PRINTED BY HEDGES AND BELL LTD.

AVIATION SAFETY DIGEST

No 24, DEC., 1960

DEPARTMENT OF CIVIL AVIATION

A V I A T I O N   S A F E T Y   D I G E S T

No. 24   DECEMBER, 1960

This Concerns You!

For a long time now we have been trying to make our incident reporting system function in a way which will result in maximum safety to the greatest number of people. We have tried in different ways to convince you of the need as well as the value of self-help, such as our system offers. None of our efforts have, so far, produced the results we are seeking and our mail-bag remains far too slim to satisfy our aims. Why should this be so?

We are convinced that the lack of reporting is not due to the lack of opportunity, at least not in the sense that incidents are not occurring. For every reported incident there are probably at least ten others which do not come to our notice for one reason or another. It is our guess that one of the reasons stems from a natural apathy towards transient situations and circumstances. Nearly all of us suffer this weakness and we frequently find that a significant experience has lost its true meaning in the atmosphere of our immediate comfort. It is sometimes described as laziness. However true this may be, it probably does not account for the whole of our problem, so we have been obliged to keep searching.

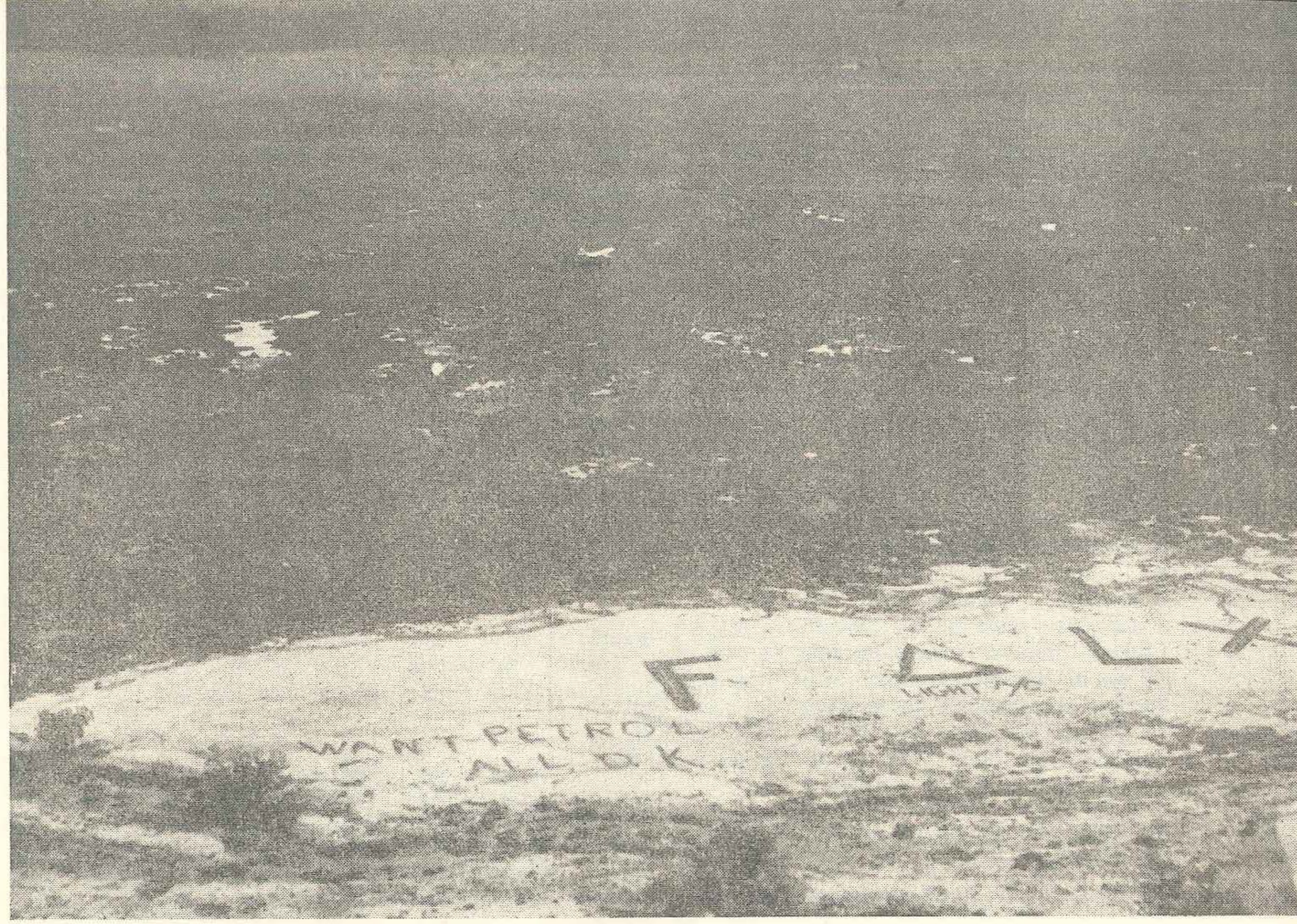
It has been suggested from time to time, that one of the main obstructions to full and uninhibited participation in the incident reporting scheme is the fear of personal consequences which may arise from some possible error or wrong-doing revealed in the incident. We have not readily accepted this as a fact but, if there is any substance in this contention, then we acknowledge the need to dispel this lack of trust so that the system may properly thrive. The purpose of the following statement is to do just that.

The Director-General has now specifically declared a policy which provides, with one exception, that no person submitting an Air Safety Incident Report shall suffer any disciplinary or punitive action by the Department for any act connected with the incident. The exception to this policy is quite explicit. Where the information provided by an incident report shows beyond doubt that persons and property have been exposed to danger because of a deliberate and contemptuous disregard for the law, or because of a dereliction of duty amounting to gross negligence, the Department will take very positive steps to deal with the offender by whatever means may be appropriate to the case.

This policy is a sincere attempt to remove any element of suspicion from the system and we hope that in doing so the way will be opened for completely frank and liberal reporting of your experiences so that others may benefit. The prime concern of the system has been and always will be **SAFETY** and not **BLAME.** We hope that this declaration of immunity offers the necessary proof of our intentions.

Can we do more? If you think we can, tell us of your ideas because we need to be convinced that the dearth of incident reports is not due to plain laziness.

CONTENTS — See Inside Back Cover



Survival Without Self-Help

In the course of a private flight from Wagga to Alice Springs via Broken Hill, Leigh Creek, and Oodnadatta, the pilot of a Piper Tri-Pacer became lost and was forced to land when in the vicinity of Oodnadatta because of shortage of fuel. The three occupants were uninjured and the aircraft was undamaged. Unfortunately, adverse weather hampered the search effort and it was not until 48 hours later that the aircraft was located and stores were dropped. A ground search party with fuel reached the aircraft on the day that it was located and it was flown to Oodnadatta on the following day.

A point of particular note about this flight was that no provision was made for any emergency of this kind and no water, emergency rations, first aid kit or other survival equipment was carried. Perhaps even more noteworthy, if not startling, is the fact that the pilot knew the compass of this aircraft to be inaccurate and, for this reason, considered it pointless to allow for drift or to make any correction for variation or deviation and flew on a compass heading equivalent to the true track. He also revealed that it was not his practice to calculate a ground speed using the forecast wind velocity unless the wind was very strong but instead, he assumed a headwind component of approximately 10 knots regardless of the wind direction.

During the first stage of the flight from Wagga the compass card became jammed for a period of 10 minutes and, after it had slowly righted itself, the pilot considered it to be operating satisfactorily and decided to continue the flight to Broken Hill.

Upon arrival at Broken Hill the aircraft was refuelled to full tanks and the pilot submitted flight details in which the endurance shown was 300 minutes, based on a fuel consumption of 7.2 g.p.h. Although it was his intention to refuel at Leigh Creek, the pilot indicated that he would not do so if a check on the fuel at that point indicated that there was sufficient to permit the flight to continue to Oodnadatta.

Leigh Creek was reached after a flight of 105 minutes which was 15 minutes less than that anticipated. At this point the pilot calculated the remaining endurance on the basis of the time flown as against the original estimated total endurance and concluded that there was 195 minutes of fuel remaining, giving a reserve of 60 minutes on the E.T.A. for Oodnadatta. The actual fuel remaining at this point was not checked to confirm this calculated remaining endurance. Had the pilot performed this simple check he may have noticed that the originally estimated fuel consumption of 7.2 g.p.h. was in error.

It was subsequently established that there was only one gallon of fuel remaining in the tanks at the time of the landing, which was made seven minutes after E.T.A. Oodnadatta, revealing that the actual fuel consumption between Broken Hill and Oodnadatta was 8.3 g.p.h. This is consistent with the fuel consumption figure given by the performance chart for the conditions obtaining. The actual reserve for Oodnadatta calculated at Leigh Creek was, therefore, in the vicinity of 15 minutes and not 60 minutes.

When within a few minutes of the Oodnadatta E.T.A., when the pilot was unable to obtain a pinpoint, two diversions to the west were made in the hope of intercepting the railway. By this time, however, the aircraft had already passed Oodnadatta and, in any case, subsequent calculations show the diversions would not have been sufficient to compensate for the track error that existed.

At five minutes past the E.T.A. the fuel was almost exhausted and, since the pilot could not sight Oodnadatta, a landing was made on an isolated clear area alongside a creek bed. Because of the possibility of flooding, the aircraft was later moved to higher ground nearby. A message to guide search aircraft was marked out as shown in the photograph and this is perhaps the one bright spot in the whole operation. As can be seen the state of the situation was indicated to searching aircraft and time and anxiety were thereby saved.

When it became apparent to the Search and Rescue Organisation that the aircraft could no longer be flying and no word of the aircraft had been received, plans were made for a search. An air search was commenced early on the following day but rain and extensive low cloud hampered the efforts of the three aircraft employed with the result that only a small area could be systematically covered. On the following day, five aircraft were available and the search was planned to commence at first light although the weather forecast indicated that this might not be possible because of expected fog. Fortunately the weather turned out to be favourable for the search as planned and the missing aircraft was located in the early afternoon at a position 23 miles north-east of Oodnadatta. In addition to those engaged in controlling the search and rescue operations there were eight aircraft crews and the ground rescue party.

In the light of the circumstances surrounding the preparation for this flight and the navigational technique employed, it is not difficult to see that the outcome could have been far more serious. The occupants were fortunate that a suitable landing area was available and that they were not subjected to a protracted and hazardous ordeal in this desolate country. In similar circumstances in the past with less good fortune, people have perished.

It is undeniable that this pilot had the knowledge necessary to avoid this situation. The thing that was lacking was proper application and care in the planning stage. We feel sure that the pilot will be the first to agree with us in this and the lesson will stand him in good stead for the future. Will it do any good for you? We hope it will because these Search and Rescue operations are extremely costly in time and money.

