Printed by Hedges & Bell Pty. Ltd., Maryborough, Vic.



Commonwealth of Australia

# AVIATION SAFETY DIGEST



No. 13
MARCH, 1958

# Aviation Safety Digest

No. 13 — March, 1958

CONTENTS



**(Prepared by Division of Accident Investigation and Analysis. Published by authority of the Director-General)**

# News and Views

## Runaway Propellers

*(Reproduced from "THE MATS FLYER", October, 1957)*

**"See that! You don't have to use but about half rudder and only a slight bit of aileron to correct for loss of an outboard engine. This is a good, stable airplane."**

The instructor was talking. It was your first flight in the four-engine transport, several months ago. He was demonstrating the amount of control deflection required to offset the loss of an outboard engine. He said that you would have no control problems, even on take-off with the most critical engine failing at lift off. He demonstrated that the yaw was easily offset and had set the throttle at 15 inches manifold pressure to simulate the full-feather-no-drag situation.

And you were convinced. You had been a little irked at yourself that you had let the heading get off 10 degrees and you edged back on heading. The indicated airspeed, you noted, had dropped gradually, but less than you had expected. After you had lost 20 knots, and had made gentle, get-the-feel turns in both directions, the instructor brought the engine back to cruise power.

A little later, at cruising speed, he REALLY convinced you. He eased the throttles back to 15 inches on both engines on one side. You handled the flight controls all the while as he eased power on the opposite side up to METO and when you rolled in trim you found that this wonderful airplane would fly on two engines—and the T.O. says you can use METO power indefinitely. Your instructor had really beamed and sat there with arms folded as you made a turn in each direction on TWO engines.

Yes, this had been a convincing demonstration. And since then, on test-hops and training missions, you had conducted both actual and simulated engine-out flight. And one day, number three had backfired and you had shut it down and made an actual three engine landing.

No sweat.

You never had a runaway prop—but you know the procedure: Power off, feather, complete the engine out check list. You also know that a runaway is a function of true airspeed and you figure that if the prop won't feather just fly the bird above stall and land at the nearest suitable field. You also know the engine freezing procedures and in the back of your mind you feel you might use them as a last resort, thinking they might reduce drag. The main thing you fear about freezing an engine is that the prop might come off and go through the cabin. (That's why you move the passengers out of the prop line, you recall.)

### YOU SHOULD ALSO KNOW:

If a propeller runs away and cannot be feathered you may not be able to maintain level flight at any altitude even with maximum power on the other three engines.

That drag of this propeller increases approximately as the square of the velocity and flight must be just above stall speed. The slower you can fly the better.

That if the engine is frozen and the propeller uncouples, the drag will be reduced considerably. However, if the engine is frozen and the propeller does not uncouple *drag will probably be increased.*

If the propeller is an outboard you will probably need full rudder and aileron trim, full or nearly full rudder deflection to maintain heading — and it is possible that power may even have to be reduced on the opposite side in order to keep the aircraft from turning into the bad engine.

Anything you can do to get the prop into higher pitch will help tremendously—but chances are you can do nothing.

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Information from the propeller and airframe manufacturers and data derived from tests and calculations on the Stratocruiser that ditched in the Pacific last October depict the effects of an uncontrollable prop for this particular circumstance. Drag resulting from this propeller with the blades on the low pitch stops, 21.3 degrees, at 145 knots, 2,000 feet MSL, would be:—

| | |
|---|---|
| Uncoupled windmilling | 520 lb. |
| Coupled windmilling | 1,880 lb. |
| Frozen | 2,320 lb. |

The additional power necessary to compensate for the additional drag in each of the above conditions is:—

| | |
|---|---|
| 520 lb. | 295 BHP |
| 1,880 lb. | 1,060 BHP |
| 2,320 lb. | 1,380 BHP |

In a C.54 accident in 1955 the plane crashed shortly after take-off and 2½ miles from the take-off runway. The probable cause of this accident was determined to be due to excessively high drag, resulting from the improperly indexed propeller blades and inability to feather No. 4. The pilot stated that No. 4 propeller drag felt "insurmountable" and it was impossible to gain or even hold altitude. Maximum power was being used on the other three engines.

A representative of the propeller manufacturer testified that according to engineering data for like conditions the drag would be 570 pounds if the three blades were properly indexed at 24 degrees whereas with two of the blades improperly indexed at 16 degrees, as was the case in this accident, the propeller drag was 1,360 pounds, or about 2.3 times greater. Both crew members stated that the aircraft hit tailfirst, full power on three engines and in full power stall.

Several years ago an Air Force crew flying a B.29 out of a midwestern base had No. 1 propeller go out of control and into full low pitch. The tendency of the aircraft to roll into the dead engine was so great that the plane entered a continuous left turn. The only way that the left wing could be levelled and directional control regained was by cutting power back on number 3 and 4 engines. Using this system a series of descending spirals was made by the crew in directing their plane back toward the base. Finally, estimating they were in the best attainable position, they pulled off power on the right side and made a diving, semi-controlled approach. Touch-down was made on the overrun, two of the tyres blew out and the aircraft continued onto the runway with no further damage.

Last winter, on Guam, a pilot test hopping a C.54 lost control of No. 1 upon unfeathering. The drag was so great, even at an airspeed of approximately 120 knots and at 2,800 r.p.m., that full trim was rolled in and the descent made with METO power on the three good engines. Upon entry into the traffic pattern it appeared that he might not be able to maintain level flight in this configuration without stalling and he flew a gradually descending pattern. Though he had been flying transports for several years he was so amazed at the drag caused by the uncontrollable outboard propeller in the low pitch that he kept checking to ascertain that cowl flaps, or some other parts of the aircraft were not out of order and causing some of the drag. Furthermore, the aircraft was empty and carried a partial fuel load.

Since there is no way in which these tremendous drag and control forces can be simulated in either a simulator or an aircraft the only emergency training that can be given in advance is to make aircrews aware of this problem in order to cut down panic and to provide them with the best possible information as to corrective action.

Panic could easily result from the high pitched whine of the runaway, the near uncontrollable yaw and rolling tendency and the fear that a blade might come through the cabin — especially since a runaway usually occurs with no advance warning.

The reason for the control problem is comparatively simple. For example, equivalent parasite drag expressed in square feet of flat plate area for a C.118 is slightly over 27 square feet. The flat plate drag area of a single uncontrollable prop on a C.118 is approximately half this and when you realise that this drag, equal to half the entire parasite drag of the airplane normally, is located well out on a wing, it is easy to understand why the turning moment is so great. Further, as power is added to the remaining engines to offset the drag the tendency to turn into the windmilling propeller is accentuated.

What should the man in the left seat do when a propeller suddenly runs away?

Here is what Hamilton Standard recommends, as reported by Mr. W. H. Furnivall of the Field Service Engineering Section, Military:

"Pull everything back but the feathering button — throttle, r.p.m., yoke; mixture on the bad engine — the works". He defines a windmilling, uncontrollable prop as one that has gone to the low pitch blade angle.

As a general rule the company states that the drag of a frozen propeller is greater than that of a windmilling propeller and freezing is not recommended. MATS crews put in a lot of air miles every day sitting next to fans built by this concern, so let's examine one of their charts. This one (Fig. 1) applies to the C.118 prop at the normal low pitch blade angle of 30 degrees measured at the 42 inch station. These curves illustrate that windmilling engine r.p.m. and drag



are functions of airspeed. The slower the aircraft can be flown the better (within safe control limits).

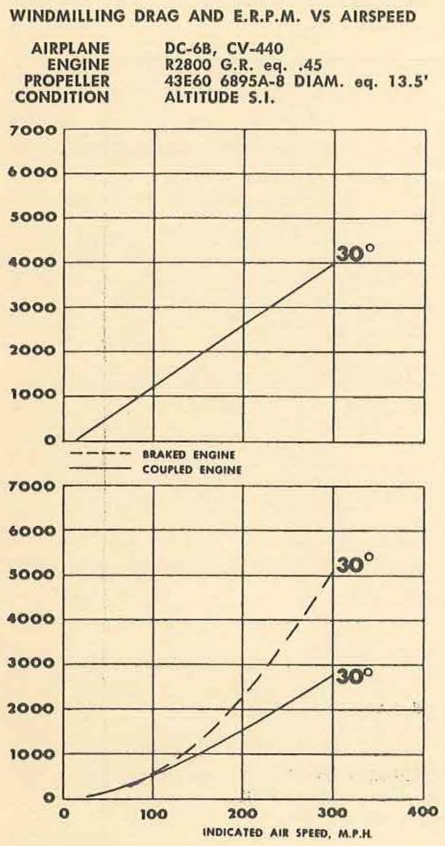



Figure 1

From the specialists at WADC we learn that if the low angle stop is not effective (this is most likely on props not equipped with mechanical low pitch stops) the blade angle will continue on down until centrifugal twisting, friction and aerodynamic moments are balanced.

In such a case, control of the aircraft may not be possible and freezing should be considered. As the r.p.m. drops due to freezing action and reaches the governing range, try feathering.

It should be noted also that in the course of stopping the propeller through freezing, a peak propeller drag is reached which is greater than either the normal windmilling or fully stopped value.

Data indicates that below a blade angle of about 15 degrees the locked propeller will have less drag than the windmilling, whereas above that value the windmilling propeller will have less drag. The cross over point is a function of propeller geometry and amount of friction and pumping torque required to turn the engine. The most favourable case for the windmilling propeller occurs when the engine becomes uncoupled from the propeller because the propeller does not have to pick up additional energy from the airstream, at the expense of drag, to overcome the friction and pumping of the engine. The only energy required from the airstream, in the uncoupled case, is that required to overcome the aerodynamic resistance of the propeller itself.

As a general rule, the people at WADC tell us, propellers equipped with mechanical low pitch stops can be expected to produce less drag (negative thrust) when windmilling than when frozen, while propellers not equipped with mechanical low pitch stops can be expected to produce less drag when frozen. This is because the mechanical low pitch stop is usually above the crossover blade angle.

Approximately two weeks prior to the C.97 incident in which Major Samuel W. Tyson* flew 1,000 miles into Hilo, T.H. with two engines out, Captain Fred L. Irwin, 48th Air Transport Squadron, flying a C.124 from Hickam to Travis on a scheduled cargo run, had a malfunction of the No. 1 propeller about three hours after take-off. He was unable to feather, change blade pitch, or in any way to control the propeller. The drag of this propeller was so great that he was unable to regain level flight until 24,000 pounds of cargo had been jettisoned. At this time he was down to 700 feet with maximum power on the other three engines. Captain Irwin was able to gradually climb back to 1,000 feet and flew approximately 250 miles back to Hilo at METO power. Drag from the malfunctioning propeller was so great that full aileron and full rudder trim were rolled in and level flight still required nearly full aileron deflection with the yoke. Flight was, at times, on the burble point of stall. Subsequently it was found that the blades had gone approximately 5 degrees.

The chart showing the relationship between blade angle and drag (Fig. 2) indicates that drag of a windmilling propeller increases rapidly below about 15 degrees.

One of the most critical aircraft in the MATS stable, insofar as runaway propellers is concerned, is the WB-50. Indicative of the problems that can be encountered in this type aircraft is the following:

The WB-50 was cruising at 18,000 feet on a heading of 105° when the crew noticed the No. 4 propeller increased 25 r.p.m. The prop selector was immediately placed in fixed r.p.m. but the r.p.m. continued to increase. At 2500 r.p.m., feathering was attempted, the aircraft was pulled up and all power pulled off to slow the aircraft and counteract the drag.

The r.p.m. increased to the maximum tachometer indication of 4,500. The aircraft commander and co-pilot applied full left aileron and rudder but the flight instruments indicated a 90° bank and tight diving spiral to the right. Rate of descent was at more than 4,000 feet per minute, aircraft completely out of control.

At 11,000 feet r.p.m. unexplainably decreased to 1200 and control was regained. The heading was now 75°. The oil shut off valve was closed. R.p.m. again increased and at 3,000 r.p.m. aircraft control was lost again.

The engine seized and control was regained at 7,000 feet and a landing accomplished at an emergency alternate. Subsequent inspection showed the prop had stuck at a flat pitch of approximately 4 degrees. When the engine was

* See following article "Good Show".

frozen at this configuration blade angle drag was sufficiently reduced for the crew to regain control.

A mechanical low pitch stop modification program has been approved for the WB-50 and is to be instituted shortly after the first of the year as the aircraft go into IRAN. This program calls for the mechanical stop to be set at 16.5 degrees blade angle which will entail moving the low limit switch angle to 20.3 degrees. In substantiating information supporting this proposal the aircraft manufacturer pointed out that from 1949 through 1953 UR's showed that in 54 overspeed cases in 97's no aircraft were lost. The propellers have mechanical low pitch stops. In nine cases reported of loss of propeller control in B-50 aircraft six of the aircraft were destroyed and in the three other cases the runaway propeller was either frozen or thrown clear. It is also pointed out that with a low pitch stop of approximately 16 degrees power can be reduced without excessive windmilling r.p.m. A mechanical stop limit of 16 degrees, according to the manufacturer, is considered to be the minimum position which should be considered as consistent with safe aircraft control.

The following advantages are cited for the 16.5° low pitch mechanical stop:—

(a) Prevent excessive engine overspeed during take-off and climb.

(b) Give a positive rate of climb at all gross weights under 163,000 pounds with one propeller windmilling.

(c) Permit control of the aircraft in-flight at all gross weights should an overspeed occur.

C.124's are also in line for modification to incorporate the mechanical low pitch stop and the first of these kits should now be in the field.

Of the 54 C.97 propeller overspeed cases reported by UR's from 1949 to 1953, 45 were feathered normally. In one case the propeller was allowed to windmill and the aircraft landed with the prop rotating at 2400 r.p.m. In three cases feathering was not effective

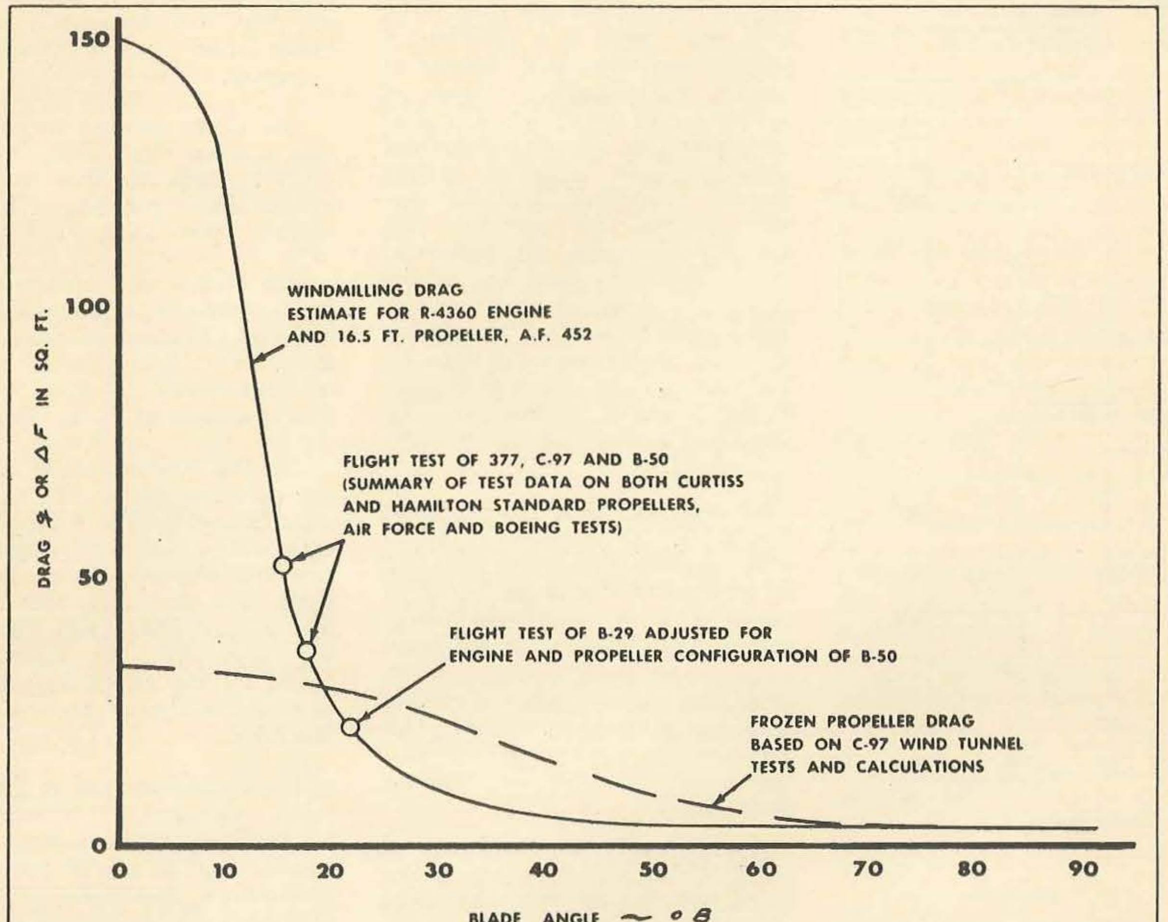


**Figure 2**



until partial freezing had been accomplished. In four cases the engines were frozen and in one case the pilot couldn't feather but whether the engine was frozen or allowed to windmill was not reported.

