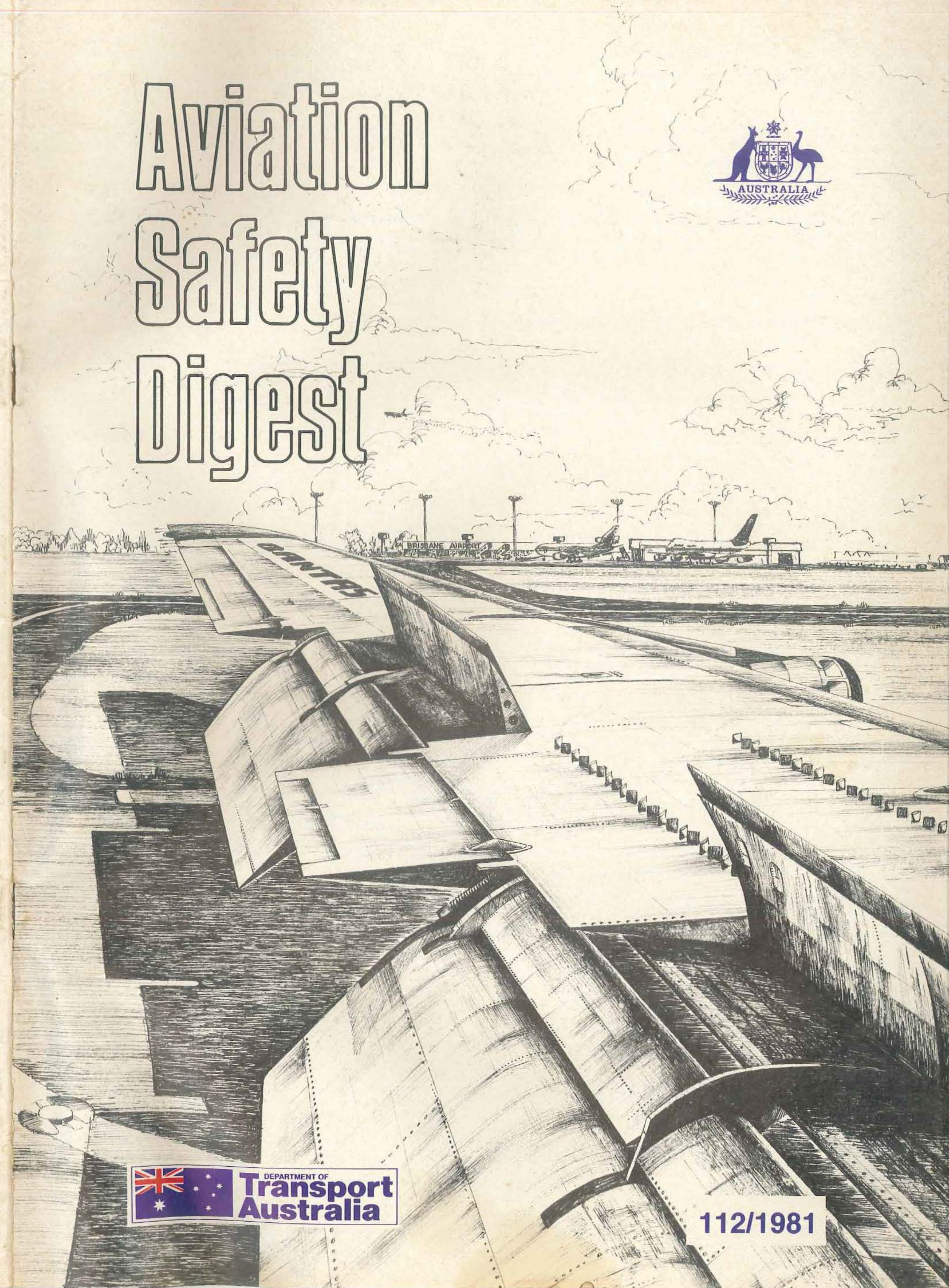
Aviation Safety Digest

AUSTRALIA



DEPARTMENT OF Transport Australia

112/1981

DEPARTMENT OF
Transport
Australia

Contents

Aviation Safety Digest is prepared by the Air Safety Investigation Branch and published for the Department of Transport through the Australian Government Publishing Service, in pursuance of Regulation 283 of the Air Navigation Regulations. It is distributed by the Department free of charge to Australian licence holders (except student pilots), registered aircraft owners and certain other persons and organisations having a vested operational interest in Australian civil aviation.

Readers on the free list experiencing problems with distribution or wishing to notify a change of address should write to:

The Publications Distribution Officer,
Department of Transport,
P.O. Box 1839Q, Melbourne, Vic. 3001.

Aviation Safety Digest is also available on subscription from the Australian Government Publishing Service. Enquiries and notifications of change of address should be directed to:

The Assistant Director (Sales and Distribution),
Australian Government Publishing Service,
P.O. Box 84, Canberra, ACT 2600.

Subscriptions may also be lodged with AGPS Bookshops in all capital cities.

Reader contributions and correspondence on articles should be addressed to:

The Assistant Secretary (Air Safety Investigation),
Department of Transport,
P.O. Box 1839Q,
Melbourne, Vic. 3001.

RM79/30212(1) Cat. No. 80 3259 X

Printed by Ruskin Press, 552-566 Victoria Street, North Melbourne, Victoria.

Front cover
Wing of a Boeing 707 *(Matthew Tesch)*

Back cover
Hang-glider built and flown by Otto Lilienthal in the 1890s *(Cheryl Poon)*

Systems knowledge — oxygen equipment

Continuing on from the article in *Aviation Safety Digest 105* on physiological aspects of high altitude flight, this article discusses the use and care of oxygen equipment and is intended to provide an insight into the requirements for the use of oxygen, the types of oxygen equipment available and some general rules for oxygen safety. It is by no means a complete treatise on the subject and should only be considered as a starting point for further study.

But first, a brief review of the effects of reduced atmospheric pressure on the concentration of oxygen in the blood to illustrate the reasons for the various features of oxygen systems and the limitations placed on some systems.

The critical factor in the prevention of hypoxia is the **alveolar oxygen tension**, i.e. the oxygen pressure within the air sacs of the lung where oxygen crosses the lung/blood vessel barrier and moves into the blood stream. At sea level in the standard atmosphere this pressure is 103mm Hg and is a function of the partial pressure of the oxygen in the inspired air. Because the atmospheric pressure, and therefore the oxygen partial pressure, decreases as altitude increases the alveolar oxygen tension will also decrease.

This progressive reduction will, initially, have little effect on human performance. But a point is reached where the pressure falls to a level too low to maintain a sufficient blood oxygen concentration and the first effects of hypoxia appear. At altitudes below 10 000 feet these effects are mild and acceptable, but above this altitude human performance degrades very rapidly and the use of supplementary oxygen is essential.

The object of breathing supplementary oxygen is to increase the concentration of oxygen (and oxygen partial pressure) in the inspired air to maintain the alveolar oxygen tension at a safe level. In this manner, sea level alveolar oxygen tension can be maintained to about 33 000 feet, above which it falls progressively, even when 100 per cent oxygen is breathed, and a point is reached where the oxygen must be delivered under pressure.

Oxygen systems

Oxygen systems are designed to deliver a concentration of oxygen to maintain at least a defined minimum alveolar oxygen tension with increasing altitude. The demands placed on oxygen systems to achieve this are, in general, prescribed by the altitude to which they are used. Accordingly, three distinct types of system have evolved. These are: **continuous flow** (for use up to 25 000 feet), **demand** (for use up to 40 000 feet) and **pressure demand** (for use above 40 000 feet); although there are concessions on the use of demand equipment above 40 000 feet, and continuous flow equipment is approved for passenger use above 25 000 feet.

Oxygen systems in general use consist of three main components: a **store of oxygen**, a **regulator** and a **mask**. Each is connected by appropriate plumbing and delivery hoses.