ENGINE STARTING HINT

For aircraft equipped with augmentor tubes in the exhaust system

Aircraft with augmentor tubes in the exhaust system should be primed with care if they are tailed into the wind. This is particularly true if the engines are warm. The vaporized fuel from the engine exhaust pipes may be blown into the engine compartment, and explode when the engine starts.

A very few isolated cases of such explosions have occurred with substantial damage to the engine cowling. In such circumstances, use the minimum possible priming to reduce this unusual hazard.

(Beech Aircraft Corporation "Safety Suggestions")

GROUND SAFETY

All accidents to aircraft on the ground are avoidable. Nevertheless, this type of accident which frequently results in personal injury or major damage to the aircraft continues to occur, mainly because common-sense precautions are ignored or normal care and vigilance have not been exercised.

Consider the following examples which are representative of the many reports.

A bystander approached an aircraft to speak to the pilot whilst the engine was running. On moving away from the aircraft he walked into the rotating propeller and received serious injuries.

After disembarking from a helicopter a passenger attempted to pass underneath the tail boom and was struck by the tail rotor.

A bystander was injured when he walked into the rotating propeller of a stationary aircraft.

A DC.4 collided with maintenance equipment when the aircraft was moved forward during maintenance. The wing was punctured and a considerable quantity of fuel spilt on the tarmac. In addition, a propeller and several servicing stands were damaged. The photograph on this page shows one stand wedged underneath the outer wing.

A tip truck, with the tray in the tipped position, attempted to pass under the wing of a parked aircraft which was being loaded at the time. The pilot signalled to the truck driver who stopped immediately but not before the tip tray damaged the aileron.

A truck was backed to within three feet of the main cabin door to unload freight. The truck had been inadvertently left in reverse gear and, when started by hand cranking, it moved backwards and collided with the aircraft.

A hand lorry loaded with newspapers was connected to the rear of a motor vehicle which had also been loaded from the aircraft. The motor vehicle driver was not informed; consequently when the vehicle was driven away part of the hand trolley struck a propeller blade necessitating a propeller change.

Only authorised vehicles which are essential for the ground servicing of aircraft are permitted on the movement area of an aerodrome. These vehicles must be appropriately fitted to guard against fire during refuelling operations. Hand trolleys should be used to handle baggage and freight except where a particular item of freight requires the use of a heavier vehicle. Passengers should be instructed to move directly away from the aircraft and keep clear of the propellers at all times.

The ground safety precautions have been evolved as a result of years of experience. If they are followed the possibility of injury or damage is greatly reduced; if they are ignored, sooner or later expensive trouble is bound to result.

On 4th November 1959, a DC.4 departed Montreal on a flight to Hall Lake, Northwest Territories. The aircraft took off at 2244 hours and approximately twenty-four minutes later the aircraft broke up in the air and crashed on farm land near the village of St. Cleophas, forming a wreckage pattern which covered an area approximately 1¼ miles by ¾ mile. All occupants—four crew members and a stewardess —died in the accident.

Engine Fire leads to DC4 DISINTEGRATION

ST. CLEOPHAS, QUEBEC

(Summary based on the report of Department of Transport, Canada).

(All times herein are Canadian Eastern Standard)

THE FLIGHT

The purpose of the flight was to transport mail and freight to Hall Lake in the Canadian Arctic. Soon after take-off the flight was requested to take a heading of 010°. The flight reported when at 6,000 feet and had changed course to 000°. It was then requested by Montreal Centre to report on reaching 9,000 feet. This was done and recorded at 2259 hours with no hint of difficulty. Three and a half minutes later, the flight reported on 119.7 mcs. that it was descending on an emergency with a fire in No. 2 engine which could not be extinguished. The flight was requested to and did change frequency to 119.3 mcs. At 2307 hours, a final transmission was received that the aircraft had lost its left wing "was in a spin and going straight in".

The aircraft was plotted on radar until it disappeared from the screen on a bearing of 031° from the transmitter site at Montreal Airport at a distance of 48 miles.

INVESTIGATION

The investigation on the spot continued for several days. The No. 2 engine which was the reported origin of the fire was found separate from the others and was relatively little damaged by fire. It was determined that fire damage to this engine must have occurred in the air. The left wing, which had landed separately with the No. 1 engine, had suffered very severe ground fire damage as also had the right wing and Nos. 3 and 4 engines. These latter items burned for several hours after the accident. The vertical stabilizer and rudder were well separated from other wreckage and whilst exhibiting flash burning, the only other damage was apparently from impact, both airborne and ground. The nose section containing the pilot and co-pilot was separated and some distance along the wreckage track from the main portion of the wreckage, consisting of the centre section, right wing and Nos. 3 and 4 engines.

The following information emerges from an analysis of field data from the ground distribution of wreckage components.

The aircraft was flying on a track 188° true, at an altitude estimated, at the time of break-up, to lie in the lower part of the range 1,750 feet minimum to 4,000 feet maximum. The left wing and engines separated from the aircraft first, followed almost immediately by separation of the tailplane. Damage and paint markings on the tailplane indicate that it was struck by the wing. The separation of the left wing represents an initial step in the aerial disintegration.

Fire in the No. 2 engine nacelle preceded the loss of the wing, causing primary structural damage, including the complete loss of the front and rear spar caps and top wing skin over a narrow spanwise band behind the engine firewall. This fire spread along the fuel lines within the leading edge of the wing between Nos. 1 and 2 engines. Structural damage is estimated to have reduced the ultimate strength of the wing (under the actual operating conditions) by about 50 per cent., while reducing the wing bending and torsional stiffness by possibly 20 per cent. However, the main spar of the wing which, because of the loss of other parts of the wing structure would be forced to carry major loads, failed at points remote from any effect of heat damage by the fire. This failure is estimated to have occurred under a minimum load of approximately 1.8G, arising from a manoeuvre of the aircraft and/or a gust loading.

Calculated trajectories of pieces of wreckage suggest that the aircraft was in a slightly nose down attitude at the instant of break-up. It is improbable that failure of the wing could be satisfactorily explained as a gust encounter alone. It is believed, therefore, that the residual wing strength was exceeded by manoeuvre and/or gusts in moderately turbulent air.

It is not possible to say precisely where the fire started, however, the area of initiation could be fairly well defined as being close to a conjunction of flexible hose lines and an electrical cable; close to and aft of the inner ring behind No. 4 cylinder.

A fire of relatively small proportions must have existed prior to the crew being aware of it or taking action to extinguish it. Two points of significance tend to prove this:

1. Examination of the generator of No. 2 engine indicates that internal insulation must have been burned from an external source which then allowed an electrical short circuit to take place, thus indicating that the fire had reached great intensity prior to the crew shutting down the engine. This they were able to do and fully feather the engine.
2. A hole was found in the steel braid of one of the flexible hose lines which was the result of an electrical short and must also have taken place prior to shutting down the engine.

A crack which was proved metallurgically to have been in existence some time prior to the accident was found in the exhaust manifold in the area opposite to the No. 4 cylinder exhaust outlet. A hole about 2½ inches by 1½ inches was found in the manifold at this point. The exhaust manifold wall thickness in the area was found to be .009", compared to .035" in its original form. It was not possible to determine when the hole in the manifold had occurred.

During the investigation, it was found that the operator was covering electrical cables within the engine nacelle and forward of the firewall with a transparent plastic tubing of a polyethylene type. Another of the operator's aircraft was found to exhibit heat damage on such a covering. In finding the reason for this condition, it was ascertained that on several Arctic stations it is the practice to pre-warm the engines by means of Herman Nelson heaters. These direct a stream of hot air into the engine nacelle and onto the flexible hose lines. It was determined that temperatures encountered with these heaters were sufficient to cause damage to the polyethylene sleeving such as to give all the marks of active burning.

It was found that most of the damage to the No. 2 engine by airborne fire was to flexible hose lines, also a heat affected zone on the inner ring assembly was established in the exhaust collector ring fracture area.

During the investigation, it was found that pilots of this operator had on many occasions used METO (maximum power except for that permissible for take-off which is higher) for their climb away from Montreal. The rate of climb of the DC.4 on the day of the accident would seem to indicate this power setting must have been used throughout the climb for the aircraft to have obtained the 9,000 foot altitude in something under 15 minutes.

The possibility exists that the fire extinguishers may have put the fire out within the forward engine nacelle but there is no doubt that it had, by that time, progressed beyond the firewall. As such late action was taken by the crew, it is possible the fire warning system did not work. Evidence was obtained indicating it had been satisfactorily tested on the three flights previous to the one resulting in the accident, however, a long history of fire warning system troubles was found.

CONCLUSION

A fire of undetermined origin started in No. 2 engine nacelle during the climb and developed to the stage where fire extinguishing equipment was inadequate to extinguish it.

The following are considered to be primary contributing factors:

1. The deteriorated condition of the exhaust collector ring.
2. The probable deteriorated condition of the flexible wire braid hose assemblies.
3. The probable use of high power during the climb.
4. The possible failure of the fire detection and warning system to inform the pilot of the existence of a fire before it had penetrated the firewall and ignited the fuel feed system and oil tank to the rear of No. 2 engine.

During the rapid let-down stresses were imposed on the weakened left wing by manoeuvre and/or gusts which were sufficient to sever the left wing spar. No subsequent action by the pilot could have brought the aircraft safely to the ground; neither was it possible to determine what effect a less rapid let-down would have had.

COMMENT

This accident shows very clearly how an accumulation of small items of neglect can lead to the worst form of disaster.

RADAR WARNING

Radar transmitters emit electro-magnetic energy. When an electro-magnetic wave impinges on an object some energy will be reflected and some, depending upon the nature of the object, will be converted into heat and absorbed.

When the energy concentration, or power density, is high as in a radar beam near its source the heating effect may become quite significant. In the U.S.A. during experiments with a five megawatt peak power radar the beam ignited photo flash bulbs at 850 feet; it also ignited dry steel wool at 45 feet and caused an explosion in a mixture of aluminium chips, gasoline vapour and air at a distance of 250 feet. The power output of airborne weather warning radar does not approach five megawatts, nevertheless it can be a hazard during tarmac operation.

The following extract from a bulletin issued by the operator of a fleet of business aircraft is worth quoting:—

> "What could have been a serious situation was averted recently through the alertness of our Flight Group. Baggage was being loaded aboard one of the planes when smoke was observed coming from a package awaiting stowage. Investigation revealed, that the package contained photo flash bulbs that had exploded and ignited film and packing material.
>
> "Radar beams operating at the airport were suspected, and to confirm this the Engineering Department's Safety Section conducted tests, with and without the radar operating. They were able to flash the bulbs by simply holding them in their hands within range of the beams".