The aircraft are presently undergoing a modification in which new Dural propellers, featuring pitch locks, are being installed to replace the old props in which fatigue failures were occurring.

As to pitch lock on 34G60 Dural propellers on C.97's this device hydraulically locks the blade angle as a function of over-speeding r.p.m. Locking pitch at a blade angle appreciably above the low pitch stops means lower windmilling r.p.m. resulting in increased possibilities to feather. If feathering is unsuccessful, the prop can be operated as a fixed pitch propeller with windmilling drag and r.p.m. substantially reduced over a non-pitch lock propeller due to the higher locked pitch blade angle.

Safety, engineering and operations personnel are giving a hard look at present emergency procedures for handling runaways when the propeller will not feather.

Currently, here are some considerations:

Slow the aircraft down to just above stall speed.

Fly at a low altitude where the density of the air is greater and the true airspeed can thereby be decreased.

Don't freeze the engine if the runaway propeller is the only consideration. Drag in most cases will be greater with the engine frozen and the propeller stopped than with the propeller windmilling. This applies in all cases to propellers with low pitch mechanical stops when the blade angle is at the limit or above. Of course, if other malfunctions exist, such as severe vibration or loss of oil, controlled freezing may be dictated. If so, freeze at the slowest possible airspeed and, if altitude and all other factors permit, consider feathering the adjacent propeller until freezing has been accomplished. (One engineer told us that if 6 inches is lost off one blade of an adjacent engine's propeller, that engine will vibrate itself completely off the wing before it can be shut down.)

Don't attempt intermittent freezing, but close the firewall shut off valve and leave it closed. Freezing will be accomplished in the minimum amount of time and there will not be the tendency for bearings to be washed away a little at a time as could be the case were intermittent freezing attempted. Other suggestions as to freezing are to move all personnel out of the prop line, depressurise, and as r.p.m.'s decrease keep trying to feather. The feathering motor may be able to overcome centrifugal turning moment working on the blade as the r.p.m. decreases. It has been done just this way several times.

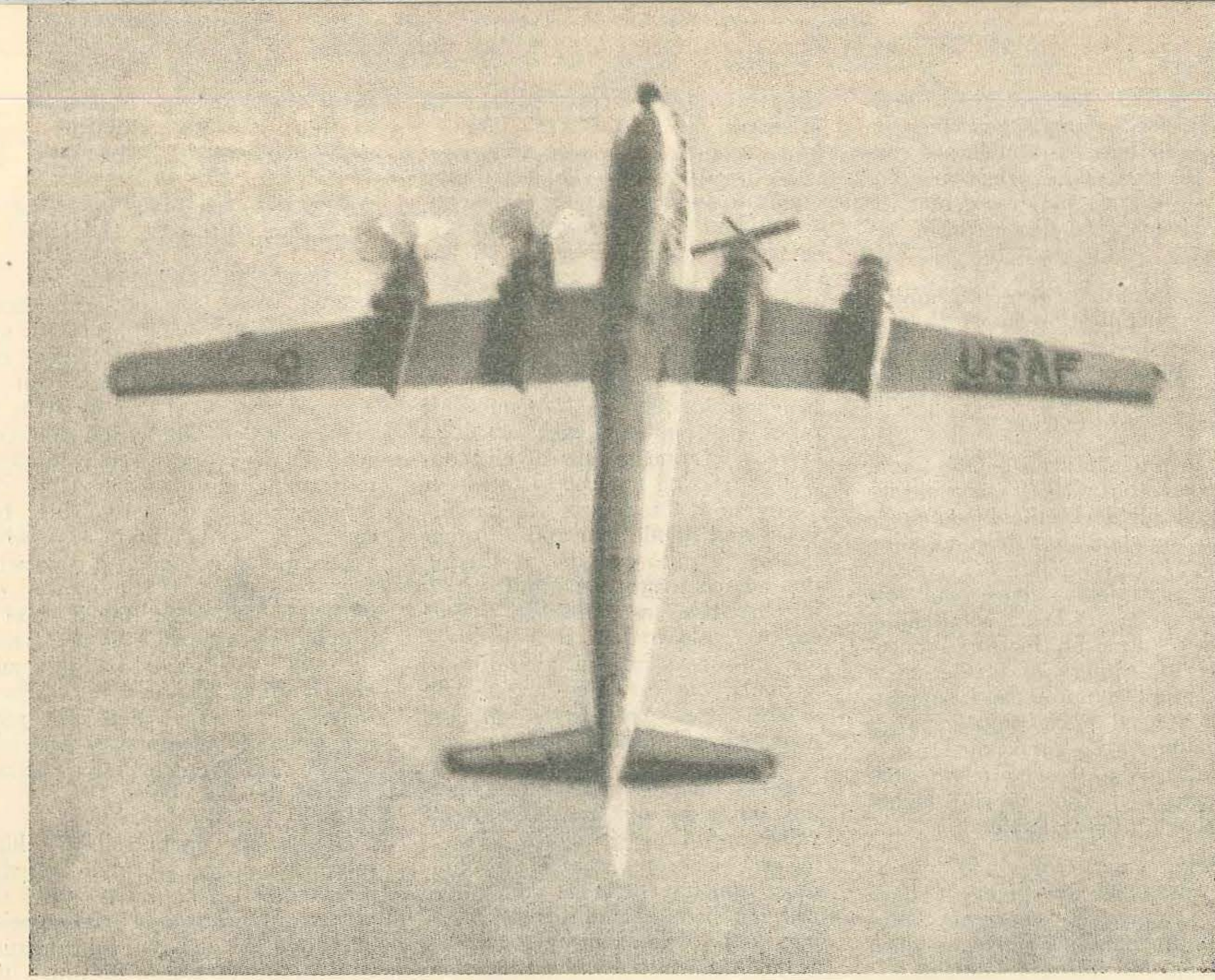
Consider dumping fuel and/or jettisoning cargo.

Remember the advantages of ground effect, as a last resort. Major Tyson, flying his C.97 approximately 100 feet above the water, realised a definite gain in airspeed and was thereby able to reduce power slightly on the two good engines and stretch his fuel to enable him to reach Hilo. In cases such as this, too, fuel becomes a consideration in what action should be taken to cope with the emergency. If the power required to counteract the drag of a windmilling propeller is such that fuel will be exhausted before a suitable landing field can be reached, freezing, in hopes that the prop will come off or uncouple from the engine and thereby reduce drag, may be the last choice.

Completely uncontrollable, high speed runaways are not everyday occurrences. Few pilots have experienced such major emergencies. They should not be misconstrued with prop overspeeds in which the procedure is: Reduce throttle; try decreasing r.p.m. manually; if ineffective, try reducing r.p.m. with intermittent feathering and if it doesn't hold, feather; if the prop will not feather, reduce airspeed by retarding all throttles and pulling the nose up.

## CONCLUSION

**The rules set out in this article represent the general procedures for coping with the uncontrollable, runaway propeller. They have been evolved from questioning of airframe and propeller manufacturers, military specialists in the field, and are based on flight and engineering test data, together with actual experiences. These general rules are thought to be the best available at this date. It should be remembered however, that each emergency of this kind is an individual emergency that may require deviation from these generally recommended procedures. The decision as to the best way to handle each individual emergency must, therefore, lie with the crew involved. It is felt that knowledge of runway characteristics and aerodynamic considerations as presented in this article will better enable the crew to analyse and handle the emergency.**




# Good Show . . . .

*(Reproduced from "THE MATS FLYER", October, 1957)*

**One thousand and ten miles out of Hilo, Hawaii, stretches a pathway that will remain forever emblazoned in MATS' annals of outstanding flying feats.**

**Here a near-impossible accomplishment was carved through the ocean skies, most of it at near wave-top level, by a crippled Pacific Division C-97 on 8th August, 1957.**

**Under the command of Major Samuel W. Tyson, 55th ATS, Travis AFB, a crew of 10 brought their huge transport and its 57 passengers in to a safe landing at Hilo with first one, then two engines out on the left side. For 6 hours and 12 minutes the two remaining engines laboured to drag the crippled plane along.**

In the crew compartment the pilots took turns at the controls wrestling against the drag of the deadened left wing. The No. 1 propeller assembly was missing entirely and the No. 2 propeller, one of its four big blades damaged by the No. 1 prop when it came off, feathered and useless and hanging from an engine drooping two inches in its mount.

The engineers carefully nursed the two right wing power plants for any sign of malfunction at the high power settings required. Even a partial loss of either one, they knew, would necessitate an immediate ditching.

The navigators, fixing positions to pinpoint accuracy, figuring exact true airspeeds and winds and cross checking with predicted fuel flow requirements as determined by the



engineers, advised the aircraft commander soon after the runaway that the flight plan was 6 hours and 30 minutes. Fuel remaining was 6 hours and 4 minutes.

And in the cabin the flight attendants, working with calm purposefulness, had everyone put on and adjust life vests and remain seated and strapped in for what was to be the longest ordeal most would ever face. Thanks surely to the example of the flight attendants as well as the reassuring words of explanation and comfort that came over the public address system from Major Tyson every now and then, there was no hysteria—if there was it never was allowed to come to the surface by the 57 people whom the major describes as "the best passengers in the world".

This flight, one of many daily over-water scheduled trips operated by MATS, was routine until reaching the top of a split climb to 16,000 feet just beyond the equal time point. Everything was normal and Major Tyson, seated in the pilot's seat, was leaning back and resting. He was waiting until cruise power had been called for by the co-pilot making the climb before making another walk-through of the cabin—one of the many gestures that are a part of the MATS policy of passenger comfort.

Perhaps he would have already been back in the cabin had it not been for another MATS policy, and the only one that has priority over passenger comfort — flying safety. He wanted to keep an eye on things until power adjustments had been made and the cruise configuration established and stabilised. Like the captain of an ocean liner, he was in complete charge and completely responsible for his craft and everyone on board. This habit of being handy, particularly during even minor power changes, was one he had developed over the years. Outwardly he was relaxed and unconcerned but an inner sense, attuned through thousands of hours in the air, kept tab on the familiar sound and feel of his huge craft.

Suddenly the growing whine of a runaway propeller broke through the gentle, smooth throb that normally permeates the crew compartment. The panel engineer, his attention pulled to the tachometers by the sound, noted the No. 1 needle winding its way around the dial. Major Tyson, even while the sound was building, reached forward, retarded No. 1 throttle, punched the feathering button, then pulled the nose up and called for 55 per cent. flaps.

But No. 1 refused to feather — even though the high r.p.m. of 3,800 dropped somewhat as the airspeed decreased and all power was pulled off. Drag from the expanse of flat plate area created by the windmilling prop in low pitch position pulled the plane to the left. Flaps were at 55 per cent., airspeed indicating 150 m.p.h. Again an attempt was made to feather — still no results.

Propeller oil quantity indicated zero. The aircraft commander decided to freeze the engine and started a slow descent to control the airspeed. Upon descent through 15,000 feet with zero manifold pressure on the No. 1 engine the r.p.m. varied between 2,100 and 2,200. There were three engineers on board, one an instructor engineer. They were all on duty now — but even this combined ability couldn't feather the propeller.

Major Tyson, at the controls, was using full trim and full rudder for directional control as he fought to overcome the drag of the spinning prop.

At 11,000 feet, starved of oil since the decision had been made to freeze, the metal inside the engine expanded from its self-generated heat until it froze and the r.p.m. dropped to zero. The propeller shaft however, unable to stand the opposing forces of the freezing engine and the windmilling propeller broke and the prop continued to windmill.

There are a lot of factors that go to make up the knowledge background that aircrews must have. Major Tyson knew that the speed of a windmilling propeller is a function of true airspeed and that the lower the altitude the lower the windmilling r.p.m. Also, in the denser air near the surface, it takes less power to keep an aircraft aloft. Descent was continued.

During this time the crew members were going about their emergency procedures. The nature of the emergency and request for Air Rescue intercept were radioed via HF. The navigators fixed position and were working on a new ETA and fuel remaining report. The engineers were monitoring the panel and the troublesome engine visually. The flight attendants were getting passengers into life vests. Major Tyson had explained the situation to the passengers and assured them that there was no immediate danger.

After passing through 7,500 feet the crew noticed a red discolouration beginning to appear on the nose section of No. 1. They took this to be indicative of only one thing—No. 1 propeller assembly was about to come off. Major Tyson knew that a thrown propeller would very possibly come toward the fuselage and could easily strike the No. 2 engine. Knowing this he did two things — all in addition to what he already was doing—to minimise the damage. He feathered the No. 2 engine to prevent its vibrating to pieces should it be struck by the No. 1 prop when it came off; and he started a bank to the right of 35 to 40 degrees in an attempt to direct the No. 1 propeller over the plane when it did come off.

These precautions paid off. It wasn't long until No. 1 propeller separated from the engine. When it did it struck the No. 2 propeller, cutting off three feet of one blade, and also doing damage to the No. 2 nacelle and comparatively insignificant damage to the fuselage and empennage. It missed the main fuselage.

Now another problem was evident. A magnesium fire, friction-ignited from the torturous twisting of the propeller, burned in the nose section of No. 1 engine. Major Tyson watched it closely. In five to eight minutes, it burned out.

Altitude was now down to 5,500 feet. It was becoming daylight. Directional control was now fair. Twenty minutes had passed since No. 1 had run away. The emergency had more than doubled in seriousness — two engines were now out. The odds were definitely not on the side of this crew, but they refused to believe that.

At 2,500 feet, descending, the navigators, who were working feverishly, reported there was a possibility of reaching Hilo, one of the islands in the Hawaiian chain and the nearest landing field.

Major Tyson, setting the flaps at 5 to 10 per cent. to reduce vibration and increase stability, ordered all baggage and mail jettisoned. The stratocruiser would fly on two engines it appeared, but there was a long way to go. The left rear hatch was opened and the flight attendants began jettisoning. The passengers, watching their belongings being thrown to the ocean, made no complaint. By looking out the windows they could see the ocean swells and waves gradually and persistently growing larger as the plane continued on down. Opening the hatch had increased drag and rate of descent.

At 50 feet the hatch was closed and maximum power applied. The big plane laboured back to 1,000 feet where the hatch was re-opened and jettisoning continued. After everything that could be spared had been thrown out, the hatch was closed again and altitude maintained at 50 to 100 feet.