Oxygen storage

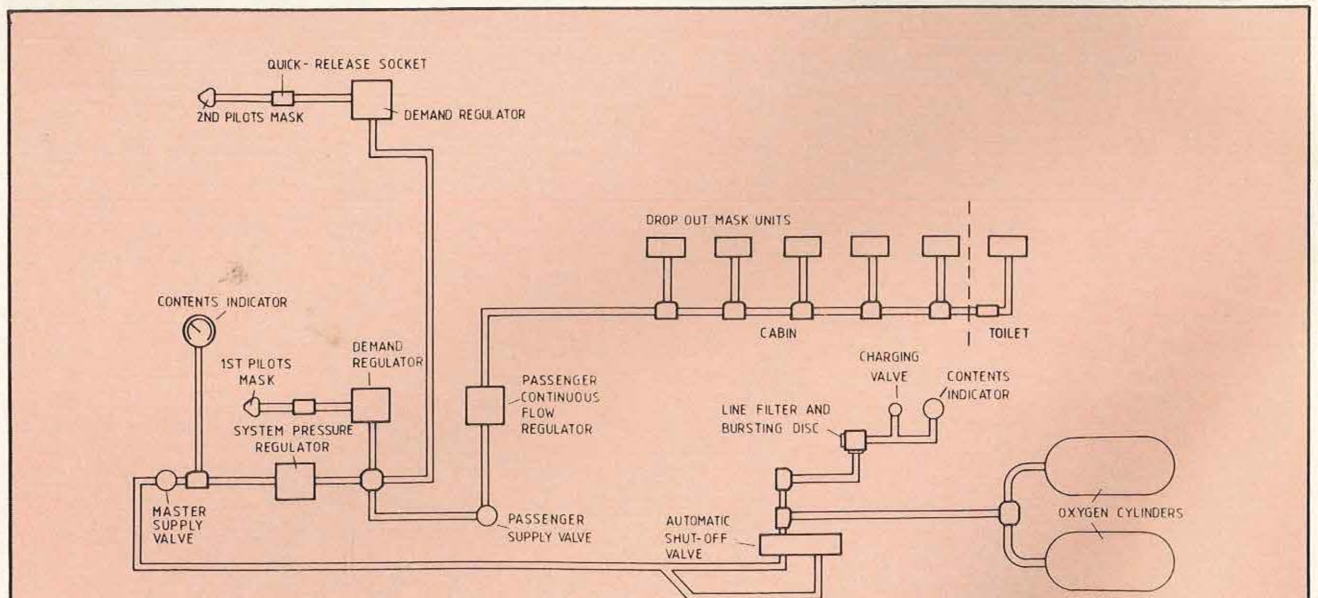
Most aircraft that operate routinely above 10 000 feet are fitted with a gaseous oxygen supply system. The oxygen is stored in high pressure (12 400 kPa) cylinders and is delivered at reduced pressure through appropriate plumbing, pressure reducers and check valves to the regulator and then to the mask.

Passenger supplementary oxygen in some modern aircraft is generated chemically. Small chemical generators supply the oxygen in a continuous flow to the mask in the event of a pressurisation failure, to provide protection against hypoxia for the passengers while an emergency descent is made.

Oxygen regulators

The following descriptions of the three types of oxygen regulators — continuous flow, demand and pressure demand — are of a general nature to provide an understanding of the principles and application of the different types. For detailed information concerning a particular installation, reference should be made to the appropriate operating instructions for that installation.

Continuous flow. In most continuous flow systems the oxygen is delivered from the regulator in a continuous flow to an inflatable storage bag attached to the mask. As the user inhales, oxygen in the storage bag is transferred to the lungs and



OXYGEN SYSTEM-SCHEMATIC.

Continuous flow oxygen system — typical operation

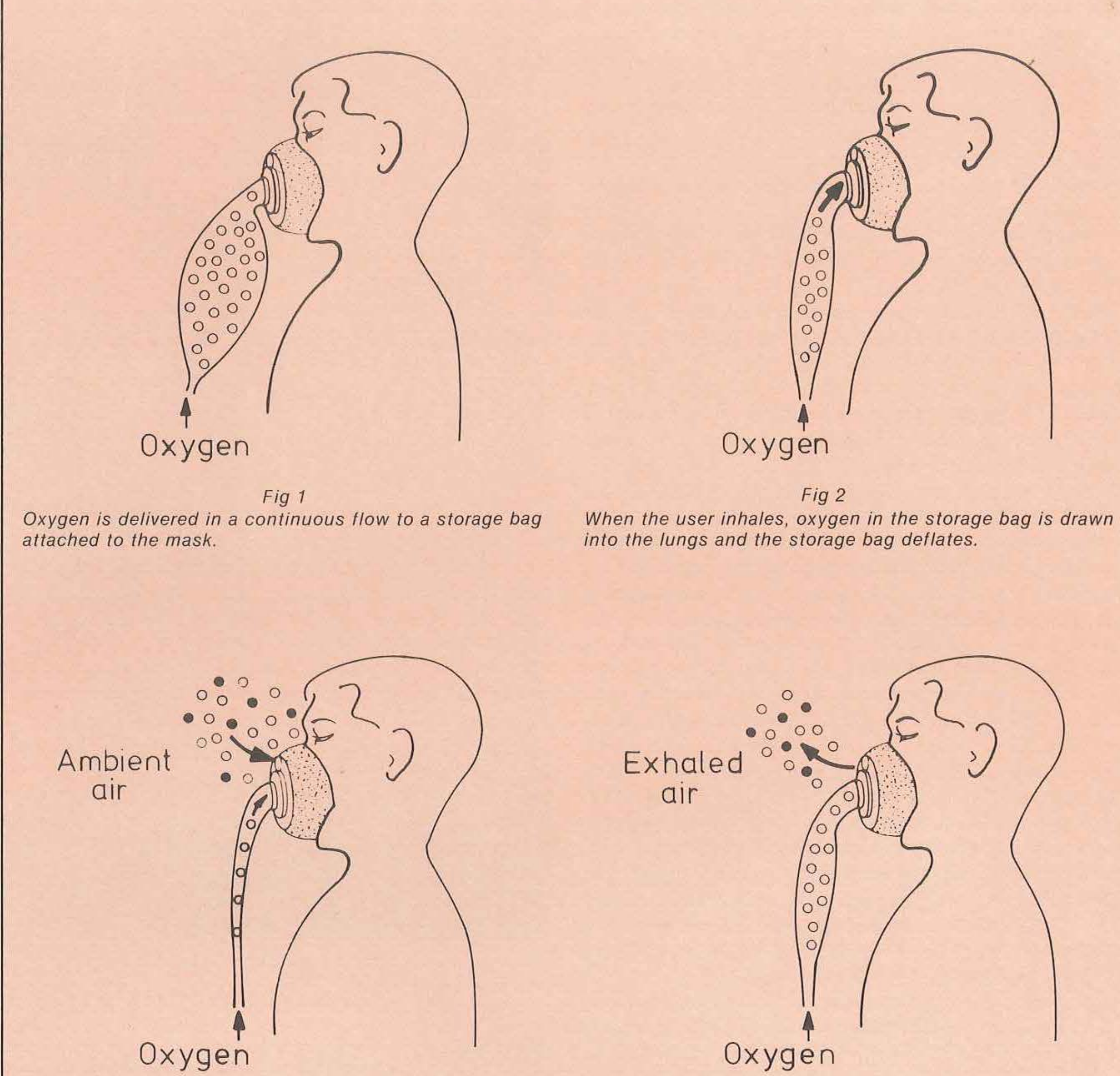


Fig 1
Oxygen is delivered in a continuous flow to a storage bag attached to the mask.

Fig 2
When the user inhales, oxygen in the storage bag is drawn into the lungs and the storage bag deflates.

Fig 3
Continued inhalation then draws in cabin air to satisfy lung capacity and to achieve economy in the use of oxygen.

