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AVIATION SAFETY DIGEST

No 26, JUNE, 1961

DEPARTMENT OF CIVIL AVIATION

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

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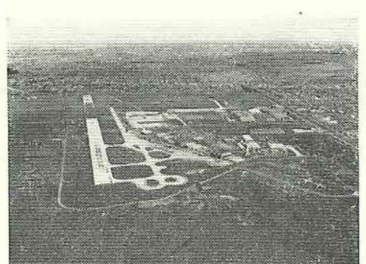
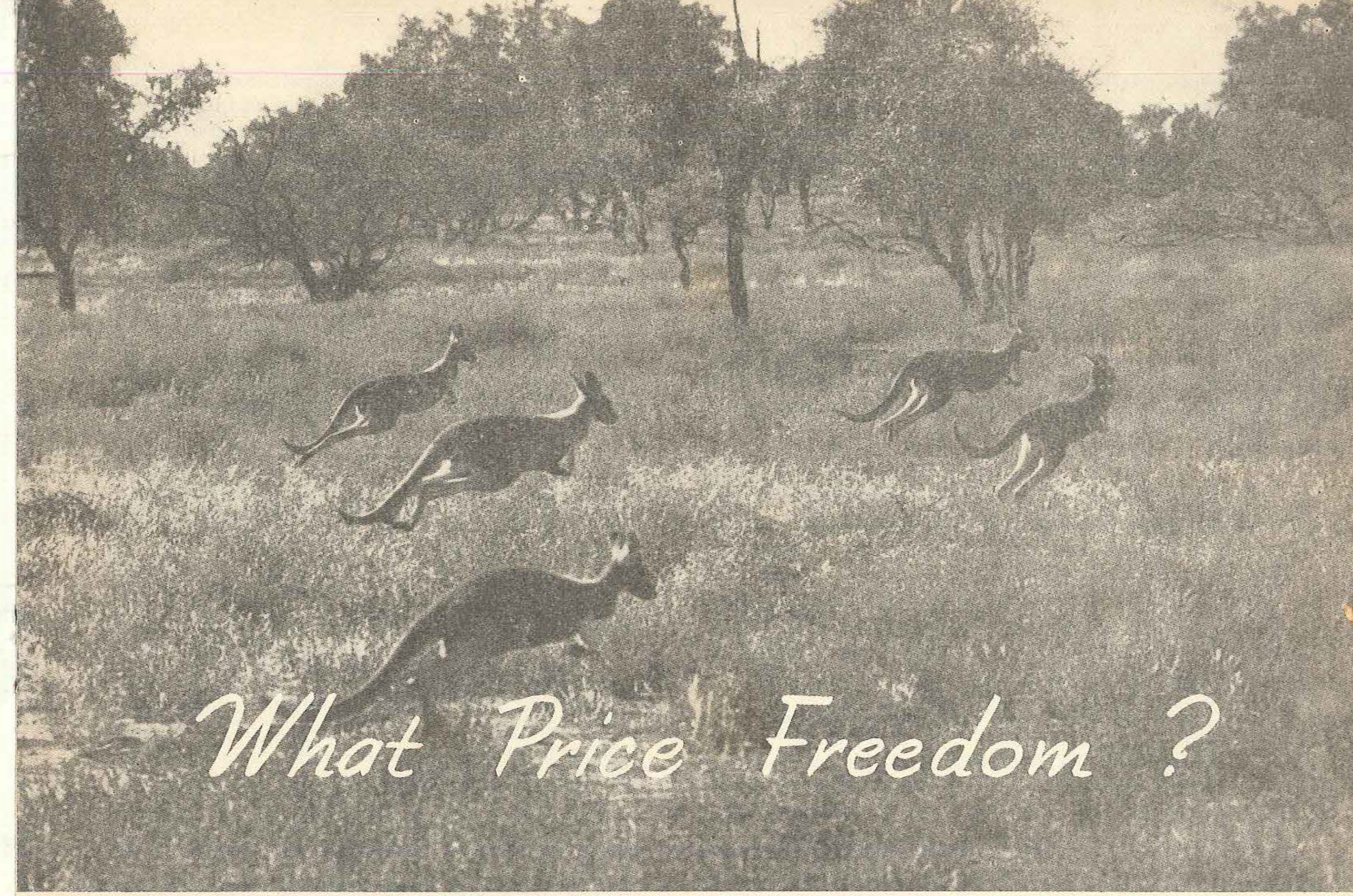


Aerial view of Melbourne Airport — looking South

Commonwealth of Australia



What Price Freedom?

Much has been done and is continually being done to protect the passenger against injury in crash circumstances — but what of the crew.

It is a known fact that the lap straps fitted to crew seats afford but little protection to the pilots in a crash landing. Serious injury due to contact with cockpit hardware has long been accepted as inevitable in these conditions because no provision was made to properly protect the pilot. This situation no longer exists. Shoulder harness that provides a far greater measure of protection yet permits freedom of movement is now fitted to some modern transport aircraft — but there is little evidence that the majority of pilots are taking advantage of the protection provided.

There is now about 20 years experience to show that, in an aircraft accident, a shoulder harness offers very much better protection than simply a lap belt. In the case of transport aircraft accidents we know, from our own experience, that—

in a Viscount accident of 1954 both pilots who were at the controls were killed by head injuries which could have been prevented if they had used the shoulder harness with which the aircraft was fitted. The actual deceleration in this crash was quite low;

in a Friendship accident of 1960 at least one pilot received a non-fatal head injury which certainly rendered him unconscious. This injury could have been prevented by the use of a shoulder harness.

When we last looked into the matter of shoulder harness on flight crew seats the prospect of retro-fitting was not good. In most of the aircraft then flying the seats were so constructed that shoulder harness could not be fitted without quite extensive modifications. The Viscount did have a seat which was strong enough but the fairlead for the shoulder harness was unsuitably high.

At that time we carried out surveys to find out whether a harness, if fitted, would be acceptable to pilots. First we had to establish whether wearing a harness would interfere in any way with reaching controls or looking at dials needed during a normal or emergency landing or take-off. Quite clearly if the harness did interfere with the pilot then it would not be acceptable.

Such a trial was carried out on a 720 Viscount and showed that there were no controls that could not be operated or dials that could not be seen when the pilot wore the harness.

An interesting point which the survey turned up was that some pilots felt that they would not use the harness routinely but would like to have it so that they could put it on "in an emergency".

This led us to examine what sort of warning time pilots do in fact get before an accident. We reviewed all the take off and landing accidents to transport aircraft in this country up to that date and found that in 39% of these accidents the warning time available to the pilot was less than 5 seconds, in 74% less than 10 seconds, in 87% less than 30 seconds and 94% less than one minute.

This shows clearly that accidents occur almost without warning. Since the pilot is going to be fully occupied in trying to control the aircraft and in dealing with the hazardous situation, he obviously has no opportunity to do anything for his personal protection.

We all know about these "emergencies" that occur at an airport when an aircraft has, say, a suspected unsafe condition of the landing gear. The aircraft circles around while ambulances, and fire brigades (and often spectators) assemble. This always makes a good sensational news story but these "emergencies" almost never result in accidents.

It follows then that if a shoulder harness is to be useful it has to be worn as a routine at least for every take-off and every landing.

We mentioned that the older aircraft could not be fitted satisfactorily but the newer types can be and often are. The Boeings and the Electras in service in Australia have shoulder harnesses with inertia reels and the Fokker Friendship has crew seats which can be fitted with shoulder harness.

We did not expect to find acceptance of the harness by all pilots engaged on these types immediately the aircraft came into service. It was anticipated, however, that its acceptance was only a matter of time, and that by now its use would have become normal procedure for the majority of pilots. Our observations over the past few months have convinced us that we were mistaken and, though we are informed that some pilots do in fact use the harness at every take-off and landing, it seems in our view that it has been discarded prematurely by the majority after inadequate trial.

There are, it seems, many reasons why pilots prefer not to use the shoulder straps. The sense of physical restriction is prominent among these objections and, in our view, is the one that gives rise to a number of others which are in fact without substance. Complete freedom, of course, cannot be had except at some price and in this case it is a matter of whether you can really afford the freedom you think you need. All of these points are dealt with in an excellent bulletin published by the Flight Safety Foundation which is reproduced below. We suggest you weigh your personal objection against the facts outlined in this bulletin.

RESTRAIN YOURSELF

Gerard M. Bruggink
Aviation Crash Injury Research, Flight Safety Foundation

When you are responsible for several million dollars worth of hardware and human lives, you don't want to be bothered with seemingly minor details. This is a healthy attitude in an environment kept intact only by constant alertness and decision making. Yet, there are times when attention or lack of attention to some lowly detail spells the difference between interment with full honours and the not so honourable grilling by an accident investigation board. Poor as this choice may be, we will assume that the average pilot prefers temporary affliction to the permanent type. We will also assume, without any attempt at cynicism, that common sense takes precedence over rank, pay scale, and age in matters concerning self-preservation.

Based on these assumptions we can, without embarrassment, bring out in the open a question that we have been asked repeatedly by representatives of airlines at home and abroad: "How can we induce our pilots to use their shoulder harness?"

Now that the cat is out of the bag, let's examine the nature of the beast. The question itself reflects three basic facts: (1) A certain number of knowledgeable people sincerely believe in the protection offered by the shoulder harness; (2) all the pilots referred to by the airline representatives had a shoulder harness available in their aircraft; (3) some pilots are not aware of the advantages of a properly used shoulder harness.

Although we cherish the truth, we must admit that the facts revealed by the question are simply statements of the obvious and, as such, they fail to stir our feelings. A lifelong association with pilots has us convinced that even this pre-eminent group has clear-cut reasons for doing and not doing certain things. We feel so strongly about this that we suggest basing a solution for this problem on a more fundamental question: "Why don't pilots use their shoulder harness?"

WHY DON'T THEY?

We did some research on the subject and found that many pilots have valid objections to the use of the shoulder harness such as:

- "Some types of shoulder harness are so uncomfortable to wear, that it is doubtful whether the safety factor is worth the loss of comfort".
- "The restriction of movement imposed by some types of shoulder harness may be hazardous in emergency situations".
- "To fasten or unfasten the shoulder harness you have to release the seat belt and you need about four hands to catch up with the loose ends."
- "It is often difficult to reach the straps when you want to fasten them, while some types are constantly in the way when not in use".
- "The dye of the harness webbing rubs off on your shirt when you perspire".

These are sound arguments which cannot be shrugged away with an annoyed, "Why care? They are not using the shoulder harness anyhow". Actually, there are indications that some pilots have never been exposed to a properly designed and properly installed shoulder harness. Therefore, we can return the hardware part of the problem to the lap of those who created it: the manufacturer and the procurement officer.

On the other hand, we also found that even the ideal type of shoulder harness can be underrated by the uniformed or prejudiced pilot. Noteworthy in this respect are the following comments:

- "The inertia reel did not appear to be functioning. It could be unreeled at any time."
- "How do I know if the inertia reel will lock automatically during deceleration?"
- "The only time the reel seemed to lock at all was manually".
- "The shoulder harness restricts my movements when locked".
- "With the shoulder harness tightly adjusted, I can still hit my chin on the wheel".
- "I'm afraid of the buckles over my chest and the straps right on my collar bones".

These critical comments indicate sufficient lack of understanding of the function of the inertia reel as to justify brief discussion of this gadget.

THE INERTIA REEL

Every standard shoulder harness worth its name is anchored via an inertia reel to the pilot's seat or to aircraft structure. The basic function of the reel is to give the pilot full freedom of movement during normal operating conditions while automatically locking the shoulder harness during an abrupt deceleration.

The freedom of movement is obtained by making the reel cable, to which the harness is attached, springloaded. This allows shoulder harness extension without apparent restraint (this is the way it should be!) while constantly taking up any slack.

We will save you a description of the well-hidden secret of the automatic locking mechanism. Let it suffice to state that this device, during the more than twenty years of its use in aircraft, has never been known to fail when needed. It is so foolproof that a pre-flight check of its function would fall into the same category as triggering a fire extinguisher to make sure it will work when needed.

To avoid confusion it should be mentioned here that there are two types of shoulder harness reel presently in operational use. The impact-sensitive type takes a 2-3G impact on the inertia reel housing itself or on an inertia switch to lock automatically. Normal flight loads, including severe turbulence, will not activate this reel. To check its operation before take-off, you would have to tap it lightly with a hammer and this would undoubtedly arouse suspicion amongst the passengers. It is so much more convenient to take the manufacturer's word for it, as you do in the case of so many other black boxes in the aircraft.

The rate-of-extension type harness reel, although mechanically different, serves the same purpose. Its automatic operation during impact depends on the speed with which the harness is "reeled off", which makes it a function of the rate of upper torso displacement, regardless of direction. A well-designed reel of this type will lock automatically before the occupant travels more than ½-inch during an emergency deceleration. The G-setting is factory adjustable and normally coincides with a 2-3G abrupt deceleration. Incredulous Thomases will be pleased to know that the automatic operation of this reel can be checked at any time by a jerk on the shoulder straps. This will also demonstrate how the shoulder harness, after being locked automatically, reels the pilot in every time he bounces back toward his seat. Eventually he'll find himself firmly secured against his seat back. To break this embrace and to restore the reel to its automatic function, the control lever should be moved to "manual" and then back to "automatic".

There are indications that the G-setting of the rate-of-extension type reel occasionally is adjusted too low. In this case, sudden movement of the upper torso as a result of emergency manipulations may result in locking of the harness. This interference with emergency duties must be avoided at all costs and pilots are advised to check the proper G setting of their reels by simulated emergency manipulations.

