthy airspeed." Their heading was about 90 degrees and the in-range check had been started when the co-pilot, who was still flying the aircraft, remarked, "Let's land on this runway," turned left toward runway 02 and lowered the landing gear handle. The captain said he looked down and saw a lighted runway but thought the aircraft was too high and possibly a little too fast to be able to land on it. He then noted the landing gear lights indicated the gear had not extended and saw the flight engineer either putting the hydraulic crossover switch into the emergency position or checking that it was in the emergency position. When he saw the switch it was in the emergency position. The captain recycled the landing gear up but there was no change in the indicator. At this time it was apparent the landing attempt would have to be abandoned and both pilots called for full power on Nos. 1 and 2 engines. The captain felt the airspeed and altitude were still sufficient to reach runway 33 but a right turn would be necessary (See diagram).

Just prior to the time the aircraft entered this right turn, a transmission was received in the tower which indicated that another engine was failing. The captain then took over the controls and started the right turn but lost sight of the runway and again handed over to the co-pilot who was in a better position to see the runway from the right hand seat.

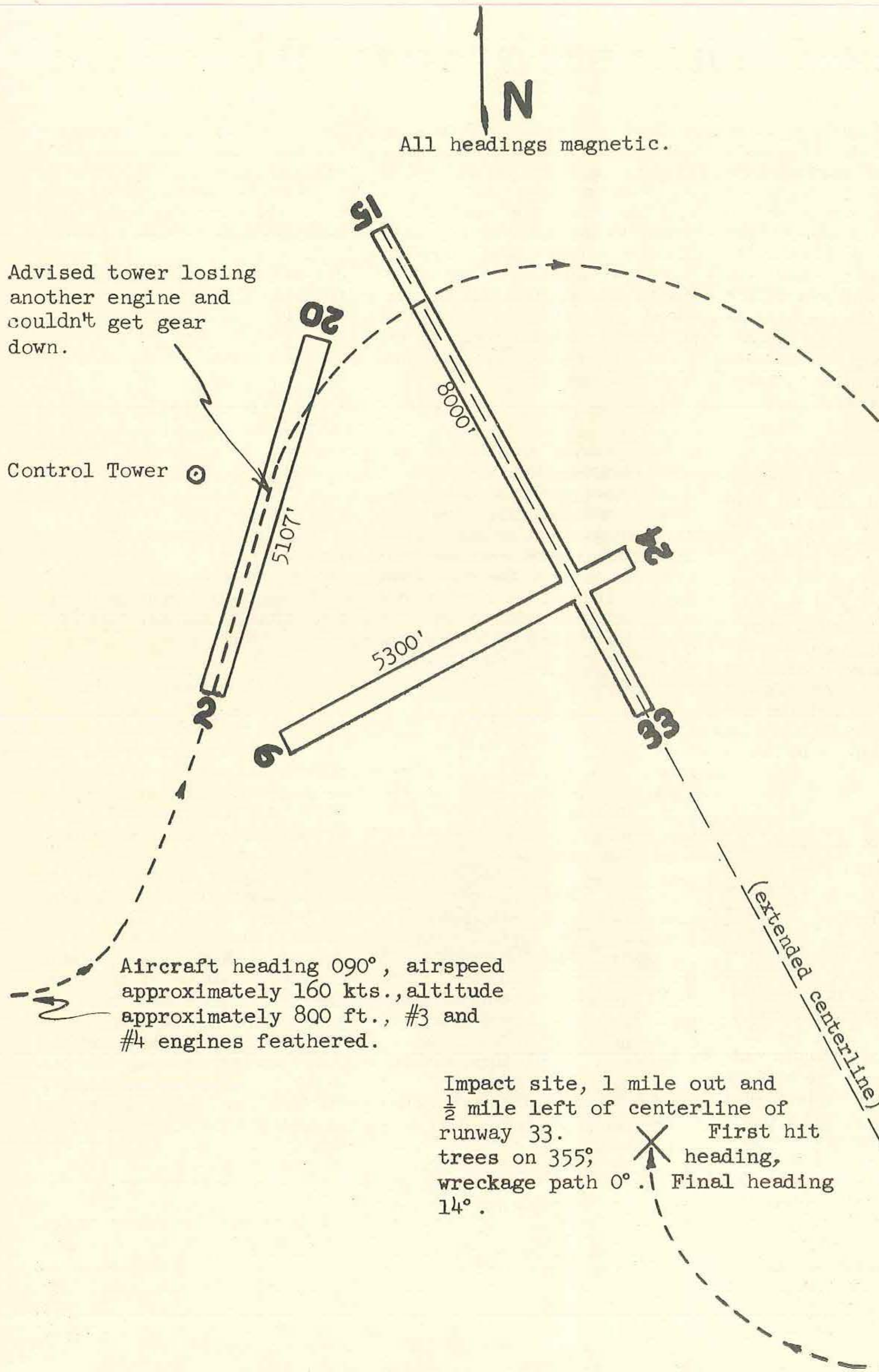
At this time the student engineer was requested to assist with the landing gear in the event that is should have to be pumped down. A continuous right turn was made until the captain could see the runway, when the flight engineer stated again that they were losing No. 1 engine. The captain resumed the controls with the co-pilot and the turn was continued. The flight engineer announced again that there was a continuing decrease in power on No. 1 engine. Somewhere in this turn, without the captain's knowledge, the landing gear handle was placed in the down position. The captain subsequently recalled seeing the student engineer assisting to pump the gear down with the hydraulic hand pumps. During the final approach the captain saw two green lights indicating two of the three landing gears were down.