Fig 4
When the user exhales, used air is expelled and the storage bag re-inflates.

the bag deflates. Continued inhalation then draws cabin air into the mask through holes or an inlet valve in the mask to satisfy lung capacity and to achieve economy in the use of oxygen.

When the user exhales, the storage bag starts to inflate again and the used air is expelled. Some masks allow mixing of some of the used air and incoming oxygen in the storage bag during exhalation. The exhaled air contains a significant amount of oxygen, and rebreathing helps reduce the waste of oxygen by allowing a lower flow rate from the regulator. The concentration of oxygen in the lungs (and therefore the alveolar oxygen tension) is determined, among other factors, by the amount of oxygen in the storage bag before inhalation which, in turn, is a function of the flow rate from the regulator and the user's breathing rate. In some systems the flow rate is progressively increased with altitude to compensate for the progressive reduction of the oxygen partial pressure — this achieves an economy in the use of oxygen at lower levels. Automatic systems incorporate a barometric control that senses cabin pressure altitude and automatically regulates the flow rate to the requirement for that altitude, while manual systems require the pilot to set the cabin pressure altitude with the altitude controller on the regulator.

Continuous flow systems cannot provide additional oxygen flow to cope with extra demand due, for example, to an increase in activity or differing individual needs. Consequently, many are designed to deliver an excess of oxygen to ensure that an adequate concentration is always available.

Continuous flow systems are the type most commonly fitted to piston engine general aviation aircraft and passenger oxygen supplies of other aircraft. They are approved for use by flight crew on flight deck duty to 25 000 feet.

Demand systems. For flight above 25 000 feet flight deck crew must be provided with demand equipment.

Demand regulators — also referred to as diluter demand — deliver a mixture of oxygen and air when the user inhales, and automatically match the amount of the mixture delivered, to the demand. A slight pressure reduction in the mask and delivery tube on inhalation opens the regulator demand valve and oxygen flows. When the user stops breathing or exhales, the demand valve closes and the oxygen flow stops.

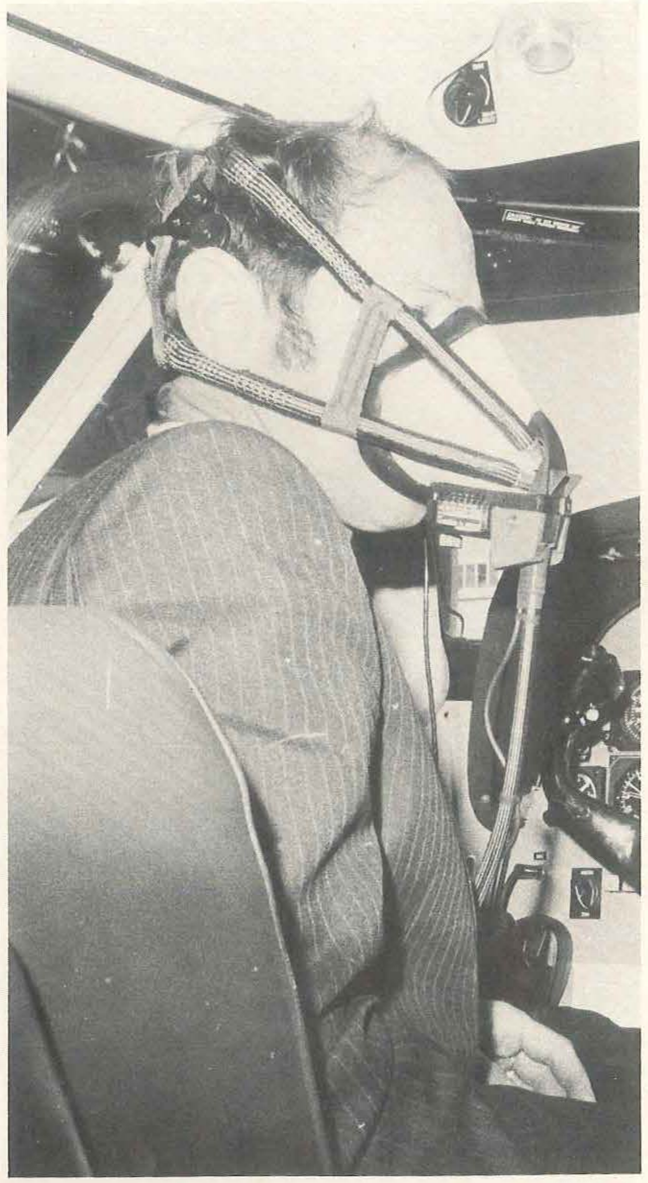
In conventional demand systems the oxygen to air ratio delivered by the regulator is controlled automatically by a barometric capsule. From sea level to near 10 000 feet the regulator, if used, would deliver only air. Approaching 10 000 feet (normally at about 8 000 feet) oxygen flow starts and the oxygen to air ratio increases progressively with altitude until, at about 30 000 feet, 100 per cent oxygen is being delivered. One hundred per cent oxygen can be selected at any altitude. When this selection is made the air mix valve in the regulator is closed and only oxygen is delivered when the user inhales. This function is useful when smoke or fumes are present in the cabin.

Demand systems may be used up to 40 000 feet. Such systems are often approved for aircraft certified to operate above 40 000 feet, but such an approval is based on design and operational characteristics of the aircraft.

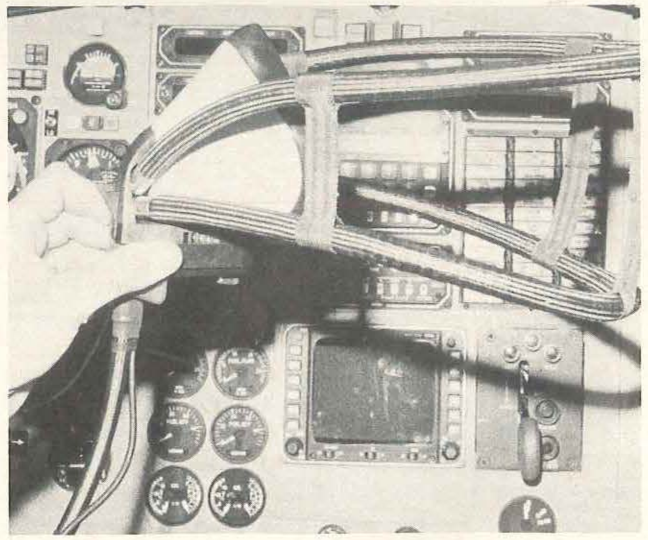
Pressure demand regulators. For flight above 40 000 feet an aircraft may be required to be fitted with pressure demand equipment. Pressure demand regulators function in the same manner as diluter demand regulators at the lower levels where pressure breathing is not required, but start to deliver oxygen under pressure soon after the air mix valve closes. The delivery pressure increases automatically with altitude to a maximum of about 30mm Hg above cabin pressure — the maximum that can be effectively tolerated without the application of external counter-pressure to the head and chest.

Pressure breathing systems are normally used in aircraft in which a rapid loss of cabin pressure could occur at high altitude. Their function is to protect the flight crew from hypoxia while an emergency descent is made to a lower level where pressure delivery is not required.

Pressure breathing is a difficult and tiring exercise. It is an unnatural mechanical process that must be consciously controlled. Inhalation requires conscious muscular effort to control the volume and flow rate of oxygen as it is forced into



Modern pressure demand system incorporating the mask and regulator in combination.



Rapid donning facility is achieved by inflating an expanding harness with oxygen.

the lungs by the regulator. Further muscular effort is then required to exhale and hold against the delivery pressure until ready for the next breath.

Pilots of aircraft fitted with pressure delivery systems should undergo training and experience decompression and pressure breathing before flying at high altitude. Courses are conducted by the RAAF Institute of Aviation Medicine at RAAF Base Point Cook, Victoria. Details may be obtained by writing to:

Director,
Vic/Tas Region,
Department of Transport,
PO Box 1733P,
Melbourne Vic. 3001.
(Attention OFAO)

or by telephone: (03) 667 2420.