A few words on the manual control lever will clear possible superstitions in that area. Both types of reels have identical control levers, usually mounted on the seat arm or other convenient location. The lever has two positions, "manual" and "automatic". The manual position permits the pilot to lock the reel if he anticipates severe conditions or any time he wants to be held tightly. This prevents further cable extension but does not keep the reel from taking up slack in the harness whenever the pilot leans back. Normally the control lever should be in automatic position. This makes the shoulder harness, a nonentity, that is, you should hardly be aware of its presence when performing your cockpit duties. At the same time, it will protect you in the described manner should the occasion arise.

WHY SHOULD THEY ?

Although a discussion of the reasons why some pilots don't use their shoulder harness may seem a rather negative approach to the problem, we have learned at least that their reluctance in this respect has a lot to do with the design and installation of the shoulder harness and the indoctrination in its use. The obvious conclusions are left to those who can remedy this situation.

From here on we'll proceed on the assumption that every pilot has a properly designed and installed shoulder harness at his disposal and knows how to use it. What reasons does he have to use it and how can you induce him to use it ? A blunt and simple way to convince him would be to show actual photographs of the face-losing effects of not using a shoulder harness during a survivable crash deceleration. These pictures are available, but we dislike this approach since we are not competing with the popular press. We prefer to convince potential shoulder harness users in a more intelligent manner by stating a few pertinent facts:

(1) Crew members are exposed to a more injurious environment than most of their passengers. Indisputable statistics (forgive the expression) prove that head injuries of cockpit occupants not wearing a shoulder harness are the most frequent cause of a fatal and serious injury. Only adequate upper torso restraint can prevent or minimize this.

(2) Use of a shoulder harness in conjunction with the seat belt considerably increases the human tolerance to transverse deceleration since it keeps the spine perpendicular with respect to the direction of crash force.

(3) The idea that emergencies will allow sufficient time to don the shoulder harness is an illusion. A brief review of survivable transport accidents will convince anybody that, with the exception of some anticipated ditchings, foreknowledge of a crash deceleration seldom leaves enough time for a rash of clear-headed actions, typical in Hollywood versions.

(4) In-flight emergencies (extreme CAT, (clear air turbulence), violent evasive action, sudden control malfunction, etc.) are much better handled by a man who is firmly restrained in his seat than by a body floating through the cockpit. Incidents have repeatedly shown that unexpected manoeuvres may snap your flagship into the type IV (acrobatic) category in less time than it takes to fluster a new stewardess. A one-time exposure to a solid dose of negative or lateral G's, without the benefit of a shoulder harness, will convince anybody that it pays to restrain yourself.

HOW TO USE IT

Elementary as it may sound, we feel that a few remarks on the proper adjustment of shoulder harness and seat belt may prevent some unnecessary harness harassment. A little guidance goes a long way, as we found out in the case of one of our female off-spring when first exposed to the bridling effects of a girdle. Her violent objections melted under the insistence of parental warmth and by the time she began to appreciate the girdle's protective value, experience had taught her to live comfortably and gracefully within its confines.

The seat belt should always be as tight as comfort will permit, regardless of the use of a shoulder harness. The seat belt webbing should cross the hip bones at approximately 45 degrees. This positions the buckle over the lap instead of the abdomen and prevents constant pressure in this tender region while allowing unrestricted upper torso movement. The snubbing action of a loosely worn seat belt is a generally recognized hazard so that further comment is unnecessary.

The shoulder straps should be adjusted tight enough to take up all slack without exerting an upward pull on the seat belt. The pressure on both shoulders should be equal and hardly noticeable. Care should be taken not to restrict your freedom of movement, afforded by the springloaded inertia reel cable, while adjusting the straps. We know of a case where an inexperienced pilot took up all available cable length by excessive shortening of the shoulder straps. He ended up with the V of the shoulder harness rubbing his neck and unable to move although the control lever was in "automatic".

The best way to prevent inadvertent strangulation and immobility is to set the control lever to "manual" before fastening the strap ends. This forces you to properly elongate the straps instead of pulling the strap ends down against inertia reel tension. After the straps are fastened, they should be drawn just tight enough to take any slack out of the webbing. This results in a "no-tension" condition when you are in a normal seated position. It is impossible to forget to move the control lever back to "automatic" unless your arms are twice as long as they are supposed to be.

WHEN TO USE IT ?

This question relates to the shoulder harness only since we must assume that every crew member has enough sense of responsibility to wear his seat belt at all times when he is actively engaged in the operation of the aircraft. We would like to say the same thing with regard to the shoulder harness, but years of frustration have dulled our crusading instincts to the extent that we enjoy a reputation of reasonableness in flight-deck circles. To foster this impression, we have tried to relax our views without torturing our own conscience.

Here is the result: IT IS OUR OPINION THAT THE PILOT "ON DUTY", i.e., THE MAN RESPONSIBLE FOR THE CONTROL OF THE AIRCRAFT, SHOULD BE WEARING HIS SHOULDER HARNESS AT ALL TIMES. WHENEVER THE PASSENGER SEAT BELT LIGHT IS ON, ALL CREW MEMBERS SHOULD HAVE THEIR SHOULDER HARNESS FASTENED.

If you think that these watered-down requirements are exaggerated, you are underrating the importance of your job as executive officer in the most sensitive spot of modern air transportation. You are cruising at speeds and altitudes that were limiting yesterday's jet fighter generation. Talking about comfort, your military colleagues, who fly the big Air Force stuff, fly missions of longer duration with full restraint at all times, in addition to a helmet. This requirement is not based upon their personal safety only. It has a lot to do with the country's capital investment in their equipment and mission. By the same token, we venture to say that the use of shoulder harness should not be left to a pilot's likes or dislikes. There is more at stake than a well-ironed shirt and personal comfort. A well-restrained man behind the controls is low cost insurance against the intangible odds of high-performance flight.

After this poetical outburst, we'll dismiss this controversial subject with some raw advice. Your willingness to wear the shoulder harness should be based upon a properly designed and installed shoulder harness. If the outfit in your aircraft does not fit this description, MAKE IT KNOWN.

There are good shoulder harness installations on the market for discriminating people. It is just a matter of getting the parties involved "on the ball".

Finally, we admit that your chances of ever having to rely on the use of a harness are remote, from the Las Vegas point of view. However, the crude state of the art of crystal ball gazing makes gambling in our profession very unpopular.

It Couldn't Happen BUT IT DID

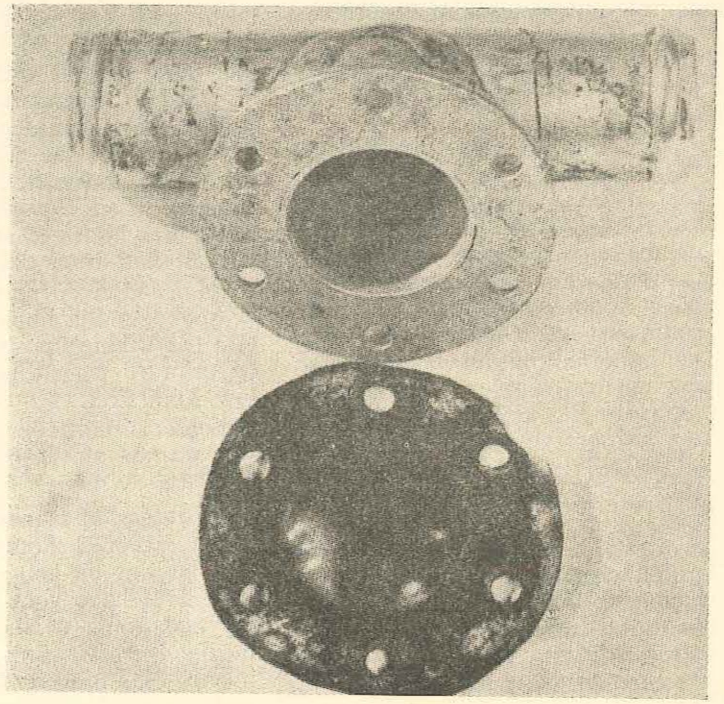
This story is about inflight fuel feeding trouble. When the pilot put down, the trouble shooters discovered a partial vacuum in the wing tanks. PARTIAL VACUUM ? The right main fuel cell had collapsed and was drawn up around the filler neck.

Removal of the fuselage tank vent line T-fitting revealed the source of the difficulty. A solid gasket, one without a centre opening, had been installed in the fitting (see photograph).

So there was no fuel tank venting. And so, with no way for air to replace the fuel withdrawn from the tank, enough negative pressure was created to collapse the tank.

We are glad we have the photograph. This story really needs supporting evidence.

(Aviation Mechanics Bulletin)



(Gasket without centre hole prevented fuel tank venting)

VIKING OUT OF CONTROL

NEAR LONDON AIRPORT

On 2nd September, 1958, a Viking took off from London Airport for a flight to Nice. Forty minutes later the aircraft crashed into houses at Kelvin Gardens, Southall about three miles north-east of London Airport causing considerable damage to property and death to the crew of three and four members of the public.

(Extract from the report of the Public Inquiry)

FLIGHT

The take-off was made at 0554 hours under conditions of little wind with fog to about 1,000 feet. The only persons on board were the three crew members, and the freight load consisted of two Bristol Proteus engines properly loaded and secured on stands. There is no certain evidence as to who occupied the pilot's seat on the port side, however, the evidence strongly suggested that it was the captain and the co-pilot was seated on his right. At the threshold of the runway, the flight engineer, the third crew member, was observed to alight from the aircraft and walk across the front of the aircraft where he stood for half a minute and watched the starboard engine before climbing back into the aircraft. He was looking for signs of an oil leak from that engine.

The aircraft was cleared to Epsom at 2,000 feet thence to Dunsfold at 4,000 feet and then to climb away to 7,500 feet at Seaford out of the airway. The aircraft duly followed these instructions until at 0609 hours when some ten miles south-east of Dunsfold, the captain reported that he was experiencing engine trouble and wished to return to Blackbushe and asked for the weather there. In reply it was suggested that he return to Dunsfold at his present altitude of 7,000 feet.

At 0611 hours, the captain was asked whether he had feathered one engine to which he replied that he had only throttled it down. Soon afterwards told that he could descend to 5,000 feet he confirmed that he was proceeding to do so, after which he was instructed that Blackbushe required him at their Beacon at 3,000 feet. This message was acknowledged. At 0616 hours, the captain advised that he had feathered the starboard engine and would be starting it again for his landing at Blackbushe. At 0617 hours, it was confirmed that the aircraft had passed Dunsfold and the captain was instructed to set course for Blackbushe beacon and told to contact Blackbushe. At this point the aircraft should have taken up a north-westerly course but instead, directed its course to the east of north towards Epsom, an error in heading of some 70 degrees.

The captain reported to Blackbushe and received a clearance to the beacon at 3,000 feet. About this time, the air traffic controller at London Airport who had controlled the outward flight saw on the radar that the aircraft was on the wrong course and approaching Epsom. The Epsom stack controller was informed and as another aircraft had been obliged to overshoot London Airport due to fog, he spoke to Blackbushe and asked that the Viking's position be checked prior to permitting descent below 3,000 feet. At the same time the other aircraft then at 2,000 feet was warned of the presence of the Viking.

On receipt of request from Blackbushe at 0622 hours to confirm that he was on course the captain replied "I have your beacon, turning and going dead ahead". Immediately afterwards, when told that he was heading for Epsom, he said he would "re-tune". Just before this exchange the Viking was sighted by the other aircraft. They estimated its height at 2,500 feet and its course roughly north-east. A glance at the sketch will show the turn which the Viking began about this time.

At 0624 hours, the captain asked for a QDM which was given and he was offered GCA. At this point came the first indication of difficulty as the captain reported having one engine feathered and experiencing difficulty in unfeathering. In fact as learnt later, his starboard feathering motor had been burnt out. Two minutes later, the captain reported his position as ten miles east of Blackbushe "and having difficulty maintaining height". He then gave his height as 1,000 feet which he immediately corrected to 800 feet.

A series of messages followed in which the captain asked for and was given QDM's while the GCA at Blackbushe attempted without success to contact the aircraft. At 0627 hours the captain reported 500 feet and a minute later when stating his distance as five miles from Blackbushe he gave a height of 400 feet. In fact at about this time the aircraft was twenty miles away and veering to the north. At 0630 hours, the first officer appears to have taken over the R/T giving the height as 200 feet. After the series of QDM's to which the aircraft could no longer correct her course, the first officer reported "almost on the deck" and soon after "over a town". Finally he gave the Mayday signal at 0632.

Eyewitnesses confirmed that the aircraft was flying on the port engine only, the starboard engine being feathered.