The aircraft was slightly to the left of the extended centre line of runway 33 on final approach when the airspeed began to decay rapidly. The captain realised the aircraft would not reach the runway and pulled back on the control column. His last recollection of airspeed just as the aircraft stalled into trees was an indication between 90 and 95 knots.

The aircraft first struck trees 50 feet above the ground in a right bank of approximately 10 degrees. After passing through a clear area about 100 feet in length, it struck a section of larger trees which brough it to a stop approximately 250 feet from the point of initial impact, one-half mile to the left of the final approach path and one mile from the runway threshold.

From all indications the aircraft struck the ground in a level longitudinal attitude and the aft fuselage suffered only light impact damage. There was no evidence of fire at any point along the wreckage path prior to where the fuselage came to rest. After the main impact the flight engineer opened the door to the cabin and the cockpit immediately filled with dense smoke. The captain left the aircraft through the pilot's sliding window, observing at the same time the co-pilot and flight engineer standing at the open crew exit door on the right hand side of the cockpit, presumably preparing to jump. The aircraft was then engulfed in flames and the entire cabin area was completely destroyed.

The student engineer apparently went to the cabin immediately before the crash to assist as a cabin attendant. The grouping of bodies in the passenger cabin indicated that many of the passengers had left their seats after impact and attempted



to leave the aircraft. The largest group of bodies was found near the main cabin entrance door which had been jammed either by the ground impact or by trees and debris which were piled up against the fuselage. There was no evidence to indicate that attempts had been made to use any of the emergency over-the-wing window exits. No positive evidence of impact injuries to the passengers was found and the cause of death in all cases was established as suffocation caused by carbon monoxide poisoning.

Wreckage examination disclosed no evidence of in-service failure or malfunction of Nos. 2, 3 and 4 engines, but No. 1 engine had suffered complete internal failure due to failure of the master rod and bearing followed by complete disintegration of the connecting rods. No. 1 propeller blades were on the low pitch stop at 17 degrees and the propeller governor r.p.m. setting indicated 2600 r.p.m.; No. 2, 28 degrees and 2563 r.p.m.; Nos. 3 and 4 were fully feathered.

The nose landing gear was in the retracted position but the uplock was in the "release" or "open" position. The main landing gear was down but it could not be determined whether the locks were engaged. The wing flaps were in the "up" position. There was no evidence of failure of the primary or secondary flight controls.

ANALYSIS

The momentary fluctuation of fuel pressure on take-off from Columbia is symptomatic of a boost pump failure. Such failure would not cause the engine to stop because the engine-driven fuel pump will continue to supply sufficient fuel to the engine. With the Nos. 3 and 4 crossfeeds open fuel from the No. 4 tank would be supplied to the crossfeed manifold under pressure by the No. 4 boost pump. Even though the No. 3 fuel tank selector valve remained open no fuel could flow from the tank. The higher pressure in the crossfeed manifold supplied by the No. 4 boost pump would hold closed a check valve between the manifold and the No. 3 fuel tank. Thus Nos. 3 and 4 engines would both be operating on fuel exclusively from the No. 4 tank provided the No. 4 boost pump remained operating.