At 1250 EDT word of the emergency was received at Headquarters MATS in Washington. A communications patch was set up to provide the fastest possible information. Reports began to filter in. Both engines out on the same side and 1,000 miles from land; descending, airspeed 150 m.p.h.

Altitude 50 feet, airspeed still 150.

And, a little later . . Estimate Hilo in 5 hours, at 2120Z. Fuel remaining 5:04. Airspeed 155 m.p.h. Altitude 100 feet.

The situation was far from encouraging—but Major Tyson was not going to give up. This crew had minimised the effects of the emergency as best they could and they were still flying. They had even been able to reduce power slightly—and with every revolution gas was being consumed and the aircraft becoming lighter.

Somewhere, possibly in the pilots' professional reading file, Major Tyson had heard of ground effect. He knew that, in theory at least, as an aircraft moves within its wingspan distance of the surface induced drag is decreased. There would never be a more opportune time to put this theory to test. He held his plane close above the eight foot swells that swept by under the nose in the early morning sunlight.

This bit of information, like so much the aircraft commander had acquired in 6,000 air hours, 2,000 in C.97's, paid off handsomely. The airspeed picked up. Power could be cut back slightly cutting down fuel flow and reducing the strain on two engines that were being called upon to do the work of four.

In such an exaggerated unsymmetrical power configuration the yaw was terrific. Despite the use of full trim, right rudder had to be held in with both feet. The major decided to utilise his two co-pilots in shifts in hand flying the plane. They had to brace themselves against the seat then hold the big transport on heading with both feet forcing the right rudder pedal. After the first shift the time had to be cut down. When Lt. Lambert, on the first shift, got out of the seat his legs crumpled under him.

The first time Major Tyson tried to relax his grip on the controls he found he had to pry the fingers of his left hand free from the wheel. He then struck his left forearm with his right fist to unclench the left hand. His watch band had broken in five places.

As if the pressure of the emergency was not enough in itself, the temperature inside the plane increased until it reached 110 degrees. Crew members and passengers alike were soaked in perspiration. Hatches could not be opened because of drag and because of the possibility of ditching — never more than a few faltering prop beats away. If ditching were to ensue, the drinking water aboard would be needed on the rafts.

The world for the 67 people on the damaged plane, including four wives and 10 children, encompassed only the plane itself, the unfriendly ocean stretching in all directions just underneath and an invisible line in space to a landing strip on an island. Their thoughts were concentrated into their immediate problem and TIME. Time became increasingly vital as with its interminable passage chances improved. The discomforture of the life vests in the heat was insignificant in relation to the passage of time. Occasionally Major Tyson gave a progress report—there was a strong bond between passengers and crew. They were all in this together. The passengers kept looking at their watches. Time was all important. The fact that all were in stocking feet, just in case of ditching, was unimportant.

These 67 people were not aware that the outside world had been alerted to their plight. News reports had spread the world. Progress reports were aired as they came in and the struggle of these 67 was followed throughout the U.S. and abroad. Wherever news media were operating people stopped to hope and pray. Few would have given them much chance at first, but as time went on more and more began to feel there was a chance of making land.

In addition to immeasurable spiritual aid, what material assistance could be provided was despatched. Navy ships on the flight path were alerted to stand by and Air Rescue planes were sent out. A sister C.97, also outbound from Travis to Hawaii and an hour ahead, turned around, came back and followed along behind the stricken craft.



Time ticked slowly on. The C.97, yawing awkwardly, ground steadily through the slightly turbulent air near the surface of the ocean. Little could be done to ease the tension. Minimum movement was mandatory as there would be little time to get into a seat and fasten a safety belt should ditching occur. The crew did what they could, but the best medication for all was steadily turning hands of watches.

The plane was getting lighter. The two big engines on the right wing were carrying the load with every indication that they could withstand the demands required.

Altitude: 100 to 125 feet. Experimenting with slight changes in altitude had proved this to be the most effective altitude. Place: 15 minutes out of Hilo.

Major Tyson eased his plane up to 500 feet in preparation for the landing. Everyone strained for the first sight of land.

LAND!

Never had anything looked so good.

The runway was 6,500 feet long; wind slightly cross. When he "had it made" Major Tyson called for the gear.

"The left gear is not down", came a voice from the engineer's compartment, then, without a pause, the voice added, "but you have enough gas for a go-around".

Hadn't this crew had enough already?

With no hesitation Major Tyson executed his go-around procedure, calling for the gear to be retracted and flaps reset to cut down the drag.

The major made a low circle, lining up again, slightly downwind this time, and the engineers cranked the gear down. When the No. 1 propeller struck the No. 2 nacelle, causing it to droop, it jammed the doors and gear inside the nacelle. Two engineers, with near superhuman strength, cranked the gear through doors—bursting rivets and all.

Were this fiction it would seem appropriate to say the touchdown was smooth and perfectly executed. This is truth, not fiction, and the touchdown WAS smooth and perfectly executed. With hatches open to help provide drag now, the big plane slowed, turned off and taxied in.

So involved was Major Tyson with the handling of his emergency to the exclusion of all other thoughts that when he made his go-around at Hilo and saw several thousand people at the field he commented as to some activity underway that they would disrupt. Oh well, he'd have to go in any way, and he made his landing, not realising that these were but an infinitely small percentage of the people who anxiously awaited his safe arrival.

**To this aircraft commander, and to his crew, summarising this exploit with the words GOOD SHOW seems pitifully inadequate. Even the fact that Major Tyson won his third Distinguished Flying Cross doesn't fully indicate the magnitude of this accomplishment. (He received his first flying B-24's in combat and his second for safely landing a C-124 at Nagoya, Japan, during the Korean War after an engine had exploded and fallen from the wing).**

**Surely this man and his crew exemplify the highest degree of professionalism and deservedly earned the tribute of Lt.-General Joseph Smith, when he declared this to be the most splendid example of flying to come to his attention in the six years he has been the MATS Commander.**

# A Favour?

*(Reproduced from Business Pilots' Safety Bulletin 57-211, December 12th, 1957)*

**A recent issue of the "5th Air Force Flight Safety News" included a short article on flight checking. It was an excellent presentation of pertinent points and subsequently was reprinted in "The MATS Flyer".**

**The manner in which the check pilot does his job, his acceptance of his responsibilities, is vitally important to the safety and efficiency of all aircraft operations. Therefore, for your consideration and possible use, an adaption of this article is offered.**

### "Buddy" Check Pilot

How many times have you seen some Yo-Yo, who couldn't fly a kite in a strong wind, be given the benefit of all doubts during a so-called check ride by a "buddy" check pilot? Is the check pilot really doing his friend a favour by "carrying" him through a check, or is he setting him up for a statistic on the Aircraft Accident Chart?

It goes without saying that the above questions are in a purely rhetorical vein. Fortunately, it is not a commonplace situation, but it has happened. When it does, the recipient of the "favour" is just an aircraft accident looking for a place to happen.

The responsibilities of a check pilot extend far beyond the scope or whether or not a particular pilot can get by on his check. Is the man marginal? Should he receive more dual time? Does he know emergency procedures? Would another check ride help him any?

### Loose Checks

Whether it be a transition check or an instrument check, the check pilot owes it to himself to do an effective and complete job. There are no "buddies" in a poker game. The stakes are sometimes high but they are much higher in the operation of aircraft. If a pilot can't satisfactorily "hack it" on a check, what will happen when he faces the elements alone? We don't mean to imply that a check rider should be a Simon Legree. However, he should face up to his responsibilities and ensure that the man he's checking is ready to go it alone—safely.

One particularly important phase of loose-type checking is on Instrument Checks. Sometimes a pilot is "passed" on his annual check only to bust his neck in weather, unfortunately taking a few innocents with him.

Another type is the check given in an aircraft with which the pilot being checked is not familiar. Discrepancies in holding between prescribed tolerances are passed over by the check pilot because he thinks it's only a case of unfamiliarity with the equipment. Actually, the weakness may lie in the fact that the man being checked is not capable of holding tolerances in any aircraft.

In other instances the check pilot may scribble his validating signature on the check sheet and merely advise the lucky (?) recipient to brush-up on his weak points.

Every once in a while rank may walk into the cockpit and attempt to dictate what the check pilot will check. Those in this minority group have a hard time realising that the man with the scythe does not distinguish between Management and Employee types. Fortunately, there are few cases of this sort, since pilots with "rank" or who are a part of Management usually are cognizant of the necessity for top proficiency and, therefore, give the check pilot little trouble.

Again, the check pilot should make *no* exceptions, allow *no* "Benefits of the doubt". By telling it to you straight, the check pilot can be the best "buddy" of them all.

# Clear Air Turbulence

*(Reproduced from Flight Safety Foundation, Business Pilots' Safety Bulletin 57-210, November 29th, 1957)*

The 0800 pilot balloon sounding in January gave a wind flow at 6,000 feet of 300°, 4 knots. At 7,000 feet, wind was 300°, 49 knots and the velocity remained at 50 knots up to 10,000 feet.

Considering the wind direction and sudden increase of velocity just east of 4,000- to 10,000 foot mountains, the forecaster stated that "turbulence and possible severe turbulence would be present". However, the stability index above the 5,000 foot level did not show conditions of severe turbulence and the atmospheric conditions were not specifically brought to the attention or operating squadrons.

### Plane Damage

During mid-morning a TV-2 was making a letdown from 25,000 feet in the clean condition. TAS was approximately 370 knots, and while passing through 7,000 feet, the aircraft entered clear air turbulence. Three violent, successive jolts were experienced, two of which the dual pilot reported "caused my head to make contact with the canopy".

There was insufficient time to make any corrections other than to reduce power as the turbulence was almost immediately passed. A normal landing was made, but as the pilots were leaving the aircraft the plane captain drew their attention to structural damage of the right wing. In addition to popped rivets and split skin along the main spar cap, the wing was found to be twisted and forced upward in excess of one inch.

Though the pilot was not tagged with pilot error, the circumstances provide a good opener for some thoughts on clear air turbulence.

### Alert to Possibilities

In the first place, the pilot of the TV-2 should have been alerted by the results of the pilot balloon sounding.

British analysis of clear air turbulence indicates that it is associated with a marked increase or decrease in the vertical wind velocity. In this case, it would be called "wind shear". A 45 knot increase in wind velocity within a thousand feet of altitude should be sufficient evidence to warn any pilot of possible turbulence.

Another possibility in this case is the presence of a mountain wave in the area. Several distinctive cloud types, such as the cap cloud, rotor or roll cloud, and lenticular clouds usually accompany the mountain wave. However, if the air is very dry, no clouds will form, eliminating any visible warning to pilots.

Clear air turbulence can often be found near the tropopause, the layer of air at altitudes varying from 5 to 11 miles above the earth at which the lower atmosphere becomes the stratosphere. Also, the jet stream is many times accompanied by isolated patches of turbulent air. The 1947 British study showed that this type of turbulence is variable in altitude, depth, length and width. A real sky tramp in its wanderings.

The average sample is 50 to 100 miles long and several thousand feet thick. There is a type of invisible turbulence linked with the dry or dew point front which often bisects the warm sectors of lows in the south-central part of the U.S.—it is distinct frontal discontinuity, without clouds or precipitation, and with dissimilar winds causing wind shear and turbulence.

An occluded front is another turbulence factory. In the areas of the occluded front, 25 to 30 miles to the north* of the peak of the warm sector, there are three different air masses in direct proximity. The wind shear associated with the different wind streams can be rough. The rule is to fly at least 50 to 100 miles north of the peak of the occlusion.

* Should be read as "south" for operations in the Southern Hemisphere.



# Danger in Auto Fuel

*(Reproduced from Private Flying Safety Bulletin 57-302, October 10, 1957)*

The octane rating of today's automobile gas may be within the octane range of light aircraft engines, but there are two differences that make the use of auto gas a hazard. These are volatility and, more important, vapour pressure. Here is what the Pure Oil Company says:

"Even though savings may be realised by using motor gasoline in light aircraft, the risk involved is so great that no operator should permit its use. Because the vapour pressure of motor gasoline is substantially higher than that of aviation gasoline, there is a good possibility that vapor lock will occur when using this type of fuel in aircraft. This could cause engine stalling, engine overheating and other engine malfunctioning which might result in a serious accident. Volatility of fuel is not as serious a factor as vapor pressure, but volatility must be proper so that fuel vaporisation and distribution to the individual cylinders is correct."

In short . . . NEVER use automobile gasoline in your airplane engine.

# One Engine Out

*(Reproduced from Private Flying Safety Bulletin 57-302, October 10, 1957)*

Every twin-engined aircraft, whether it's a light twin or a heavy, has a minimum engine-out control speed. Below that speed, the best pilot in the business cannot control the aircraft, as long as only one engine is developing power. With some light twins the minimum engine-out control speed is lower than the stalling speed. That's so much to the good. Under present regulations, however, it is possible for this critical engine-out speed to be as much as 30% above stalling speed, and also well above the best climbing speed.

This means that whereas the airplane's best rate of climb may be 75 m.p.h., for example, its minimum engine-out control speed may be 80 m.p.h. The pilot who takes-off and climbs out at 75 m.p.h. is gambling on his two engines continuing to operate normally. But . . . if one engine should quit on him, his only hope of survival lies in cutting the good engine instantly and dropping the nose.

Moral of the message is: On take-off, always fly your light twin at least 5 knots above minimum single-engine control speed.

# Overseas Accidents

## *Viking Crashes Following Engine Failure on Take-off*

*(Report by the Commissioner of Public Inquiry into the Causes and Circumstances of an Accident to Viking Aircraft G-AJBO on May 1st, 1957)*

**On the evening of 1st May, 1957, a twin-engined Viking G-AJBO (normally called Bravo Oscar) was due to take-off from Blackbushe on a trooping flight to Idris in Tripoli. She had a crew of four, comprising Captain Jones, a first officer, radio officer and a stewardess, also one supernumerary crew ranking as a passenger, and in addition thirty passengers who consisted of service personnel, women and children.**

**The weather was fair with no cloud under 3,000 feet, the wind was slight and from the north but visibility was only moderate — it was in fact 2.4 nautical miles which was described to me as indifferent, or neither good nor bad.**

**The aircraft took off up wind at about a quarter past nine G.M.T. and two minutes later reported a failure of the port engine and that it was intended to make a circuit to port and land again. Having completed the down wind and base legs of this circuit the aircraft crashed in a wood just as, or just after, she had turned on to her final approach and at a distance of about 1,200 yards from the threshold of the runway.**

**Thirty-four of the thirty-five persons on board lost their lives.**

It is necessary to restate the above bald account in rather more detail in order to consider the implications of the facts. Before the aircraft took off a number of the staff of the operator spoke to Captain Jones, who appeared fit and well, and one of them who spoke to him immediately before the aircraft was started observed that he had taken his seat on the port side, this being the seat normally used by the captain of a Viking.

At 21.08 hours G.M.T. by which time it was fairly dark and the runway lights were on, Bravo Oscar asked for taxi clearance and in reply the control tower at Blackbushe gave permission for the aircraft to taxi to the holding point for runway zero eight and at the same time informed the aircraft that the Q.N.H. was 1,021 millibars. By this the air traffic controller meant that the barometric pressure at Chatham, the station into whose area the flight would normally proceed, was as stated — the Q.N.H. being given in order that Captain Jones might set his altimeter accordingly once he had taken off from Blackbushe and attained a suitable height.

Shortly after 21.14 hours the control tower, which had in the meanwhile given instructions as to the course to be followed, informed Bravo Oscar, which had by this time reached the threshold of the runway, that she was clear for take-off with a right turn out.

This message was acknowledged by Bravo Oscar at 21.14.53s and within a few seconds thereafter she was observed to make her run and to take-off.

Zero Eight runway at Blackbushe lies almost parallel to the Camberley-Basingstoke road but to the north of it and the aircraft was taking off from west to east, that is from the direction of Basingstoke towards Camberley.