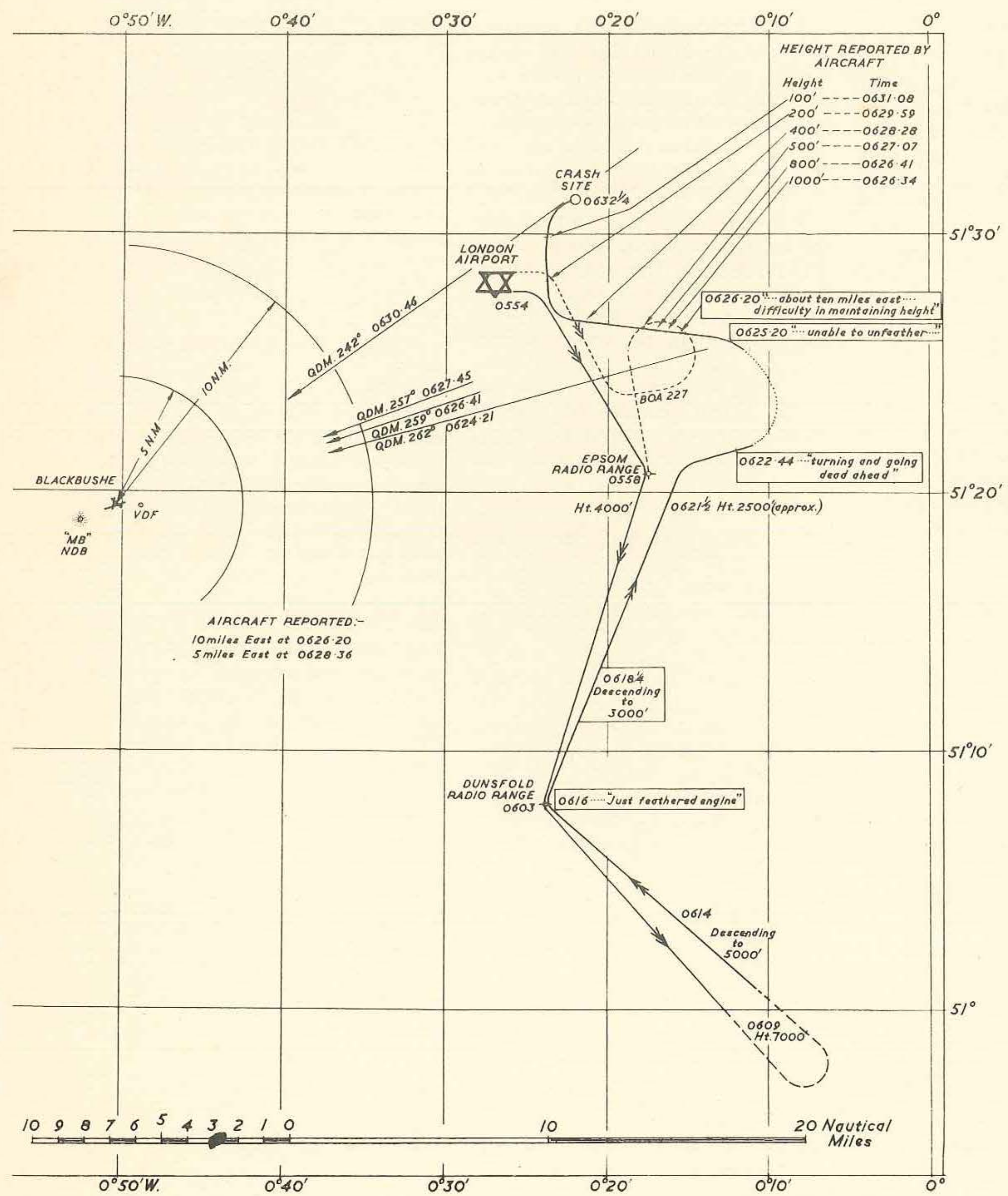
(All times herein are G.M.T.)

INVESTIGATION

Despite the scattering of the wreckage and the fire which followed the crash, evidence proved that the engines were in sound working order and that the starboard engine showed no signs of lack of lubrication. It was also proved that the propellers were in sound working condition. Equally, however, it was found that the starboard feathering motor was burnt out and that this had occurred prior to the crash.

Investigation revealed that in the six days preceding the accident the aircraft had been in the air for 44 hours 45 minutes. On 1st September on completion of a flight in the aircraft, the captain reported "starboard engine C.S.U. oil leak also surging suggest change C.S.U. (or seal)". During subsequent servicing a new stalk seal was fitted to the starboard propeller and the C.S.U. was replaced with another taken from store together with a new gasket. Subsequent events, however, strongly point to the fact that the source of the oil leak was not discovered and this was perhaps due to the fact that the maintenance staff were working difficult hours and proper supervision was largely impossible.

At 1410 hours the aircraft left Blackbushe for London Airport and, after being taxied to a standstill after landing at London a pool of oil was found on the tarmac underneath the front of the starboard engine, which was still dripping oil. The leak was again attributed to the seal of the C.S.U. but as there was no C.S.U. available at London the engineer proceeded to take the old unit apart and refit the seal. The oil leak was probably wrongly attributed to the C.S.U. for the investigation of the wreckage revealed that the starboard engine showed no signs of lack of lubrication although the destruction of the sump was so complete that it was impossible to ascertain the source of any leak. In fact it



was revealed that the seal was properly fitted and functioning perfectly, whilst the same was true of the gasket.

The load sheet signed by the captain before leaving London Airport purported to show that the weight at take-off was 32 kilogrammes within the permitted maximum. However, the inquiry revealed that the aircraft was in fact overloaded to the amount of nearly 400 kilogrammes.

The captain was a pilot of considerable experience and had flown over 13,000 hours. He joined the company in May, 1956. He was tested by the company's chief pilot in April and again in August, 1958. From May to August he flew 389 hours, of which 135 were in a Viking. The tests however, were insufficient to test his ability to deal with a true emergency involving the flying and landing of the aircraft on one engine.

No proper test of the competency of the first officer to act in that category on this aircraft had been carried out prior to the flight and there is no reason to suppose that the flight engineer's experience fitted him to form a member of this crew upon which the pilot could rely.

On available evidence it was found that the captain could have been suffering from fatigue to a serious degree. Similarly the first officer and flight engineer had had a disturbed night. In short the crew had not had the rest desirable and to which they were entitled, before taking off in an aircraft whose condition was suspect, overloaded in order to enable it to make a flight which was beyond its proper range with the load it carried.

ANALYSIS

At 0609 hours, after leaving Dunsfold, the captain announced that he had engine trouble, confirming his height at 7,000 feet and his ability to maintain altitude. It is, of course, possible that his engine trouble bore no reference to an oil leak, however, this seems improbable. It is also possible that he had no oil leak but that some instrument failure caused him to think so — there is no reason to think this likely. It is possible that there was an oil leak, and the fact that the Investigation Branch found signs of oil sprayed from the starboard engine on the starboard tail plane when investigating the wreckage is an indication that there was a true leak.

The record of the R/T messages indicates no anxiety at this stage. It may be concluded that there was probably an oil leak apparent from the cockpit but it was not considered serious and accordingly the captain merely throttled back instead of feathering the starboard engine.

Between 0616 and 0618 hours the captain was told that he could set course from Dunsfold to Blackbushe Beacon and descend to 3,000 feet to arrive at the Beacon at that height. Perhaps the most remarkable feature of the flight is that at this point he made his course towards Epsom instead of towards Blackbushe; the magnitude of the error (70 degrees) being illustrated in the sketch.

There are really two possibilities which can explain the course taken —incidentally the error is difficult to credit when one reflects on the experience of the pilot, the fact that he was flying in bright sunlight and had in addition a magnetic compass if he cared to refer to it. Firstly either he or the first officer tuned the A.D.F. equipment to Epsom instead of Blackbushe, or there is an elaborate scientific explanation, namely that the captain was misled by the Amsterdam Beacon. It so happens that Blackbushe Beacon was established some years ago operating on a frequency of 379.5 kilocycles and to an effective range of 15 nautical miles, interrupting its signal at intervals of eight times per minute by the code signal MB. Meanwhile, Amsterdam, which is a powerful navigational Beacon with a frequency of 381 kilocycles, transmits its signal interrupted at half minute intervals with its code sign PHA. If a set is mistuned towards Amsterdam at a point outside the 15 mile radius of Blackbushe, the effect may be that the radio compass needle will be influenced by the Amsterdam signal and will show a false reading. If the pilot follows this bearing he will fly an incorrect course and the error is likely to increase.

It is not possible to determine whether in this case the captain and his crew followed the course they did because they flew towards Epsom through forgetting to tune to Blackbushe or because they mistuned in the direction of Amsterdam and were thus led gradually astray.

At 0622 hours the aircraft was clearly informed that it was off course, its messages were clear and there was no sign of panic up to the end, a little over two minutes later.

CONCLUSIONS

It seems likely that the oil leak showed itself at 7,000 feet but that it did not seem serious. It must be largely speculation as to why the aircraft took the wrong course, in fact it was an extraordinary error for a pilot of his experience to make in the circumstances. Equally extraordinary are the loss of height without warning, the failure to observe the probable red light warning of the feathering motor, and finally allowing the speed to drop so that he could no longer climb on one engine. It is apparent that the captain was flying the aircraft in a manner which was quite out of keeping with his experience. Undoubtedly he was affected with fatigue to a very marked extent. He had been ill a few days before, he had had insufficient rest, the maintenance of his aircraft was subject to grave suspicion and his crew were scarcely known to him and inexperienced. The pilot was placed in a situation which no pilot should be required to face, and it is dangerous to criticize in detail his handling of it.

CAUSE

The aircraft was allowed to lose height and flying speed with the result that the pilot was no longer able to exercise asymmetric control.

Inspection Reminder

In October, 1960 the following report was received from a student pilot — "Propeller fell off on downwind leg and aircraft was landed safely on the aerodrome".

Examination of the Gipsy Major I engine involved revealed that the crankshaft had broken in the region of the thrust nut. Further investigation into the history of the engine disclosed that it had suffered propeller damage on three occasions prior to the crankshaft failure. It is believed that the shock loading received on one of these occasions, or perhaps the combined effect of the three, had initiated the eventual fatigue fracture.

This type of failure has occurred on several occasions in the past ten years or so. About four years ago the known cases were analysed by aeronautical engineers in this Department with a view to determining whether there was need for specific inspection at regular intervals. As a result, a letter was directed to all licensed aircraft maintenance engineers concerned, drawing attention to the type of failure.

In the interests of safety, and as this letter may not have reached all the engineers currently engaged in the maintenance of light aircraft engines, it is reproduced below. It should be borne in mind that aircraft are frequently over inhospitable terrain, where a failure of this nature can be fatal for the occupants.

"It has been thought advisable to draw your attention to a recurrent, although comparatively infrequent, defect of Gipsy Major I series engines which involves loss of the propeller in flight due to fracture of the crankshaft forward of the propeller thrust bearing. In the past three years, six or seven such incidents have occurred in Australia, the failure of the shaft having been characterised in each case by a brittle, fatigue type fracture which had started in the region of the thrust race retaining nut threads. Similar cases have been reported overseas.

"Failures of this nature are associated to some degree, although not exclusively, with the use of metal propellers and it is also believed that shock loading (due, say, to a propeller being damaged in a "nose over" accident) can result in a serious reduction in the fatigue life of the shaft. In this latter case, it is worth noting that heavy shock loading could sow the seed of an eventual fatigue fracture without either permanently distorting the shaft or giving rise to an immediately detectable crack, the final fracture only occurring after some hundreds of hours of additional operation.

"Since we have not received any reports of Gipsy Major I crankshafts being found cracked at overhaul and since at least one failure has occurred within a short time of complete overhaul, at which time the shaft had been given a magnaflux inspection, it is suspected that fractures of this nature propagate fairly quickly once an initial crack has formed.

"As far as remedial measures are concerned, it is recommended that all Gipsy Major I crankshafts be carefully inspected at regular intervals for cracking in the critical region of the rear of the keyway and the thrust bearing retaining nut threads. In this respect, we would refer you to De Havilland Technical News Sheet No. G.8, revision dated 20th September, 1956, which gives comprehensive inspection instructions. It will be noted that, for effective inspection to be possible, it is necessary to remove the front cover and the thrust bearing retaining nut in addition to the propeller and hub assembly.

"From what has been said previously, it will be appreciated that repeated inspection will be **particularly** important in the case of crankshafts which have been severely shock loaded due to an accident with a metal propeller. In this case it may also be advisable, depending on the circumstances, to give serious thought to the replacement of the crankshaft at next overhaul.

"If desired, Modification No. G.2094 can be carried out on crankshafts at overhaul. This modification, details of which can be obtained from De Havillands, involves complete removal of the thrust race retaining nut threads, a new design thrust race and retaining nut then being fitted over a sleeve shrunk on to the crankshaft.

"The foregoing advice and recommendations are passed on for your information and for observance in your own interests. Although the department does not intend to make these inspections mandatory for all Gipsy Major engines at the present juncture, you will realize that inspection of individual engines, where special circumstances warrant it, can always be demanded."

It Will Spin!

Loss of Control During DC3 Training Flights

(Based on reports appearing in I.C.A.O. Aircraft Accident Digest)

SWITZERLAND; NEW DELHI, INDIA

At 0832 hours* on 13th March, 1957, a DC.3 took off from Safdarjung Airport, New Delhi, on a training flight. Seven minutes later it reported 20 miles north of the airport at 5,000 feet. There was no further contact with the aircraft and at 0915 it crashed 10 miles north of the airport and was destroyed by impact and fire. Both occupants were killed as were three inmates of a hut in the labour colony where the crash ocurred.

INVESTIGATION

The flight was the first of a series for the purpose of training a captain as a flying instructor. The instructor's total flying experience exceeded 12,000 hours including 4,381 in command in DC.3's. The "Trainee" had a total of 5,874 hours of which over 5,000 had been flown in DC.3's including 1,434 in command.

No proper load sheet was prepared for the flight but the laden weight at the time of take-off was estimated at approximately 24,380 lb. Ballast of 2,550 lb. was taken on board and stowed between seats but not lashed. It was considered reasonable to assume on the evidence that the centre of gravity of the aircraft was within permissible limits.

It was concluded that the aircraft struck the ground in a straight steep dive; there was no structural failure in the air nor was there any fire in flight. All control surfaces were functioning when the aircraft struck the ground.

Examination of the engines revealed no evidence of internal failure and there were no signs of inadequate lubrication. Both engines were developing power at the time of impact.