The Department has been well aware of this potential hazard, and has prescribed certain precautions that must be observed during all ground operation of airborne weather warning radar equipment. These precautions require that the equipment shall not be operated in its normal mode (antenna rotating) unless the sector scanned is clear of passengers, cargo, fuel tankers, fuelling equipment, hangars and other aircraft to a distance of 120 feet. If the antenna is stationary the beam must not be directed toward any of these objects unless they are at a distance of at least 200 feet from the radar unit. The figures quoted are general, and may be reduced by 75% where approved attenuating devices are used. The beam should, however, be directed with the maximum upward tilt toward a clear area whenever possible.

The radar equipment must not be operated in any aircraft whilst it is being refuelled or defuelled. In addition, it must not be operated when the aircraft in which it is installed is in a hangar unless a suitable micro-wave energy absorbing shield is fitted over the antenna.

Remember radar beams cannot be seen, heard or felt, and for this reason give no warning of their existence. Failure to observe the precautions could prove costly.

Silent witness to a Premature Touchdown at Perth Airport

Fatal Beaver Accident in Agricultural Operations

UTIKI, N.Z.

Whilst spreading superphosphate in the Taoroa district, 12 miles east of Utiki a Beaver aircraft struck a steep slope whilst executing a steep turn in a confined valley. Fire occurred at impact and the pilot was fatally injured.

(All times herein are N.Z. local time)

(Summary based on the report of the Air Dept., N.Z.)

THE FLIGHT

Having fulfilled a 25-ton contract on the morning of the 21st December, 1959, the pilot returned to his base strip and, after refuelling his aircraft, went home for lunch. At 1330 hours he resumed and flew to the scene of operations. The dressing of the area in question involved a series of parallel runs, on the same heading, across the face of a steep slope. The nature of the terrain was such that it was necessary for the aircraft to continue into a comparatively narrow valley in order to effect a turn onto a reciprocal heading.

During the afternoon the pilot was in contact with the chief engineer by radio telephone and, on the flight prior to the last, some transmission difficulty was experienced. The pilot intimated that he would call when airborne on the flight which involved the accident and the chief engineer was listening out on the frequency at the time.

At 1500 hours, the pilot took off on the thirteenth sortie carrying 18 cwt. of superphosphate. Mixture was seen to be falling away from the aircraft as it traversed the dressing area. The aircraft was seen to fly into the valley in accord with the normal procedure and start a steep turn to the left, at which point it disappeared from the view of the witness behind an intervening hill. At 1505 hours the chief engineer heard a sudden and unintelligible transmission over the radio telephone. The tone of voice was such that an emergency was clearly indicated. A few seconds later a column of black smoke was seen to rise from the valley.

The nature of the damage and the distribution of the wreckage indicated that the aircraft, while heading uphill, had squashed at a high rate of descent on to the face of a steep slope at an angle of attack parallel to the slope.

The rear petrol tank was dislodged from its mounting and was tilted upwards approximately 45° and was protruding about 12 in. through the port side of the fuselage. The forward corner of the tank was exposed to flames licking around the port side of the hopper with the result that a hole was melted in the wall of the tank, the edges of which folded inwards. The filler pipe was torn away at the hose connection to the tank. There was no evidence of fire within the tank, or of any explosion.

The only reliable evidence obtained from the cockpit controls related to the idle cut-out, which showed the lever to be in the closed position coinciding with the position of the idle cut-out valve in the molten remains of the carburettor. The rudder, elevator, and ailerons were correctly attached and free to move and their respective control runs were intact until they entered the main seat of fire. The elevator trim tab was in the neutral position. The fuel cock, situated aft of the hopper was selected "front tank".

The condition of the propeller clearly indicated that the engine was not delivering power at impact. There was no concentration of superphosphate on the ground to indicate that the jettison had been used, although the trail of phosphate, which extended over 160 feet, leading to the wreckage was of more than average concentration. The position of the jettison at impact could not be established owing to damage.

While the terrain in the vicinity of the wreckage offered little chance of a safe forced landing, the face of the slope on which the aircraft was resting was one of the least suitable areas.

INVESTIGATION

It is quite evident from the RT transmission that a sudden emergency arose in the air just prior to the accident and it is logical to accept that the nature of the emergency constituted the primary cause of the accident.

It is possible to fix the time of the emergency with a high degree of accuracy by the time of the RT transmission and the time at which the pilot's watch had stopped (1505 hours). The stage of flight at which the emergency occurred can also be established. The aircraft was seen to complete a dressing run and start a steep left-hand turn within the confines of the valley. Taking into account the distance the aircraft could have covered in the time taken to decelerate from cruising speed to stalling speed it is evident that the emergency occurred when the aircraft had completed 90° of this steep turn. It can be stated, therefore, that the emergency occurred just before 1505 hours while the aircraft was in a steep turn to the left.

The unintelligible transmission heard over the RT can be explained by the fact that the pilot had made a previous arrangement to call headquarters during the course of the flight. It is probable that he was holding the microphone in readiness and when the emergency occurred he made an exclamation of alarm an instant before he discarded the microphone.

The area in which the emergency occurred has achieved a certain notoriety amongst topdressing pilots over the past years and many have remarked on its propensity for down draughts and loss of lift. The pilot had dressed the area on previous occasions and was familiar with the vagaries of the conditions in the turning area. A Beaver aircraft flown by an experienced pilot simulated the operation on the day after the accident and, while there was room to turn in the valley, precision flying was necessary. It was clear from this test that, if an emergency occurred during the turn on to a reciprocal heading, the pilot would be hard pressed to retrieve the situation.

As to the cause of the emergency, it is evident that the pilot was able to recover from a steep turn, fly the aircraft for a distance of approximately 1,000 feet, then pull it up in a steep angle of attack in order to squash the aircraft deliberately on to the face of the slope. This clearly indicates that the structure of the aircraft and the flying controls were intact. The circumstances are, however, entirely compatible with loss of power as it would have been well within the performance of the Beaver to have cleared the crest of the slope on which the wreckage was resting.

In associating the cause of the emergency with loss of power it is impossible to ignore the significance of the fact that the engine would have failed through exhaustion of fuel at approximately 1505 hours if the pilot had forgotten to change from rear tank to front tank at the correct time. Under normal topdressing conditions the fuel consumption of the Beaver is 18 gallons per hour. It has been established that the pilot filled his aircraft to capacity at the base strip before lunch. During the luncheon period the engine would have cooled down sufficiently to require a warm-up period of eight minutes before take-off and it can be accepted that the pilot, who was meticulous in such matters, would not have taken off until temperatures were correct. The flight from the base strip to the operating strip would have taken seven minutes. On arrival at this strip the engine was stopped, then restarted and warmed up for a period of two minutes. The petrol consumed, therefore, before the afternoon's operations were started, is calculated at seven minutes flying time at 18 gallons per hour and 10 minutes warm up at 7 gallons per hour—giving a total consumption of 3.25 gallons.

It is apparent that when the aircraft took off on the first sortie the 21-gallon rear tank contained $17\frac{3}{4}$ gallons of petrol. At normal consumption this petrol would have been consumed in 59 minutes or by 1459 hours. However, the pilot vacated the cockpit, leaving the engine running, on two occasions for intervals of approximately two minutes which would increase the endurance of the rear tank slightly and extend the time of exhaustion of fuel to between 1500 and 1505 hours.

While the foregoing is a theoretical evaluation of the fuel situation, more positive evidence can be derived from the condition of the rear fuel tank in the wreckage. Had the fuel selector cock been changed from "Rear" to "Front" at the correct time a residue of 3 to 4 gallons of fuel must have been left in the rear tank and owing to the tilt of the tank this petrol would gravitate to the lower end leaving a large area at the upper end for the accumulation of petrol vapour. The fact that a naked flame was able to burn a hole through the wall of the tank and penetrate this area without an explosion or petrol fire points conclusively to the absence of petrol in the tank at impact.

On the premise that the rear tank was drained in the air, it is necessary to explain how the vapour, which must inevitably have remained in the tank, was dispersed. When the tank was dislodged from the fuselage at impact the filler pipe was torn away at the hose connection leaving a $1\frac{1}{2}$ inch diameter outlet at the upper end of the tank; at the same time the tank was subjected to intense heat from the fire which was burning in close proximity. The application of heat would accelerate the venting of vapour through the filler aperture and by the time that flame penetrated the tank the concentration would have been reduced sufficiently to result only in a deflagration which would dissipate through the melted aperture and filler pipe without causing additional damage to the tank.

The fact that the aft-selector cock retrieved from the wreckage was selected "front tank" is quite compatible with the circumstances of the accident, because, as soon as the engine faltered, the pilot's attention would have been drawn to the petrol situation and he would immediately have switched to "front" tank. On dismantling, the selector proved to be in full ON position, confirming that the cable relay from the selector in the cockpit to the aft-selector cock was functioning correctly.

In order to find a reason for the failure of the engine to pick up when the cock was selected to the front tank, and in order to examine the possibility of remedial measures to prevent recurrence, it is necessary to describe briefly the petrol system of the agricultural version of the Beaver aircraft. The fuel is carried in two tanks attached to the fuselage floor. The centre fuselage tank, which is a normal feature of the aircraft, is removed to facilitate the installation of a hopper. The front tank, holding 29 imperial gallons, is situated immediately below the pilot's seat and the rear tank, holding 21 imperial gallons, is positioned aft of the hopper.

Fuel is supplied by selecting "front tank" or "rear tank" on the fuel cock situated on the left side of the instrument panel. To change tanks from rear to front a 270° anti-clockwise rotation of the fuel cock is required. This cockpit-selector lever is cable linked to a remote-selector cock situated in the fuselage aft of the hopper, below and some 9 feet from the carburettor. Fuel is drawn from the tanks by an engine-driven pump and a wobble pump for carburettor priming and emergency system operation is incorporated. This wobble pump is right-hand operated by a lever on the port lower side of the central control pedestal. The petrol pressure gauge supplemented by a red warning light to indicate loss of pressure is fitted on the instrument panel together with content gauges for the front and rear tanks. The fuel consumption of the Beaver under normal topdressing conditions is 18 gallons per hour and for C of G considerations the rear tank is used first when the aircraft is employed in the agricultural role.

It will be apparent from the description of the fuel system that if the engine fails due to exhaustion of fuel in any tank, it will take an appreciable time for the engine-driven pump assisted by the hand wobble pump to reprime the 9 feet of empty pipeline between the aft selector cock and the carburettor.