At 21.16.44s Bravo Oscar called the control tower and on receiving its acknowledgment passed the following message at 21.16.52s (almost precisely two minutes after take-off):— *"I have got a port-er-engine failure I am making a left-hand circuit to come in again"*.

A minute and a half later at 21.18.16s the control tower, which had been taking energetic action to clear the runway of other aircraft, received the message:—*"Bravo Oscar is down wind"* indicating that Captain Jones had successfully turned left-handed and was flying westwards parallel to the runway. To this message the air traffic controller was able to reply:—*"Bravo Oscar clear to final number one"*— that is to say to land as soon as she was ready to do so: he followed this message, which was duly acknowledged, by informing Captain Jones that the surface wind was Zero Two Zero at 7 knots.

At 21.19.08s the aircraft, having acknowledged the message in regard to the wind, asked for the Q.F.E.— that is the barometric pressure at Blackbushe itself which would govern the altimeter setting for landing.

At 21.19.13s the aircraft sent its last message acknowledging the Q.F.E. which had been given as One Zero One Zero.

Shortly afterwards, at 21.19.47s, the control tower record shows the following entry: — "Transmitter switching — unmodulated"; a few seconds later a Viscount Aircraft (Hotel Kilo), which was stationary in a lane near the runway, passed a message that it had seen Bravo Oscar, adding *"I have lost sight of him on the approach very low"*.

By 21.20.28s this message was supplemented by the further report *"We have him there, he is on or it looks like him on fire"*.

In fact, as the airport fire services found when they reached the



scene some few minutes later, Bravo Oscar had crashed some 1,200 yards short of the runway threshold at a point south of the Basingstoke - Camberley road but directly in line with the extended line of the runway.

The account of the crash given by the only survivor, Second Lieut. Taylor, describes the steady turn to port after the take-off, throughout which he could watch the lights of the runway, the message from the captain given by the stewardess that there was trouble with an engine and that they were turning back to land again, and then the final scene in the following words:—

*"After a time, which I cannot estimate exactly, the aircraft banked very steeply to port. I could still see the runway lights when this occurred. A little later there was a tremendous shudder throughout the whole length of the aircraft, almost as if a gigantic hand had seized the aircraft and shaken it. A few seconds later the aircraft struck the ground. I am satisfied that when the shudder occurred the aircraft was banking to port. I am also satisfied that the shudder was not caused by the aircraft striking anything by its very nature and because enough time elapsed between the shudder and the crash on the ground for me to turn round and say something to re-assure the children who were sitting behind me.*

*"Immediately after the crash I looked at my watch and it was 22.25 hours. The stewardess, after giving out her message to the passengers, had sat down on the tip-up seat attached to the door of her cabin and strapped herself in.*

*"I had noticed that the window next to me was labelled "Emergency Exit — Push" so I knocked it open and climbed out. I ran a few yards and then turned back towards the aircraft. It was not then on fire and I heard someone shouting 'Get the children out'. I ran back to the window I had climbed through and shouted 'Pass the children through here'. There was no answer and at that moment there was a terrific explosion somewhere to my left and burning petrol was sprayed all over and around the aircraft so that the whole area within a radius of about 50 yards from the port engine was in flames. I scrambled over the tail of the plane to the starboard side and when I was about 20 yards away from the aircraft I looked back again. The whole aircraft was on fire and there was clearly nothing I could do. At that moment I saw Captain Routledge emerge from the flames and, as he was on fire, I ran towards him, grabbed him and rolled him on the ground to put the fire out.*

*"Just after this a man rushed up to me and said that I was on fire too. He pulled my burning clothes off and then went to the aid of Lieut. Andrews, who was also burning. Shortly after this, the ambulances arrived and we were taken to the Cambridge Hospital at Aldershot, where I am still a patient."*

In fact the fire caused by the exploding petrol caused such severe injury to the other passengers that none has survived the crash, whilst Second Lieutenant Taylor was, at the date of the inquiry, still in hospital. The engines were so severely damaged that it was necessary to exercise extreme caution is assessing any evidence to be derived from their condition.

The story which I have outlined shows that this crash was preceded by the apparent failure of the port engine some two minutes after take-off. The crash itself occurred about three minutes later when the aircraft, having almost completed its circuit, had reached a point about 1,200 yards short of the threshold of the runway to the line of which it was turning preparatory to coming in to land.

It is convenient to record that, as a result of his most skilful and painstaking investigation of the scene of the crash, a senior investigating officer of the Accidents Investigation Branch of the M.T.C.A., was able to establish that the aircraft struck the ground first with the port wing tip and then, having attained an inverted position, severed the top of a tree with the starboard wing following which it doubtless lost both wings and spun round so that the fuselage came to rest pointing back in the direction from which it had come.

The evidence adduced in the course of the inquiry was directed to two main issues:— Firstly to the question whether and if so why the port engine failed, this evidence covering the airworthiness of the aircraft, its loading and trim, the condition of its engines and in particular the question of their proper maintenance. Secondly, evidence was directed to the question of why this aircraft crashed where it did. A Viking twin-engined aircraft should be capable of landing without undue difficulty on one engine and I was accordingly required to consider the competence of the pilot and first officer, the course followed during the circuit with particular reference to height and speed, the lighting of the airport and the precise circumstances of the crash.

It is I think convenient to follow a similar order in this report and to deal first with the aircraft itself and the question of its condition and maintenance.

### The Aircraft

Bravo Oscar was first licensed in 1947 and was acquired by Eagle Aviation Limited from the British European Airways Corporation (hereinafter referred to as "B.E.A.") in 1954. The current Certificate of Airworthiness was issued on the 11th May, 1956, and was not due to expire until the 10th May, 1957. The last major inspection (Check 4) was completed on the 4th February, 1957, and at the time of the accident the aircraft had flown 488 hours since that date.

Both engines were well within their approved life, which is 1,500 hours after a complete overhaul. The port engine was completely overhauled by Bristol Aero Engines

Limited on the 16th October, 1956, since when it had run some 662 hours: the starboard engine had had a similar overhaul on the 3rd December, 1956, and had since been run for 488 hours.

It may not be universally known that in the course of a complete overhaul the whole engine is normally taken to pieces and reassembled with a replacement of such parts as the Aero Engine Company (in this case the Bristol Aero Engine Company) think necessary. In the result any engine which has been overhauled several times may well contain few, if any, of its original components.

In short, these engines probably bore little, if any relationship to those installed in the aircraft in 1947 and were well within the span allowed by their makers. The propellers were also well within their approved life.

I heard a body of evidence in regard to the maintenance of the engines and the aircraft generally. With the assistance of my assessors, this evidence was scrutinised with great care and in the result I am satisfied that this aircraft and its engines had been properly maintained

The evidence put before me and which I accept, was to the effect that Bravo Oscar had had a complete Check 1 of the whole aircraft, including its engines, carried out on the 27th April, 1957, following which a Certificate of Maintenance was issued which was valid at the date of the accident. Following this check the aircraft was flown to Palma on the 28th April and returned via France and Germany to Blackbushe on the 29th, having flown for some fourteen hours. During this flight certain minor snags were noted by the pilot.

On the 30th April and 1st May a further complete Check 1 was carried out since, as it happened, the engineers had time available. During this check a few matters left over from the 27th, and also the minor snags noted by the pilot during the flight on the 28th and 29th were all rectified and the engines fully checked. I am satisfied that at about 2 o'clock on the 1st May both engines were run in the presence of a representative of the Bristol Aero Engine Company and proved entirely satisfactory. I am further satisfied that they were run again to the proper test revolutions at about 8 o'clock that evening and Second Lieutenant Taylor's account makes it clear that they were again run by Captain Jones before take-off.

Within a very short time after the crash the petrol caught fire, as previously described, with resulting severe damage to the engines. In the circumstances it was impossible for the experts of the Accidents Investigation Branch of the M.T.C.A. to ascertain whether the port engine had in fact failed and, if so, why. Certain factors could be shown to be satisfactory: the sparking plugs of both engines were still in working order and all those parts which could be examined appeared to have been properly lubricated. It is fair to say that no evidence of failure to maintain was disclosed by such examination as could be made and in the light of the history of the operators and their service company it would be entirely wrong to assume that, if in fact the port engine failed, this was due to any fault of their engineers. The Company has since 1950 carried over a quarter of a million passengers without injury to any one of them and such a record could hardly have been attained without efficient and conscientious maintenance.

A great deal of evidence was put before me as to the loading and trim of the aircraft. It is quite clear that this aircraft was properly loaded and trimmed and if there was any excess weight at the time the aircraft actually left the ground it was so trivial—at most 20 kilograms —that it could not possibly have contributed to this accident.

To sum up:— this aircraft was, in my opinion, provided with a valid Certificate of Airworthiness and a valid Certificate of Maintenance. It was properly loaded and trimmed, and it was properly maintained.

Why the port engine failed, if it did, must remain a matter of pure speculation—the evidence is quite insufficient to enable any conclusions to be drawn. It is always possible for example that the pilot's decision to regard the engine as having failed may have been due to the failure of some instrument, and not the actual failure of the engine itself.

### Handling of the Aircraft following failure of the port engine

Whilst it must necessarily remain the subject of conjecture, it seems likely that at the same time the port engine was considered to have failed the aircraft had attained a height of between 500 and 700 feet. According to the Performance Schedule of this aircraft it should have been capable, with the load carried, of climbing on one engine at the rate of 155 feet per minute or, if that engine was run continuously at take off power, at the rate of 250-300 feet per minute. According to the Operations Manual the ideal height when turning on to final approach should be 700 feet when landing on one engine and the speed should not be allowed to fall lower than 110 knots (109 being described as the minimum effective control speed) until the decision to land has been made.

The cardinal principle in making a landing with one engine inoperative is to avoid an undershoot, namely, the position where the pilot after turning on to final approach finds himself with insufficient height and speed to reach the runway. The fact that one engine is inoperative renders the aircraft power asymmetric so that, if, as in this case, the port engine is dead, it tends to fly port wing low, this tendency increasing as the speed drops. Thus if the speed is low it is obviously dangerous to bank steeply, especially in the direction of the dead engine.



In these circumstances when landing a twin-engined aircraft with one engine only, the practice is to maintain height and speed so as to enable the approach to be made more steeply than with two engines, it being remembered that, once the undercarriage and/or flaps are let down, the difficulty of regaining height or speed is far greater than when the power of two engines is available. For these same reasons if the circuit is being made at a low height it is desirable to fly a tight circuit so that the aircraft may not be too far from the threshold of the runway when the turn on to final approach is made.

If the aircraft loses flying speed it will stall, this event being preceded by "noticeable buffeting" to use the wording of the Operations Manual, or "shuddering", to adopt the more graphic term employed by a witness. There can be no doubt that this aircraft undershot the runway and stalled port wing down some 1,200 yards from its threshold. Is it possible on the evidence to reach a firm conclusion as to the reasons which caused it to do so?

As I have said, there is evidence from a number of witnesses who saw and spoke to him before the flight that Captain Jones was fit and in every way normal before he took the captain's seat on the port side of the aircraft preparatory to the flight. At 21.16.52s, at which time Bravo Oscar informed the control tower of port engine failure and that it was making a left hand circuit to come in again, it is reasonable to assume that Captain Jones would have already taken the appropriate action which would include feathering the port propeller. That the propeller had been feathered was confirmed on examination after the crash. In the course of the Inquiry it was suggested that Captain Jones ought to have attained more height before attempting the circuit and that he ought to have made his circuit to the right, namely against the live engine, instead of to the left.

It must be recognised that the failure of an engine shortly after take-off is rare and represents a serious emergency for the pilot. It may be true that to land the aircraft in such circumstances is, as one experienced captain said, "part of the job", and that it merely requires, as another put it, "a somewhat higher degree of concentration than for a normal twin-engined landing". The fact remains that a pilot has a short space of time in which to make a number of difficult decisions.

Captain Jones decided to turn to port at once rather than to attempt to gain further height before doing so. I do not think his decision to turn to port was wrong and indeed I am inclined to think it was entirely right. Although turning against his dead engine, Captain Jones was turning in the normal circuit direction and, since the emergency occurred at night, a turn to port had this great advantage that it enabled him (whilst sitting in the captain's seat on the port side) to keep the lights of the airport in view, whereas, if the turn had been to starboard, this would have been far less easy. In the absence of any certainty as to the height he had attained at the time he started his circuit, it would, I think, be entirely wrong to criticise his decision.

The course followed by the aircraft has been described by a number of witnesses. Second Lieutenant Taylor, the sole survivor, describes the steady bank to port, during which he himself sitting on the port side was able to keep the lights of the airport in view. Captain Langley, who was in charge of another Viking of the company and was waiting close to the threshold of the runway to take off, saw Bravo Oscar as she crossed the eastern end of the airport to turn down wind and again when she turned on to her base leg and from that on to final approach. This pilot formed the view that when she turned down wind Bravo Oscar *"seemed to have sufficient height"*. He noticed no violent change of height during her circuit but only a *"gradual descent into the last stages of final"*. He did, however, form the view that Bravo Oscar overshot the approach originally and had to turn back to port again, albeit it was not a violent turn. He regarded the aircraft's circuit as in no way unusual.

Captain MacKenzie, a pilot of B.E.A. who was also waiting to take off in the Viscount Hotel Kilo, but whose aircraft was some 600 yards further from the crash than that of Captain Langley, also saw Bravo Oscar, but not until she turned on to base leg. Whilst watching the aircraft at this point and thereafter as she turned onto her final approach, he formed the opinion that the aircraft was rather lower than he himself would have wished to be in that situation. He observed that it was steadily losing height until it disappeared behind the hill on its approach: at that time as he judged it was making a turn to port into line with the runway.

Those who heard the various messages from Bravo Oscar on the radio telephone, namely Captain Langley, Captain MacKenzie and the two Air Traffic Controllers, all agree that none of them disclosed any sort of anxiety or tension, whilst nothing emerges more clearly from the statement of Second Lieutenant Taylor than the absence of any indication that the aircraft was in serious jeopardy.

The obvious conclusion from this body of evidence is that from the moment that Bravo Oscar turned to port it made its circuit certainly without gaining and probably whilst losing height steadily. No sort of anxiety was apparent amongst the crew and everything appeared to be set for a successful landing. The aircraft appeared to one observer, namely Captain MacKenzie, to be lower than he himself would have wished to be. The picture thus presented by the evidence is of Captain Jones making an unhurried and not unduly worried circuit to port, probably losing height as he did so but at all events not gaining any. He may or may not have turned slightly wide when turning on to final approach and had to correct but if so the turn was gradual.

Some suggestion was made that the airport lighting at Blackbushe was such that it did not provide the pilot with adequate assistance. It was suggested that the fact that Captain Jones may have had to correct his turn on to final approach, supports this view and emphasis was placed on the decision which has now been reached that cross-bar lighting should be introduced and the approach lighting extended from 1,500 yards to 3,000 yards.

Having heard all the evidence and the addresses of Counsel it is perhaps sufficient to say that I am satisfied that the lighting of the airport on the evening in question was adequate and that it had no effect on the accident which occurred.

It is curious to note that the aircraft when proceeding to take off never asked for the Q.F.E., that is the barometric pressure at Blackbushe, but was merely informed of the Q.N.H., that is the barometric pressure at Chatham. Although not strictly encouraged it is common practice in a twin-engined aircraft when there are two altimeters to set the Q.F.E. on one and the Q.N.H. on the other. It may not be readily appreciated that any confusion between the two can prove serious. For example in this particular case, if in fact Captain Jones had set the Q.N.H. on his altimeter and forgotten that he had set the Q.N.H. instead of the Q.F.E., he could reasonably have supposed that his aircraft was about 300 feet higher than in fact it was. In other words if Captain Jones was judging his height from an altimeter on which he had set Q.N.H. instead of Q.F.E. he might have supposed that his height on turning on to final approach was 550 feet instead of only 250 feet.