According to the evidence of the chief pilot the instructors' course is conducted with special accent on speed and manoeuvre limitations. The first period includes change of speeds, change of heights, turns and stalls. The exercise of approaching the stall is generally done twice, once with full flaps and undercarriage retracted and then with flaps and undercarriage extended and normally in this order. Considering that the aircraft was airborne at 0832 hours and crashed at approximately 0915 hours, the training could have reached the stage of demonstration of stall because the trainee was considered to be quite capable of completing the initial exercises within a short period of time.

ANALYSIS

After taking off with the instructor in the left hand seat, the aircraft proceeded to an area about 20 miles to the north of the airport. Some exercises were commenced at a height of 5,000 feet above mean sea level.

The nature of this instructor's course required the pilot under training to take corrective action in the case of a faulty manoeuvre. During one of these manoeuvres, which included an approach to stall, the aircraft entered a spin. It appears that this spin was entered inadvertently as intentional spins are prohibited in DC.3 aircraft. Corrective action was taken and although partial recovery had been effected, the height available was insufficient for the aircraft to recover from the ensuing dive before it hit the ground.

The following data had previously been obtained from wind tunnel studies made by the National Advisory Council for Aeronautics using a DC.3 model and analyzing the aircraft's aerodynamic characteristics; "While the tests gave evidence that spin recovery is normal, an altitude loss of approximately 3,000 feet can be expected prior to a full recovery. Such altitude loss would be particularly true in the event of experiencing a power-on-spin. The spin would be steep with the nose down about 55 degrees from the horizontal, and the rate of descent would be about 10,500 feet per minute".

Once this DC.3 entered a spin, it appeared to behave in the classic manner and reproduced all the manoeuvres described in the N.A.C.A. study. No minimum height for these exercises had been laid down and 4,000 feet above msl corresponds to 3,300 feet above the ground at the accident site. If this was the height at which the aircraft stalled and entered a spin, then it did not permit a sufficient margin of safety.

An additional complication in this instance could have been the unlashed ballast which would have retained its position in normal flight but could have shifted after the aircraft entered the spin. It is difficult to calculate the exact effect of the displaced ballast but it would not have assisted in the recovery from the spin and might have added to the minimum height that was necessary for the recovery.

It was concluded that the accident was caused by a loss of control of the aircraft as a result of a spin inadvertently entered into at a height too low for recovery.

* All times herein are Indian Standard Time.

A DC.3 on a training flight took off from Kloten aerodrome, Switzerland at 0857 hours on 18th June, 1957. At 1020 hours, the aircraft entered a spin and crashed into Lake Constance 4.5 km north-east of Arbon. All nine occupants, which included the instructor, co-pilot, five student pilots and two company engineers, were killed and the aircraft was destroyed.

INVESTIGATION

The flight was being conducted for the dual purpose of training airline transport pilots and planning department tests for a revision of the DC.3 flight performance table. The pilot training consisted of VFR flight exercises in cutting of one engine and feathering and unfeathering propellers in cruise.

The aircraft left Kloten and two minutes later informed the control tower that it intended to operate in the Lake Constance - Schaffhausen area in VFR conditions. No further communication was received.

The exact flight path could not be determined but statements of witnesses revealed that the aircraft flew in various directions approximately 1,000 and 3,000 metres above sea level in the Lake Constance area. Several witnesses claim to have seen the aircraft operate on one engine.

Shortly before 1020 hours the aircraft flew in an easterly direction between Romanshorn and Arbon and witnesses observed a brief sinking motion in the level flight followed immediately by a climb during which the aircraft suddenly stalled and entered a spin. The altitude at the commencement of the spin is estimated between 1,100 and 2,100 metres above the ground. The aircraft struck the surface of the water and sank in a few minutes.

Investigation revealed no evidence of malfunctioning. On impact the aircraft was in the following configuration: —

Undercarriage fully extended, flaps retracted, trim position impossible to determine, right propeller not feathered, twin RPM indicator showed left engine 1550 RPM, right engine 1350 RPM.

ANALYSIS

The co-pilot had 263 hours flying experience and occupied the left pilot seat.

According to a number of witnesses, the level flight first turned into a brief descent immediately followed by a climb, and then suddenly the aircraft stalled and entered a spin dive. The aircraft struck the water in a very steep dive, practically without a turn along its longitudinal axis. Statements on the number of spin turns vary between four and twelve.

It was concluded that the aircraft after an unknown manoeuvre reached a point where its airspeed became too low and thus unexpectedly went into a spin. Although the crew were able to stop the spin shortly before impact, it was impossible to level off within the altitude available.

PROBABLE CAUSE

The accident is attributed to the stalling of the aircraft following loss of airspeed, whereupon it unintentionally went into a spin. In view of insufficient altitude it was not possible to level off the aircraft.

COMMENT

These two reports again draw attention to the danger of the stall/spin accident in aircraft of the DC.3 type when training manoeuvres are being performed. In Aviation Safety Digest No. 14 of June, 1958, we reported a similar accident.

The DC.3 in wind tunnel tests has shown itself to be a perfectly normal aircraft in its spin characteristics. There is nothing about the spin in itself which would justify a sense of fear and any pilot who has been trained in spin manoeuvres in any spinable light aircraft should be capable of recognizing the spin and of applying correct recovery measures. THERE IS ONE VERY IMPORTANT DIFFERENCE HOWEVER: the larger and heavier the aircraft the more height is required for recovery. It has been shown that from the time of applying recovery controls to the point of full recovery from the dive, the DC.3 requires a minimum of 3,000 feet. THIS IS A LOT OF HEIGHT, especially if you haven't got it. Apart from this there is a minimum height penalty of 600 feet for every turn in steady spin. It is important to remember that these figures are minimums for the DC.3 and could be exceeded by large margins depending on particular circumstances. Remember also that they may fall far short of the requirement for any larger and heavier aircraft.

WHAT TO DO ABOUT IT? Regardless of the pilot's experience whenever stall manoeuvres are being performed there can be no guarantee that at least an incipient spin will not occur and where any yaw couple is introduced at the point of stall, such as can easily occur under asymmetric power conditions, the risk of a fully developed spin is great. At this point the moral should be clear. Since you can't be certain that a spin will not develop from a stall manoeuvre you must safely provide for such an eventuality by ensuring adequate height above the ground or water before engaging in these manoeuvres.

It is true that we have no proven case of the DC.3 stall spin accident in Australia but in at least one of our unexplained DC.3 training accidents the surrounding circumstances justify more than idle reflection on the possibility. DON'T BE IN IT — AT LEAST NOT WHEN GROUND LEVEL IS REACHED.

NOT SO FAST

(Extract from Flight Safety Foundation Bulletin)

The folly of operating an aircraft beyond its allowable speed is well known to pilots. If taken in one large dose, the airplane can come apart, and even in smaller doses it may cause unseen structural damage which, at some later date, could result in a disastrous failure. Thus, while an offending pilot may not kill himself, his folly may get his best friend flying that same airplane at some future time.

All aircraft are designed with certain structural limits. To operate beyond those limits is to invite trouble. Typical limit designations are VNO, the normal operating speed, and VNE, the never-exceed speed.

The jet transport operates closer to its high speed limits than the piston-engine airplanes we've been accustomed to flying. A jet at low altitude—22,000 feet—at its maximum cruise is flirting with VNO constantly. Lowering the nose rather than reducing power to accomplish an altitude change may quickly slide the airplane beyond its safe range.

The jet transport gives its best miles-per-pound-of-fuel performance at high altitude. Therefore, it is advantageous to stay high as long as possible. Also, the complexities of air traffic often make quick descents necessary . . and the sleek jet transport picks up speed fast. These factors, superimposed one upon the other, invite pilots to exceed safe speed; in fact, they sometimes force him to do so.

When excessive high speed is approached at high altitudes, buffeting occurs. This can be mistaken for light turbulence, so pilots should be suspicious when encountering buffeting at high altitude and at high speed.

For pilots, eternal vigilance is the word. All flight crew members should be quick to call attention to potential excesses. A good airplane commander does not object; instead he encourages other crew members to bring irregularities to his attention.

Most air traffic controllers are beginning to realize the jet pilot's problem and they try their best to give him the time he desires for descent. Although very seldom heard in jet operations, the expression "make best possible time" directed to a descending jet pilot could be the beckoning finger that invites him to exceed speed limits. This is especially dangerous if turbulence is encountered.

A serious and alarming situation was uncovered recently when VGHT (velocity, acceleration, altitude, time) recorders were installed on turbine-powered aircraft operated by more than a dozen of the world's airlines. The purpose of this installation was to study turbulence, especially clear-air turbulence.

The data showed that turbine transports frequently have been operated at speeds above the normal operational limits, and have attained speeds beyond the never-exceed speed much more frequently than have piston-engine transports in operation.

Operation above placard speeds is potentially unsafe and should be avoided. The coupling of high speeds with rough air, during descent for example, is a real strain on the molecules that hold your plane together.

JET BLAST INCIDENTS

(Extract from Flight Safety Foundation Bulletin)

The effect of jet blast is not an unknown quantity to flight crews. Cautions have been printed, but incidents still occur. There will be times when physical conditions require use of more than normal power to get an airplane moving and to keep it moving. At other times, however, it appears that excessive power has been used when it was not necessary. Following are a few of the incidents recorded over an 11-month period of jet operations:—

Excessive power in taxiing to gate blew cart into the nose on starter and air duct connection on a parked DC8.

In departing from gate, blast blew over an electric passenger stand.

Departing from the blocks, engine blast moved jeep into mechanics building, causing three feet of the building to be pushed in three inches, damaging interior plywood and the jeep.

In departing from gate, engine blast caught a latched open door on cabin supply truck, which blew into and bent right rear door panel.

Departing flight's jet blast lifted hose from holders on heater truck and blew the end of the hose into a water truck, damaging both hose and truck cab.

In making sharp turn out of the gate area, jet blast moved one parked loading stand 3½ feet into other parked equipment, two 150-lb. Ansul extinguishers into step ladders six feet away; other stepladders were blown into blast fence; three sections of the fence were moved a considerable distance, with one section going 15 feet, and one work stand was blown into the side of a fuel truck.

Departing flight blew passengers' stand into a parked truck.

Making a hard turn in departing gate, engine blast blew ladders chained to pier through an 8 x 5 ft. wiremeshed glass window.

Jet blast tore hood of conditioner loose and threw it against windshield of unit, shattering it.

Using excessive power departing from gate, right side of engine hood of oil truck was slammed into windshield, shattering it. "Excessive power" was determined by plane's taxi speed.

Jet blast lifted deplaning passenger off the ramp and hurled her 15 feet, causing injury to nerve in her arm and inducing a traumatic condition.

Another passenger, carrying a child, was pushed into a baggage cart, with no injury.

Employee injured back when he was struck by a ladder blown across ramp by jet blast.

Burns and scratches on face and body inflicted by hot stones thrown by jet blast.

Employee driving a truck had hood of his truck blown into his face by jet blast from another airline's jet at another gate.

Employee struck in leg by ladder blown over by jet blast.

COMMENT

Our own records show that jet operations in Australia have been accompanied by similar incidents, such as those which follow —

On turning away from the terminal on departure, jet blast blew the ¼ inch plate glass completely out of one of the main entrance doors of the terminal building. The glass was shattered into small pieces and blown up the stairs and across the passenger lounge. Four traffic officers sustained minor injuries from the flying glass.

During a turn whilst taxiing from the terminal building, blast from the aircraft shattered the plate glass in the entrance door to the terminal building.

Damage was sustained to a hut on the north-eastern end of a hangar by the blast of a taxiing aircraft. One wall of the hut was fractured, the roof lifted and displaced electrical wiring damaged and broken.

90 SECONDS FOR ACTION

in Emergency Evacuation

Where fire is involved in an accident in air transportation the aircraft must be evacuated in not more than 90 seconds. This can be done despite the ever increasing passenger capacity of modern airliners and the wide range of circumstances that may be encountered.

Not often, but once in a while, it can be expected that a transport aircraft will be forced to make a landing away from an aerodrome or will crash-land during the take-off or on approach. When this happens the crew will be faced with getting the passengers out in the absolute minimum time because if fire occurs, the interior of the aircraft will remain habitable for a very short period only. This period will be governed by the volume of the fire, its relationship to the cabin, the design of the aircraft and the integrity of the structure at the time. Depletion of oxygen, inhalation of smoke and hot air, high radiation temperatures as well as actual flames are all hazards which face the occupants both within and close to the aircraft. This poses the problem of evacuating the occupants whilst they are physically capable of escaping and while crew is able to direct the escape.

The actual time available will vary with the circumstances, but it is known from experience that evacuation must be completed within 90 seconds in cases where the fire is extensive. This cannot be achieved unless full use is made of **all available** exits. Some may be blocked or lead directly into the fire, limiting egress to exits which, by reason of the aircraft attitude, could be up to 20 feet above the ground. Under these circumstances escape slides are the only means by which a large number of people can be evacuated within this extremely short space of time available for survival.

Both the inflatable and the simple sheet type slides are designed to convey people from high door heights to ground level rapidly and in relative safety. They will do this—at the rate of up to 60 people per minute per slide — if they are serviceable, properly installed and managed, AND the people can be induced to leap into the slide without hesitation and then immediately disperse from the area at the bottom.

The evacuation slide has to meet a rigid design specification which will permit it to remain an effective means of egress under a wide range of conditions. It must be made from fire resistant material so that it will remain effective at temperatures beyond the threshold of human tolerance, thus permitting escaping persons to pass through temperatures which they could not endure for more than their brief transit time. Slides must be stowed near the exit at which they are to be used and be packed in such a way that they are not only available for instant use, but the manner in which they are to be attached and operated is self evident. Hand-holds must be provided along the unit to permit a person to climb up or down the slide if occasion arises, but these must be so positioned that they do not offer any opportunity for a "rider" to grasp and retard progress. The width and length must be sufficient to retain even the largest person within the slide without loss of downward speed when it is held at the most adverse angle likely to be encountered.