Pressure breathing systems require a good mask-to-face seal. Any outward leakage will reduce the oxygen pressure in the mask and lungs, and may also make it impossible to stop the flow of oxygen between breaths.

Oxygen masks

Oxygen masks vary in style from lightweight plastic disposable masks for use with continuous flow systems to complex units incorporating the regulator, inhalation and exhalation valves, microphones and special harnesses to facilitate rapid donning. Regardless of their complexity, the purpose of the mask is to cover the nose and mouth and deliver oxygen to the lungs. Pilots must be as familiar with the procedures for the use and care of the mask as they are with the rest of the oxygen system. Masks designed for use with demand and pressure demand regulators need particular care and protection to ensure their serviceability. A small amount of dirt in the outlet valve, for example, can prevent the operation of the regulator through inward leakage, or cause an outward leakage under pressure.

Servicing and maintenance of oxygen systems

Oxygen installations are potentially dangerous if improperly installed or poorly maintained. Any equipment that is unserviceable or shows evidence of inadequate or improper maintenance should be repaired or replaced.

Aircraft oxygen systems should be serviced only with oxygen produced to an approved specification. The specifications (listed in ANO 108.26) prescribe the maximum acceptable concentrations of specific impurities and specify cleanliness standards for storage and handling equipment.

Refilling of oxygen systems should be conducted only by a properly qualified person. The servicing equipment should be approved and it must be scrupulously clean. Most hazards in oxygen systems occur because of the use of dirty recharging equipment resulting in the entry of dirt and contaminants to the aircraft system.

Considerations on the use of oxygen

Before using any aircraft oxygen installation the pilot must study the operating instructions for that equipment and be thoroughly familiar with its operation. The following comments relate to the use of oxygen systems in general.

- Ensure that the installation has been properly serviced and contains enough oxygen for the intended flight.
- Conduct a thorough preflight inspection of the system — including masks. Use a checklist if one is available.
- Ensure that all components of the system are compatible. There are different types of hose connections for continuous flow systems and not all are compatible. Incompatible items cannot be joined without the use of force. *Do not use force.*
- Ensure that the equipment is ready to use and is accessible so that it may be quickly donned and operated in an emergency. You cannot maintain adequate oxygenation during a loss of cabin pressurisation by holding your breath! Only a timely application of supplementary oxygen will prevent the rapid onset of hypoxia and possible loss of consciousness. Remember, the period of useful consciousness following rapid loss of cabin pressure at 30 000 feet is only about one minute on the average, and can be substantially less in some cases.
- Brief your passengers on the use of oxygen before flight. Describe the symptoms of hypoxia to them and brief them to be alert for those symptoms in one another.
- Do not smoke or permit smoking when oxygen is in use. In an oxygen-rich atmosphere combustion is accelerated dramatically and many materials that will not normally ignite burn readily.
- Ensure a proper mask seal, particularly with demand and pressure demand systems. An inward leak will cause excessive dilution of the oxygen and may prevent operation of the demand valve. An outward leak will reduce mask pressure during pressure breathing. Beards and improper adjustment of mask retaining straps impair mask-to-face seal, and dirt may prevent mask inlet and outlet valves from seating properly.
- Monitor oxygen flow indicators. Remember that the ability to breathe from a regulator does not guarantee that oxygen is flowing. Some systems allow the user to continue to breathe after a failure of the oxygen supply. Again, study the operating instructions for the equipment and know the indications of correct operation.
- Periodically check hose connections and system contents, and check your passengers and their oxygen equipment.
- As soon as possible after a cabin decompression check that your passengers are receiving oxygen and supervise them during the time oxygen is in use.
- Ensure that the oxygen is turned off when not in use. With high concentrations of oxygen the risk of fire increases dramatically. The danger is normally associated with oils or grease, but in a recent overseas incident, cheese in a crewmember's sandwich ignited when it was exposed to oxygen flowing from a mask. (There are also several

recorded cases of burns suffered when lip balm ignited spontaneously under an oxygen mask).
• Before flying above 10 000 feet understand the physiological requirements for the use of oxygen.

Departmental requirements and specifications

Departmental requirements concerning the provision and use of oxygen, and the specifications for oxygen equipment for operations up to 40 000 feet are covered in Air Navigation Orders. The requirements for oxygen systems intended for operations above 40 000 feet are determined individually according to the type of aircraft and operation.

Briefly, for flights in unpressurised aircraft above 10 000 feet oxygen shall be provided for, and used by, all flight crew on flight deck duty for the duration of the flight above that altitude. For flights in pressurised aircraft oxygen shall be provided for, and used by, all flight crew on flight deck duty for the entire time that the cabin pressure altitude exceeds 10 000 feet.

Pilots should be conversant with ANO Part 20 Section 20.4 before operating above 10 000 feet.

Details of oxygen systems and equipment specifications are contained in ANO Part 108 Section 108.26. While this information is mainly of a technical nature, pilots should be familiar with it for a full understanding of system specifications and servicing practice. Copies of this ANO may be obtained from:

Department of Transport (Attention EPSD)
PO Box 1839Q
Melbourne, Vic. 3001.

Conclusion

With the growing numbers of turbocharged and turbine engines in general aviation aircraft, more and more pilots are discovering the advantages of flight at levels that require the use of oxygen. Before embarking on such flights, pilots should be thoroughly familiar with the physiological effects of high altitude flight, including the cause and effects of hypoxia, and the effects of loss of cabin pressurisation. Similarly, they must have a thorough knowledge of the operation of the oxygen system in their aircraft.

Properly used, an oxygen system will allow great flexibility and economics in the operation of your aircraft. On the other hand, improper use or inadequate knowledge of your oxygen system could spell disaster ●

Review of free distribution list

In *Aviation Safety Digest 111/1980* we asked recipients of the Digest who are not holders of an Australian flight crew or maintenance engineer licence (or one of the other categories entitled to a free copy), to respond to a questionnaire and confirm their wish to remain on the Digest free distribution list. We also invited all readers to comment on the format and content of the publication.

The response to the invitation to make comments or suggestions was particularly gratifying. At first we attempted to reply individually to all those responses, but the task soon became overwhelming.

We plan to publish a brief analysis of the responses in *Aviation Safety Digest 113*. In the meantime, we wish to assure readers that a lack of personal acknowledgement should not be taken as an indication of indifference to their suggestions, and to express our appreciation to those who responded to the survey.

The free distribution list for Australian readers has been reviewed, and the amended list was used for the distribution of this volume of the Digest. However, for reasons undetermined, overseas readers did not receive Digest 111 until after the nominated closing date for responses. Consequently, the overseas list has not yet been reviewed ●