In a ground trial after the accident a Beaver aircraft was run off the rear tank until the engine failed. Fifty seconds before the failure occurred the petrol pressure needle began to drop and the red fuel warning light flashed intermittently and gradually became steady. Immediately the engine faltered the fuel cock was changed to "front" tank and the wobble pump operated vigorously. It took eight seconds for the system to become reprimed and 12 seconds for the engine to revive. In addition to this test, one actual example is on record of an engine failure at 200 feet after take-off as a result of fuel exhaustion of the rear tank. In this case the pilot immediately depressed the nose, changed tanks, and attempted to restart over a period of 20 seconds. However, the engine failed to revive before the aircraft was force-landed directly ahead on the aerodrome. There was an element of pilot inexperience on type in this example.

While the figures quoted may not be absolutely typical they do lead to the conclusion that if engine failure occurs due to exhaustion of fuel in any one tank, a time lag in the region of 12 seconds must be anticipated before the engine can be restarted.

When the above figures are considered in conjunction with the time taken for the Beaver in level flight to decelerate from sowing speed to stalling speed they become of vital importance to the top dressing pilot flying at a height which does not permit depression of the nose to maintain speed. In flying trials with a clean unladen aircraft, the time taken to decelerate in level flight from 95 m.p.h. to the stalling speed was 14 seconds. Initial deceleration to 65 m.p.h. occupied nine seconds at which speed the aircraft would be difficult to manoeuvre for a landing. In a similar trial employing an actual topdressing aircraft the deceleration took 10 seconds with controls becoming sluggish at seven seconds.

It is clear, therefore, that in the event of fuel exhaustion the restarting time lag and rate of deceleration could result in loss of control before the engine could be restarted. From the situation of the wreckage in this accident it would appear that the pilot devoted the major part of the time at his disposal to restarting the engine, until he was forced, at the last instant, to put the aircraft down on unsuitable terrain. The lesson to be learned from this accident is that if a pilot is faced with a similar emergency he should devote his primary effort towards making a safe landing, with the starting of the engine a secondary consideration.

The flight trials referred to above revealed that an adequate 50 seconds warning of impending engine failure is given by the fuel-pressure gauge and the red fuel-pressure-warning light. If tanks are changed during the warning period the engine would pick up immediately on an alternative tank. The disadvantages of these methods of warning lie in the fact that the fuel-pressure gauge is not conveniently placed for cursory cockpit inspection and, the red warning lamp, although conveniently placed directly in the pilot's line of sight, suffers from the weakness associated with this type of dome shaped red glass in that, under certain light conditions, it is difficult to assess whether the light is "on" or "off".

Allied to these difficulties is the fact that topdressing pilots flying in close proximity to the ground can devote little time to cockpit inspection.

The question of fuel management of the Beaver was considered during this investigation. It is apparent that the pilot was in the habit of flying off a full rear tank for approximately one hour, which would leave a residue of 3 to 4 gallons before making the change to the front tank. While it is perfectly safe to fly the Beaver to these limits at altitude, it is questionable practice in low level agricultural flying. Apart from the fact that the margin for error is at a minimum, there is a possibility that a state of unbalanced flight in a steep turn could cause the petrol to vacate the tank outlets which are in the centre of each tank.

CAUSE

The accident was caused by mismanagement of the fuel system which resulted in loss of power in a flight situation which did not afford sufficient altitude and time for the engine to be restarted before the aircraft struck the ground.

AMENDMENT TO DIGEST ISSUE NO. 23

Super Constellation Overturns during Landing

Page 6. Insert the following paragraph in column 3 immediately before "Cause" —

"Very little evidence was given on the subject of fatigue but that does not mean that it might not have played a part in the accident. The crew went on duty at 09.00 hours on the 20th January, 1960, and remained on duty for 17 hours and 24 minutes. That period is within the permitted maximum of 20 hours and if it were possible to assess the hours one may work without suffering fatigue and to legislate accordingly the problem would present no difficulty. To provide against fatigue by prescribing that the crew shall not remain on duty for more than 20 hours or be engaged in flying for more than 12 hours would seem to lose sight of factors that in themselves may bring on fatigue. The nervous strain brought on by handling an aircraft with one engine not functioning properly may itself be equivalent to more than 20 hours of ordinary duty. Then there must be a great variety of duties — some light others heavy. The crew flew some six hours or more over the United States. Over such territory the work load is heavy. To that load was added the strain of a malfunctioning engine, the anxious wait for repairs to be done in Miami and the renewed anxiety when the second engine started to give trouble and the anxious wait to have it repaired. The accummulation of such circumstances might very well have affected the pilot sufficiently to cause an error of judgment. It was found, therefore, that the crew were fatigued at the time of the accident."

Page 6. Insert the following paragraph in column 3 at the conclusion of the existing "Cause" —

"The primary responsibility for this accident must rest on the captain. However there is evidence of mitigating circumstances in that the errors of judgment that precipitated the disaster reflect some deficiency of knowledge which should have been instilled in the training and flight proficiency checking of the pilots. A measure of responsibility for the accident must therefore devolve on the supervisory and advisory authorities responsible for the overall conduct of the operation."

Sometimes it Happens

(Extract from Flight Safety Focus)

From an airline captain's report we quote:—

When I arrived the actual weather was scattered rainshowers, visibility 10 miles, wind 150/07, runway in use 15. NW the field over the city and to approximately 1 mile from the runway was low stratus and fog. I decided to make a short approach and ordered gear down at 1200 feet on down wind leg. We got no indication on the left main and I ordered gear up and down again with the same result. Took gear up for the second time, ordered pump selector in general system and emergency pump on. This time we got indication on all three and I turned left for base but came now into the stratus clouds NW the field over the city, altitude 1,000 feet.

I decided to make a pull-up and a new approach. Ordered full power and gear up. When F/E was setting full power we got fire warning engine No. 4, zone 1. I ordered feather, selector and release and the fire went out O.K. Now on three engines I asked for runway 33 instead and landed with 5 knots tailwind after taking gear out again by using the emergency pump.

As can be seen from this it is not only in the simulator that several failures occur within a few seconds.

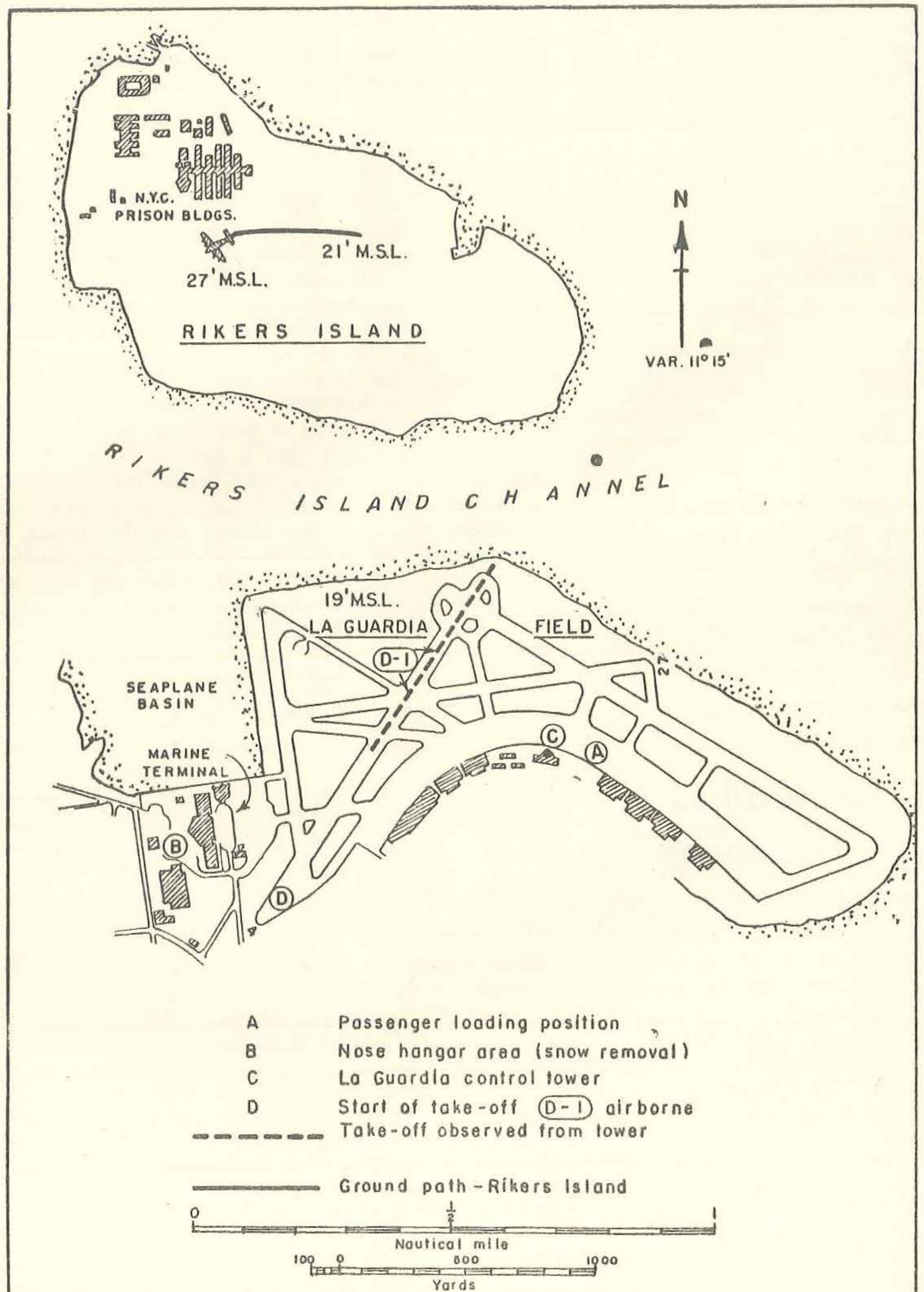
Faulty Control on Instruments

DC6 CRASHES AFTER TAKE-OFF

RIKERS ISLAND, NEW YORK

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

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



Immediately after take-off from La Guardia Field, New York, a DC.6 crashed in the vicinity of Rikers Island.

There were 101 persons aboard the aircraft, 95 passengers and six crew members. Of these, 20 passengers were fatally injured, 25 passengers and 3 stewardesses were seriously injured and 50 passengers received minor injuries. The pilot, co-pilot, and flight engineer were uninjured.

The aircraft was extensively damaged on impact and destroyed by subsequent ground fire.