Both the inflatable and simple chute type slides installed in the more recent of transport aircraft will do all these things. The manufacturer has supplied the goods and can do no more. From this point onwards the effectiveness of these units and the success of any evacuation is entirely dependent upon the maintenance engineers and flight crews.

The responsibility of the maintenance engineer may appear to be limited but it is, nevertheless, vital. The serviceability of the unit depends upon the inspections and overhauls specified under the maintenance system being conscientiously performed. An unserviceable slide could result in serious injury, whilst one that is improperly packed or stowed could easily lead to the onset of panic and disorganisation of the evacuation drill. Particular attention is necessary to ensure that where colours are used to identify the location of attachments, they are kept freshly painted for quick identification. Where inflation type slides are used the proper maintenance of the associated equipment is essential.

We appreciate that flight crews are instructed in the fitting and use of the various items of emergency equipment during endorsement training and that most are provided with refresher training from time to time. The procedure is, however, only one of many and it is inevitable that in the environment of day by day activities a drill so rarely used will fade from memory. For this reason it is important that all crew members occasionally refresh their mind by having a look at the location of the equipment and mentally revise the evacuation drill.

In crash conditions it is probable that the preparation of the slides and the initial organisation of the evacuation will be done by the cabin attendant crew members. Knowing exactly what to do and doing it unerringly in these circumstances not only allows more time to be devoted to control of the passengers, but instills confidence in those who must obey if success is to be achieved. Any uncertainty or confusion at the critical time could be disastrous.

The actual method of attaching and using the slide is dependent upon the type installed in a particular aircraft. Some general rules are, however, applicable to all types.

Correct attachment is essential. Despite the fact that the method of attaching each type is simple and obvious, it is also quite easy to connect them incorrectly. If this is done, the slide is useless.

Inflatable slides must, of course, be ejected prior to being inflated. If the exit is high, it is also necessary to release the extension so that the slide reaches the ground.

The non-inflatable types must be held out tight, waist high, with any surplus length folded under. This results in the riders arriving at the bottom with their feet on the ground — ready to continue on away from the aircraft.

Where speed is vital, passengers should be encouraged to leap into the slide so that they land in it in a sitting position. Where this is done the persons holding the bottom of the slide must be braced against the sudden load. If not warned, the slide could be torn from their grasp.

The alternative method of evacuation is to sit on the door sill and slide from there. In either case, it is essential that high heeled shoes should be discarded. Apart from the possibility of stiletto heels ripping the bottom out of the slide, the few seconds that may be lost if a lady passenger trips due to high heels could perhaps make all the difference for those still to leave the aircraft.

Evacuated passengers must be instructed to get clear of the bottom of the slide, and the aircraft, as quickly as possible.

We hope, just as you do, that this equipment will remain nothing more than a "passenger" in your aircraft. Just in case, however, we suggest you make a check on both maintenance and operational procedures. Take a look at the location of the slides and the attachment points on your next rostered flight so as to be **sure** you know where they are. While you're at it also check on the other items of emergency equipment just to be sure you know where they are and how to use them.

Below Minima Undershoot

FATAL CONVAIR ACCIDENT AT NANTUCKET, MASS.

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

About 2334 hours on 15th August, 1958, a Convair 240 crashed during a straight-in VOR instrument approach to the Nantucket Memorial Airport. The crew of three and 22 of the 31 passengers received fatal injuries, while the nine surviving passengers were seriously injured. The aircraft, which burned after impact, was destroyed.

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

INVESTIGATION

The aircraft was engaged on a scheduled flight from New York to Martha's Vineyard, Massachusetts, with one intermediate stop at Nantucket. Departure was about two hours late following cumulative delays to the aircraft on earlier flights.

At the time of departure, en route weather information indicated that VFR conditions existed but, by the time the flight reached Nantucket fog might necessitate an instrument approach. The flight departed VFR, but on a despatch release and flight plan which authorised instrument operation if necessary, in which case Boston was designated the alternate airport.

Whilst en route, the flight was in radio communication with the company radio located in the Nantucket terminal building and with Otis RAPCON (Radar Approach Control), an air traffic control facility responsible for instrument traffic for Nantucket. The aircraft was equipped with one VHF communications transmitter and one VHF communications receiver. Therefore, the flight could not communicate with Otis RAPCON and Nantucket company radio at the same time. Communications with Otis were electronically recorded; those with the company radio were logged by the ground operator.

Initial contact between the flight and company radio was made when the flight asked for Nantucket weather. A company agent passed the last hourly sequence report but, immediately afterwards, the senior agent took the microphone and passed a special report of 2311 hours according to which the weather was "partial obscuration, three-fourths mile, fog".

Shortly after, at 2314, the flight contacted Otis RAPCON and advised it was "visual" and past the Newport intersection, 50 miles south-west of Nantucket, at 2312. The flight requested and received an instrument approach clearance to Nantucket, estimating it would reach Nantucket at 2326.

About 2324 the flight transferred from Otis to company frequency and obtained from the company agent information as to the active runway, surface wind and altimeter setting. Probably during the same communication the flight requested that the strobe lights* be turned on, and this was done during the five-minute period preceding 2330 hours.

The company's senior agent testified that he passed a special weather report of "partial obscuration, one-half mile visibility, fog" to both the flight from New York and to an aircraft awaiting take-off at Nantucket. This observation had been logged by the Weather Bureau observer at 2327, was immediately passed to the company agent over an intercom system, and passed by the agent to the flights. No acknowledgement from the flight approaching Nantucket was logged, but the senior agent recalled a conversation between himself and the first officer, a personal friend whose voice he recognized, associated with the weather information.

* Two condenser discharge flashing approach lights in the approach zone 250 feet from the threshold lights, one on each side of the runway edge extended.

At 2327 the flight did not respond to a call from Otis but before 2328 returned to the Otis frequency. At 2328 the flight reported it had not started procedure turn but was ". . . just past the marker outbound" and, at 2330, ". . . procedure turn". Otis then cleared the flight to company frequency.

At 2330 the Weather Bureau observer logged a special observation of "partial obscuration, one-eighth mile visibility, fog." Within the next two minutes this was given to the company agent who twice transmitted the information to the flight with a substantial pause between each transmission. While there was no verbal response from the flight, the agent recalled a sound over the radio which he thought was a "mike click" following each transmission. The captain of the aircraft on the ground at Nantucket did not hear this sound, nor did he click his microphone. About 2335 the captain of this aircraft reported a fire in the approach area to runway 24.

Runway 24 is the instrument approach runway at Nantucket Memorial Airport. There was no ILS or ladder type approach light system. The runways were equipped with conventional threshold lights and medium-intensity elevated runway lights of low, medium, and high-intensity settings. The airport had a regular clear-green, medium-intensity, 3,000,000 candlepower rotating beacon in addition to the 10,000,000 candlepower strobe lights previously noted, which were designed as a visual lighting aid to the instrument approach, projecting a beamed white light into the approach zone at an angle of 3.4 degrees above horizontal so that the lower side of the beam would be 300 feet above the ground over the "H" facility (low-power non-directional radio beacon) located six-tenths of a mile from the threshold of runway 24. The position and altitude of the beam at this point would coincide with the approximate position of an aircraft at minimum altitude during an instrument approach. At the time of the accident the strobe lights, airport beacon, threshold lights and runway lights were on, the last set to high brilliance.

The weather conditions required that the flight execute a straight-in VOR instrument approach. For this procedure the ground radio facilities consisted of the VOR station located 1.9 miles from the runway threshold and the "H" facility mentioned above, positioned between the VOR station and runway on an inbound track of 240 degrees. The manoeuvring area for the approach is over relatively flat unobstructed terrain with the runway elevation 47 feet above mean sea level.

The VOR instrument approach procedure required establishment of a 60-degree outbound track after station passage. This is followed by a standard procedure turn on the north side of the track within 10 miles of the VOR station. Minimum altitude in the procedure turn is 1300 feet. An inbound track of 240 degrees is then required to again cross the VOR station and "H" facility to the runway. Minimum altitude over the VOR is 600 feet after which descent to the appropriate landing minimum altitude is permissible.

The authorized company minima for the VOR straight-in instrument approach at Nantucket were ceiling 300 feet and visibility one mile. The pilot, once aware of the existence of sub-minimum weather conditions during an instrument approach, was not permitted to descend below the minimum altitude unless clear of clouds. Thereafter, the flight was not permitted to descend more than 50 feet below the minimum altitude unless (1) it had arrived at a position from which normal approach could be made to the runway, and (2) either the approach threshold of the runway or the approach lights or other markings identifiable with the runway were clearly visible to the pilot. If, at any time after descent below the clouds, the pilot could not maintain visual reference to the ground or lights, he should immediately have executed the prescribed missed approach procedure. Company witnesses stated that white - painted 55 - gallon drums spaced along the extended centre-line of runway 24 were not intended to lead the pilot to the runway threshold and did not qualify as "other markings identifiable with the runway". However, the assistant chief pilot stated, in response to questions, that it was conceivable a pilot might use the barrels as a guide to the runway in poor visibility or might consider them as "other markings . . .".

The description of the weather conditions by the weather observer on duty did not differ substantially from the description given by ground witnesses. He noted that stars were visible through breaks in the fog and estimated the fog was about seven-tenths coverage at 2311, increasing to nine-tenths coverage at 2330. He stated that when he took the one-eighth mile observation he thought the fog seemed fairly uniform and at that time he did not note a fog bank as such but, being outside only for a short period, he could have been in it at the time. The observer said that in his experience it was not unusual to have a heavy fog at the airport with the surrounding areas generally clear. He testified that in measuring the one-eighth mile visibility there were references which showed the visibility to be equal to this value and not less. He said, however, that measuring visibility at Nantucket was hampered by the lack of reference in all quadrants and at varying distances.

Evidence was obtained from eye-witnesses of manoeuvres carried out by the aircraft in the vicinity of the VOR station, but there was no reliable description of the flight path of the aircraft from the area of the VOR to the crash.

The aircraft initially contacted the ground approximately 1450 feet short of runway 24 and about 650 feet to the left (inbound) of the extended runway centre-line. The initial contact was shown by light tyre tracks made by the tyres of all three landing gear components. The lightness of the tracks in soft ground showed the aircraft had little, if any, rate of sink or descent at initial contact. Because all the tracks began nearly simultaneously it was also evident that the aircraft was nearly level laterally and longitudinally.

The wheel tracks ended after about 145 feet when the wheels contacted a rise in the ground and the aircraft catapulted into the air. A propeller cut on a tree showed that the aircraft was rolling rapidly left at the time it passed through the trees. Approximately 400 feet from the initial ground contact the left wing struck the ground and progressively disintegrated as it dragged for the next 300 feet. The aircraft entered a scrub pine thicket cutting a swath the narrowness of which showed the aircraft was then nearly vertical in its roll axis. It then veered left and reached an attitude slightly past inverted. Nose down in this attitude it plunged to the ground making simultaneous contact with the right wing and powerplant and the nose section. The centre section and fuselage then cartwheeled forward to an upright attitude and slid to a stop some 1,100 feet from the initial contact. Fuel was hurled into the main wreckage area and ignited. The resulting fire consumed a major portion of the wreckage.

ANALYSIS

Available evidence indicated that, except for a late departure, the flight operated in a normal manner to Nantucket. Position reports, requiring the use of navigational equipment, and other communications from the flight gave no indication of operational or equipment difficulty. Although portions of the aircraft wreckage were destroyed or badly mutilated, no evidence was found to indicate the aircraft or its equipment contributed to or caused the accident.

It is believed that at or about 2311 the flight was given the Nantucket 2311 special weather observation of "partial obscuration, visibility 3/4 mile". Because the flight had operated VFR before this and reported it was "visual" when requesting Otis for an instrument approach clearance, it would be logical to assume the crew knew IFR conditions existed at Nantucket and therefore requested the IFR clearance. The Board considered that, in all probability the "partial obscuration, visibility 3/4 mile" report was repeated at 2326.

The Board also accepted that the flight was on company frequency when the special observation of "partial obscuration, 1/2 mile visibility" was transmitted by the company senior agent.

A question of even greater concern is whether or not the flight received the special weather report of "partial obscuration, visibility 1/8 mile" and, if so, when the report was received. This concern is generated because the reported visibility was below the authorized landing minimum for the flight; if the report was received before the flight reached the radio facility on final approach, the captain was required to discontinue the instrument approach. After arduous study and careful evaluation of all the evidence, it was the opinion of the Board that the report was received and at a time when the approach should have been discontinued.

At 2328, according to the Otis tape, the flight reported, "We're just past the marker outbound," and at 2330 it reported, "Procedure turn." These reports and ample evidence that the entire approach procedure was flown would place the accident very close to 2334. This time correlates reasonably to the report about 2335 that there was a fire at the end of the runway, which the senior agent recorded at 2336 after using approximately one minute to look for the reported fire.

Testimony of the senior agent indicated the below - minimum weather report was transmitted two times during a 60-90 second interval preceding 2333 when the action was completed and logged. Correlated to the timing of the approach procedure the flight would not have passed the VOR inbound and, more specifically, should have been in its procedure turn when the information was first transmitted. Because the flight was released from Otis to company frequency at 2330 and because each transmission of the 1/8 mile visibility was followed by a sound identified as a microphone click the Board believed the information was received.

The nature of the local weather conditions may have been a factor in the captain's decision to continue the approach. From the available evidence it is apparent that a heavy rolling sea fog extending to at least 300 feet existed over the airport and into the approach area. It is believed that the fog was very heavy to the "H" facility, rapidly decreasing in density north-eastward until, in the area of the VOR, the conditions were generally clear. It is possible that as the aircraft passed over the vicinity of the airport, lights on the airport were clearly visible vertically through the fog. This, together with generally clear conditions in the VOR area, could have led the captain to believe weather conditions were much better at the approach end of runway 24 than at the terminal where the conditions were being measured.