It is strange that he obtained the Q.N.H. before starting his run but not the Q.F.E. and that he only asked for the Q.F.E. a little more than half a minute before the aircraft actually crashed. It would not be right in the absence of conclusive evidence to draw any firm deduction but I cannot help thinking that the absence of any anxiety on board, the failure to attempt to gain height and the sudden request for Q.F.E. at so late a stage of this circuit tend to indicate that Captain Jones thought his aircraft was a good deal higher than it was and that he may in fact have been relying on an altimeter on which the Q.N.H. had been set. One of the altimeters recovered from the aircraft was found to be set at 1,020 millibars, a setting almost equivalent to the Q.N.H., but it was impossible to prove whether the altimeter in question was that in front of the captain's seat. Unless some such confusion took place, it is difficult to understand how this aircraft found itself so low at so great a distance from the threshold in all the circumstances of this flight.

Finally I have found it necessary to consider whether the crash might have been caused by a failure of the remaining engine. As to this I can only point to the fact that the aircraft evidently proceeded to circuit on the starboard engine and there is no indication in any message that Captain Jones was disturbed at its performance. It would indeed be remarkable if it also had failed, nor is it likely that Captain Jones would have let down the undercarriage, which was found locked in the down position after the crash, if he had not had confidence in his remaining engine. To my mind the possibility is virtually disposed of by the evidence of Second Lieutenant Taylor and by the fact that examination of the site showed that the starboard engine had still been under considerable power at the time the engine hit the ground. The investigator was able to establish that the starboard propeller cut through a tree root some eighteen inches thick.

The evidence is, then, entirely clear that Bravo Oscar after her turn to port continued her circuit until she turned onto final approach. There is no evidence that she gained height and the evidence suggests that she lost it consistently during her circuit. There is no evidence of anxiety over the loss of height, and indeed the evidence indicates that Captain Jones and his crew did not appreciate that any grave emergency had arisen. The request for the Q.F.E. at so late a stage of the circuit may indicate the sudden realisation that all was not well. The fact that the flaps were not used is perhaps a further indication to the same effect. The sudden shudder described by Second Lieutenant Taylor is the normal precursor of a stall. The fact that the tip of the port wing struck first is exactly what was to be expected in the case of an aircraft whose port engine was dead and which had lost flying speed. Everything points to the fact that Captain Jones had no idea that the aircraft was so low; he made no attempt to climb and had his undercarriage down, thereby of course increasing the stalling speed, and stalled his aircraft some 1,200 yards from the threshold of the runway he was seeking to reach.

Before reaching a final decision it is necessary to consider Captain Jones' record. It is all too easy to attribute blame to a man whose evidence is not available. Captain Jones, who was described as a careful responsible and above average pilot, was aged 34. He held a valid Air Transport Pilot's Licence endorsed for Viking aircraft in Group 1. He had served some 1,000 hours as a R.A.F.V.R. pilot during the war and thereafter had served as a pilot with Hunting Air Travel. From 1950 to 1953 he had served with B.E.A. holding a Senior Commercial Pilot's Licence endorsed, inter alia, for Viking aircraft in Group 1. From 1953 until 1955 he had not flown but in 1955 he took a series of tests at the M.T.C.A.F.U. (Ministry of Transport and Civil Aviation Flying Unit) as a result of which he was graded "above average" and obtained a Commercial Pilot's Licence. On the 17th June, 1955 he joined Eagle Aviation Limited as a first officer, having converted his licence into an Airline Transport Pilot's Licence. On the 1st August, 1955 he became a captain and was given a Viking command, having recently taken a type test to obtain the endorsement of his licence to fly Vikings.



He had in all by the 1st May, 1957 flown a total of 6,800 hours, of which 4,800 had been flown with Viking aircraft, and of these some 1,586 with Eagle Aviation Limited. He had made no less than 36 night landings in Viking aircraft at Blackbushe alone in the period of 18 months prior to this accident.

The first officer was also well qualified.

In the course of examining the record of Captain Jones as a pilot, I found it necessary to consider in some detail the actual tests of ability to which he had been subjected since joining Eagle Aviation Limited in 1955. These tests were of three sorts:— first the type rating test which he took on the 20th July, 1955 in order to qualify for the inclusion of Viking aircraft in Group 1 of his Licence, secondly, tests for the purpose of renewing his instrument rating which he took on the 26th April, and 1st May, 1956, and on the 9th April, 1957, and thirdly, tests conducted from time to time to satisfy the requirements of Article 18(4) of the Air Navigation Order, 1954 and Regulation 44 of the Air Navigation (General) Regulations, 1954. Examination of the circumstances of some at any rate of these tests and of the records relating to them disclose certain defects.

It is satisfactory to observe that Eagle Aviation Limited held a meeting on the 15th January, 1957—that is some 3½ months before this accident — at which certain decisions were taken with a view to tightening up the procedure under which tests of the second and third categories I have mentioned were carried out.

As I have said, Captain Jones took his type rating test on the 20th July, 1955, in order to qualify once again to fly Viking aircraft. This test was conducted at Blackbushe, Captain Jones being tested or examined by Captain Bright, one of his fellow pilots in the employment of Eagle Aviation Limited and designated by that company as a "check" pilot.

The requirements of the test are set out in the form known as C.A. 528 issued by the M.T.C.A. The test is of a comprehensive nature and although the wording of the form is not as clear as could be desired, it would appear (and I am told is generally understood) to require the candidate to make at least four take-offs and landings—two by night and two by day, one landing in each case being made with the use of both engines and the others on one engine only. As completed by Captain Bright the form suggests that the test had been completed satisfactorily in all respects.

The records maintained at the Control Tower at Blackbushe record three flights only as follows:—

| | |
|---|---|
| Take-off 20.32—Landing 20.47 | G.M.T. |
| Take-off 20.55—Landing 21.07 | |
| Take-of 21.09—Landing 21.14 | |

The above times in accordance with the definition of night then imposed by the regulations were all to be classified as "day" landings. It follows that on the facts as recorded by the Control Tower only three take-offs and landings were made, none of these being made at night as then defined by the regulations. If these facts are correct it will be obvious that the regulations, not having been complied with, the test was not properly completed.

I heard Captain Bright in evidence and his statements on oath will be found in the Transcript. Having read the Transcript he wrote me a letter. Having heard his explanation that in completing the form he had mistaken B.S.T. for G.M.T. and having listened to his account of the test I am satisfied that he was not a witness on whom I could rely. It is curious that if Captain Bright had made the mistake of confusing B.S.T. and G.M.T —a mistake in itself somewhat surprising where an experienced pilot is completing a form to record a test of this nature—Captain Jones should have made the same mistake, as appeared from his private log which was produced to me. In his letter Captain Bright now suggests that he confused watch time with G.M.T., an explanation which I find no more convincing.

It may of course be true that the conditions resembled those at night but the fact remains that whatever the conditions of visibility it was admittedly not "night" as required by the regulations, and I am not satisfied that four take-offs and landings were made or indeed that any landing was made in conditions of darkness with one engine inoperative. Having heard the evidence of Captain Bright, Mr. Scarman, who appeared for Eagle Aviation Limited, stated in open Court that the company had decided to suspend him from acting as a check pilot. I observe from his letter that this suspension has since been removed.

On the strength of Captain Bright's certificate that the test had been properly completed Captain Jones was granted the inclusion of Viking aircraft in Group 1 of his licence. I expressed in the course of the Inquiry some doubt as to whether in these circumstances he could be regarded as properly licensed to fly Vikings, but I am satisfied that the licence granted must be regarded as legally valid even though its issue may have been influenced by inaccurate information.

On the 26th April, 1956, Captain Jones took his Instrument Rating Flight Renewal Test, being checked by Captain Henderson, one of the company's check pilots authorised by the M.T.C.A. to check such tests on their behalf. This test was conducted in the course of a flight from Biarritz to Blackbushe. Part 1 of the test covers pre-flight action, take-off, climbing and level flight, Part 2 airways procedure, and Part 3 the procedure on landing by instruments and on over-shooting.

Captain Jones failed in Parts 2 and 3 of this test and in particular when told in Part 3 to maintain 500 feet he lost 250 feet and allowed his air speed to drop off to 95 knots, so that he was in danger of stalling. His basic knowledge of instrument flying was classed as poor. Five days later he took the test again at Blackbushe, checked once more by Captain Henderson, and on this occasion passed. It is, however, to be observed that Captain Henderson made the following note:— "Improvement on first attempt but needs to be watched". He then deleted the words "to be watched" and wrote instead "more practice". Despite the note made by Captain Henderson on this occasion I was told that Captain Jones had not received any special practice.

Captain Jones took this test again on the 9th April, 1957, being checked and passed by Captain Bright in the course of a passenger carrying flight from Blackbushe to Le Bourget and back. I find it difficult to believe that Part 3 of the test and in particular the procedure on overshooting could have been properly conducted on such a flight.

Regulation 44 to which I have referred prohibits the operator, that is to say in this case Eagle Aviation Limited, from permitting any person to fly as a pilot unless his competence to act as such and to use the equipment provided in the aircraft to enable him to act in that capacity has been established either:

(a) By test administered by the operator within a period of six months immediately preceding the flight, or

(b) By two tests administered by the operator within a period of twelve months immediately preceding the flight, the period between the two tests being not less than four calendar months.

The precise nature of this test (usually called "the six-monthly check") administered to test the pilot's competence is left to the operator, subject only to the fact that a liaison officer of the M.T.C.A.—in the case of Eagle Aviation Limited it is Mr. Chouffot—visits the various operators in his area to check their records, including the records of these particular tests, the nature of which is accordingly explained to him when, if he regards the test as in any way insufficient, I understand that he informs the operator accordingly.

Eagle Aviation have devised a form to record the completion of this test, which form Mr. Chouffot said that he regarded as satisfactory although he added that it might be improved by the insertion of more detail.

Although the form provides the phrase day/night I was told that in fact little regard had been paid to whether the test was carried out by day or by night until the meeting on the 1st January, 1957 at which it was agreed that alternate tests should be made by night. It is fair to add that an experienced pilot of the B.E.A. told me that the corporation did not consider that it made any difference whether such test was conducted by day or night, the procedure to be adopted particularly in the case of the two times referred to, being identical in the case of day or night.

I have no hesitation in the light of all the evidence put before me in concluding that it does make a good deal of difference whether a pilot is required to land a twin-engined aircraft with one engine inoperative by day or by night. The weight of the evidence shows conclusively that it is on the whole more difficult at night and I do not suppose that any pilot would wish to make his first landing with one engine inoperative at night at a time when his aircraft was fully loaded and carrying passengers.

According to the evidence Captain Jones carried out the "six-monthly check" on the following dates:—

(a) On the 15th July, 1955 when he was checked by Captain Bright—this test immediately preceding his promotion by the company to captain.

(b) On the 16th and 17th January, 1956 when checked by Captain Watkins.

(c) On the 18th July, 1956 when checked by Captain Sauvage.

(d) On the 4th December, 1956 when checked by Captain Davis.

(e) On the 18th March, 1957 when checked by Captain Storm Clarke.

It is necessary to comment on each of these tests:—

(a) The form as completed by Captain Bright indicates that Captain Jones had satisfactorily completed all the manoeuvres involved. He eliminated the word "night" in regard to items 2 and 3.

Captain Watkins, the company's chief pilot told me that this test was carried out with a view to testing Captain Jones' efficiency and fitness for promotion to captain. Since, as I have said, the form requires a landing made with one engine inoperative, I was surprised to find that on the 15th July, 1955 the Viking used made a flight from Blackbushe to Turnhouse (Edinburgh) and back and that passengers were carried in both directions, although on the flight north there were only two, both being employees of Eagle Aviation Limited.

It is fair to Captain Bright to record that his recollection of the flight was not unnaturally somewhat vague. He did however say that since Captain Jones was only a First Officer, the test was not such a gruelling test as for a captain and that the landing would have been effected with one engine throttled back to simulate a one-engined landing and that it was the practice at that time to conduct the test even if carrying passengers. So far as item 3 the simulated engine failure, was concerned, Captain Bright explained that he would, after reaching a very safe height, have gradually reduced power on one engine so as to watch the pilot's reaction and whether he applied the necessary correction to hold the aircraft straight and level and then would have required him to go through the feathering drill without actually feathering the engine.

If the test was carried out as Captain Bright described it can have had only a very limited value and certainly would not justify its being treated as a promotion test from first officer to captain. Obviously a



serious test including a true landing on one engine would not be carried out with passengers on board in the course of a normal flight. The fact that the chief pilot of this company appears to have thought that the very limited test carried out in fact had been of an entirely different nature serves to illustrate the attitude adopted towards these tests at this time.

(b) On the 16th and 17th January, 1956 the Viking aircraft in which Captain Jones was tested by Captain Watkins, who is the Chief Pilot of Eagle Aviation Limited, flew from Blackbushe to Idris, via Nice and from Idris to Blackbushe via Elmas and Marignane.

It is to be observed that on the form completed by Captain Watkins, items 2 and 4, the latter being "all manoeuvres used in normal flight with one engine inoperative", were not completed and he himself agreed that a test which had not included item 2 was not a proper test.

(c) This test was made at Blackbushe by Captain Sauvage on a special flight following a minor accident in the course of a landing made by Captain Jones. He told me, and I accept that Captain Jones, in the course of this special flight made by day, landed a Viking on one engine perfectly satisfactorily, and went through the other items of the normal test equally competently.

Although the usual form was not completed in regard to this test, contemporary records were made and I entirely accept that the matter having been discussed with Captain Watkins, it was properly agreed to treat it as a satisfactory six-monthly check.

(d) The test carried out by Captain Davis on the 4th December, 1956 was again obviously unsatisfactory. Items 2 and 4 are not completed. The aircraft was on the day in question flying from Blackbushe to Luqa via Marignane on a normal trooping flight which of course rendered it impracticable to effect a single-engined landing.

(e) This, the most recent test, was carried out by Captain Storm Clarke. I was satisfied that it was properly carried out in the course of a special flight at Blackbushe shortly after mid-day.

It is desirable to sum up the effect of the evidence as to the type rating and instrument rating tests and the Captain's six-monthly tests. In my opinion they show the following:—

There is no satisfactory evidence that in the course of his employment by Eagle Aviation Captain Jones was ever required to land an aircraft at night on one engine. He did make such a landing on at least two occasions by day, namely with Captain Sauvage on the 18th July, 1956 and with Captain Storm Clarke on the 14th March, 1957. He may have made such a landing with Captain Bright on the 15th July, 1955. So far as the other six-monthly tests are concerned, namely those carried out by Captain Bright, Watkins and Davis, I am satisfied that they did not amount to satisfactory tests to satisfy the regulations. It is, as I have said, reassuring to observe that Eagle Aviation Limited had started to put its house in order a considerable time before May, 1957.

So far as the instrument rating tests are concerned, I have grave doubt as to whether that conducted in April, 1957 by Captain Bright can have been a proper test.

I am satisfied that the type rating test that this captain conducted in July, 1955 under Captain Bright did not comply with the regulations and I am not satisfied that it comprised a landing with one engine inoperative in night conditions.

I thought it right in the light of the facts disclosed to hear the evidence of Mr. Chouffot as to the supervision he exercises over the records of operators. So far as the type rating test is concerned, the test is strictly a personal matter between the captain, the examiner and the M.T.C.A. and no form or copy of the form submitted is retained by the company whose pilot is applying for the type addition to his licence. There is, accordingly, no record for Mr. Chouffot to inspect.

Again, the instrument rating renewal test is primarily a matter between the pilot, his examiner and the M.T.C.A..