Contrary to the flight engineer's testimony that the fuel system was returned to the normal tank to engine configuration after reaching cruising altitude, it is the Board's opinion that the greater part of the flight was conducted with the crossfeeds open and the boost pumps on. This opinion is based on analysis of the conduct of the entire flight and testimony of the various witnesses.

During the investigation the possibility of fuel contamination as a casual factor was thoroughly explored and it was found that the refuelling truck which had serviced the Nos. 3 and 4 fuel tanks did have considerable contamination, sufficient to be classed gross contamination. It is believed, however, that the samples of fuel tested were of considerably higher contamination concentration than the fuel which actually went into the aircraft's fuel system, and it is felt that the amount of contamination was not sufficient to cause a complete loss of fuel pressure as reported. It is not likely that, following several hours of normal operation, contamination would, either by restricting the flow or causing malfunction of a component without warning and simultaneously, cause loss of fuel pressure in two separate fuel systems.

Using the same engine powers and rates of fuel consumption as outlined in the company's operating manual, and operating Nos. 3 and 4 engines on crossfeed from the No. 4 tank for the majority of the flight, it was calculated that 800 gallons of fuel in the No. 4 tank would have been exhausted approximately at the time at which the crew indicated the loss of power occurred. The sudden yaw to the right and loss of fuel pressure on Nos. 3 and 4 engines simultaneously also indicate fuel exhaustion or starvation. Engine surging followed by complete power loss would also be expected.

From the foregoing evidence it is clear that the loss of power on Nos. 3 and 4 engines was not the result of a malfunction or mechanical failure or of fuel contamination, but was caused by fuel exhaustion brought about by improper fuel management. The procedures followed by the flight engineer in attempting to restart the two engines indicate lack of knowledge and inability to diagnose the results of the inoperative fuel boost pump and determine appropriate corrective action. Had the proper procedures been followed there is no reason why Nos. 3 and 4 engines could not have been restarted.

When the first contact was made with the Richmond tower Nos. 3 and 4 propellers had been feathered and the decision made to land at Richmond. The crew was experiencing no unusual problems in operating the aircraft on its two remaining engines and the aircraft, in fact, flew satisfactorily for at least eight minutes after this call was made.

At the time the decision was made to land on runway 33, both pilots were issuing orders and both were attempting to command the flight. The co-pilot who was senior with the company, issued orders to the other crew members as captain during the emergency. His sudden turn to attempt a landing on runway O2 is a clear indication that a division of command and lack of co-ordination existed. His actuation of the landing gear selector handle was equally rash. From all of the testimony the Board concluded that confusion prevailed in the cockpit due to lack of crew co-ordination and the issuing of conflicting orders.

The particular aircraft involved in this accident was equipped with a hydraulic crossover valve (normally operated from the cockpit by a switch) which would permit hydraulic pressure from Nos. 1 and 2 engine-driven pumps (the primary hydraulic system) to be supplied to the landing gear which is normally supplied by the Nos. 3 and 4 engine-driven pumps. The crossover valve and its motor were recovered and showed no evidence of malfunction. Investigation showed that hydraulic pressure was available from No. 2 hydraulic pump, but the crossover valve was in the closed position. The Board concluded that the crew did not open the crossover valve and was unaware that the aircraft was equipped with this valve. Had the valve been opened the landing gear would have extended in 20 to 25 seconds.

From the location of the wreckage it was apparent that the landing pattern was poorly executed. It is believed that, when the aircraft was on base leg, the angle of bank was steepened in an attempt to avoid overshooting the extended centre line of the runway. This increased angle of bank and increased rate of turn bled off airspeed and the aircraft began to sink. To try to arrest the rate of sink the co-pilot called for "all the power you got." By this time the No. 1 engine was destroying itself as a result of overboosting during the emergency, and it failed completely. With only one engine delivering power it was impossible to maintain flight and the aircraft stalled into the trees.

From a study of all the information available, the Board concluded that this flight crew was not capable of performing the function or assuming the responsibility for the job they presumed to do. It was further concluded that the company management should have been aware of the manner in which company operations were being conducted, and it is believed that sub-standard maintenance practices of company employees were condoned by the management.

PROBABLE CAUSE

The Board determined that the probable cause of the accident was the lack of command co-ordination and decision, lack of judgement, and lack of knowledge of the equipment, resulting in loss of power in three engines creating an emergency situation which the crew could not handle.