The approach was most likely continued inbound with reference to the ground and by the time the flight reached the "H" facility it was at a low altitude. The low altitude is shown clearly by the light touchdown of the aircraft and the short distance from the "H" facility to the touchdown. Considering the distance, the computed groundspeed, and that practically all descent had been arrested at touchdown, only an excessive rate of descent would permit the flight to have passed the "H" facility much above 100 feet. At this altitude and position the Board was convinced that intervening fog between the flight and runway threshold precluded visual reference to the threshold complex. This was clearly substantiated in that the ground tracks of the aircraft were proceeding away from rather than toward runway alignment. It is considered that the relatively short runway may have influenced the descent to low altitude and it is possible that a desire to pick up and follow the line of barrels was a contributing reason.

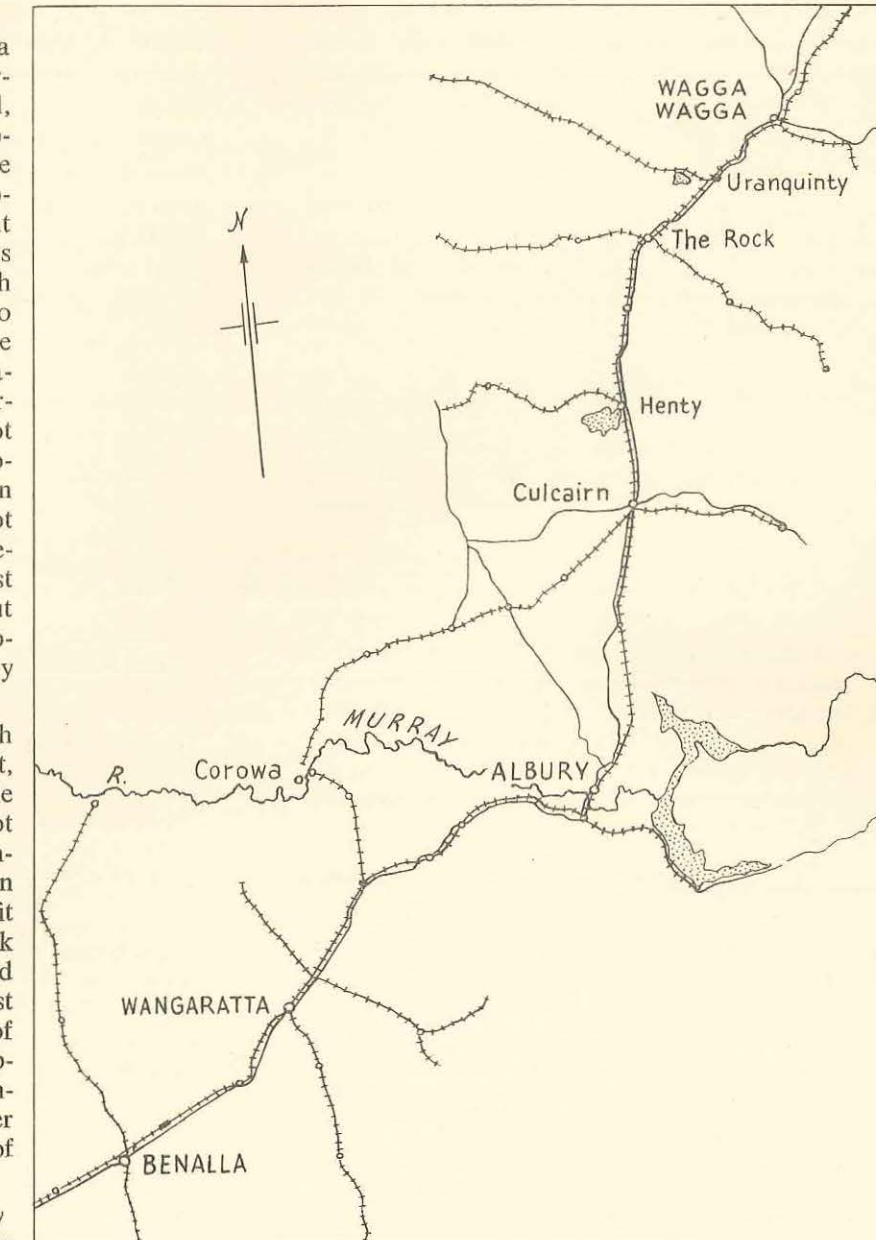
At low altitude in the area of the "H" facility it is believed that the flight entered the heavy fog bank, described by an eyewitness. It is believed that at this time all ground reference was lost and before transition to instruments could be made and the approach discontinued the remaining altitude was lost and the aircraft contacted the ground.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was the deficient judgment and technique of the pilot during an instrument approach in adverse weather conditions in failing to abandon the approach when a visibility of one-eighth mile was reported, and descending to a dangerously low altitude while still a considerable distance from the runway.

Groundspeed Guessing

On a travel flight from Benalla to Wagga the pilot of a light aircraft calculated an E.T.A. and, apart from checking that he was approximately on track at the time of crossing the Murray River, proceeded blithely on. About eight minutes before E.T.A. a town was observed on the port side which was assumed to be Uranquinty, so heading was altered for Wagga (see sketch). On E.T.A. the communication unit was advised that the aircraft was over Wagga but the pilot was unable to locate the aerodrome. After circling the town without locating the field the pilot returned to the area which he believed to be Uranquinty whilst A.T.C. endeavoured to sort out just where he was from the description of a lake, roads and railway lines provided by the pilot.



Courses flown, together with times, were obtained from the pilot, but these proved to be of little assistance as the resultant plot showed the aircraft to be north-west of Wagga. As the description given by the pilot seemed to fit one particular town further back along the track the pilot was asked to orbit over the township whilst A.T.C. contacted the post office of the town which fitted the description given. Sure enough, they confirmed that the aircraft was over Culcairn — 37 miles south of Wagga.

Post analysis of the flight showed that the pilot had incorrectly computed his flight times, and his E.T.A. for Wagga was about 20 minutes ahead of the correct computation. This caused him to expect his destination much too early and apparently resulted in the associated errors in map reading. A simple calculation of ground speed at the most obvious check point, the Murray River, would have revealed the initial error and thus more than likely saved A.T.C. a lot of time as well as taxpayer's money in telephone expenses.

By simply calculating an E.T.A. and paying little attention to the progress of the flight until such time as the estimated flight time had elapsed this pilot failed to apply the basic principles of pilot navigation. Wise pilots will not only ensure that they are heading in the right direction but will use their maps to calculate their ground speed at the first convenient check point and then, armed with this knowledge, check the progress of their flight as frequently as possible right through to destination.

To know where the aircraft is at all times is inseparable from the art of pilot navigation.

The Importance of VEE EM CEE

(Extract from Flight Safety Foundation Bulletin)

Earlier in this issue we called attention to the importance of observing speed limits—on the high side (V NO and V NE)*. Failure to do so was described as an invitation to trouble in the form of structural problems.

An equally important speed limit which the pilot must keep in mind is one on the low side—minimum control speed (V MC). The effect of ignoring this, under some circumstances, could be loss of control, resulting in a seriously hazardous manoeuvre.

The condition which is critical with respect to V MC is associated with loss of power on one side on a multi-engined aeroplane, particularly when high power is being applied to the remaining engines, such as during the take-off and initial climb.

When power is lost on one or more engines, the resulting asymmetric thrust must be counteracted (1) by rudder force; (2) by banking away from the inoperative engine(s); or (3) by reducing power on the operative powerplants. On take-off or climb-out, the third alternative may not be possible, since you may need all the power you can get to maintain flight. The amount of rudder force and/or lift available is, of course, proportional to airspeed. The higher the speed, the more effective is a given amount of rudder or aileron deflection.

Minimum Control Speed is defined in the Civil Air Regulations as the minimum speed at which it is possible to recover control of the aeroplane, after the critical engine is suddenly made inoperative, and maintain it in straight and level flight—either with zero yaw or with an angle of bank not in excess of five degrees. The aeroplane manufacturer is required to demonstrate this during type certificate tests.

The configuration required for this demonstration is as follows:

1. Take-off or maximum available power.
2. Rearmost (or "most unfavourable") centre of gravity.
3. Flaps in take-off position.
4. Landing gear retracted.
5. Cowl flaps (on piston-engined aircraft) in position normally used for take-off.
6. Maximum sea level take-off weight.
7. Aeroplane trimmed for take-off .
8. Propeller windmilling on inoperative engine (or different position if specific design makes this more logical) and full power on other engines.
9. Aeroplane airborne and out of ground effect.

Additionally, the rudder control force required to maintain control must not exceed 180 lb.

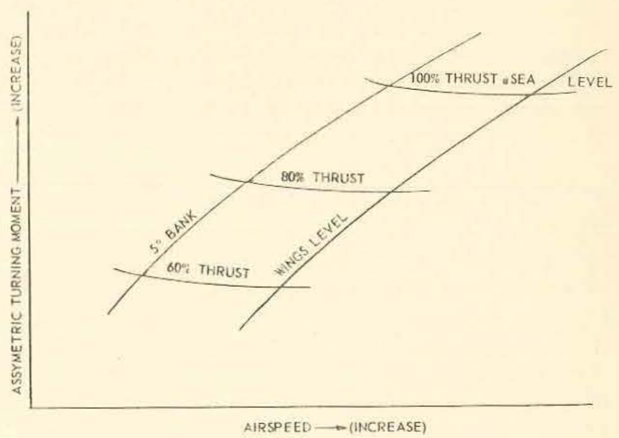


FIG. 2 – EFFECT OF ASSYMETRIC THRUST ON V_{MC} – AIR

The minimum speed which will satisfy these conditions is quoted in the aeroplane flight manual as V MC-air. On all aircraft currently certified for transport operation, this speed is determined with the aeroplane in a **five degree bank** with the operative engines on the low side, since this results in the lowest possible speed, and the capabilities of the aeroplane are utilized to the fullest advantage.

It is important to recognize that, with the wings in any position less than a five degree bank angle, the minimum control speed is substantially higher than the value shown in the flight manual. On the most modern aeroplanes, the difference in V MC between the five degree bank condition and wings level condition may be as high as **20 to 25 knots.**

The reasons for this large increase in minimum control speed with varying bank angle are fairly complex. Essentially, the effect of the bank is to reduce the amount of rudder power required to overcome the assymetric thrust condition. As the wings are brought to a level position, more rudder power is necessary. For a given rudder deflection or rudder pedal force, therefore, a higher speed is required.

This characteristic applies to all multi-engine aeroplanes. It is accentuated in the latest designs because of the large amount of power or thrust available for take-off and the fact that the engines are disposed further out on the wing span. This increases the turning moment caused by the unbalanced thrust condition.

The point of all this discussion is that in order to achieve the best performance in case of an engine failure during take-off, climb, or any other flight condition when high power is required, the aeroplane should be kept in a five degree banked attitude with the inoperative powerplant on the high side. The normal take-off procedure assures that airspeed will be above the minimum control speed (air) with the most critical engine inoperative. **This is only true, however, if the five degree bank angle is maintained.**

Any variation from the configuration of flaps, gear, and power specified in the regulations, of course, will tend to make the situation less critical. The same principle, however, applies, namely that the control of the aeroplane is improved when the aeroplane is banked.

For specific information with respect to your particular aeroplane's handling characteristics and performance, refer (as always) to your aeroplane operating manual and the publications of the aircraft manufacturer.

* An extract from the Flight Safety Foundation Bulletin entitled "Not so Fast" appears at page 12 in this issue.

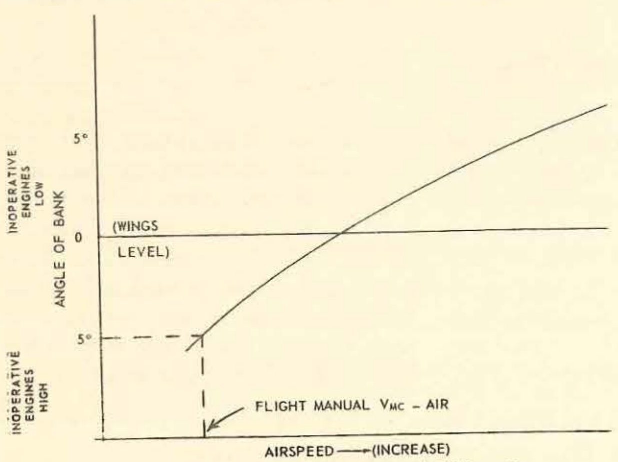


FIG. 1 – TYPICAL EFFECT OF BANK ANGLE ON V_{MC} – AIR

Replace that Sutton Harness

In a recent accident the pilot of a Private Category aircraft suffered head and facial injuries because of failure of a shoulder strap of his Sutton harness in a crash.

The crash was one of moderate severity, and as has been the case in so many accidents in the past, once again it focussed attention on the Sutton harness.

This type of harness was developed many years ago for aerobatic flying and was first used in Australia in 1925. Though it has undoubtedly saved lives, its value in a crash situation is limited for the following reasons:—

1. Even in the new condition the strength of the Sutton harness falls below crash protection strength requirements accepted in ALL countries.
2. If the harness does hold, the pilot may slide forward under it, suffering serious or fatal spinal injury. This happens because the junction point is too high and the lower straps slope downward and FORWARD.

Our crash injury studies over the past 10 years reveal numerous cases of injury due to one or other of these causes. Some years ago the Department issued Air Navigation Order Section 105.1.0.1.1 calling for the removal of the obsolescent Sutton harness from all aerial work, charter and flying training aircraft and the installation of a harness providing adequate crash protection and a proper form of restraint.