RAAF Diamond Jubilee lithographs

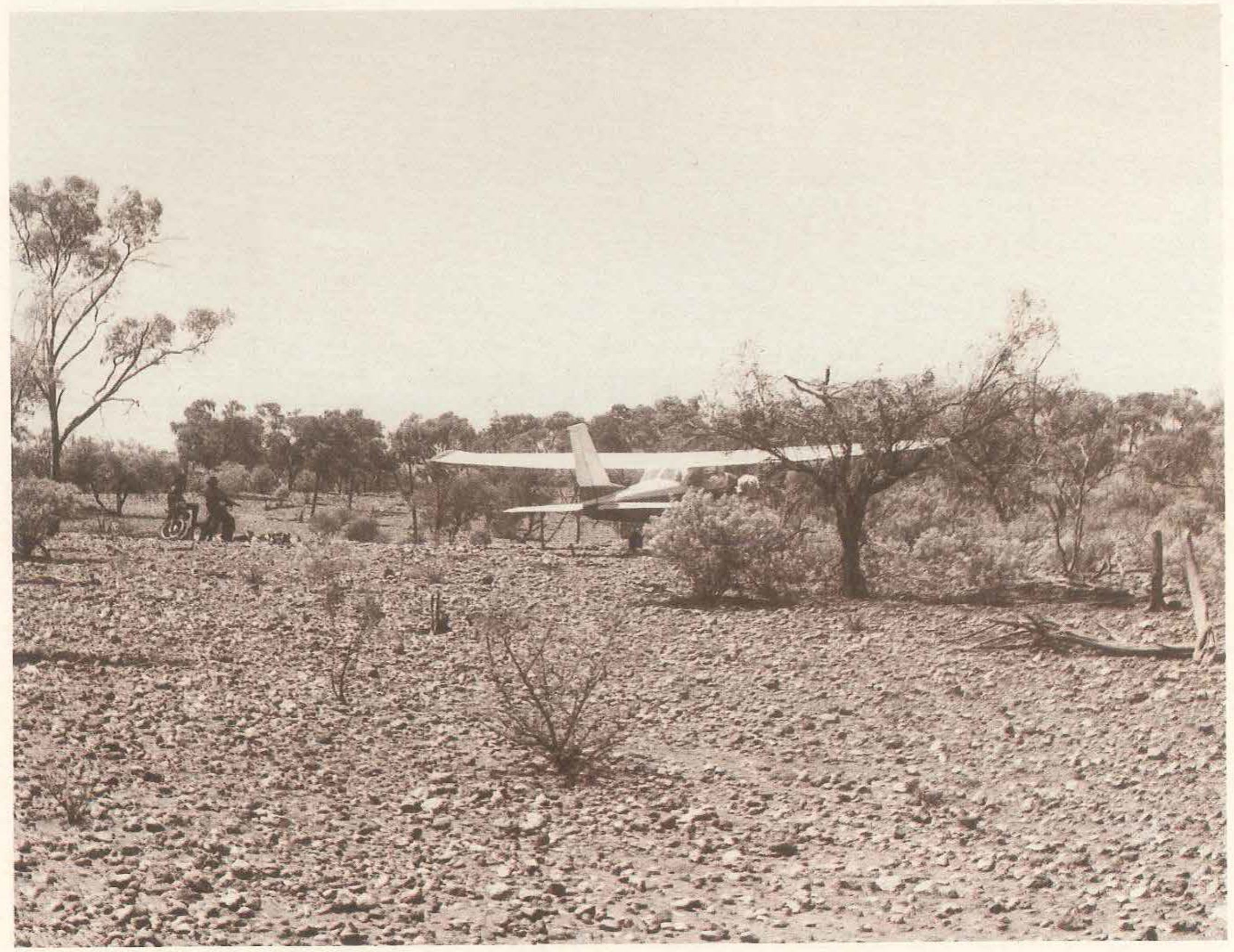
To commemorate its Diamond Jubilee, the Royal Australian Air Force has produced 16 lithographs of RAAF aircraft. The series is the first full-colour pictorial coverage of representative aircraft flown by the RAAF during its six decades of service to the nation.

The aircraft include the Avro 504K of the 1920s; artistic impressions on one lithograph of the Bristol Bulldog, Supermarine Southampton and Hawker Demon of the 1930s; the CAC Wirraway, Lockheed Hudson, Wackett Trainer, de Havilland Tiger Moth and Douglas Dakota of the 1940s; the GAF Canberra, CAC Sabre, CAC Winjeel of the 1950s; the Lockheed Hercules, GAF-CAC Mirage III-O and Bell Iroquois of the 1960s; and the Lockheed Orion and General Dynamics F111C of the 1970s. As a special bonus, the 1912 Deperdussin appears in colour at Point Cook for the first time.

The lithographs, which measure 42 centimetres x 30 centimetres, are ideal for wall mounting or framing. They could also be bound into a commemorative book as a fitting keepsake of an important milestone in RAAF history.

The lithographs are available in two sets of eight. Set One features aircraft from 1921 to 1951, and Set Two from 1951 to 1981. They can be purchased from Australian Government Publishing Service bookshops in capital cities for $4.00 per set, or ordered by mail from AGPS, P.O. Box 84, CANBERRA A.C.T. 2600 for $4.50 per set ●

Throttle linkage separation in flight — warnings ignored



The pilot was flying his own aircraft on a sheep mustering task when he was faced with a forced landing on unsuitable terrain. He was unable to regain power after closing the throttle. The engine was running at idle but operation of the throttle, which felt 'sloppy', had no effect on RPM. At that time the aircraft was at 500 feet above undulating terrain and the most suitable area for landing was a rough rocky upslope sparsely covered with trees and saplings. During the landing roll the aircraft was substantially damaged by the rough terrain and from impact with trees. The pilot and his passenger escaped injury.

Investigation showed that the throttle arm had separated from the drive shaft on the carburettor because the lock screw which clamps the arm to the shaft had worked loose. The lock wire had not been effective in preventing movement of the screw and had eventually broken due to working as the throttle arm rotated around the drive shaft.

The pilot had not opened the engine cowling since the last 100 hourly inspection. He had noticed some intermittent free play in the throttle control over the few days preceding the accident and had noted that rapid throttle movements were not necessarily reflected by rapid engine response. However, he had not considered there was anything mechanically wrong with the engine.

The loss of throttle control was contributed to by a design weakness rectified in later model carburettors which have a more positive connection of the arm to the shaft. In this case the pilot could have prevented the accident by investigating an abnormal indication. Although he had been aware of slackness in the throttle control for some 20 hours, he made no attempt to identify the cause.

Pilots must be alert for the appearance of abnormalities of operation in their aircraft. Early recognition and investigation of a developing fault may well prevent a disastrous failure ●

Be aware of the options

The pilot of a DHC-2 Beaver commenced superphosphate spreading operations early in the morning. He was operating from a good agricultural strip 3200 feet above sea level. The strip was some 800 metres long and the take-off run was down a one per cent slope. The surrounding terrain was rugged and heavily timbered.

By 0830 hours local time 10 flights had been completed. Conditions were good with nil wind and clear skies. Temperature was around zero degrees Celsius. Early in the next take-off run the pilot thought he detected a miss in the engine, but all power indications were normal and there was no vibration. About half way along the run there was a loud bang from the engine. The pilot closed the throttle, simultaneously applied full brake, and pulled the hopper lever to dump.

Brake effectiveness was reduced by the frosty grass surface and the pilot could see that he would not stop in the remaining distance. He briefly considered trying to swing the aircraft, but decided against this course of action as the sloping ground around the strip was covered with trees to one side and stumps and logs to the other. The complete load of 916 kilograms of superphosphate had been dumped by the time the aircraft had reached the end of the strip.

The aircraft continued off the strip and through a wire fence. After rolling 30 metres beyond the fence down a five per cent slope, speed had been reduced to walking pace. At this point fallen logs caused the aircraft to very slowly nose over on to its back. Several tree stumps penetrated the starboard wing as the aircraft nosed over, and the top of the rudder was bent. Other damage was minor.

The pilot released his harness and vacated the aircraft. He then noticed a fire in the exhaust manifold, so he retrieved the fire extinguisher from the cockpit and extinguished the fire.

A general outbreak of fire then occurred, fed by fuel that was now flowing freely from the fuel tank vent pipe outlet under the port wing. This intense fire destroyed most of the fuselage, the inboard sections of the wings and much of the engine before being brought under control with water pumped on to the fire with a hand pump. The port wing was destroyed when fuel vapour inside the wing exploded.

The cause of the engine malfunction was failure of number one cylinder head resulting in a partial power loss. The pilot briefly considered the possibility of dumping the load and flying a circuit; however, he discarded that option and decided to abandon the take-off because of the nature of the surrounding terrain. (If the surface of the strip had not been frosty the aircraft might have been stopped in the remaining distance without damage). Had he hesitated in rejecting the take-off, or elected to continue, a far more serious accident could well have resulted.

There is a lesson in this for us all — be aware of the options at all times. This not only reduces decision time should an emergency arise, but also leads to good decisions ●

Landing performance

After an uneventful travel flight on a late autumn afternoon, the owner/pilot of the Twin Comanche arrived over his farming property in south western Victoria. Two grass strips were available: one was 670 metres long and aligned north east/south west, the other was 550 metres long and aligned north west/south east. The windsock was indicating a light and variable breeze with a south westerly tendency.