In the case of the six-monthly test, however, this is essentially the responsibility of the operator and Mr. Chouffot told me, that in the course of his visits, which he stated that he normally made every six months, he makes a spot check by naming two or three pilots and then asking for their records. He had not found any significant fault in the case of those he had examined in the offices of Eagle Aviation Limited but had not seen those of Captain Jones. He agreed that if he had seen a form on which item 2 had not been completed he would have regarded that as a significant fault. It must be understood that Mr. Chouffot covers a large area including a number of operators and cannot check everything. It so happened that in the case of Eagle Aviation Limited Mr. Chouffot when asked as to his last visit informed me that it was in February, 1957, his previous visit having taken place exactly twelve months before.

I have considered whether any weight is to be attributed to the deficiencies I have referred to in the tests carried out by Captain Jones in connection with the circumstances of this accident and in particular the fact that he had had no recent experience of making a night landing with one engine inoperative. I have come to the conclusion that I would not be justified in doing so. Captain Jones was a very experienced pilot, particularly in Viking aircraft, and very experienced in making night landings in normal circumstances. The fact that he may in the course of tests many months before have fallen below standard is common in the experience of any pilot and must be viewed in proportion and against the background of his general experience and efficiency. He was described to me by Captain Sauvage, who proved a good witness, as a very thorough captain in his application to his duties—a deliberate sort of man who kept himself rather aloof from others and generally did a very good job on the ground as well as in the air—a very reliable man.

I think I am accordingly justified in regarding the matters disclosed in regard to the various tests as matters upon which I should consider recommendations rather than as having any necessary connection with the circumstances of this particular accident.

### Questions and Answers

*My answers to the questions asked by Her Majesty's Attorney-General are accordingly —*

*Question 1: Did the aircraft have a valid Certificate of Airworthiness and current Certificate of Maintenance at the time of the accident?*

*Answer 1: Yes.*

*Question 2: Were the crew properly licensed and adequately experienced for the proposed flight?*

*Answer 2: Yes.*

*Question 3: Was the aircraft loaded and trimmed within the specified limits set out in the Certificate of Airworthiness?*

*Answer 3: Yes.*

*Question 4: Had the aircraft been maintained in accordance with the approved Maintenance Schedule?*

*Answer 4: Yes.*

*Question 5: What was the cause of the accident?*

*Answer 5: The failure of Captain Jones to maintain height and a safe flying speed when approaching to land on one engine after the failure (or suspected failure) of the port engine due to some cause which cannot be ascertained.*

*Question 6: Was the loss of the aircraft caused or contributed to by the wrongful act or default of any person or party?*

*Answer 6: No, I think the error made by Captain Jones was an error of skill and judgment.*

### RECOMMENDATIONS

The defects in regard to the various tests to which Captain Jones was put clearly require consideration with a view to improvement and to ensuring that the regulations are properly complied with.

Various suggestions were made by Counsel with particular reference to the captain's six-monthly checks. It was suggested that any application for renewal of the pilot's licence should be accompanied by some form of record of the completion of the six-monthly check, also that not all tests or checks should be carried out under examination by a captain in the same company as the pilot, and that the M.T.C.A. should lay down in detail the precise nature of the test required to comply with Regulation 44 and should insist that testing at night is included. It was also proposed that the M.T.C.A. should inspect the records of all pilots at regular intervals and that regulations should forbid the carrying out of tests in the course of passenger flights.

To these suggestions Counsel for the M.T.C.A. raised various objections. It was said that the efficient conduct of operating companies was best left to themselves subject to gentle prodding from time to time towards a higher standard from liaison officials such as Mr. Chouffot. It was pointed out more regulations and more forms, whilst they may require more Civil Servants to file, administer and enforce, do not necessarily lead to greater efficiency. Emphasis was placed on the fact that it is in the interests of operating companies themselves to observe the regulations and maintain the highest standards of efficiency.

Whilst I would hesitate to recommend any action which would involve more inspectors, or more forms, I cannot help thinking that the argument that everything should be left to the operator is too optimistic. The fact remains that in this accident 34 people were killed. Whilst it may have had nothing to do with the accident it remains true that the pilot had not carried out properly the test required to fit him to fly this aircraft, had not at any rate in the last two years landed a twin-engined aircraft with one engine inoperative "at night", the very manoeuvre which he was required to perform on this occasion with a full load of passengers, and further the various six-monthly checks which he should have undergone and which should have included landing with one engine inoperative had not in three cases out of five been done in fact. It is also doubtful to what extent he had been properly practised in instrument flying. It is, I think proper to recommend that these matters should receive the attention of the M.T.C.A. with a view to consideration of the most convenient steps to prevent a similar state of affairs.

It may be helpful if, without making any more detailed recommendation, I make a few suggestions for consideration in regard to the three types of test:—

#### (1) The Type Rating Test

This is an important test because depending on its result the pilot or candidate for qualification may or may not become licensed to fly a type of aircraft. At present the candidate is examined by any pilot who has himself the qualifications for which the candidate is applying, and the only parties involved are the M.T.C.A. and the examining and candidate pilots. On completion of the test the form C.A.528 is transmitted to the Ministry, and save for providing the aircraft for the test and perhaps paying for the fuel consumed the operating company which employs the examining and/or candidate pilots is not directly concerned.



Unless the Ministry through its officials is to conduct the test or those pilots allowed to conduct it are to be selected by the Ministry the responsibility must be placed upon the operating companies. Just as certain operating companies are authorised to carry out instrument rating tests through approved pilots so I suggest they should be authorised to carry out this test, the pilots whom they select to examine being approved by the Ministry for the purpose. If this responsibility were placed on the operators and if any serious departure from the regulations was visited by withdrawal from the operating company of its qualification, I cannot help thinking that a very much higher standard would be enforced by the companies in question since removal of the qualifications would involve serious practical disadvantages.

So far as the form used is concerned it is far from clear. It should specify in terms the number of take-offs and landings involved and require the times of each whether by day or by night to be stated.

#### (2) The Instrument Rating Renewal Test

I suggest that steps be taken to ensure that part 3 of the test is only carried out in the course of a special flight.

#### (3) The Six-monthly Check

Again, in so far as this involves landing with one engine inoperative, insistence should be placed upon it being conducted on a special flight.

I see no need for the M.T.C.A. to lay down the matters which ought to be comprised in the test; these are of course well known to operators and can be checked by the Ministry's liaison officers. I am, however, strongly of opinion that at least every other test ought to include a landing with one engine inoperative at night. It is desirable that the checking by the Ministry's liaison officer of the records of these tests should be facilitated by the operating companies. The present system by which Mr. Chouffot calls for the forms in relation to two or three pilots as a spot check may mean that the records of some pilots are never checked at all and the unsatisfactory character of some of the tests may never be detected. It would not be difficult, I suggest, to insist that each operating company should provide a statement of the test as laid down and maintain in tabular form a record of the tests as completed by each pilot. This would enable the Ministry's liaison officer to observe at a glance the broad position and he could then, if he thought necessary, send for the more detailed records of individual tests. Alternatively operating companies could be required to provide a certificate as to the carrying out of the tests confirming that all pilots have been tested in accordance with the regulations, any exceptions being stated. I should think that most of these matters would not require further forms or regulations but could be dealt with by letters of request from the Ministry to the operating companies. None would seem to involve much, if any, additional labour or time in the Ministry, and I imagine that a procedure which would require operating companies to keep a close eye on these tests and ensure their proper conduct would be welcome by most companies and certainly no company operating trooping contracts would be likely to withhold its co-operation.

Finally, I should refer to a point which arises from Second Lieutenant Taylor's evidence. He states:— *"No instructions were given concerning emergency exits, their location or manipulation by any member of the crew."*

I should at once make it clear that the above sentence is not to be regarded as any criticism of Eagle Aviation Ltd. since there is no obligation to give such instructions. My assessors, however, inform me that it is the practice of some airlines to do so either verbally or by means of a safety instruction pamphlet. It is to be observed that in this case Second Lieutenant Taylor had noticed that the window exit next to him was labelled "Emergency Exit—Push" and had done so and was followed by a few other passengers. It is a matter for speculation whether, if instructions had been given, more of the other passengers might have acted in the same way. I can only suggest that the question of whether instructions should be given and, if so, in what form, is deserving of consideration.

# *Stinson Crashes During Snowstorm*

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

**During a snowstorm a Stinson AT-19 crashed near Nome, Alaska, at approximately 1825 hours on 2nd October, 1956. All five occupants were killed and the aircraft was demolished.**

#### The Flight

The aircraft was engaged on a scheduled flight from Unalakleet to Nome with intermediate Alaskan stops. The VFR flight plan estimated a cruising true airspeed of 90 miles per hour and showed that there were 74 gallons of fuel aboard, enough for 4 hours 30 minutes. The flight was routine to Council, and when take-off was made at Council the flight time was 2 hours 25 minutes and the elapsed time (including ground time at intermediate stops) was 4 hours 24 minutes.

The flight departed from Council with four passengers at 1745 on the last leg of the operation to Nome.

The estimated flying time to Nome was 40 minutes and the departure time of the flight indicates that it would not be completed before the end of civil twilight which was of approximately 48 minutes duration beginning at 1727. The aircraft was observed after take-off on a southwesterly heading toward the coastline route to Nome. At 2023 the flight was overdue and unreported. When it could not be contacted search procedures were initiated.

### Investigation

At 1500 on October 3, 1956, the wreckage of the aircraft was located on Cape Nome, at a point about 15 miles east-south-east of Nome. Initial impact was on level ground at an altitude of 25 feet m.s.l. at the eastern base of a 650 foot ridge of high ground running north and south. The southern end of this ridge is three-tenths of a mile north of the shoreline to which it descends in a steep slope. This ridge lies across the flight path between the point of impact and Nome.

Examination of the terrain disclosed no trace of impact by the plane against the higher ground of the ridge. The wreckage itself showed that it had struck the ground at a downward angle of more than 45 degrees while heading approximately 157 degrees true. The bearing from this point toward Nome is 284 degrees true.

Impact occurred while the left wing was low. A gouge in the ground 12 feet long at right angles to the centreline of the fuselage ended at the left wing. This wing, the nose, and the landing gear which had separated, had absorbed most of the impact forces.

The left wing remained attached to the fuselage by the aileron cables only, the structural attachments having failed in an upward and rearward direction. The aileron, although severely damaged, remained attached to the left wing as did the flap. The left wing tip was demolished by forces which included dragging contact with the ground. The leading edge of the wing was flattened along its length into a plane almost normal to its chordline.

With the exception of impact damage the fabric covering of both right and left wings, ailerons, and flaps was found in good condition with no evidence of tearing or fraying prior to impact. Both fuel tanks, located in the wing butts, were severely buckled and ruptured by impact. Stains on the ground and on the structure immediately adjacent to the ruptured fuel tanks indicated that considerable fuel spillage had occurred. The attachment of the right wing and its aileron and flap was distorted but unbroken. Flaps were in the retracted position with controls still connected. The powerplant was completely embedded in the frozen ground. Gouges in the earth showed that the propeller was rotating at high r.p.m. at impact. The elevator tab was set slightly to trim the nose downward.

Because of severe impact damage the only cockpit control positions that could be determined were: Fuel tank selector on "Right tank", ignition switch "On both", radio receiver set at 250 kcs. Equipment included a complete set of blind flight instruments with artificial horizons, directional gyro, and bank and turn indicator, all operated from an engine-driven vacuum pump.

The Weather Bureau forecast for the period 1400, October 2, 1956, to 0200, October 3, 1956, was available to the pilot before his take-off from Nome eastbound and before his take-off from Unalakleet westbound (returning to Nome) at 1321. The forecast for the southern Seward Peninsula (which included the scene of the accident), the remainder of the Koyukuk Valley, and the middle Yukon Valley west of Ruby, was: Ceiling 3,000 and scattered to broken clouds.

On October 15, 1956, an aftercast was made by the U.S. Weather Bureau Airport Station at Anchorage, Alaska. This aftercast is quoted below:

"AFTERCAST OF WEATHER CONDITIONS IN THE VICINITY OF CAPE NOME, ALASKA, DURING THE AFTERNOON AND EARLY EVENING OF OCTOBER 2, 1956.

"The weather maps of October 021830Z, 030030Z, and 030630Z showed an elongated trough of low pressure oriented north-south along a line from Bettles to Anchorage, with a complex low pressure system to the southeast of Kodiak Island. While the trough was moving slowly eastward during the day, a cold front that had passed over the Seward Peninsula the night before was moving southward over southwestern Alaska in the strong northerly flow behind the trough. By evening the front had passed to the south of Bristol Bay.

"The air mass in the vicinity of Cape Nome was cold and unstable, and there was scattered snow shower activity in the area. A study of available evidence indicates that there were broken to scattered clouds with bases at 3,500 to 4,000 feet, mean sea level, tops general 6,000 feet, but with occasional cumulus build-up to 10,000 feet. The weather at the scene of the accident could have ranged from the above described conditions to as low as 500 feet obscured, one half mile visibility, in moderate snow showers. The surface winds were very likely from the northwest at about 15 m.p.h., but could have been as strong as 25 m.p.h. The freezing level was at the surface, and light icing could have occurred in the clouds. Some low level turbulence undoubtedly existed; this would have resulted from the unstable air mass and the fairly strong low level winds."

The pilot had logged proposed details of this flight as a (day) VFR flight plan. He was not certificated



to fly under instrument flight rules, nor was the company authorised to conduct instrument flight over this route with light aircraft. Also, as far as can be learned, the pilot had had no training or experience with instrument flight.

### Analysis

From Council to Nome along the coast is 74 miles, or 17 miles longer than the direct route. At the planned true cruising airspeed of 90 m.p.h. it would require some 11 minutes more than the direct route. The coastal route could be flown at near sea level whereas the 11-minute shorter direct route passed over rugged terrain. Also, the coastal route offered an occasional ground light.

When the flight departed Council at 1745 the weather there and reported weather ahead, was above VFR minima. Sunset at Council on that date was at 1719; at Nome it was at 1726. Official civil twilight on that date and for that area lasted from 1727 to 1815. The operations specifications of the air carrier restricted its operation over this route to day only. By definition "day" ends at the end of civil twilight. There was an overcast in the crash area and it is probable that total darkness existed at the time of the crash. This condition is confirmed by a qualified witness who was in the area of the crash at 1745.

The judgment of the pilot in planning and executing a flight under these circumstances is open to serious question. Having departed Council for Nome so short a time before sunset, he was committed to complete the flight at Nome since the lack of lighting facilities at Council made it impossible to return to his point of departure and no other suitable airports were available along the route for use as alternates.

It appears that the pilot, aware of the failing light, flew directly to the coastline and then proceeded westward along it toward Nome. He may well have seen no evidence of snow showers approaching from the northwest because of the overcast and failing light. As the flight, now in near total darkness, approached Cape Nome snow showers may have been encountered which further reduced visibility. However, the flight continued with the pilot probably attempting to fly contact by reference to the road or coastline. It appears likely that the pilot was not completely sure of his position when he reached a point near the scene of the accident. It is believed that at this time he completely lost visual contact, and without instrument training, lost control and struck the ground in a steep spiral. It is also possible that he had a fleeting glimpse of the ridge while at low altitude and in attempting to avoid it lost control of the aircraft.

Since the only icing conditions mentioned in the aftercast were — " . . . and light icing could have occurred in the clouds" and since the flight was limited to day VFR conditions, it seems improbable that the icing conditions could have contributed to this accident.

### Probable Cause

The Board determined that the probable cause of this accident was the action of the pilot in flying into conditions of darkness and adverse weather in which he could not maintain adequate control of the aircraft.