Private aircraft were not included in the above requirement as it was hoped that private owners would voluntarily modify their aircraft in the interests of their personal protection.

There are still a number of private aircraft fitted with Sutton harness. Many of these harnesses would, if tested, be found to be well below their original strength. In fact, several Sutton harnesses tested by the Department have had a breaking strength as low as "3g" due to deterioration with age, sunlight, and other facts encountered in service. This figure is only slightly higher than average aerobatic flight loads for the particular aircraft from which the harnesses were acquired.

Private owners owe it to themselves, their dependents and the progressive development of flight safety generally to discard the Sutton harness.

Good harnesses are available, and the cost of fitting one is small compared to the safety gained.

Pardon Me Your Stratus is Showing

By G. B. S. ERRINGTON

The DeHavilland Aircraft Company with acknowledgement to Shell Aviation News September, 1960.

I was looking recently at two sample jars of fuel tapped from an RAF Transport Command Comet at Darwin, en route for Adelaide. One jar was crystal clear ("gin clear" would be more revealing to the toxicant community), the other, opaque to a milky white. Was it suspect? If not, why not?

The conditions at the time on Darwin's apron were very hot and very damp. I said to the perspiring "drainer-off-of-fuel samples", indicating the misty jar, "Pardon me, but your stratus is showing". The subtlety of this ill-timed quip was completely lost on the de-fueller who at once qualified me as an intellectual half-wit en route for the Woomera range. Since then I have travelled to many parts of the world with Comets and have noticed that all too often the cloudy phenomenon remains a mystery.

This being a practical application of a subject which is often dealt with in technical treatments only, an explanation as to what is going on, when and why, might be helpful and can provide the answer to any other questioning half-wit. It is this: all fuel has a strong affinity for water, just as air has, and in like manner the capacity for holding water in solution relates to temperature. The higher the temperature, the greater the invisible water content.

Out of Solution into Suspension

Cooling the air will bring it to its saturation point; the water then comes out of solution into suspension and is seen as fog, or micro-water-particles in suspension. At altitude, we see the same effect as the all too prevalent stratus cloud for one.

So also with fuel. If warm fuel is cooled, the water content, which is quite normally in solution, can start showing itself in suspension, to cloud the whole mass of fuel in the tank — and thus in the tapped-off fuel sample.

Many times I have seen Comet fuel samples showing this marked difference in the sampling jars, all from the same wing, the same fueller or tank supply, same original temperature, same fuel.

How comes this conjuring trick as in the picture shown?

The Comet's wings contain most of the fuel carried, and the tanks being "integral" (wing structure tank), the fuel the more quickly picks up the cold surface temperature. This is mostly convection heat loss in the troposphere cruising band of the aeroplane—60°C and lower, but plus a little kinetic heat. The engine fuel supply drill follows a concise sequence; certain tanks are run dry and the subsequent fuel disposition is monitored by the flight engineer, so as to relieve the bending moments at the wing root for one. There are nine tanks to consider.

This is the general principle for the monitoring of fuel usage but another factor has to be considered at the same time in the case of swept wings, namely that the disposition of fuel outboard shifts the centre of gravity aft.

For this reason a proper balance must be achieved between bending moment considerations and pitching moments induced by a fuel disposition in a swept wing. (The aeroplane spends its life deleting minutes from sector times and moments from wing influences.)

As the flight progresses so the fuel contents are watched and adjusted with this in mind, the last fuel to be used being outboard. At the end of the sector certain tanks are dry and others (symmetrically disposed) may contain, for instance, some two tons of ice-cold fuel, the amount and temperature both depending upon the length of sector flown. In refuelling we now consider, for best effect, the case of the tropical coastal airfield with the fuel influenced by local conditions of heat and damp. The fuel filling the empty tanks remains virtually unchanged, but that meeting our two tons standing at a temperature which still relates to soakage at — 60°C for some hours, takes on a change.

This warm fuel on mixing with the cold immediately begins to condense out, the water in solution going into a cloud. If this is tapped off at the right time the fuel sample will be an opaque white. The photograph we reproduce shows this effect, and was taken at Trinidad; samples of fuel taken from an Aerolineas Argentinas Comet which had just completed the long sector across Brazil. The gin-

clear jar is from the tank which landed empty — No. 3 tank. The stratus effects are from the mixed fuel in No. 2 tank.

But this "stratus quo" won't stay for very long. As the contents of the jar warm up in the sun, the water micro-droplets will once again go back into solution and the fuel becomes clear. Thus, warming the jar and its contents up to the fuelling temperature provides a convenient check that no free water was delivered with the fuel uplifted.

One or two interesting things are associated with this.

Some of the water in suspension in No. 2 tank coalesces eventually as droplets big enough to fall to the bottom of the tank, given sufficient time, and this is collected off from the drain points at the next stop. It is always No. 2 tank that has the most water tapped off for the reasons we now see, but with longer sectors it would be No. 4 (outer wing) tank.

There is another aspect. As the aircraft climbs back to the troposphere, we can visualise the fuel in all the tanks going into a cloud formation of micro-droplets of mist as the fuel cools.

Does this matter? No, in fact if anything the engine likes it. (Some operators even inject water into the engines under certain conditions.) The engine filters will easily pass the infinitesimal droplets measuring approximately .01 microns in size. But when the fuel temperature drops to zero, this is the time for action to prevent ice crystals building up on the filter surface. Fuel heaters are now brought into action to prevent filter ice accretion and a glance at the fuel temperature gauges on the Comet engineers' panel at any time during the later stages of the flight will show the fuel temperature always maintained above 0°C.

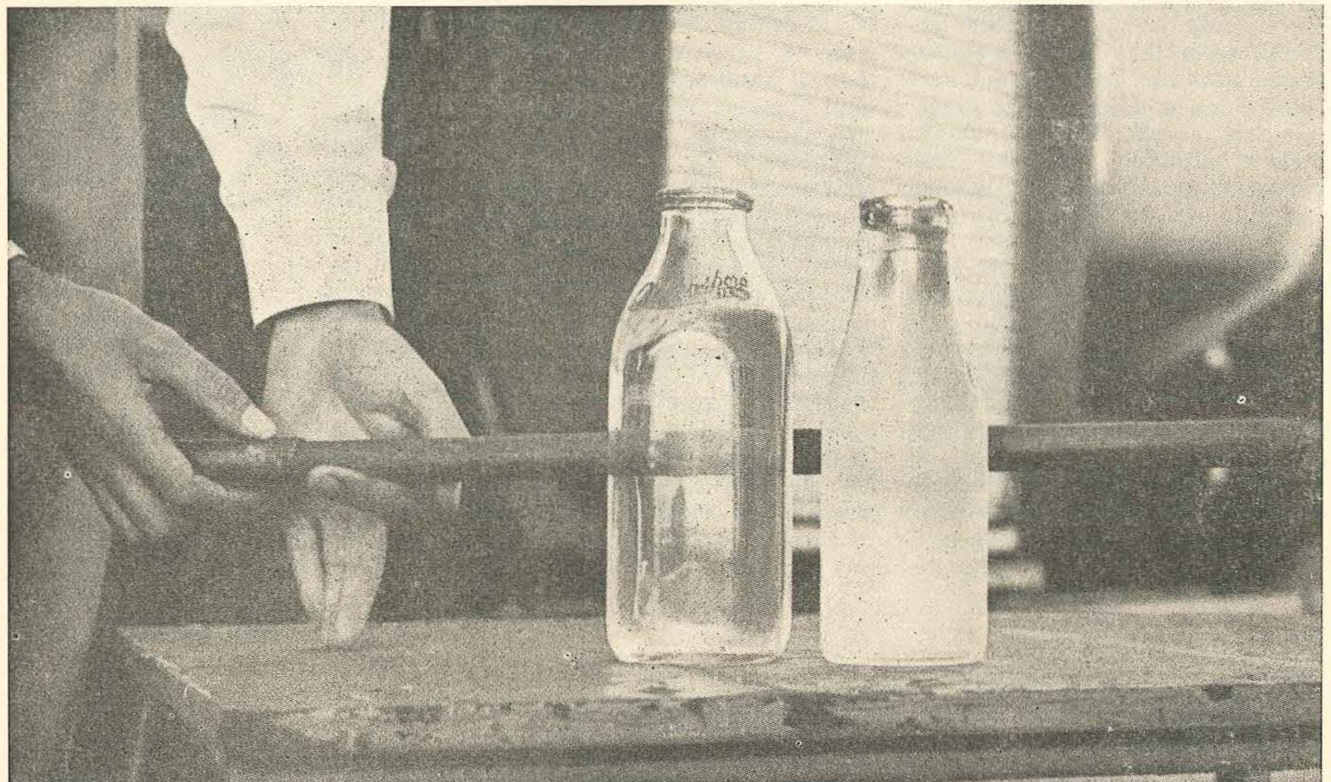
Thawing Ice Pockets

What happens to the water precipitating out on the climb? It is a very small quantity, for the fuel is in constant motion and that which settles out into small depressions at the tank bottom freezes straight-away and remains as inert ice, the tank skin being well below zero temperature. Here is a point to watch — a delay at a stop will thaw the ice pockets.

The skin in contact with fuel will remain below zero after landing, and one of the interests of passengers and onlookers who approach the Comet after a long sector is to see the effects of bringing down a super-cooled wing. The outboard tanks which still contain fuel (the pod tank and the No. 4 as mentioned) will be covered in hoar-frost sometimes 3/16 inch deep on the bottom skin. The more humid the air the greater the depth. It is the moisture content of the surrounding air which is condensing out and freezing on to the super-cooled surface — super-cooled by the fuel inside the tanks which is still holding the high altitude temperatures.

The skin temperature gradient is usually so sharply defined that the frost-line shows the depth of fuel in the tank.

On still nights, quite a long cloud will stream away downwind from these tanks. This is once again the stratus cloud cooled to saturation by the Comet tanks and, to make the picture complete, rain will be pouring off the lower surfaces as the melting frost is joined by further condensation. Once again your home-made stratus is showing; make the most of it, because it won't last for very long.



Engine Failure • Disturbed Airflow • Loss of Control

SANTA MARIA, CALIFORNIA

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

At approximately 2018 hours on 26th October, 1959, a DC.3 crashed near the Santa Maria Airport, California, whilst making an emergency landing following the failure of the left engine on take-off. The co-pilot was killed, the pilot seriously injured and the steward and 17 passengers received injuries of varying degrees.

INVESTIGATION

The aircraft was engaged on a scheduled flight between Los Angeles and San Francisco with intermediate stops at Oxnard, Santa Maria and Paso Robles, California.

The flight to Santa Maria was uneventful and the aircraft landed at 1945. Whilst passengers and cargo were being unloaded a station agent called the first officer's attention to the left engine which was leaking oil. The first officer left the aircraft and examined the engine by means of a flashlight. He returned to the cockpit and advised the captain that everything seemed to be all right and that no more oil was present than one would normally find on an engine. Further, not enough oil had leaked to cause any to be added. The captain, who had looked at the left engine from the cockpit window, agreed that the leak was not sufficent cause to interrupt the flight.

A few seconds after the aircraft became airborne and the first power reduction was made, a loud explosion was heard and fire was observed in the left engine.

Buffeting became severe, the captain knew that a crash landing was imminent and, seeing the silhouettes of oil derricks ahead and above him, he turned the aircraft in an effort to avoid them. The aircraft struck the ground almost immediately.

After the aircraft came to rest the steward was able to free himself from his seat, which had become detached from the floor and had inverted. He immediately opened the main cabin door, through which the passengers were deplaned. The first officer was thrown clear of the wreckage and was found strapped in his seat. The captain, after freeing his foot which was caught in the debris near the right rudder pedal, left the aircraft through a large opening which had been made in the left front of the nose.

All of the aircraft structure, powerplants, and propellers were found either near the main wreckage site or on or adjacent to runway 30. Parts found on the runway were from the left engine, its cowling, and from the No. 5 cylinder and associated structure.

The left engine was torn free of the aircraft by impact forces. It was found minus its cowling in the vicinity of the main wreckage. Examination disclosed that the No. 5 cylinder had separated from its base at a point about 1¾ inches above the base flange or near the fourth or fifth fin from the bottom of the cylinder. This area is covered by cylinder baffles and is in the rear row of twin rows of cylinders. The No. 5 cylinder was found near the main wreckage and it is believed that it remained in the cowling until the left wing contacted the ground and the aircraft started to cartwheel to the left; both valves and spark plugs were in position. The piston parts and piston pin with a portion of the connecting rod attached were found on the runway. The piston head had a deep circular gash in it which fitted the broken edge of the cylinder wall of that portion which separated from the base. The piston parts bore evidence of having been subjected to severe forces which had broken and cut the piston into various pieces. The engine's rear power section was severely damaged. The case was punctured, the link rods were broken, and the cylinder skirts were flared. The engine's rear master rod and crankshaft could not be moved.

The front row master and link rods were in normal condition. There was evidence of fire around the rear and upper portions of the engine and the accessory cowling behind these areas. The left engine's cowling, both main and accessory section, was damaged by the failure of the engine and by impact with the ground. Seven small round rubber mounts used as cowling supports were found on the runway; the first was found only 1,900 feet from the take-off end. A rectangular rubber rocker box pad, which matched the cowl fastenings at No. 5 cylinder position Dzus fasteners, a cowling hook, a ten-inch section of the heater ram air scoop, and a section of cowl flap were also found on the runway. The accessory cowling section was the more extensively damaged. This section bore evidence of intense heat and some blistering. A section of the top of this cowl with the ram air scoop for the carburettor attached was bent upward and rearward at an angle near the bottom left corner. The entire accessory section of the cowl was deformed somewhat with fasteners torn out in some portions and tears in others. The propeller governor and feathering pump were checked and found capable of normal operation.