The PAY OFF

The value of strict application of the pre-take-off cockpit drill is exemplified in a recent letter from the owner/pilot of a Cessna 175:

"I had just completed a local flight with some passengers and decided to do some solo flying practice.

After completing a few circuits and landings, I aimed to do one more before finishing flying for the day. I taxied to the end of the strip and commenced to run through the pre-take-off checks quickly, as one tends to do after having repeated them a number of times previously that afternoon.

To my surprise, when I moved the aileron control, it firmly locked in the turn to the right position.

Upon inspection beneath the instrument panel, I found the following:—

During fore and aft movement, the control column had been rubbing against the hot air duct to the pilot's windscreen.

The rubbing had obviously been occurring for some time and as a result, the fabric outer covering of the duct had been worn away, exposing the reinforcing wire beneath.

On this last check prior to take-off, the duct reinforcing wire had become firmly entwined with the aileron gearing and chain mechanism, thereby completely jaming the system.

In retrospect, it occurred to me that during the previous flights that day, the aileron control seemed a little heavier than normal whereas the elevator control was as light as ever.

It was clear that the wires were becoming more entangled to a stage where—luckily for me—the final complete jamming of the aileron control system occurred on the ground during the last pre-take-off cockpit check for the day."

COMMENT

Following receipt of the above information, steps have been taken to have the technical aspects investigated and if necessary modifications to obviate any weakness in design will follow.

This incident highlights the value and importance of pre-take-off checks and the pilot's action in telling others about his experience is commendable.

A Stitch In Time

"The aircraft was seen to plunge into Lake Ontario about 100 yards off shore. Both occupants were killed and the aircraft was destroyed."

Why did this happen? The investigation conducted by the Canadian authorities established that there was an explosion whilst the aircraft was airborne but no evidence of fire or chemical explosion was found. It was concluded, however, that the noise heard was the bursts of the fabric on the right wing.

Examination of the wreckage established that the fabric covering on the right wing failed at or near the vicinity of the wing tip. A tear apparently progressed to the extent that it admitted the air stream, which, in turn ripped about four feet of the covering from both the upper and lower surfaces of the wing. Deprived of wing covering in this vital area, control of the aircraft was lost and it rolled, inverted and plunged into the lake.

Portions of the wing fabric were salvaged and were found to exhibit a condition of "teasing"—a term applied to the fraying of fabric during exposure to a stream of air, which left no doubt that it parted whilst the aircraft was airborne.

The underlying cause of this accident was the employment of unusual and improper techniques during the course of a fabric repair at the time the entire upper surface of the wing had been recovered. The old enamel had been removed from the leading edge portion of the lower surface by the use of a strong solution of caustic soda. It was considered that the uncontrolled use of a cleaning agent of this nature may have weakened the fabric to the extent that subsequent failure under flight loads was inevitable. It was also established that, at a subsequent service repair which included redoping of the right wing upper surface, loose enamel was removed and the old enamel blended into the new by "feathering" the edges with dry abrasive paper. Although the advanced state of "teasing" precluded the finding of evidence which would support such a conclusion, it is believed that abrasive wear on the threads of the fabric due to the "feathering" work may have contributed to its ultimate failure.

In Australia we have experienced a fatal accident from loss of fabric covering on a wing surface. As in the Canadian accident, the Auster concerned became uncontrollable and plunged into the ground. There was also another case, again involving an Auster, in which the pilot managed to retain control for sufficient time to execute an emergency landing, mainly because the failure occurred close to the root end of the wing. Despite a long and detailed investigation the precise cause of these failures was not positively determined, but was believed to have been due to the combination of a number of factors, one of the most significant being deterioration of the material under the enamelled registration lettering. These areas merit particular attention when assessing the condition of a fabric covering.

Considering the number of fabric covered aircraft in use in both private and aerial work operations, as compared to the rarity of fabric failure it is obvious that licensed maintenance engineers have established methods of inspection and workmanship which ensures the necessary standard of serviceability. Nevertheless, there are sound lessons for all engineers, aerial work operators and particularly private owners in these accidents.