Because there were cattle 'camped' on the long strip, the pilot elected to land towards the south east. As the aircraft approached to land the pilot thought there was also something on the closer end of that strip. On finals it was determined that there were two or three sheep there.

The aircraft crossed the fence at 80 knots with full flap down and the pilot added a little power to pass over the sheep. Touchdown was made at the intersection of the strips which left 369 metres available for the landing run. The pilot braked hard and the recently replaced brake pads did their job well. The wheels locked up and skidded along the wet grass surface which was very soft and 'greasy' from the 75 millimetres of rain which had fallen during the previous eight days. When it became obvious that the aircraft would not stop, the pilot applied power to the left engine to try and induce a ground loop. The aircraft veered off the strip to the right, struck a boundary fence and suffered substantial damage.

Following the accident the pilot indicated that he had considered a go around after touchdown but was concerned that the aircraft would not clear the power lines near the far boundary of the strip. He did acknowledge that a go around from the approach would have been the correct action.

A check of the landing weight chart from the aircraft flight manual revealed that, for a landing in the prevailing meteorological conditions on a level surface, the distance required was 488 metres. This is the distance required to bring the aeroplane to rest on a level, short-dry-grass runway from a height of 50 feet above the threshold following a steady approach to land, at a speed of 73 knots, with the aircraft in the landing configuration and maximum braking applied immediately after touchdown.

The ground roll, under ideal conditions, could be expected to be approximately 60 per cent of the above. Therefore, a realistic stopping distance on a level, dry surface would have been about 300 metres, not far short of the actual distance available.

Unfortunately, the strip was not level but had a downhill slope of about three per cent from the point of touchdown. The effect of the slope alone would increase the ground roll required to a figure in excess of that available; add a very wet grass surface and the pilot obviously had no hope of stopping the aircraft before the boundary fence.

The total required landing distance as given in the aircraft flight manual is in excess of 600 metres for a runway slope of two per cent downhill, the maximum given on the performance chart. Putting aside the fact that, in landing on a three per cent downslope, the pilot was operating outside the approved performance boundary for his aircraft, a runway slope of this magnitude would increase the landing distance to well in excess of 800 metres.

Once again a pilot did not give enough consideration to the landing performance of his aircraft. Had he consulted the performance charts and thought about the factors affecting the landing, his self protection responses should have alerted him to the degree of difficulty in achieving a satisfactory landing under the existing circumstances ●

Nesting places

The speed and tenacity of some birds when attempting to build nests sometimes needs to be seen to be believed. This first-hand report from a pilot illustrates the problem:

'Having left my plane, a Cessna 182-H, parked one Friday afternoon, I returned at noon on Sunday to find a note tucked under the door handle. It said: "Check your engine for myna birds. Found a nest in the 150 this morning." And written obviously later was the addendum, "3.15 pm, there is a nest in this engine."

'On peering into the ventilation opening beside the spinner, I could see the remains of a nest which our unknown friend had removed for us. There seemed to be more grass and sticks still remaining, enough to start a fire, so I pulled the top cowl off to get rid of the remains, and found yet another large nest on the same side back near the firewall; a mass of small sticks and grass. Prime fuel for a fire in flight!

'It took us nearly an hour to get rid of it all; if it had not been for a friendly and concerned fellow pilot we might very well have been in trouble. On leaving a note of thanks on his 150, parked nearby, I noted that he had a mosquito net barring entry for the mynas.'

The following extract from an incident report shows what can happen when the bird nest is not found before the engine is started.

'As the aircraft had not been flown for eight days, I wanted to ground run it before flying it the next day. I checked the fuel for water; inspected control surfaces, tyres, struts, pitot head and, finally, the engine and propeller — checking oil quantity and for foreign objects. All appearing in order, I started the engine and taxied to the run-up bay where I carried out a complete run-up and check of the radios and navigation aids. I noticed a faint smell during the run-up but assumed the source to be oil spilt around the engine. After I stopped the engine in the parking bay dense smoke appeared from under the cowls. I extinguished the fire and removed the cowls to find the remains of a bird's nest in the engine. The nest was concealed from my view at my pre-start inspection.'

Aircraft structures offer many attractive nesting opportunities for a variety of birds and winged insects, with the potential for causing serious accidents. These two accounts say enough about the fire potential of nests in engines. Other problems are encountered when bird or insect nests obstruct vents, pitot heads, cooling air intakes for electronic equipment etc. and interfere with flight control movement. A thorough before-flight inspection is always important. But in the nesting season or when the aircraft has been unattended for some time the importance of conducting a meticulous inspection, including a detailed visual check of possible nesting areas, cannot be over-emphasised ●

Cleaning and lubrication of landing gear

The malfunction of retractable landing gear continually appears as a factor in air safety incident and accident reports. This is particularly true in the case of general aviation aircraft operating from dirt or grass strips. Airworthiness Advisory Circulars, which are distributed to aircraft owners, operators and maintenance engineers, also regularly contain articles about problems associated with retractable landing gear. Because pilots are quite often responsible for ensuring the completion of the daily inspection, and are **always** responsible for the safety of the aircraft and its occupants, the following two articles from AACs are presented.

AAC 116-9, **Piper PA-31 landing gear downlock hook defects**, deals specifically with problems associated with the Piper PA-31 Navajo aircraft and malfunctions due to dirt preventing normal operation of the gear:

'Over the last two years there has been a spate of defects associated with the PA-31 main landing gear downlock system. The majority of defects resulted in air safety incidents. The basic cause of these defects was dirt ingress into the hook and rod end. Binding of the downlock hook assembly then prevents its proper functioning, which leads to rivets shearing in the downlock rod, cracking of the bearing boss, and, of course, faulty operation of the landing gear.

'Frequent cleaning and lubrication of the mechanism would eliminate these problems. Although the maintenance schedule requires it to be cleaned, inspected and lubricated at 100 hourly intervals, operators should check it more frequently if they are operating the aircraft in a harsh environment. A few minutes taken up by a check could well save much time and expense later on should the gear fail to operate correctly.'

Following the release of AAC 116-9 we checked the air safety computer records and surprisingly found that there were equally as many occurrences reported of PA-31 gear malfunctions following cleaning of the gear. The culprit this time was the lack of subsequent lubrication. This prompted us to reprint AAC76-3, **The good oil (or have you had any hangups lately?):**

'With the fitment of retractable undercarriages to an increasing range of general aviation aircraft types, there has been a steady increase in the number of landing incidents associated with undercarriage malfunctions. A large proportion of these can be attributed to defects arising from faulty maintenance practices.

'For example, in a recent incident the nose gear of a light twin did not fully extend because the actuator-to-drag-brace attach bolt was seized due to lack of lubrication. Admittedly there was no nipple through which grease could be applied to the bearing surfaces. However, lubrication means using an oil can as well as a grease gun, and in this case the regular application of a drop of oil would have prevented an expensive incident.

'The servicing of modern aircraft relies as much on common sense and good maintenance practices as on detailed instructions to be found in the "manufacturer's recommendations". It is impossible to detail every step or foresee every eventuality in the wide spectrum of operating conditions. Following another recent incident involving an aircraft operating continuously in dusty conditions, the operator complained to the Department that lubrication at every 100 hours, as recommended by the manufacturer for that particular undercarriage mechanism, was obviously not sufficiently frequent. Unfortunately there is nothing the Department can achieve in such a case by approaching the manufacturer. The latter determines maintenance minima for the benefit of operators and never undertakes to guarantee that these minima are sufficient for all possible conditions. He advises the operator on maintenance in order to facilitate aircraft operation, but neither he nor the Department intends to run the operator's business. Departmental airworthiness action is only initiated when a safety problem is detected on an aircraft type and, in the case of maintenance, when the minima recommended by the manufacturer are insufficient in general application. In the case above it would be obviously unreasonable to impose a 50 hour schedule on all operators because the 100 hour period is inadequate for a very few. Therefore if your aircraft is in need of lubrication, lubricate it without waiting for the manufacturer's invitation, a Department Airworthiness Directive or for a seized hinge in one of the undercarriage legs.'