The right engine also separated from the aircraft because of impact forces and was found near its nacelle. This engine suffered impact damage but examination showed that prior to impact it was functioning in a normal manner.

As would be expected the aircraft was badly damaged by impact and the subsequent cartwheel. None of the damage to the aircraft contributed in any way to the cause of the accident.

(All times herein are Pacific Standard Time)

The aircraft was based at Los Angeles and therefore was under the supervision of International Flight Service with respect to maintenance. It had been given a 1250-hour inspection 25 or 30 hours prior to the subject flight. The left engine of this aircraft had a number of oil leak complaints which were entered on the flight record by several captains; these began October 10 and continued through October 26. Each item was initialled by a mechanic and an explanation given indicating the corrective action taken. Corrective action included the replacement of rocker seals and gaskets, rocker box covers, and the tightening of holddown nuts around the propeller governor. On October 15, 1959, an item written in the log was "oil leak left engine". The explanation of the corrective action was written as follows:

> "Checked for oil, washed down left engine and replaced gasket and rocker box gaskets."

These items were initialled by the mechanic doing the work and according to International Flight Service the aircraft in each instance was considered to be airworthy.

On October 26, 1959, the owner of International Flight Service, had the following teletype message sent to the operator's San Francisco office:

> "Maint. Boller req that ship 110 be used on Flt. 308/DTE in order to get it back to SFO. Has oil leak in left engine which we have been unable to stop LAX-RR/IFS/1243/26BOB."

At 1252, October 26, 1959, the following message was received from the operator's flight control:

> "LAX-K-WL Plan 110 on Flt 308 X 1252/26H."

Accordingly ship 110 was scheduled as directed.

International Flight Service testified that they had done everything they could to find and stop the oil leaks under the limitations of their contract. They said that the night before the flight was scheduled the engine was washed down and the above corrective action taken; the cowling was then left off overnight in order to be able to see any oil which may have leaked during the night. None was found the next morning and the engine was then run until it was hot to see if oil might leak under this condition. Again no leak was found and accordingly the cowling was put on and the aircraft made ready for flight. They further stated that they considered the engine to be airworthy.

ANALYSIS

The question arises, should the aircraft have been despatched as a scheduled flight the day of the accident in the light of its history of oil leaks?

The operator had knowledge of the trouble with this engine from two sources — i.e., engine and aircraft records that are maintained in San Francisco and which should be kept up-to-date daily, and from the message sent by International Flight Service to the operator from Los Angeles which clearly requested that the aircraft be returned to the main base because of an oil leak that could not be stopped. Knowing that oil leaks are often the forerunner of serious engine trouble, the Board believes that both the service company and the operator should have taken definite steps to determine that the engine was airworthy before allowing the aircraft to be used on a scheduled flight.

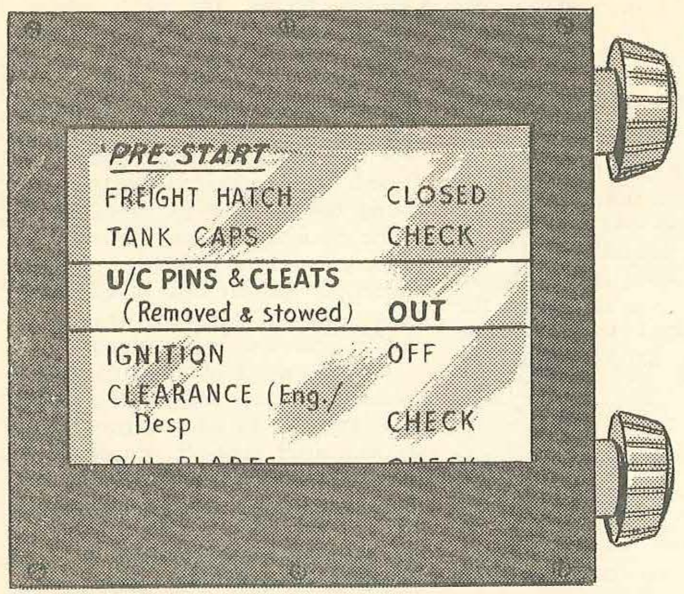
Since this was not done, the Board believes that when the crew found the oil leak at Santa Maria to be of a magnitude sufficient to cause concern of a fellow company employee, the aircraft should have been delayed until the source of the trouble was determined.

There is no doubt that the No. 5 cylinder of the left engine failed and that this failure occurred only seconds after take-off. Proof of the time of the failure lies in the fact that engine and cowl parts belonging to this engine were found on the take-off runway after the accident occurred. The time of the failure is most important because it indicates that it occurred very soon after take-off before any appreciable airspeed and/or altitude had been gained, and therefore narrows the field of possible corrective action which could have been taken by the crew. It is recognized that this engine's ring cowl was badly deformed as a result of this failure and that a section of it was displaced upward and rearward. The Board believes that the deformation of the cowling disturbed the airflow over the centre section and the empennage sufficiently to cause both a severe buffet and a serious drag condition.

PROBABLE CAUSE

The Board determined the probable cause of this accident was that, following the failure of the left engine, the left engine's ring cowl was deformed causing a buffeting and drag condition which made sustained flight impossible. A contributing factor was the scheduling of the aircraft by the operator when there should have been reasonable doubt concerning the airworthiness of an engine.

Dangerous Interruptions



The captain of a DC3 began to prepare his aircraft for departure and noticed that the hydraulic pressure was low. He requested the ground engineer to leave the undercarriage pins in position until the engines had been run. Although this was a departure from the normal chain of events it left no room for criticism. Except in the view of those who have implicit faith in the fool-proof design of the DC3 undercarriage locking system, the captain's decision could be classed as justifiable caution — even the mark of a careful thinking pilot. All too sadly this was not the end but only the beginning.

The aircraft was taxied away from the tarmac with all (?) checks carefully performed. The captain's state of mind gave no cause to anticipate trouble and even when the undercarriage failed to retract after take-off there was no realisation of the truth and he just had to see to believe.

Yes, you have guessed it, **the pins were left in.** Why? because the "u/c pins and cleats out" drill normally precedes a lot of others which the captain had performed subsequent to his request for the pins to be left in. The habit pattern had been disturbed and because the later checks had been performed the pilot subconsciously believed that all preceding checks had also been correctly and completely performed.

It is all too easy to fall victim to this sort of trickery, it does happen frequently and it is the root cause of far too many accidents. Even in this instance the seed of an accident was sown. Everybody knows that the single-engine performance of a DC3 with its undercarriage extended is not something to inspire great confidence. It is not difficult therefore to imagine what the consequences might have been had there been an engine failure at a critical point in the take-off climb.

Accidents arising from this cause can only be avoided by proper recognition of the human weakness involved!

The Department, of course, recognises the need to continue its study of this problem and is currently examining the practicability of some improved system to take care of those occasions when there has been any interruption to the normal progress of safety checks.

Until you have been provided with fool-proof protection, **keep well in mind that you are only human, that you can fail and, above all, that your luck can run out.**

CORRECTION

In issue No. 24 of the Aviation Safety Digest we published an article entitled "Accident by Practice". The credit line for the article was attributed to the Pilot Safety Exchange Bulletin. This credit line was in error as the article was written by a U.S.A.F. pilot and published in Flying Safety, a U.S.A.F. publication which is now published as Aerospace Safety. Our apologies to Aerospace Safety.

Frequently we have invited air safety incident reports of unusual situations which arise in routine operations so that others may share in the knowledge gained from the experience. We have also made no secret of the fact that these reports play an important part in the continuous review necessary to keep our safety requirements abreast of the ever-changing demands of the industry. The action taken as a result of a recent report clearly illustrates the benefits that can result from thoughtful incident reporting.

An alert traffic officer noticed that one of the passengers boarding a regular public transport flight was carrying a revolver on his person. He advised the passenger that carriage of firearms was not permitted on an aircraft and invited him to discuss the matter with the captain. It transpired that the passenger was in possession of the appropriate licence for his firearm but was quite unaware that Air Navigation Regulations prohibited its carriage in aircraft except with special permission and under special conditions. As it was necessary for the revolver to be available to this passenger at the conclusion of the flight it was suggested to him that the magazine be removed and both the revolver and the magazine be surrendered to the captain until his destination was reached. The passenger willingly agreed to this proposal and the flight proceeded.

This arrangement was a sound and sensible approach to an awkward situation and achieved the desired standard of safety without creating unnecessary inconvenience for the paying passenger. On the other hand, the regulation clearly prohibits any person, **including a flight crew member,** from carrying a firearm except where specific permission is granted by the Director-General. This means that the action taken had the effect of transferring guilt from the passenger to the captain; an unsatisfactory state of affairs.

Quite clearly this air safety incident report and the suggestions submitted by the pilot showed that the existing orders prescribed under the Air Navigation Regulations to govern the carriage of firearms in aircraft do not provide the flexibility necessary to meet present day needs of some air travellers. As a direct result of the report, action is being taken to amend the requirements so as to allow firearms to be carried at the discretion of the captain and in accordance with any instructions that may be prescribed in the company's operations manual.

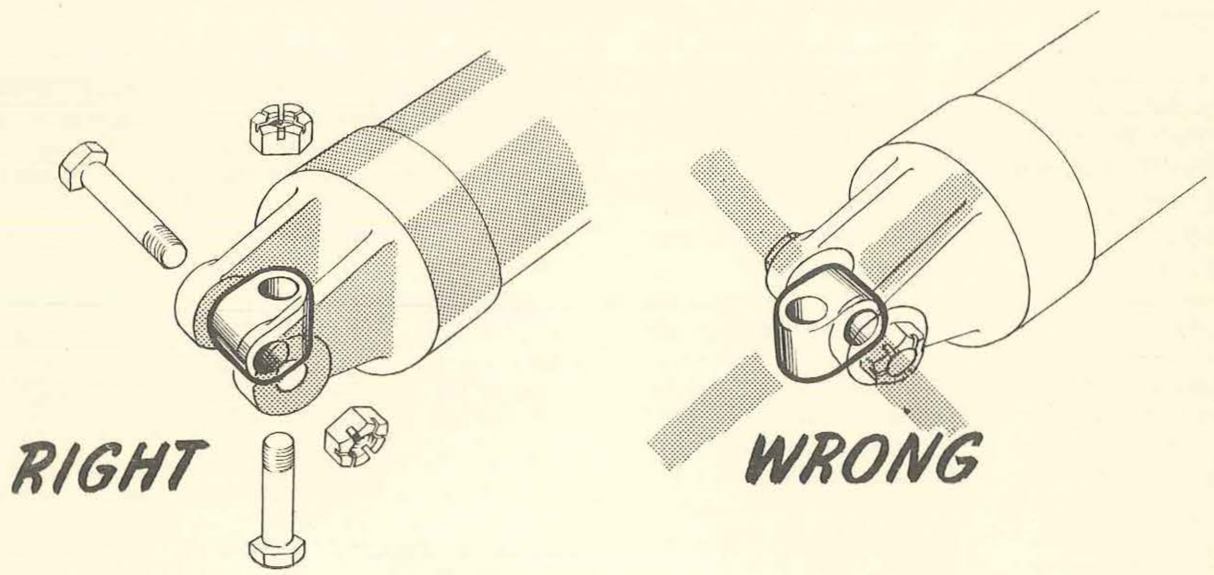
It is realized, of course, that the change of regulations will be of little help in cases of undisclosed firearms but it will provide a more convenient means for the legitimate carrier of firearms to observe the law while travelling by air.

Since the man who has the lawful right to carry firearms is not the person likely to misuse any such weapon whilst on board an aircraft the cynics might be tempted to ask "Where does safety come into this?" We concede that this air safety incident report has merely led to steps which will legalize action such as that taken by the captain or, alternatively, permit the captain to do what he probably would liked to have done on this occasion—i.e. allow the passenger to retain the firearm. Now think how much less nerve fraying it will be for a captain under the new "order" when he will have legal rights to adopt one of several courses of action according to the circumstances. This will be especially so where a passenger proves to be one possessed of strong feelings of righteousness—as well as a gun. **Now, who can tell what danger might result from a captain's nerves being frayed!**

Murphy Calling

When the landing gear of a transport aircraft was retracted after take-off the "intransit" red warning light remained on. As a visual check indicated that the main wheels were retracted the flight proceeded to destination. Subsequent inspection revealed that the main wheels had locked up normally, but although the nose wheels appeared to have retracted it had not completed its full movement and the nose wheel doors had remained open. The position of the actuating ram had been inadvertently altered by reversal of a universal joint fitting during maintenance, with the result that the ram piston bottomed before the nose wheel locked up.

The aircraft had been laid up for maintenance work, during the course of which the nose wheel actuating ram had been disconnected at its anchored end purely for the purpose of checking a suspicion of looseness in the attached bracket. Unfortunately the universal fitting which permits movement of the ram at its anchored end could be fitted in two ways although only one of which would allow the gear to fully retract. The way in which the ram position was affected by reversal of the fitting during installation can be seen in the diagram.



A number of aircraft of the type concerned have been operating on the Australian register for some fourteen years during which time the particular fitting must have been removed and correctly replaced many times without error. This only proves the inevitability of Murphy's law which rules that if a part can be installed incorrectly someone will install it that way.

Apart from reminding us of the ubiquity of Murphy, and the obvious necessity for extra care with fittings which can be installed incorrectly, this incident reflects the need for close supervision and expert check inspections of all work, particularly those odd jobs that are done whilst major work is being performed on other sections of the aircraft.