Many of our fabric covered aircraft are now operating in remote areas or are engaged in work which requires minor repairs to be carried out by pilots and owners who have not been trained in the care of fabric surfaces or in needlework repairs. This opens the way for unwitting use of techniques which will not only have a detrimental effect upon the fabric, but also throw additional responsibility onto the licensed engineer when he is called upon to certify the aircraft at regular intervals. Because of this a review of some of the basic practices necessary for the proper care of fabric may be of value to the owner who takes pride in knowing that his aircraft not only looks good, but remains safe under all conditions.

As in most other things cleanliness is the first essential, for grease, oil and any acid or alkaline product can cause rapid deterioration of both the fabric covering and the interior structure. Frequent washing down with warm soapy water, followed by clean water, is best. Many of the cleaning products available today may not be harmful to fabric, but some are and for this reason, it is wise to avoid the unknown particularly any that are in the category of a harsh detergent. If a hose, or water under pressure is used, care should be taken to avoid forcing jets of water into the interior of wings and control surfaces, and to see that lubricant is not forced out of hinges and bearings.

Ventilation of fabric covered areas is also essential, and care should be taken to ensure that all drain holes are clean. Moisture trapped within fabric areas will cause both the fabric and the structure to rot and, if large quantities are present, can seriously upset the balance of flying controls.

Visual inspection should be frequent—look for tears, cracks and "crazing" of the surface. If these are present, a stitch in time may possibly save your life. Small tears must be repaired immediately and cracks and crazes, together with bare areas and worn corners, should be repaired as soon as possible, by removing the old dope and re-doping according to a proper repair scheme. The standard methods of making minor repairs are fully described and illustrated in a variety of publications and we suggest that owners should consult Regional Offices of the Department for advice regarding the publication which is best suited to their needs.

The Canadian authorities drew attention to the possibility of damage resulting from the use of dry abrasives on the fabric material. For this reason use of scrapins or abrasives should be avoided when removing patches of old dope. The safest and simplest process is to place an acetone soaked rag over the patch to be removed and, after it has been in position for a while, gently press the rag to the surface and move it in a circular motion to gather up the dope, re-soaking the rag to remove the old dope as required and repeating the process until the affected area is bare.

Serious slackness of fabric surfaces, particularly along ribs, demands attention by a licensed engineer, as does any major repair or complete evaluation of the fabric to decide whether it requires rejuvination or replacement. There is, unfortunately, no yard stick by which the condition of fabric can be reliably determined without removal of some of the covering, but the advice of experienced engineers is the surest safeguard against the dangers that can arise from fabric failure in flight.

With proper care fabric covering will last for many years—but if small repairs and common sense precautions are neglected serious failures short of a reasonable life are more than a possibility.

An Expensive Oversight

An improperly secured oil temperature connection after engine oil change and filter clean, caused an unnecessary forced landing and engine replacement in a Cessna 172 aircraft.

Several days prior to undertaking a private travel flight the owner/pilot of a Cessna 172 aircraft arranged for a periodic oil change and filter clean, to be carried out by an approved aircraft maintenance organisation.

No indication of the loose connection was apparent to the pilot on pre-flight inspection during which an oil quantity check was made.

The flight was planned for a cruising level of 6,500 feet. Engine temperature and oil pressure were normal on take-off. When at about 5,000 feet, the engine temperature increased and a slight loss of power was noticed, whereupon the pilot decided to return to the departure aerodrome on reduced power. Shortly after contacting air traffic control, the pilot noticed a drop in the oil pressure and he carried out a successful forced landing approximately 8 miles from the departure aerodrome.

Subsequent examination of the engine, showed that the oil temperature connection to the oil filter had not been properly secured and as a result oil had been escaping. The licensed aircraft maintenance Engineer who was responsible for the oil change and filter clean, stated that the work had been carried out in a hurry and the connection referred to had not been re-tightened properly after completion of the work.

It was mere good fortune that loss of life did not result from this act of carelessness.