Obviously both of the preceding AACs are applicable to operators of all aircraft with retractable landing gear. The message is clear: If you operate an aircraft with retractable landing gear, ensure that the gear is clean and lubricated before flight. If it is dirty, clean it. If you clean it, lubricate it. If you are unsure about how to clean or lubricate the landing gear, talk about it with the operator and his maintenance organisation ●

Fatal accident following fuel exhaustion

At 1508 hours a Rockwell Shrike Commander 500S with one pilot, a passenger and a load of freight crashed onto a golf course near Essendon Airport, Victoria, following fuel exhaustion on a flight from Flinders Island to Essendon. Both occupants were killed, and the aircraft was destroyed by impact forces.

History of the flight

The aircraft had departed Essendon at 1335 hours on the day before the accident with a load of freight for Cambridge, Tasmania. The flight was conducted on an IFR flight plan without recorded incident and took 121 minutes. The freight was unloaded at Cambridge and the aircraft was then flown empty to Launceston, where freight for Flinders Island was loaded. Flight time to Launceston was 32 minutes. The aircraft departed Launceston at 1720 hours and the pilot reported arrival Flinders Island to Flight Service at 1746 hours — a reported flight time of 26 minutes. However, the evidence indicates that the aircraft did not arrive at Flinders Island until some time after the reported arrival time, and calculations based on witness evidence, flight manual performance data and known meteorological conditions suggest that a more probable flight time was 35 minutes.

Next morning, the pilot submitted an IFR flight plan for a flight from Flinders Island to Essendon quoting a flight time of 91 minutes and an endurance of 214 minutes, corresponding to a margin of 64 minutes over IFR reserves. The planned route was via Wonthaggi and Plenty at 4500 feet. Freight on this flight consisted of frozen fish and fresh crayfish.

The aircraft departed Flinders Island at 1329 hours. Forty one minutes later, at 1410 hours, the pilot reported to Melbourne Flight Service that he was experiencing 50 knot headwinds at 4500 feet and advised of his intention to descend and proceed VFR. The flight plan ground speed suggests that this headwind was 20 knots stronger than expected. The pilot reported his position at Tulip at 1432 hours, five minutes later than the flight plan estimate. At 1502 hours he called Essendon Tower approaching Channel 0 (now Channel 10, a VFR reporting point in the Melbourne terminal area) with a request for an expedited clearance into the Melbourne Control Zone. A clearance to track to Essendon via Clifton Hill at 1500 feet was given promptly, and after reporting at Clifton Hill at 1506 the aircraft was instructed to make a visual approach, join left base and report final for Runway 26. One minute later the pilot transmitted a MAYDAY call, advising that he 'appeared to have a fuel problem' and that he would have to land on a golf course at his present position. Shortly afterwards, the aircraft collided with trees during a turn and crashed in a nose down attitude onto the golf course, only eight kilometres from Essendon Airport.

Investigation revealed that neither engine was delivering power at impact. The landing gear was down and the flaps were partially extended, but neither propeller was feathered.

Investigation

Fuel. Prior to departure from Essendon the previous day the aircraft had been fuelled to capacity and, in addition, three 20 litre drums were filled with fuel and placed in the aircraft baggage compartment. No additional fuel was taken on at Cambridge, Launceston or Flinders Island, although fuel was available at both Cambridge and Launceston. Furthermore, investigation revealed that the drums placed in the aircraft at Essendon were full and in the aircraft at the time of the accident.

Aircraft loading. Calculations indicate that on departure Flinders Island the aircraft gross weight was approximately 4060 kilograms, more than 800 kilograms over the maximum take-off weight of 3243 kilograms for IFR operations. Similarly, at Essendon and Launceston the gross weight at take-off had been in excess of the maximum take-off weight. The freight from Flinders Island consisted of frozen fish in 10 kilogram packs, two bags of fresh crayfish and 86 kilograms of miscellaneous freight. None of the freight was tied down or secured against movement.

The pilot. The pilot held a current First Class Airline Transport Pilot licence and was in full-time employment as an airline captain with a major operator. He was also involved financially and managerially with the company operating this aircraft. Neither the company nor the pilot held a Charter or Aerial Work licence, and the names of another pilot and another operator were used on the flight plan.

Both the pilot and the company were experiencing financial difficulties at the time and there was evidence that the pilot had overloaded the aircraft on other occasions. Furthermore, some flights had not been recorded in the maintenance release.

Examination of the pilot's flying log book revealed that no flight times had been recorded in the four months preceding the accident. His total aeronautical experience was about 8500 hours, of which 88 hours 55 minutes was recorded as Aero Commander experience. His actual Aero Commander experience at the time of the accident could not be determined.

Aircraft serviceability. The investigation did not reveal any defect or malfunction in the aircraft. However, examination of the engines and propellers revealed that neither engine was delivering power at impact. There was no significant fuel in the fuel system. There was no suggestion of fuel or oil system contamination, nor was there anything to suggest that any fuel system component was unserviceable before impact.

Examination of the aircraft maintenance records revealed a number of discrepancies, but there was no evidence to suggest that any maintenance deficiency had contributed to the accident.

Flight plan endurance. The flight plan showed an endurance of 327 minutes on departure Essendon, and 214 minutes at Flinders Island. Flight time from Essendon to Flinders Island was 188 minutes, excluding the time intervals between take-off and departure at Essendon, Cambridge and Launceston. No fuel was added at Cambridge, Launceston or Flinders Island. Therefore the endurance on departure Flinders Island must have been less than 139 minutes, assuming the original endurance of 327 minutes was accurate. Endurance required at brakes release Flinders Island was 150 minutes, comprising: 91 minutes flight fuel, 14 minutes variable reserve and 45 minutes fixed reserve. The accident occurred following fuel exhaustion 99 minutes after the reported departure time from Flinders Island.

Fuel consumption data. The flight plan recorded an endurance of 327 minutes with full tanks on departure Essendon, and indicated that the planned cruise speed was 180 knots TAS. Assuming this was based on use of 75 per cent maximum continuous power and best economy mixture, in the expectation that this would achieve 180 knots TAS, the calculated endurance using manufacturer's performance data from the flight manual would have been 332 minutes, including 45 minutes reserve at 45 per cent maximum continuous power. That endurance figure includes an allowance for engine start, run-up, taxi and take-off, and for the higher fuel flow with maximum continuous power set during climb to 4000 feet. After leaving Essendon, the aircraft made three additional take-offs, thereby reducing the above endurance to about 307 minutes. Fuel used during the climb following each of those take-offs would have further reduced the amount of fuel available for cruise, but because of the gross overload of the aircraft, climb performance figures can only be estimated. Assuming an average climb time of six minutes and maximum continuous power for the climb, the higher fuel flow would have contributed to an endurance penalty of about seven minutes, further reducing the original endurance of 332 minutes to about 300 minutes. On the reasonable assumption that cruise power was maintained to fuel exhaustion on the last flight, the endurance would be further reduced by 17 minutes to 283 minutes, 44 minutes less than the flight plan figure.

Fuel exhaustion occurred after some 287 minutes. The close agreement between the calculated and actual endurance may well be coincidental; there are many unknown factors, and the assumptions made may have resulted in a solution that is purely academic. But the figures do show that there is at least one operating configuration that is compatible with fuel exhaustion after the known flight time of the aircraft.

The greatly overstated flight plan endurance of 214 minutes at Flinders Island, implying a margin of 64 minutes over the flight fuel and reserves required for the flight, does not appear to be the result of any miscalculation or obvious mathematical error, nor does it support a possible erroneous belief by the pilot that he had transferred the drum fuel to the aircraft tanks.