THE FLIGHT

The flight scheduled to depart at 1445 hours was to be non-stop from La Guardia Field, New York, to Miami, Florida. Due to a continuing snowfall the flight's IFR departure had to be delayed until snow removal had been completed. Take-off clearance was issued at 1800 and a tower controller saw the aircraft airborne at approximately 1801 hours. The controller advised the flight to contact La Guardia radar departure control on 120.4 mcs. This message was acknowledged, but the radar controller did not receive a call from the flight; however, he did observe a target on the scope that indicated an aircraft over the runway. Subsequent sweeps showed the target beyond the end of the runway, turning left, and then it disappeared from the scope. The La Guardia tower controllers saw a large flash at approximately 1802 hours in the vicinity of Rikers Island, the approximate centre of which is about one mile north of the point where the aircraft left the runway. At 1819 hours it was learned that the flight had crashed.

INVESTIGATION

Both pilots of the flight had been captains for over fourteen years, and both had acted in pilot supervisory capacities. The captain had a total of 85 hours on DC.6 aircraft. His actual DC.6 instrument time, as testified, was approximately 10 hours during training and checkouts and from 5 to 15 hours during scheduled operations. The flight was released by company despatch at Miami at 1301 hours to fly from La Guardia to Miami via airways on an instrument flight plan with the alternate West Palm Beach. The gross weight of the aircraft was 92,575 pounds or 265 pounds under the maximum allowable weight.

The captain stated that the take-off roll, except for some sliding of the nose wheel at low speed, was normal and the aircraft became airborne after a normal ground run. He also stated that the landing gear was retracted immediately after becoming airborne and then, with a good rate of climb established, the wing flaps were retracted; further, he remained on "solid" instruments from the boundary of the field until the first officer exclaimed, "Al, ground!" The captain said that at no time did any of the pertinent instruments on his panel indicate anything but a straight flight out on the heading of runway 4 and in a climb with airspeed in the order of 135 knots.

The first officer stated that he had been monitoring his own instruments and that his observations were the same as the captain's up to the time that his attention was given to the flight engineer starting the first power reduction. Both pilots stated there was no indication of a turn, from their instruments, and they did not physically sense a turn or abrupt movement of the aircraft.

Rikers Island is irregularly oval with its greatest dimension, from east and west, approximately one mile. Its southern shoreline is some 600 yards north of the north-east corner shoreline of La Guardia Field.

The aircraft first struck small trees while on a heading of 285° magnetic. The left wing tip struck the ground first; the right wing tip struck 150 feet beyond. The aircraft, after striking the ground nearly level longitudinally, skidded approximately 1500 feet and came to a stop on a heading of 241°. The ground elevation differential between the initial impact point and the stopping place is less than 10 feet. It was determined that the angle of descent at impact was seven degrees. Groundspeed at impact, computed from propeller slash marks and engine rpm, was approximately 138 knots. Impact occurred approximately 60 seconds after start of the take-off and after a left turn of approximately 119 degrees from the heading of runway 4.

Consideration of the wreckage distribution and detailed examination of the airframe wreckage disclosed no evidence of structural failure, control malfunction, or fire prior to ground impact. Testimony of the pilots and flight engineer also reflected no indication of structural failure, control malfunctioning, fire, fire warning, or unusual sounds during the brief time that the aircraft was in flight.

ANALYSIS

In analyzing the operational phase of this flight a careful study was made of all known facts in conjunction with the testimony of the crew. In the analysis it must be borne in mind that the aircraft was airborne approximately 31 seconds during which time it travelled a distance of some 6600 feet and turned approximately 119 degrees to the left.

Both the captain and the first officer testified that the take-off was normal and that they observed no indication of any irregularity or deviation from the take-off heading. Testimony of the crew and passengers appears to be in general agreement in that the aircraft was not banked when it passed over the runway, and there was no feeling of any abrupt changes in attitude during the flight. One passenger, with 400 hours of piloting experience, testified that the aircraft was in a steep left bank just prior to the time he observed a levelling action of the aircraft immediately prior to impact. Considering this testimony, the time consumed in reaching the end of the runway, and the time involved in attempted recovery, it must follow that the turn, although steep, was a co-ordinated one and was accomplished within a period of some 20 seconds. Thus, the rate of turn was in the magnitude of six degrees per second.

From the testimony, it is evident that the aircraft's acceleration after take-off was normal and that the captain followed the prescribed company procedures in ordering the landing gear to be retracted, the wing flaps raised, and power reduced to METO. Considering the short time involved in the execution of these commands, it is considered highly probable that, when the power was being reduced to METO, the wing flaps were still either in the process of retracting or were just completing the retraction. During this period, in which the configuration of the aircraft was progressively changing to en route climb, it would be imperative that the pilot devote his full attention to his flight instruments in order to control the aircraft effectively.

The captain testified that he observed the flight engineer in the process of reducing to METO power. Without reference to the proper flight instruments at this time, the captain would be unable to take the proper control action. He stated that his prime concern was the airspeed, rate of climb, and direction. Further testimony indicated that he used his ADF indicator as a primary directional instrument, took little advantage of the C-2A Gyrosyn compass or azimuth card of the course indicator and made little reference, if any, to the artificial horizon or turn-and-bank indicator. He did not use the magnetic compass.

The captain testified that he knew at the time that the C-2A Gyrosyn compass had been somewhat unreliable. This fact, and the knowledge that the course indicator was a repeater, should have alerted the captain to check the C-2A Gyrosyn compass against the magnetic compass at the engine run-up position. Following take-off he also disregarded the altimeter and substituted the rate of climb indicator, referring to the altimeter only on every third or fifth scan of the panel, attaching little importance to this instrument. From this testimony it is evident that he did not take advantage of his full instrumentation nor did he rely upon primary instruments.

A consideration that cannot be overlooked is the possibility of the pilot becoming disoriented by reason of attempting to remain visual for too long a period after take-off and losing visual contact before the transition to instrument flight. However, the captain was very emphatic in his testimony that he went on instruments when the gear was retracted and did not look out again until he saw the ground immediately prior to striking it. Snowfall occurring during the take-off at night, with the landing lights on, could have produced a glaring effect or a period of temporary blindness, and the time involved after reference to the instruments may not have been sufficient to allow return to normal vision. This consideration cannot be completely ruled out; however, because of the captain's testimony it would appear not to have been a major contributing factor.

Both pilots stated that they went on instruments shortly after take-off. They described their duties and manner in which they performed such duties and both stated everything was normal. Neither pilot was able to give a reasonable explanation for the unusual attitude of the aircraft.

The possibility of pilot fatigue was considered. The crew reported on duty some 10 hours prior to the accident. Total flight time involved a period of approximately four hours. A delayed departure and waiting for the aircraft, which was fully loaded with passengers for several hours, to be released for flight may have caused the crew some concern; however, there was no evidence to indicate that fatigue was a factor in this accident. Had the flight to Miami been completed in the planned time the total duty hours of the crew would not have exceeded their contract limits.

It is customary for the first officer to monitor the flight instruments during an instrument climb-out. According to his testimony, the first officer monitored the engine instruments and the flight instruments until the command was given for METO power. He then devoted his attention to monitoring the flight engineer's actions without further reference to the flight instruments. This action, according to his testimony, consumed quite a few seconds and lasted until his attention was attracted to the outside immediately prior to striking the ground. Had the first officer had opportunity to devote his attention to the flight instruments during this critical period in the flight he would undoubtedly have detected the deviation from course.

The cockpit was equipped with both electrical and pitot static flight instruments. With the exception of the C-2A Gyrosyn compass and one cross-pointed indicator, the instrumentation was identical on the pilot's and co-pilot's panels. The captain testified that, with the exception of a turn from 40 towards 45 degrees, no turns were made during the flight and that no indication of a turn or bank was displayed on any of the flight instruments. Both pilots testified that there was no warning of any instrument failure. Assuming that there had been a failure of a directional instrument and that the indicator either remained in a fixed position or assumed a rotational motion, the perceptibility of a turn not evident in that instrument would be evident on other instruments as would a turn to follow a rotating directional indication. Similarly, a failure of an attitude instrument and any attempt to follow an erroneous reading would be revealed by other attitude and directional instruments.

There is no evidence that any such irregularities did occur, and there appears to be no reason why the radical departure from course would not be displayed on the instrument panel. Based on this and other facts on record the Board can only conclude that the captain either did not properly observe his flight instruments or failed to refer to the proper instruments in his control of the flight.

CAUSE

The probable cause of the accident was the failure of the captain to —

1. properly observe and interpret his flight instruments, and
2. maintain control of his aircraft.

INTO THE ROUGH AFTER LANDING

A landing was made at Munich after dark. Visibility was 1300 metres, wind calm. The runway surface was reported to be slightly slippery because of light snow.

The approach was made on ILS in a normal manner. When breaking clouds at 500 feet above field-elevation, however, it became apparent that the pilot's visibility was badly impaired by an excessively rich spray of alcohol on the windshield. Also after switching off the pumps alcohol continued for some time to flood the screen. This gave rise to inaccuracies in aligning the aircraft which necessitated corrections. When finally flaring out the aircraft had still 8° drift to the right. Touchdown was just past the ILS reference point and only a few metres from the right hand edge of the runway, which was lightly covered with snow. The aircraft slid off the runway to the right and it ran for some time parallel to the runway, violently bumping and shaking on the rough, frozen terrain, then came back onto it.

As the aircraft rolled to a stop, engine No. 1 burst into flame. The flight engineer tried to extinguish the fire by opening the throttle, but on re-closing it the flames broke out again so that fire action was taken which immediately suppressed the fire. Later it appeared that presumably the flames had been caused by afterburning of an excessively rich mixture, and were sucked forward by the reversed propeller which in the dark gave an impression of fire. It was only then that all propellers were found to be in reverse, although none of the crew members had applied reverse after touchdown. Presumably, then, the handles had been thrown up during the fast bumpy roll on the rough ground.

The investigators agreed with the captain's own assessment of the incident which literally read as follows:

"My own assessment of the incident is:

1. the basic trouble was an excessively rich adjustment of the alcohol spray on to my front screen;
2. poor airmanship — inasmuch as I should have gone around:
   a. on limits, when I found the alcohol on my screen was interfering with my vision.
   b. when I had to make the second correction to align myself with the runway, particularly bearing in mind the reported poor condition of the runway surface."

(Extract from Flight Safety Focus)

Light Aircraft SEAT ATTACHMENTS

A number of incidents have been reported involving malfunctioning of the seat attachments and slide stops on several types of modern light aircraft. On occasions the pilot's seat has suddenly slid rearwards during take-off, resulting in sudden application of full up elevator. In at least one case, the seat over-ran the aft slide stops, left the rails and came to rest hard up against the rear seat of the aircraft.

In cases like these, happening as they do during a critical phase of the take-off, a serious situation can develop very quickly, and in fact, several fatal overseas accidents have been attributed to this very cause.