# Australian Accidents

## *Collisions With Power Cables*

**On the afternoon of 16th May, 1957, a DH-82 returning to land after an aerial agricultural flight flew into high tension power cables and crashed three miles south of Nanangroe, New South Wales.**

The pilot, in company with two other pilots, had been engaged on aerial fertilising over Nanangroe Station for about four weeks. This property, which covers about 20,000 acres of hilly country averaging 1,800 feet above sea level, is traversed by numerous high tension power cables associated with the Burrinjuck Dam. The strip was located one mile south of the main property buildings and there were innumerable power supply cables and telephone wires running from this area to dwellings, woolsheds, and isolated camps.

At about 1530 hours E.S.T. the pilot was returning from his 28th trip for the day having logged 4 hours 25 minutes flying time. Some three or four trips earlier the area being fertilised had been changed to a new area which involved a flight of 1½ miles from the strip and a descent of about 200 feet to river flats. On completing the dropping run the pilot climbed out of the valley to 100 feet above terrain then, when about half a mile from the strip, he descended to 50 feet above terrain in an attempt to minimise the effects of turbulence. As on the previous trips, he planned to land off a right-hand circuit, necessitating flight over primary power cables (11,000 volts) strung from 35-foot high poles, 1,200 feet apart, positioned on either side of a slight depression. The cables were 45 feet above terrain at the midpoint of the span and at right angles to the flight path of the aircraft when it was proceeding down wind.

Although he had flown this same route on the previous two or three trips to the new area at a similar height the pilot was not aware of these cables. He first sighted them slightly ahead of the aircraft and a little below the centre of the flight path. He instinctively pulled back on the stick but decided that the undercarriage might contact the cables and cause the aircraft to nose over. Therefore, he then pushed the stick forward on the basis that if the aircraft flew directly through the cables it would be more likely to come to rest the right way up and consequently the risk of injury would be minimised. The aircraft struck the cables with the propeller and engine cowling and spun around in a flat attitude landing on the engine and undercarriage 178 feet further on. It then bounced 15 feet coming to rest facing the reciprocal of the direction to which it had been flying. The pilot received a minor cut on the back of his head.

The pilot stated that it was his intention to fly at 50 feet above terrain and it was at about this height that he flew into the cables. There was no question of him having misjudged his height above the terrain, therefore, the cause of the accident was assessed as a lack of care on the part of the pilot in that he failed to maintain a safe height when flying over an area known to contain numerous obstructions.

Although the pilot had made a survey of the area it was considered that it would not have been possible for him to have remembered the position of all the obstructions. Nevertheless, after four weeks flying from the one strip he should have been aware of the obstructions within the circuit area. It is probable that contributory factors leading to the accident were pilot fatigue and complacency arising from familiarity with aerial agricultural operations.

**At 0830 hours on 1st June, 1957, a DH-82 flew into electric power cables and crashed whilst engaged in low level spraying on the boundaries of various properties near Derrinallum, Victoria. The pilot received serious head injuries.**

The last run was over almost level terrain, strewn with rocks, except that over the final 100 feet the ground rose sharply some 15 feet. The aircraft was flown at a height of 12-15 feet and about 50 feet from and parallel to the boundary which was bordered by both telephone and high tension cables 20 and 30 feet high respectively. The boundary towards which it was flying consisted of a fence and well defined telephone cables 20 feet in height with poorly defined high tension cables 30 feet in height immediately above.

The pilot was well aware of the existence of the cables as he had surveyed the area from the ground prior to commencing operations and had flown in close proximity and parallel to them on two runs a few minutes before the accident; he also flew over them on the run preceding the last one.

The aircraft commenced to climb as it approached the rising terrain then "appeared to go straight up as it came to the wires". The aircraft struck the high tension cables, the propeller cut the "active" wire, but the neutral wire, remaining intact, caught in the undercarriage assembly and pulled free from supporting poles. The aircraft came to rest inverted some 100 feet from the point of contact with the cables, the pilot striking his head on a stone.

The pilot's total aerial agricultural experience was 70 hours, only three hours of which had been gained on spraying operations. There was no evidence of malfunctioning of the aircraft or pre-crash defects which may have contributed to the accident. Therefore, it is thought that the probable cause of the accident was inexperience on the part of the pilot in that he concentrated on the immediate task of accurately flying and positioning the aircraft to the extent that he misjudged the point where it was necessary to commence climbing to avoid the cables. This error in judgment may have been accentuated by the sharp rise in terrain when nearing the cables, also, this was the first run the pilot had made downwind, the component being about five knots.



## *Another Fatal "Beat-up"*

On the morning of Saturday 23rd March, 1957, a Chipmunk operated by the local aero club was ferried from Grafton to Casino to undergo a 50 hourly inspection. After taking charge of the aircraft and documents the resident L.A.M.E. returned to his home as he was not rostered for duty. The pilots who had ferried the Chipmunk to Casino returned to Grafton in another aircraft.

During the afternoon a local resident, who was a member of the aero club, arrived at the aerodrome and, on sighting the Chipmunk and being endorsed for this type decided to fly it. Whether or not he checked the aircraft documents is not known but the aircraft was serviceable and, after re-fuelling, he took off at 1600 E.S.T., without obtaining prior authorisation; the flying instructor responsible for the area being on duty in a nearby town. A few minutes after take-off the aircraft was observed executing steep turns over the town of Casino at a height of about 800 feet above the terrain.

Some fifteen minutes later the aircraft arrived over the homestead of a friend about eight miles west of Casino. The aircraft passed to the rear of the homestead, turned and dived toward the homestead, completing a low-level left hand turn to pass in front of the building. This manoeuvre was then repeated. On the third "pass" the dive was commenced from about the same position as previously but the aircraft descended to below the level of trees surrounding the homestead and a left hand turn commenced so as to turn before reaching the homestead and pass to the rear of it. After passing the homestead, and whilst still turning the aircraft struck the top of a denuded tree and crashed inverted after travelling about 260 feet. The aircraft fell onto power cables and was destroyed by fire. The pilot, who was the sole occupant, was killed on impact.

There was no evidence of any malfunctioning of the aircraft which may have contributed to the accident.

On the fatal dive the aircraft had descended to below tree-top level and passed between the homestead and a nearby tree, in a fairly steep left hand turn. From this position the pilot was virtually committed to continuing the left hand turn to avoid a number of trees on the starboard side of the aircraft. These trees with one exception were covered with foliage, the exception being the tree that the aircraft struck. Not only would these trees tend to be obscured by the aircraft whilst it was banked to the left but the denuded tree would have been difficult to sight against the rising terrain towards which the aircraft was flying. However, it was not possible to resolve whether the aircraft flew into the tree because the pilot did not see it in time to take avoiding action, or whether he misjudged the rate of turn.

It was ascertained during the investigation that it had been the practice of this pilot over the previous 18 months to "beat-up" the homestead. This pilot, like every other pilot, undoubtedly realised that "beat-ups" of this nature are dangerous, but, as he regularly engaged in such flying, he had apparently adopted the motto "it can't happen to me". This motto, seemingly full of security, is nothing but the reverse of the truth. IT CAN HAPPEN TO YOU! No further comments are necessary, but it might be worth reminding pilots who may be having difficulty in resisting temptation of the well proven statement "there are bold pilots and old pilots but no old bold pilots".

## *"Uphill"*

**At mid-day on 31st March, 1957, a DH.82 returning from an agricultural flight crashed whilst attempting to outclimb rising terrain following a baulked approach to a landing strip on a hillside. The pilot was uninjured but the aircraft was extensively damaged.**

The aircraft, in company with another DH.82, was engaged in dropping superphosphate on a property in the foothills of the Australian Alps in north-eastern Victoria and was operating from two cleared sub-standard strips on a nearby hillside. The strips followed an "L" pattern with take-off being made on the longer strip which was about 760 feet long, an average width of 100 feet, and with an initial downhill gradient of 1 in 6 but averaging 1 in 13 over the full length. The landing strip was approximately 380 feet long with an average uphill gradient of 1 in 10 although the top end had an uphill gradient of 1 in 6. The average width was 100 feet and the approach was either over or between 50 feet high trees.

During the morning the pilot had completed about 48 trips before refuelling and, when returning from the first dropping run after this break, the aircraft overshot the landing threshold. When at a height of 20 feet and, after having flown about half the length of the strip, full power was applied with the intention of carrying out a baulked approach. On passing the intersection of the strips the aircraft was maintaining about 20 feet above the ground and climbing straight ahead over terrain rising at an average gradient of 1 in 6. Eight hundred feet beyond the strip the pilot realised that the aircraft would not outclimb the terrain and he attempted to land straight ahead. After running a short distance the aircraft struck fallen timber and overturned.

Wind conditions until midday were calm, with a cloudless sky and warm temperatures; however, in the early afternoon this area was usually subject to an intermittent anabatic wind of about five to ten knots. Eyewitnesses state that this wind commenced after the aircraft had taken off; the pilot however, claimed that he did not realise that he was landing downwind until the aircraft had flown half the length of the strip. It was considered that the pilot should have been aware well before this time that he had misjudged the approach, even if the reason was not apparent.

At the time of commencing the baulked approach the aircraft was about 20 feet above the ground at an airspeed of 55 m.p.h., half way along the strip. From this position an accident was inevitable. If the landing had been continued the aircraft would have struck trees off the end of the strip and because of trees and rising terrain each side of the strip a baulked approach involving a turn towards lower terrain would not have been successful. The climb straight ahead had to better a gradient of 1 in 6, requiring a rate of climb of about 800 feet per minute which is in excess of the performance capabilities of the DH.82. However, it was considered that if the baulked approach had been commenced from the vicinity of the threshold of the strip, where it should have been apparent that the aircraft was overshooting, the accident could have been avoided. The cause of the accident was assessed as the failure of the pilot to abandon the approach before reaching a stage beyond which a successful baulked approach was not possible.

# *Stuck With It*

**At approximately 10.30 a.m. on 29th May, 1957, an Avro 643 sustained substantial damage during a forced landing on a hillside near Wallabadah Station, 27 miles south of Tamworth. The pilot was uninjured. The aircraft was operating from a strip on Wallabadah Station.**

Flying had been abandoned the afternoon prior to the accident due to low cloud and light rain. The gypsum, which was a mixture of C.S.R. (fine) and Ivanhoe (coarse) was being handled in bulk and had been dumped at one end of the strip. It was covered with sheet iron to protect it from the rain; a fall of 35 points being recorded overnight. By the morning the weather had improved and the covers were removed from the gypsum to allow the sun to dry it—gypsum tends to absorb moisture from the air and, even though it had been covered overnight, it was quite damp.

The pile was then turned over and fed through the ground loading hopper to break it up and ensure that it was suitable for dropping from the aircraft. It is noteworthy that, originally, the owner of the property had supplied C.S.R. (fine) gypsum to be dropped but the operator had refused to handle this, as experience had shown that it was difficult to drop successfully because of poor flow characteristics. For this reason Ivanhoe (coarse) gypsum was mixed with C.S.R. to improve its flow characteristics.

Flying commenced at 10.00 a.m. and the pilot requested that 400 lb. be loaded in the hopper. After take-off he turned right through about 120 degrees to commence the dropping run about half a mile from the strip over terrain about 100 feet higher than the strip. From this point the ground rose steeply to ridges some 300 feet above the strip. The drops were to be continued over these ridges. The pilot stated that on commencement of the drop, at which time the aircraft was about 250 feet above the strip, the gypsum flowed quite steadily for about 2/3rds of a mile, then it ceased and, shortly afterwards, started dropping in puffs. He then returned to the strip, rocking the aircraft, and landed with the louvres open, this being the normal practice to ensure that the complete load had been dropped and the louvres unobstructed.

After landing the louvres were closed and another 400 lb. of gypsum was loaded. Take-off appeared to be normal and a speed of 65-70 knots attained by the end of the strip. The pilot then turned right to proceed on a run similar to the previous flight. He stated that, as the aircraft approached the dropping point, it was 50-100 feet lower than on the previous run but he was not concerned although he was well aware that it would be necessary to climb a further 100-150 feet in the next 1/3rd of a mile to clear the first ridge.

Just prior to reaching the dropping point the louvres were opened to the normal position (half-way) but, apart from one puff of gypsum, it did not flow. The dump position was then selected but the gypsum still did not drop. By this time the aircraft was only 50-60 feet above the ground and the pilot was of the opinion that it would not clear the rising terrain ahead. Therefore he decided to land on the only clear area available which was on the side of the hill to the right of the aircraft. After an approach between trees the pilot successfully landed the aircraft but, after rolling about 30 yards the starboard wheel struck a depression which caused the undercarriage to collapse. The aircraft came to rest after skidding a further 40 yards.

An examination of the ground below the flight path revealed that, apart from slight traces at the point where the louvres were first opened and at the point where the dump was attempted, no gypsum was dropped. After the undercarriage collapsed the base of the hopper containing the louvres was torn off but there was only a light spread of gypsum over the wreckage path. The hopper louvres and attachment bracket, although damaged in the accident, were intact and were jammed in the full open or dump position.

The gypsum was removed from the hopper via the loading aperture and it was found, after removing about 2/3rds of the load, that the remaining gypsum had compacted and completely bridged the hopper about 18 inches from the outlet. This bridge resisted considerable pressure before it collapsed and later when the aircraft was lifted, it was found that the gypsum had stuck to the sides of the hopper and almost completely obstructed the hopper outlet. Some 400 lb. of gypsum was removed from the hopper above the compacted gypsum and the total amount removed from the hopper was 532 lb. This, together with about 40-50 lb., which, it was estimated, was spread along the flight path and wreckage trail, gives a total of 580 lb. on take-off.

The hopper installed in this aircraft was designed primarily for the carriage of liquids, the front and two sides of the hopper being almost vertical while the rear face converged to the base at a relatively shallow angle of about 45 degrees. Near the base there was a slight curved step in the hopper walls where they narrowed down to the outlet. This consisted of an opening of 14 x 9 inches, with a vertical drop of 9 inches, and two louvres rotating through 90 degrees. This installation had proved satisfactory when dropping seed or superphosphate and gypsum when dry. However, it was considered that, when the gypsum was damp and tending to stick to the sides of the hopper, there was insufficient fall on the rear wall of the hopper to ensure a good flow and this was further obstructed by the ridge near the base of the hopper.

It is apparent that about 40 per cent of the first load compacted and remained in the hopper, the second load being placed on top of this. This resulted in the all-up-weight of the aircraft being about 2,240 lb., or 240 lb. greater than the maximum permissible. At the point where the pilot realised that the gypsum would not drop a rate of climb of 400-600 feet per minute would have been necessary to clear the terrain immediately ahead of the aircraft. At the all-up-weight and density altitude, this was beyond the performance capability of the aircraft.

**From the foregoing it will be realised that gypsum must be handled with care as the fine gypsum will tend to compact under practically any conditions and gypsum generally tends to absorb moisture from the air. The majority of aircraft hoppers are so placed that the pilot cannot observe the contents and the loader can only see into the hopper with difficulty. It is most important, therefore, that positive action be taken after each landing to establish that the hopper is in fact empty and unobstructed.**

# *Overshoot Action Taken Too Late By DH.82 Pilot*

**At about 1030 hours on 29th January, 1957, near Murrindal, Victoria, a DH.82 engaged on superphosphate spreading struck the boundary fence of the field from which it was being operated when the pilot attempted to go round after landing too far into the field. The pilot escaped injury but the aircraft was extensively damaged.**

The field was situated on a rise and the section being used for take-off and landing extended up the slope into the north east for 1,100 feet to the top of the rise and for a further 350 feet down the opposite side. The superphosphate loading point was located near the top of the rise and landings were being made up the short slope, terminating at the loading point. Take-off was then made down the long slope, commencing from the loading point. It appears that wind conditions were mainly calm with occasional gusts to about 10 knots from the south west.