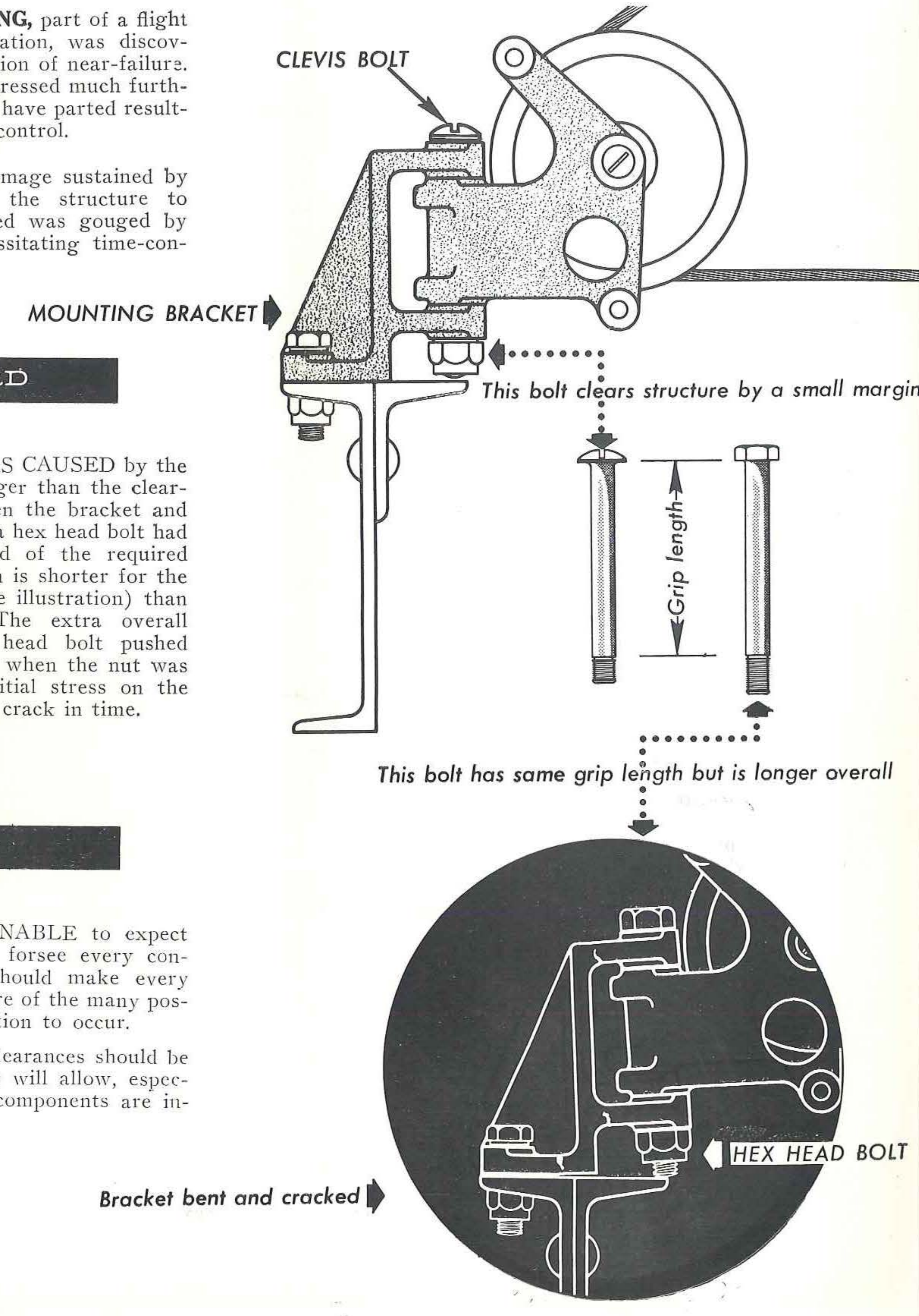
DESIGN NOTE

SURFACE CONTROLS — Pulley Installation

The SITUATION

A CRACKED CASTING, part of a flight control pulley installation, was discovered to be in a condition of near-failure. Had the damage progressed much further, the bracket would have parted resulting in loss of aileron control.

In addition to the damage sustained by the pulley bracket, the structure to which it was attached was gouged by the swivel bolt necessitating time-consuming repairs.



The HAZARD

THE TROUBLE WAS CAUSED by the swivel bolt being longer than the clearance provided between the bracket and structure. Evidently, a hex head bolt had been installed instead of the required clevis type bolt which is shorter for the same grip length (see illustration) than the one installed. The extra overall length of the hex head bolt pushed against the structure when the nut was tightened, putting initial stress on the bracket causing it to crack in time.

COMMENT

IT IS NOT REASONABLE to expect aircraft designers to forsee every contingency but they should make every effort to become aware of the many possibilities for malfunction to occur.

Whenever possible, clearances should be as generous as space will allow, especially where moving components are involved.