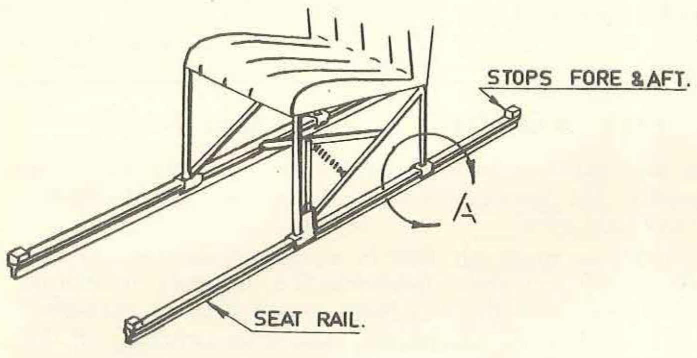
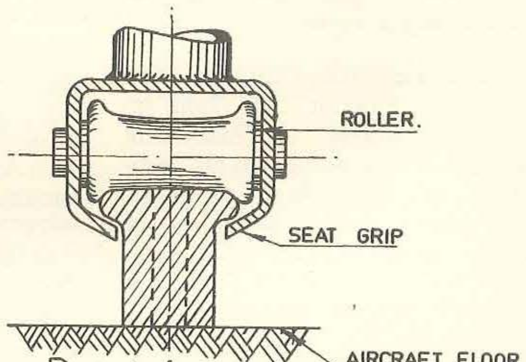


FIG 1



DETAIL A

The seats slide on light alloy extruded rails which in some types of aircraft form part of the fuselage structure. The seats are adjustable to different positions, being moved for either pilot comfort or entry to the aircraft. The seat is then locked by means of a spring loaded pin engaging a hole in the seat rail. Stops are attached to the rails fore and aft to prevent excessive seat travel. Fig. 1 shows a typical arrangement where the seat is supported at four points on metal rollers with rail grips to prevent any vertical motion.

Holes are spaced at intervals along the rails to receive the locking pins, which when engaged provide a positive lock restraining the seat from fore and aft movement. The pins have a tapered end to facilitate engagement and are forced toward the closed position by means of a spring. Fig 2.

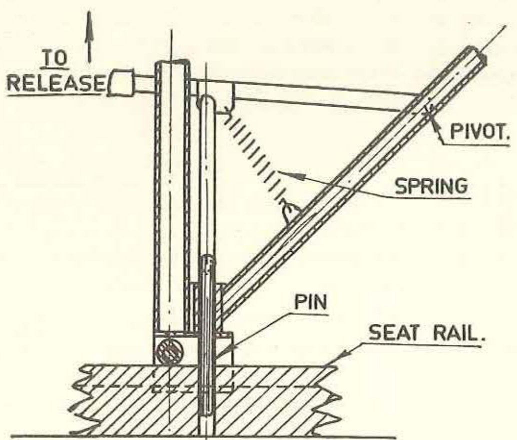


FIG. 2

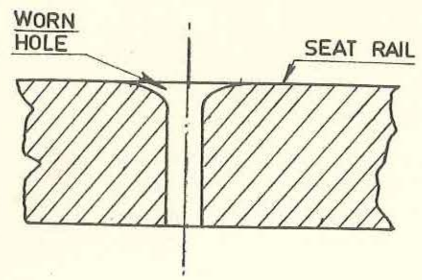


FIG. 3

However, with continued use the holes are liable to become worn and elongated as shown in Fig. 3. This worn condition will not detract from the effectiveness of the lock itself. However, it is possible for the pin, if not properly engaged prior to take-off to over-ride the holes as the aircraft accelerates, thus allowing the seat to move to the limit of its travel.

It is therefore considered advisable that the following checks be carried out during regular maintenance periods:—

Seat stops are in place and firmly fixed, there is no dirt or blocking material in the locking holes and the seat rails are free of any obstructions. The pilot, as part of his pre-flight cockpit drill, should also check that the slide mechanism is operating smoothly and that the seat is positively locked in position before take-off.

Failure to observe the above simple rules could very well lead to a serious accident.

PREMATURE TOUCHDOWN

A recent report states that numerous tyre marks on the paved overrun adjacent to the east end of Runway 10-28 at London Airport indicate that touchdowns short of the runway threshold are being made. This overrun is 900 feet long, with 150 feet of this adjacent to the runway end paved with blacktop and the remaining 750 feet a gravel surface. The report conveys the impression that the number of short touchdowns is greater than the very occasional inadvertent "shorts" should be.

The fact is that there is 150 feet of hard surface beyond the normal load-bearing paving and this should not be interpreted as being a runway extension and capable of repeated use for touchdown. This 150 feet of hard surface overrun is much less in weight-bearing capability than the runway proper. It is intended only as a safety feature for landing runs on 10 which may overrun the far threshold, and for protection against erosion from jet blast for the beginning of a jet take-off on 28. Without such protection from erosion, it is possible that the end of runway paving can be gradually uncovered, thus exposing the shoulder which could be hazardous in a short landing.

The point in all of this, of course, once again, is to use caution in handling landing techniques so as to avoid short touchdowns. This problem is especially critical with the jets and is aggravated at high-altitude airports on hot days when available engine thrust is seriously reduced. Quoting from a particular Aircraft Flight Manual —

1. Control the touchdown spot by keeping power on during the approach.
2. Pick a spot for landing 500 feet to 1000 feet down the runway from the threshold. This is most important with a flat approach, for the touchdown point will be difficult to prejudge.

(Extract from Flight Safety Focus)

This type of incident is not confined to overseas as the picture on page 7 will show.

AIRBORNE RADAR IN TURBOJETS

(Results of an Air Transport Association survey which included replies from 84 turbojet pilots)

Most pilots believe that airborne radar is as useful at turbo-jet cruising levels for avoiding thunderstorms as it is at lower flight levels. Their comments indicate that the radar may not always "see" the ice crystals or snow normally present in thunderstorms that extend up to about 30,000 feet. The larger cells which extend well above 30,000 feet are normally clearly defined by the radar.

Pilots report that it is desirable to attempt locating thunderstorms when they are at least 50 miles away. At that point the vertical spread of the radar signal, emanating from the radar antenna, extends at least a total of 25,000 feet from top to bottom. If the antenna tilt is zero degrees, and the flight is cruising at 30,000 feet, the bottom edge of the beam is extending downward to about 18,000 feet. When cruising at 30,000 feet pilots have found it desirable to carry 3 to 4 degrees of "downward" antenna tilt on the 20 and 50 mile ranges to assure that the bottom edge of the beam extends down to layers where water droplets are more likely to predominate. The radar signal returned from water droplets is at least five to seven times greater than that returned from ice and snow.

When thunderstorms are picked up by radar at 50 to 60 miles range, pilots have found it desirable to plan circumnavigation. When approaching storms which can be observed visually to have tops averaging 30,000 feet, and assuming it has been decided to pass directly over a thunderstorm cell, pilots have found that to avoid both turbulence and the possibility of hail encounter, it is desirable to plan on clearing the tops of thunderstorm cells by at least 3,000 to 5,000 feet. Pilots have found that flying over thunderstorm cells which "top" a few thousand feet below the flight level, rough conditions and vertical currents are apt to be encountered.

Most pilots recommend circumnavigation if a precipitation echo shows on the scope and recommend avoiding the echo, (or cloud observed visually) by at least five to seven miles, more conservatively ten to twenty miles.

Referring specifically to the usefulness of radar to detect hail when cruising above 25,000 feet, pilots have had varying experiences, normally good when the cell is well defined by the radar. If the cell is not well defined, they do not assume that a safe pass at close range can be assured.

(Extract from Flight Safety Focus)

Some Facts About FUEL CONTAMINATION

by V. A. FOSTER

(Extract from "Flying" March, 1960.)

Commonly attributed to "carburettor ice", sudden engine stoppages may be due to an easily preventable situation.

It all began one day out in the middle west with the president of an insurance company watching a pilot complete a pre-flight check of a popular make, high-wing monoplane. The pilot drained about a pop bottle full of clear gasoline from the sediment bowl. "There", he said with satisfaction, "Now I know there's no water!"

The insurance executive waved a hand as the pilot taxied out for take-off. Suddenly, just before the plane pulled out on the take-off runway, the engine quit cold. Examination, with the insurance president an interested onlooker, showed the sediment bowl full of water!

The executive, himself a pilot for over 27 years, with constant and varied flying experience, went home that night mulling over this seemingly inconsistent occurrence. The lowest point in that aircraft's fuel system had been drained, more than a usual amount of fuel removed, to check for contamination. Water was the heavier liquid, wasn't it? When combined with gasoline, water invariably sank to the bottom, the lowest point in any container? It had to. And yet — for some reason, water in the fuel system of the aircraft he had just watched — had not obeyed this common, scientific precept.

For some time he had not felt satisfied over the common explanation of sudden engine stoppages, "carburettor ice". This, he knew, causes a gradual loss of rpm, manifold pressure, accompanied by engine roughness. Seldom does a smoothly running engine suddenly gulp, sputter and die due to icing.

There are approximately 600 major accidents due to engine stoppage each year, a look at the FAA statistical handbook reveals. Pilots experiencing sudden, unexpected engine stoppage must often land in highly unsuitable areas, frequently demolishing their aircraft. Engine failure on take-off presents the pilot with an even more hazardous problem.

While good initial design, close quality control and conscientious maintenance have reduced engine stoppage to a "once in every 300 years" occurrence, it still does happen occasionally. Pilot error —failure to switch tanks, failure to carry adequate fuel, wrong selector setting, inadequate estimates of fuel consumption, accounts for a large percentage of it. Actual failure of the engine itself is a rare occasion today.

The executive went home, built a fuel system duplicating exactly that of the plane he had seen exhibit such strange behaviour. It consisted of clear plastic wing tanks, metal tubing, and a sediment bowl. First, he filled the tanks with gasoline. The fuel system operated smoothly. Then he poured a large quantity of water into the tanks and waited for it to appear in the sediment bowl. He waited 30 minutes — no water. He added more water to the tanks. Again waited, this time for an even longer period. Still no water. He found that he could drain three soft drink bottles full of clear gasoline out of this system before the water showed up. When it did appear, it acted as it was supposed to, the water draining, clean gasoline following. The puzzled executive again built a fuel system, this time with clear plastic fuel lines. Now he would be able to actually see what was happening. In went clean gasoline. The lines filled smoothly. Then he added a generous quantity of water. The water settled to the bottom of the clear plastic "wing tanks", in the approved fashion — but — and the veteran pilot could scarcely credit his eyes — the water did not penetrate the fuel-filled fuel lines. It remained as shown in Figure 1.

A pilot might drain a sizeable quantity of gasoline — or glance inat the clear sediment bowl — and take off, confident that the fuel system was safely water free. If water was in the wing tanks, apparently it would wait until the gasoline was consumed, then follow it to the carburettor!