The aircraft landed up the short slope but ran beyond the loading point and commenced to roll down the long slope into the south west. The pilot waved away personnel who went out to provide wing tip assistance and continued on down the slope and took off. He then turned and approached for a landing up the long slope. Touchdown was apparently made well up the slope with the objective of terminating the roll at the loading point but again the aircraft ran beyond it. The landing was also made to the left of a line over the centre of the rise with the result that as the crown of the rise was approached the aircraft encountered a steepening transverse grade and swung left about 30 degrees and ran down the steep grade towards a boundary fence. The pilot decided to take off but this decision was made too late. It appears a gust of wind occurred at the same time as the pilot opened the throttle to take off and this probably aggravated the situation. However, it was considered that the pilot should have abandoned the landing sooner than he did and when it must have been obvious that touchdown would be to the left of the suitable area and the remaining run was of marginal length.

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## *Do You Still Know?*

1. How minimum control speed for any particular aircraft is established?

2. How take-off safety speed (V2) is established for a particular aircraft?

3. How take-off critical speed is established for a particular aircraft?

4. The effect of weight on the speeds mentioned in 2 and 3 above?

5. Whether take-off safety speed (V2) aims to provide a minimum—
   (i) initial obstacle clearance; or
   (ii) gradient of climb; or
   (iii) rate of climb?

6. Whether your take-off chart provides for you to come to a stop from take-off critical speed (V1) on a critical runway?

7. The necessary actions to take to stop your aircraft most efficiently after engine failure before take-off critical speed (V1) is reached.

8. Why engine power checks are carried out at field barometric pressure?



# INCIDENTS

## *Door Check*

Shortly after a Convair 340 departed from Sydney a loud noise was heard in the cabin and at the same time the door open warning light came ON. The aircraft returned and on inspection, it was found that the rear passenger door had sprung open at the rear edge by approximately half-an-inch. The locking handle had moved from the fully locked position—where it had been checked before taxying—about halfway to the unlocked position.

Three days later the same aircraft, when departing from Melbourne experienced similar trouble. This time the locking handle was found in the unlocked position and the lower rear lock had become disengaged.

Resulting from these incidents and other reports action was taken to fit a cable and shear link to the inside door handle to prevent movement of the handle, pending modification of the locking assembly.

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During the take-off run in a DC.3 the nose loading door opened. The take-off was discontinued before becoming airborne. An exhaustive check by engineers failed to reveal any fault in the locking mechanism. The locking action on this door is such that it would be impossible for it to become unlatched of its own accord, or for the locking handle to be accidentally rotated by the movement of luggage. It was considered that the door had not been securely locked and checked before take-off.

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The pilot of a Dove, cruising at 1,300 feet, heard a loud noise towards the rear of the aircraft. This was followed by vibration for a few seconds after which the flight continued normally. On landing it was found that the rear locker door had become detached from its hinges and was lying in the locker.

Investigation indicated that the door had been held in the open position by the retaining rod during take-off. The front hinge then failed and the air pressure forced the door into the locker shearing the retaining rod attachment and the rear hinge. The pilot stated "it appears that I could not have checked the locker thoroughly".

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A few minutes after take-off in a Viscount the luggage door warning light came ON. The aircraft returned and, after landing, it was found that the rear luggage door handle was not in the fully closed position. A despatch engineer had checked this door before the aircraft departed and had ensured that the locking button was showing and that the handle appeared to be in the fully locked position. However, this check had been performed from ground level using a torch for illumination and, from this position, he had not observed that the warning discs were indicating incorrect closure of the door.

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Immediately after take-off in a B.170 the pilot advised he was returning to land as the entry hatch had opened. The door locking mechanism on this aircraft consisted of primary and secondary locks and if either of these locks was correctly engaged the door should have remained closed. However, it was ascertained that interference from inside the aircraft could result in a condition whereby the door would appear to be correctly locked but could have come open. It was also ascertained that there was a distinct possibility that the door locks may have been disturbed by a race-horse attendant who was travelling on the aircraft.

Whether or not this attendant had been adequately briefed before commencing the flight is not known, but the necessity to do so is now apparent.

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Shortly after a Hudson had reached its cruising level of 8,000 feet, the pilot's escape hatch blew out. It was not recovered. Prior to flight the hatch had been removed for inspection. It was considered that when refitting, the securing links had been over-tightened with the resultant tendency for the clip to jump over-centre.

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**The foregoing incidents have been selected from the records for 1957. It will be noted that the incidents arose from poor design, maintenance errors, despatcher and pilot omissions. The pilot is the person who has to cope with any emergency situation which may arise and, in pressurised aircraft, such an emergency could be of a serious nature; therefore it is suggested that all pilots have a personal interest in this matter and they should double check as far as possible that all doors are in fact locked, and the correct procedures followed.**

# *DC.3 Engine Failure*

### The Incident

The port engine of a DC.3 failed shortly after the aircraft had passed the critical point on a flight from Meekatharra to Port Hedland. The engine was shut down, the propeller feathered and the aircraft proceeded to Port Hedland, the nearest suitable aerodrome.

### The Circumstances

The forecast for the flight indicated that the route and terminal weather would be fine. Flight plan cruising level was 90 and the estimated time interval was 2 hours 41 minutes. Sufficient fuel was uplifted to meet the statutory requirements.

The aircraft departed Meekatharra at 0130 hours Western Time and the all-up-weight on departure was 25,950 lb. At approximately 0220 hours, while cruising at flight level 90, the port engine back-fired once but then ran smoothly. However, at approximately 0310 hours, some eighteen minutes after passing the critical point, the port engine backfired several times and commenced to run roughly with fluctuations of r.p.m. and manifold pressure. The engine was thereupon shut down and the propeller feathered. Automatic rich mixture and 2550 r.p.m. were selected on the starboard engine and full throttle was applied, giving 37½" of manifold pressure. With this power setting and an indicated airspeed of 96 knots, the aircraft gradually lost height until it reached an altitude of 5,800 feet, which it was found could be maintained with slightly less than rated power.

When the port engine failed, the aircraft was some 140 miles from Port Hedland and over terrain rising to 4,024 feet. However, involuntary descent from 9,000 feet to 5,800 feet occupied some 45 minutes by which time the aircraft was approximately 70 miles from Port Hedland and over the coastal plain where the terrain in the vicinity of the route was below 600 feet. The descent was continued from this point and the aircraft landed at Port Hedland at 0437 hours. The weather throughout the flight was as forecast.

### The Cause of the Engine Failure

Examination of the port engine revealed that the malfunctioning was caused by the failure of a tooth on the cam reduction gear, P/N. 19185, resulting in subsequent stripping of the teeth from the gear. The cause of the failure of the tooth could not be established.

### Comments on the Flight

The engine failure occurred 1 hour 40 minutes after take-off by which time the all-up-weight was approximately 25,000 lb. The ambient air temperature was 21°C. The DC.3 performance data shows that, at this temperature and the above all-up-weight, using the maximum available power and the optimum airspeed, 96 knots, the aircraft would have a rate of descent of 110 f.p.m. at 9,000 feet pressure altitude. Further, that, at 96 knots, zero climb will be achieved at 5,800 feet pressure altitude at rated power in an ambient air temperature of 21°C. In other words, the performance of the aircraft on this occasion was almost identical with that to be expected.

The statutory fuel requirement for this flight was 300 gallons, based on the engine out/critical point formula which gave a higher figure than the "15% + 45 minutes" reserve fuel requirement (AIP/RAC/1-7-6, paragraphs 12.4.1.1 and 12.4.1.3 refer). The aircraft departed Meekatharra with 330 gallons of fuel and landed at Port Hedland with 72 gallons, having used 258 gallons. It was established that the consumption rate prior to the engine failure was approximately 75 g.p.h. and on one engine was 91 g.p.h. These figures are consistent with the standard rates and the fuel consumed agrees substantially with the theoretical figure for this flight of 250 gallons.

It is reassuring to know that in this incident the aircraft performed almost exactly in accordance with the single engine limitations prescribed for the DC.3. The circumstances also show how important it is to the pilot's peace of mind for him to be thoroughly conversant with the normal and emergency limitations of his aircraft. Greater peace of mind means greater safety: make sure you are conditioned for it.

# *Brake Fires*

During pilot training activities at Williamtown, a Lockheed Constellation was being parked when a severe fire broke out in the left hand wheel. The fire was controlled after a short time by the use of hand extinguishers. The pilot reported that the foam was of little use and CO2 was the most effective. However, care must be taken in combating brake fires as highlighted in the following experience featured by the Flight Safety Foundation in Accident Prevention Bulletin 56-13 dated July 10th, 1956.

"An air transport recently experienced a main landing gear wheel 'explosion' after taxying back to the ramp following a rejected take-off. Here's a blow-by-blow account of the incident.

"At approximately V1 speed, the No. 2 engine fire warning came on. The take-off was immediately discontinued and the transport stopped by use of reverse thrust and moderate braking. The fire warning went out when power was pulled back.



"The airplane was taxied back to the ramp (about two miles), using light braking action. As the airplane pulled up to the ramp a ground service man observed that the No. 1 wheel assembly was hot and smoking. He applied CO2.

"A few seconds after the CO2 application, the No. 1 wheel assembly 'exploded'. The axle nut blew off and a portion of the wheel (weighing some 96 pounds) left the axle (outboard), went through a finger gate and came to rest 585 feet away. Fortunately, there was no personnel injury.

"This explosion caused the No. 2 tyre to blow and ruptured the shuttle valve. Hydraulic fluid leaked on the hot brake and started a fire which the airport fire department extinguished with dry chemical.

"Preliminary investigation indicates that the initial wheel failure may have been triggered by the chilling effect of the CO2 and the force which propelled the wheel was the air pressure in the exploding tyre."

### Comment

The fires related to many of these incidents are really no more than smoke issuing from spots of oil or dirt that have dropped on the brake drum. Allow it to cool off while standing by with a fire extinguisher but do not use the extinguisher until it is certain that a fire has really occurred.

Whenever brakes are overheated to the point that a fire extinguishing agent is required, it is advisable to use a dry chemical rather than a cooling agent such as CO2, or water.

If a dry chemical is not available and CO2 must be used, stand behind or forward of the wheel several feet away, and operate in a to and fro motion. This will provide effective fire extinguishing action due to the smothering effect of the CO2 and will minimise the possibility of wheel damage due to excessive localised cooling.

# *Instrument Filters in Agricultural Operations*

During the course of a recent accident investigation it was discovered that the Reid and Sigrist type turn and bank indicator, installed in the aircraft, was unserviceable due to the air filter being choked with superphosphate dust. This type of instrument is not mandatory for operations under the visual flight rules; nevertheless, its presence in an aircraft suggests to the pilot that it is there to be used if the need arises.

The air filter is only 7/16" in diameter and it will choke in a few hours of dusting operations. The remedy is to install a larger capacity filter and it is recommended that it should be separated from the instrument and placed as far forward and as high in the aircraft as is possible where dust will least affect it. Alternatively, the existing filter should be inspected and cleaned regularly, for example, after at least every ten hours of operation.

It is obvious that the presence of an unserviceable and unplacarded flight instrument in any cockpit is a menace to safety. It is strongly recommended that instrument air filters in aircraft engaged on agricultural operations be modified, cleaned frequently or the instrument removed. For short term unserviceability it should be placarded "unserviceable" as required by Air Navigation Order 20.18.7.

# *Fire and Spill Valve Warning Lights*

A recent incident involving an airline DC.3 in the Mascot circuit area showed that confusion can occur, particularly at night, in distinguishing between the fire warning lights and the spill valve warning lights.

Immediately after take-off the first officer saw what he believed to be a fire warning light and directed the captain's attention to a warning light on the right hand header panel. The normal fire drill was carried out and the captain returned to the aerodrome. After landing he realised that it was the spill valve warning light which had indicated. The two sets of lights are identical in colour and type and are located within three inches of each other, so the error in determining which was indicating was understandable.

In order to differentiate between the two sets of lights, the operator intends to change the colour of the spill warning lights from red to amber. Other operators of DC.3 aircraft have been advised accordingly.

# LANDING GEAR – Main, Torque Tube

## Dissimilar Materials — Corrosion

### the Situation

A main landing gear of an amphibian aircraft collapsed on landing. Considerable damage to the structure resulted, and the crew sustained minor injuries from being severely shaken up. Cause of the accident was failure of a torque tube in the retraction mechanism.

### the Hazard

The failed torque tube, made of an aluminium alloy, was attached to the retraction actuating lever by steel taper pins. Constant exposure to the corroding effects of sea water produced electrolysis between the dissimilar metals (aluminium and steel) inside the tube where it escaped notice. The internal corrosion progressed to where the tube was weakened sufficiently to fail when landing loads were applied.

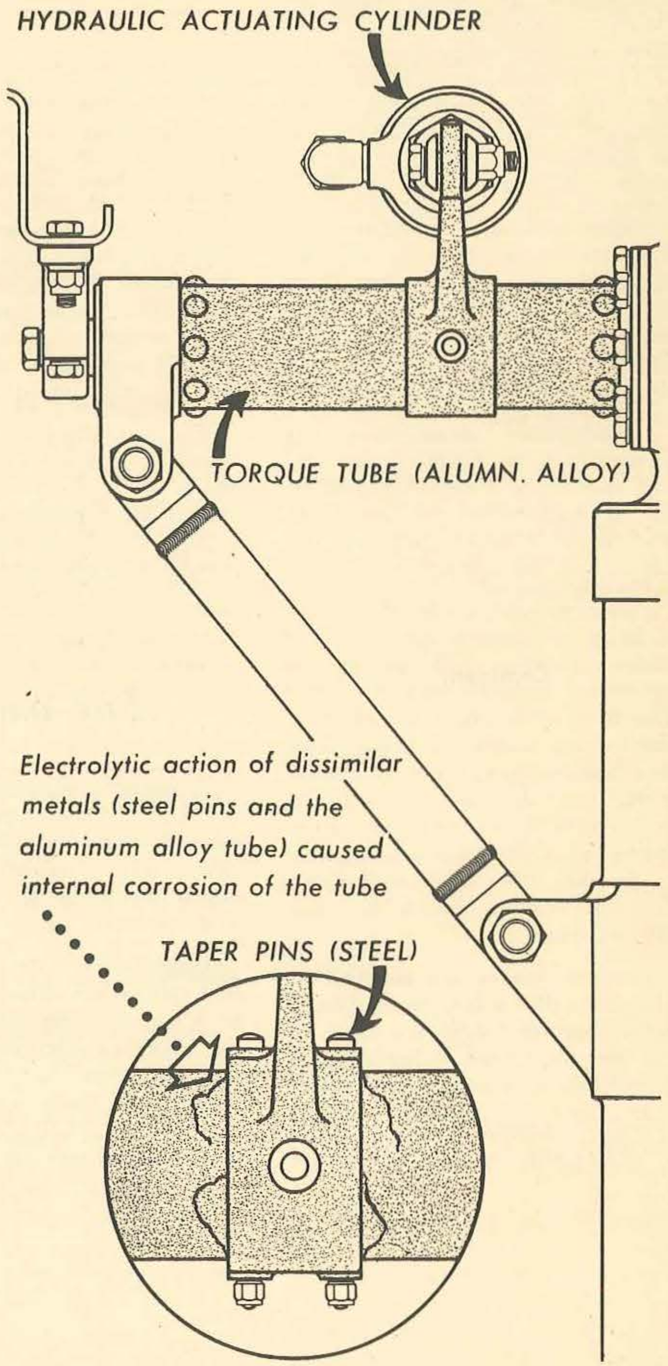
Examination of the opposite gear also revealed internal corrosion which had progressed to where failure was imminent.

### the Fix

The aluminium alloy tubes were replaced by welded assemblies consisting of steel tubes, actuating levers, and shock absorber strut attachment flanges.

### PRECEPT

The structure and its components should be designed to provide optimum reliability during its specified time of operation under given environmental conditions.




*(By courtesy Flight Safety Foundation Incorporated)*