The investigator took his apparatus and theory to an aircraft manufacturer where the engineers could scarcely believe the evidence. Upon seeing the demonstration the engineers realized that the lighter gasoline blocked the path of the heavier water because it had in effect "gained weight" by being enclosed in the tubing.

Many personal planes have fuel lines entering the wing tanks just above the bottom of the tank to provide a sump area in which small quantites of water and sediment could accumulate without entering the engine. These impurities are generally removed during each periodic inspection.

But consider the following situation. The aircraft has not been in use for a long period of time, parked outside or under cover. Moisture has collected in partly filled tanks and settled at the bottom. There is not enough water to reach the fuel lines while the plane is in level flight (Fig. 2) but on the first turn, after take-off, especially if the turn is poorly co-ordinated, water will enter the lines (Fig. 3) and cause the engine to stop.

Interesting? Yes!

A preventable situation? Of course!

Simply drain wing tank drains as well as the sediment bowl. It's as easy as that. For maximum peace of mind, install quick drains on wing tanks.

The insurance executive who made the experiments described here took his mock-up to Washington. There aeronautical engineers and engine experts asked for an actual test in a commonly used, very popular aircraft. The experts watched in amazement as the executive poured three gallons of water into a half-full fuel tank. After a few minutes the fuel strainer (gascolator) was checked for water. It was necessary to drain ten liquid ounces (a soft drink bottle full) before any water appeared in the strainer bowl of this aircraft! Since this aircraft was equipped with a tail-wheel, a second test was made. In the second test the same aircraft had the tail raised to simulate later models with tricycle gear and the fuel system cleared of water. Then one gallon of water was added to a half-full fuel tank. Only clear gasoline appeared at the sediment bowl. More than a quart of fuel was drained this time, before any water appeared.

In both tests about nine ounces of water remained in the fuel tank after the belly drain and gascolator strainer had ceased to show any trace of water. This residual water could be removed only by draining the tank sump area! Engineers noted with interest and concern, two highly significant findings from these two brief tests: Water introduced into fuel tank did not flow down the fuel line into strainer and did not drain to the low point in the system! It was necessary to drain fuel tank sumps in order to remove all water from the tank. It appears that one or two drops of water put into the top of a fuel line will penetrate the tubing full of gasoline. But greater quantities fail to do so and seem to follow the fuel to the carburettor!

Involved in this phenomenon are physics too complex to explain readily. Capillary action seems to be the chief factor. Surface tensions of varying fluids may also enter the picture. But the point pilots are most concerned with, is the uncertainty that fuel lines are free of water contamination until tanks and sediment bowl are checked.

Statistics may soon reflect a decrease in those abrupt engine stoppages — a satisfying percentage at least!

The airlines learned the lesson a long time ago. Regulations require that all fuel tanks sump areas must be drained and checked for water whenever the airliners are refuelled. As a result, no accidents due to fuel contamination have been reported in airline operations.

FIG 1.

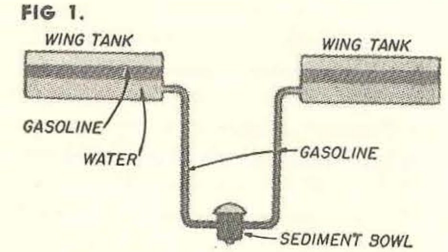


FIG. 2.

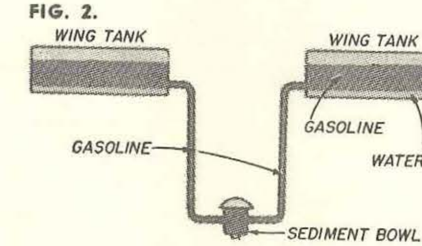
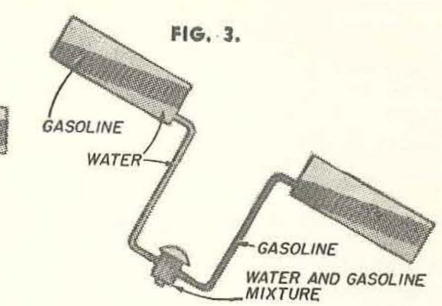


FIG. 3.



Comment

The author's remarks about regular checking of fuel tank drain points are heartily endorsed. In fact, of course, it has for many years been a requirement in this country that tank drain checks be carried out daily and also after each refuelling and Air Navigation Order 20.2 covers these matters.

It is also an Australian requirement that all aircraft fuel tanks be completely drainable in the normal ground attitude and that the drain points be fitted with convenient valves or cocks to facilitate the regular water checks and this requirement is dealt with in Air Navigation Orders Section 105.1.0.1.13.

It is unfortunate that there are a few models of light aircraft of overseas manufacture with bag type fuel cells in which the introduction of drain cocks is impracticable owing to the difficulty and cost of the modifications which would be involved. In several cases the Department has accepted the use of a larger-than-normal fuel line filter as an alternative means of compliance with the Air Navigation Orders, for want of a better solution.

The foregoing article clearly shows that pitfalls may be inherent in fuel systems which rely purely on filter drainage for the detection of fuel contamination. Owners of aircraft in this category, therefore, would be well advised to ponder the lesson and make a practice of drawing relatively large samples from the filters when making their water checks.

Accident By Practice

(Extract from Pilot Safety Exchange Bulletin)

It is ironical that many accidents happen while practising procedures designed to prevent accidents.

(Although the following article refers to military aircraft, it has equal application in the operation of civil aircraft—in which case the IP (Instructor Pilot) might well be a Check Pilot, and the student pilot actually a pilot, co-pilot, First Officer or even a Captain, any of whom are given refresher training and/or proficiency checks from time to time. But whether military or civil, the objective is the same: greater safety in flight through pilot performance.)

The bird was taxied around for another take-off. The student pilot was in the left seat, listening as the instructor pilot explained techniques and procedures, the do's and don'ts, the good points and the bad of the new aircraft.

As we rolled onto the runway for the next take-off, the IP remarked, "You'll find good performance and no particular problem on partial engine work — traffic pattern with two out should be no sweat at this weight." The stage was set for an "accident by practice".

We took off. Shortly after breaking ground the IP signalled the flight engineer to cut one engine. The student pilot went through his newly learned emergency procedure and continued to climb. Prior to reaching traffic pattern altitude, the IP signalled for a second engine to be cut — no problem, same procedure. But as he turned on cross-wind, the pilot found he was having trouble holding airspeed and reaching traffic pattern altitude. In fact he was still a few hundred feet short. Observing the difficulty, the IP said to the engineer, "Bring those engines back in to 18 inches; we'll simulate there."

The IP went on to explain technique to the student as the aircraft was turned downwind. It soon became apparent, however, that 18 inches was not going to suffice, and so the IP confidently said, "Bring 'em up to 22 inches". He then went back to instruction . . . with little thought that Rome was burning. In an instant, the IP broke off with, "Better make it 24 inches," and finally, "Make it 26."

At this point the so-called student pilot was having considerable difficulty holding a safe airspeed, and altitude was being compromised in an effort to pick up the lagging airspeed. Indeed, all was not well. In rapid succession came the IP's order, "Rated power, all four." Then, "Max power!"

But we were still losing altitude and holding just above a stall! A frantic check by all on the flight deck disclosed the impossible. With our power settings the aircraft should have been heaven bent. The feeling in the cockpit was one of complete disbelief. Instead of being upward-bound, we were 200 to 300 feet above the ground and in a rapidly deteriorating situation. Flaps were milked down to buy a few extra seconds. A crash in a populated area seemed certain.

Then came a flurry of hands, the engineer's, and a moment of silence. The airplane seemed to hang in the air. Then came a surge of power followed by what could only be described as the climb of that proverbial homesick angel.

What had made the bird act like a reluctant dragon? Mixtures! An experienced crew had failed to note that two mixtures were in the idle cut-off position! The airplane could have made it despite two dead engines, but not with two dead wind-milling engines absorbing much of the output of the two operating engines.

While this practice-induced emergency situation involved a four-engine transport, it — or a situation equally serious — can happen to any aircraft. The words may be different but all too often the tune is the same.

A multi-jet military aircraft crashed when instrumentation differences, unfamiliar to the student pilot, compounded a practice unusual-position recovery to the point where aircraft limitations were exceeded and control lost.

Similarly, a plane was lost when its crew practised emergency procedures at low level — too low to permit a correction of a mistake — use of a wrong switch.

A helicopter pilot practising autorotation landings went in when the engine failed as he tried a power recovery.

Here's one from another accident report: "The IP was over-confiident of the aircraft commander's ability to make a practice no-flap landing." Too late the instructor pilot noted the captain's too low approach.

In another instance, the pilot of a small jet on a simulated flameout approach came in too low, too slow, and the check pilot was too late on the power. Result — one washed out jet trainer.

In still another instance, the crew of a twin-engine (reciprocating) medium transport goofed on an engine-out practice manoeuvre and the aircraft crashed from low altitude.

All these accidents have one thing in common: In each case the emergency-procedure practice plus an additional factor or factors led to trouble. Known accident causes in this category are numerous and many unexplained accidents undoubtedly fall in this same category. It is ironical that many accidents happen while crews practice procedures designed to prevent accidents.

At first thought, we might take either the "we-should-have-stood-in-bed" attitude or the "perhaps-we-could-do-better-from-the-flying-safety-standpoint-if-we-refrained-from-emergency-procedure-practice" point of view. I think we all agree, however, that practice under controlled conditions should be a better, or at least a safer, way to gain experience than the old familar school of hard knocks.

Emergency-procedure practice is necessary. Therefore, if we are to reduce the accident potential present during this activity, we must remove the additional factor or factors mentioned earlier as adding up to trouble. From experience and the study of accidents in this area, the following are additional factors which, when added to our practice situations, result in unnecessary risks:

Complacency

Lack of an adequate margin of safety

Working beyond experience level

Instructor-student or check pilot-pilot relationship

The short fix for these risk magnifiers is alertness, judgment, knowledge, and understanding. But let's delve more deeply.

First, complacency: This old bugaboo always seems to be close at hand. The more time we log in a particular aircraft, the easier (or so we think) the manoeuvre; and the greater the simplicity of the equipment, the less alert we tend to become. It seems that often the most hazardous pursuits are accomplished in the safest manner because everyone is on his toes. In this flying business you can't be too alert.

An answer to the complacency problem is a check and double-check attitude. Following the thought pattern of a student demands a check and recheck on the part of an instructor or check pilot. A second look would have prevented that wheels-up landing, for example; or a second look would have caught that fuel selector on the low front tank.

As far as lack of adequate margin of safety is concerned, this factor falls in the judgment area. Limitations must be established if risk is to be minimized. To let a student or a simulated emergency manoeuvre go too far is to be out-manoeuvred by fate. The possibility of a real emergency compounding a simulated situation into double trouble is always present and should be taken into account in the choice of adequate margin of safety.

Deliberately getting into dangerous positions in order to practise getting out of the difficulty is like practising parachute jumps or other pursuits which must be done correctly the first time. It is always nice to have safely experienced in practice any difficulty you may find yourself in. However, safety is the keyword and judging from the statistics, all training-induced situations cannot be put in the safely experienced category. Here's where we need good judgment.

Next is the beyond-experience-level factor. Too often a pilot, student or otherwise, is forced to run long before he has learned to walk. He is expected to perform complicated manoeuvres before he has completed the fundamentals. The "student" should have ample time for familiarization and should receive adequate experience on normal procedures before being subjected to unusual situations or trying them out himself, perhaps in an aircraft relatively new to him. When a pilot is at home in the cockpit environment, the emergency procedures training or check may be started. He can then understand them and will not be merely going through the motions.

An instructor should make a point of knowing the skill level of those he is instructing. Working in areas too far advanced for a student's experience level is often both dangerous and a waste of time. And check-training even an experienced pilot on new and unfamiliar equipment can be dangerous if manoeuvres go beyond the basics he knows.

The value of ground instruction in the actual equipment or in simulators cannot be over-emphasized. To have that feeling of "lost in the maze of gauges, levers and switches" minimized prior to actually flying, and to be able to crash in safety in a simulator are experience "extras" we should take advantage of.

Last, the instructor-student (or check pilot-pilot) relationship. There often are factors present in this relationship which are potential sources of trouble. They are complex in that they have to do with frame of mind, conflicting areas of understanding, and the fact that things often appear differently to the expert than they do to the pilot inexperienced or new to the particular type of equipment.

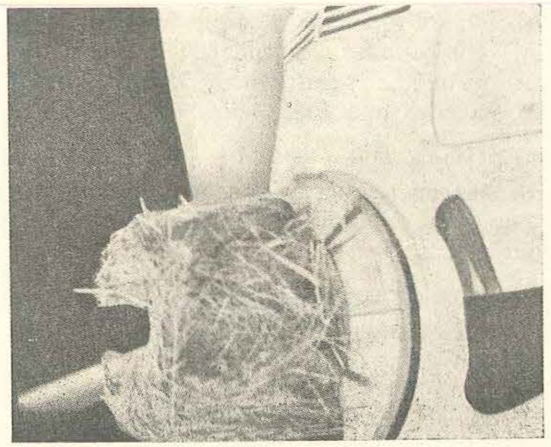
Why does an experienced pilot, during a standardization check, take an unexplained action? Psychologists are still trying to reason out this kind of problem. An instructor or check pilot must understand that even an experienced pilot may get "checkitis". If the check pilot fails to understand this, he's in for trouble.

That "I thought you had it" situation frequently arises when a check pilot or an IP is present. It is just one of many areas of misunderstanding. Another is the student pilot too often relies on the instructor to keep him out of trouble, and the instructor too often gives the student credit for being able to keep out of trouble.

Frequently, the most obvious facts to the instructor or the check pilot are points of confusion to the pilot who is supposed to be doing the learning. No matter how simple a manoeuvre or procedure may seem to a check pilot or instructor, it's a good idea to make sure the "student" has complete understanding.

Shall we control these "additional factors" which, when added to emergency-procedure practice, result in risk? Or shall we keep breaking up aircraft and pilots in practice undertaken to prevent accidents?

Add alertness, judgment, knowledge and understanding to emergency procedure practice . . . and get the flying safety results practised for!



Watch the BIRDIE

The bird's nest in the picture was discovered during pre-flight inspection of a Beechcraft Bonanza. The aircraft had not been flown for six days. Had the bird used shorter raw material so that none protruded from the blade cutouts in the propeller spinner, the nest might have gone unnoticed.

It takes a chicken 21 days to hatch an egg, and a turkey 28 days. Thus it would seem the harder the mother hen sits (or sets) on the egg the longer it takes to hatch. From this we wonder how long it would take to hatch the bird egg at the loads encountered in the spinner at the cruising r.p.m.

Remember that an extensive bird nest construction programme has been placed in effect by the local bird population. The rapidity of construction from raw materials to finished product is amazing. Pilots and maintenance personnel must be particularly meticulous in conducting inspections.

(Beech Aircraft Corporation "Safety Suggestions")

A LITTLE MISTAKE

Many times the difference between having an accident and not having an accident is too small to measure. This difference can be a fraction of a second in time, a slight hand movement that was omitted, a dial that was glanced at and misread, a statement that was made unknowingly and erroneously.

Examples

The altimeter setting given as 30.40 instead of 29.40.

The gear handle that was not lowered.

The procedure turn on the wrong side.

The homer that was not identified, or was mistakenly identified.

The controller who said "left" when he meant to say "right".

Every now and then the "straw" that breaks the airplane, and frequently those in it, is one that has been done correctly and routinely hundreds and hundreds of times .The gear-up landing accident is a classic in this category.

But this problem is known and accepted — though not always respected. Because of this we have check-lists, simulated emergencies, periodic proficiency checks, questionnaires and other devices designed to train aircrew members to **ALWAYS** do the right thing.

And still we have accidents, because of one little mistake.

Must we accept such accidents as an irreducible minimum? Have we reached the ultimate in perfection on the part of the human component? There are arguments that we have.

Consider the housewife for example. She knows that the burners of her stove are hot and if she touches a burner she will be burned. On the average, the housewife works around these hot burners three times a day, every day of the year. She has a strong incentive never to make a slip — pain; and she has enough training to make her an expert. Still, the housewife burns her fingers. She makes but one little mistake and pays the penalty.

There is one more situation of this kind we must consider because it is even more difficult to comprehend. This is the one in which two or more aircrew members make the same mistake. They misread the altimeter and fly into the ground on final or they all fail to notice the gear is not down, or they fail to identify the station tuned in on ADF or they think another crew member has the controls. In such cases, the workload can be shared, but the responsibility can't. In final analysis one person is as responsible as if he were flying alone.

The Non-Thinkers

Do such accidents have to be accepted? Do we have to continue to live with burned-fingered housewives, with crashed aircraft and aircrew fatalities?

NO! At least the price can be whittled way down from the one we now are paying. In virtually every case of this kind, there was **one common human failing. The individual was not thinking about what he or she was doing.**

All the supervisors, safety specialists and check pilots that can be crowded into a plane can never find all the accident-prone tendencies of an aircrew member. Supposition to the contrary, they are not psychic. All their conclusions are based on what they see or hear. When the pilot being observed lowers the gear handle, they have no way of knowing what his mind was thinking of at the time. They can see only the results. They can't be sure whether the action was a result of thought, habit, instinct, or whether he might even have inadvertently moved the handle while attempting to reach an itching ankle. They observe, then draw their conclusions based on their observations, never knowing for certain exactly what was going on in the mind of the person under observation.

Before ALL accidents can be prevented, there is one thing sure — the individual, whether housewife or pilot, has to think about what is being done, while it is being done, at all times.

If you are really safety conscious, there is another measure some employ with excellent results; **they think about the job before they do it.**

***(Extract from Pilots Safety Exchange Bulletin** 60-106)*

Food for Thought

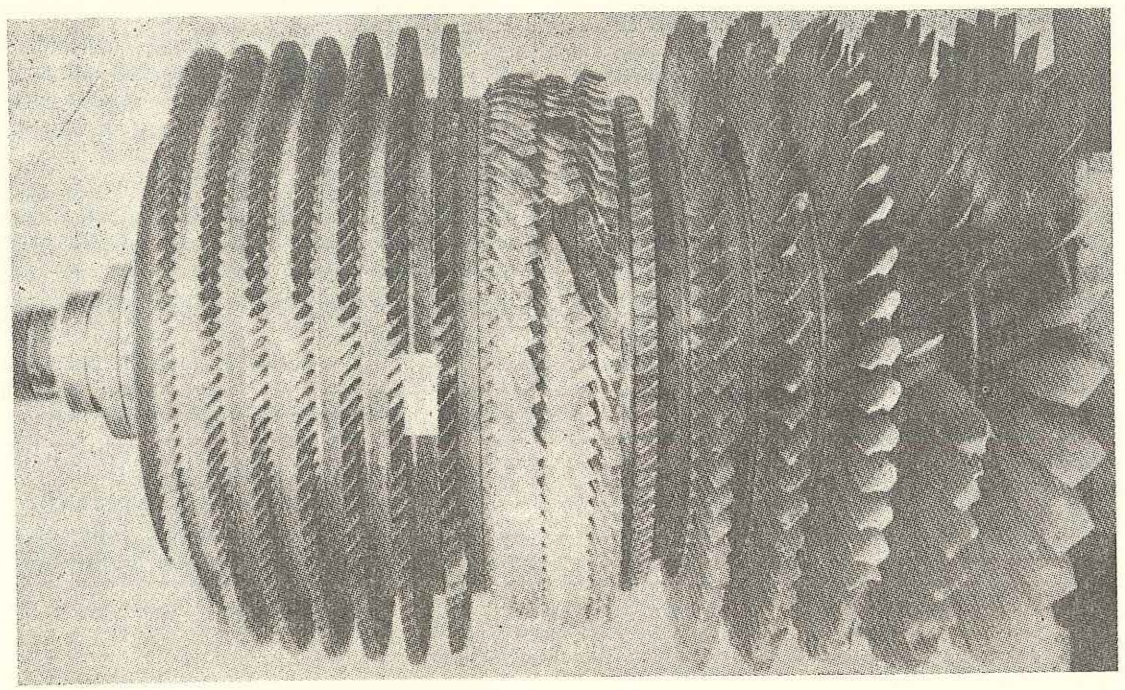
(Extract from Flight Safety Focus)

During cruise No. 3 engine was shut down because of vibration accompanied by a drop in r.p.m. and jet pipe temperature. After landing, part of a cabin services cardboard food box was found in the engine air intake pressed tightly against the entry guide vanes. The compressor blades were damaged and the engine was changed.

The aircraft had transmitted a station during the hours of darkness and during the transit the empty food boxes were placed on the platform of the steps at the crew entrance door. It seems that one piece of box was knocked or was blown into No. 3 engine intake.

When the engine was started the box pressed against the entry guide vanes and by partially blocking off the intake air caused the compressor to stall. The resultant high frequency vibration led to fracture in fatigue of a first stage rotor blade.

The photograph shows the extent of the resultant compressor damage. Approximate cost — £20,000.



Contents

Passenger Terminal — Adelaide Airport

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