Analysis

There was evidence that on other occasions the pilot had operated to less than statutory fuel reserves and that he was apparently unconcerned about landing with as little as 10 gallons of fuel remaining after a long flight. But it would be difficult to accept that he would have knowingly undertaken the flight with insufficient fuel to reach his destination. On this assumption, two hypotheses emerge. Firstly, that he totally overlooked the question of fuel; and secondly, that he believed there was sufficient fuel in the tanks to satisfy his own reserve requirements, and unforeseen events eroded those small reserves during flight.

The flight plan was submitted to Launceston FIS by telephone three and a half hours before departure from Flinders Island. The rest of the morning was spent in arranging freight for the flight to Essendon. This apparently took longer than anticipated. A number of witnesses stated that, at the aircraft, both the pilot and the passenger were in an obvious hurry to depart. The pilot had arrived at the aircraft about an hour before take-off and conducted a run-up while waiting for the freight to be delivered. He then supervised the loading operation and departed as soon as the freight was loaded. In his haste, he may have forgotten to transfer the drum fuel to the aircraft tanks — had that been his intention. Although the drum fuel would not have been sufficient to satisfy statutory reserve requirements, an accident would have been avoided — on this occasion.

The following examination of the second hypothesis will be similarly inconclusive, but will illustrate how a number of seemingly minor factors can combine to consume meagre reserves. The flight plan endurance on departure Essendon was 327 minutes. The flight from Essendon to Flinders Island took 188 minutes and involved en route stops at Cambridge and Launceston. Fuel allowance for start, taxi and departure at those places and at Flinders Island would have reduced the endurance by about 30 minutes, leaving about 110 minutes for the flight from Flinders Island to Essendon. The flight plan time interval to Essendon was 91 minutes, leaving about 20 minutes reserve on the basis of the foregoing calculations. The pilot may have arrived at a similar figure and accepted it as adequate. For the purpose of the following discussion that is the assumption.

A stronger than expected headwind increased the planned flight time to the site of the accident (a little over one minute from Essendon at cruise speed) to 99 minutes. Nine minutes of the '20 minute reserve' were thus eroded by headwinds.

The endurance profiles in the manufacturer's handbook for this aircraft are based on a usable fuel capacity of 156 US gallons at a density of six pounds per US gallon, or a specific gravity of 0.72, giving 936 pounds of usable fuel. That specific gravity is not representative of all AVGAS 100 available in Australia. Varying grades of crude oil and differing manufacturing processes will produce AVGAS with a specific gravity range from about 0.69 to 0.73 at 15 degrees Celsius, allowing up to four per cent difference from the figure used in the performance data calculations. This will be reflected in a similar percentage difference in the endurance available from a given volume of fuel (see article on page 28).

Laboratory analysis of the small amount of fuel recovered from the aircraft fuel tanks revealed that the specific gravity of that fuel was 0.69 at 15 degrees Celsius. Assuming that the endurance shown on the flight plan on departure Essendon had been calculated from the flight manual endurance profiles, the figure obtained would have been approximately four per cent higher than the actual endurance available. The endurance given on the flight plan (327 minutes) would then be reduced by 13 minutes, reducing the assumed endurance of 110 minutes at Flinders Island to 97 minutes. The engines failed through fuel exhaustion 99 minutes after departure from Flinders Island.

If the flight had been conducted with at least the required reserves, the effect of the lower specific gravity of the fuel would have been relatively insignificant. But the combination of higher than expected winds and low specific gravity fuel was sufficient to erode a calculated reserve of about 20 minutes to zero. Had the endurance been confirmed by comparing the calculations against fuel actually remaining, the true nature of the fuel state should have been revealed. On the evidence available it seems unlikely that the pilot had dipped the fuel tanks, and it was reported that he believed the fuel contents indicator under-read by 10 gallons, although nothing was found to support such a belief.

Conclusion

This accident would not have happened if the aircraft had carried fuel to satisfy statutory fuel reserve requirements. However, the investigation suggested that, while the pilot had previously operated with less than statutory fuel reserves, other factors intervened on this flight to erode what meagre reserves he may have had on departure Flinders Island. Those factors were: higher than expected headwinds, fuel specific gravity lower than that against which flight manual endurance and range data are calculated, and an erroneous belief that the fuel contents indicator under-read.

Although the specific gravity of the fuel was lower than the assumed figure of 0.72 the aircraft was suitably instrumented to allow detection of the discrepancy between theoretical and actual fuel flows caused by this difference. The pilot may have misinterpreted the discrepancy and assumed a fuel contents indicator error of 10 gallons to be the explanation for lower than expected fuel readings at the end of a flight. This error equates to about 20 minutes endurance at high cruise power settings — the reserve that the evidence suggests may have been expected by the pilot.

Operation with less than the required fuel reserves and a belief that the fuel contents indicator under-read, probably combined to result in fuel exhaustion on this flight and had probably led to operations close to fuel exhaustion on other occasions ●

Helicopter self-destructs

A recent report from our New Zealand counterparts in the business of air safety investigation illustrates the degree of damage which can occur as the result of a very small amount of improper maintenance.

'The Hughes 269 helicopter was to land at a helipad and collect two passengers. After landing on the pad, the helicopter was left running at 2500 RPM with the collective fully lowered while the pilot waited for his passengers to board the aircraft. Without warning the helicopter suddenly lurched and tore the cyclic control from the pilot's hand as the aircraft commenced to shed pieces of the airframe. The situation rapidly deteriorated and the helicopter destroyed itself within five seconds.

'The subsequent investigation indicated that the helicopter had suffered a serious main rotor imbalance. A comprehensive examination eliminated ground resonance as a cause factor and attention was concentrated on the rotor head area which had been severely damaged in the break-up sequence.

'The casting of one of the main rotor dampers was found to have fractured adjacent to its attaching bolt and allowed the complete damper to separate from the rotor head. There was considerable fretting around the damper attachment bolt which passes through the blade grip. The nut had been stripped from this bolt and no remains of a locking split pin were found. If the split pin had been missing from the bolt this would have allowed the nut to back off and the bolt to work with the lead-lag action of the damper. (This would account for the fretting found on the bolt and hammering that had occurred between the damper face and the blade grip). This movement could then have progressed to the point where extra loads experienced in the gusty conditions could have stripped the thread from the nut and transferred all the torsional stresses to the damper case adjacent to the other retaining bolt. The overload failure of the casing in this area would then prevent any further restraint of its main rotor blade in the lead-lag direction and almost immediately lead to a massive main rotor imbalance and the type of damage encountered. Examination of the failed components supported this hypothesis but did not eliminate other possibilities, e.g., that the split pin had been in place and the nut had been either undertorqued or threadbound. Any of the three possibilities could have led to the nut being stripped from the damper retaining bolt.'

There may be some degree of conjecture as to which hypothesis is the most probable cause of the failure; however, any one of the three reasons postulated could have been prevented with a little more care during maintenance. For the sake of either a few cents worth of split pin, or a few extra minutes of careful maintenance, the helicopter was destroyed. How fortunate it occurred on the ground, not a short while later! ●

Corrigendum

Figure three on page 12 of *Aviation Safety Digest No. 111/1980* illustrates a section of the article, 'Vision 4 — Visual Illusions'. It refers to a pilot's natural tendency to displace his approach path upwards or downwards when approaching a sloping runway.

Unfortunately the captions of the last two diagrams of the illustration were transposed during printing. As the diagrams depict, the captions should state that the pilot's natural tendency is to correct downwards to intercept his 'natural' approach path to an upsloping runway and upwards, to a downsloping runway ●

Notes on the care and use of ropes

After completing his daily inspection the pilot found that the battery was flat, so he decided to hand start the engine of his Cessna. He applied the hand brake and, as an additional precaution, tied the tail of the aircraft down with a 10mm diameter synthetic tie-down rope. When the engine started the brakes proved to be ineffective. Furthermore, the tie-down rope broke with little apparent strain and the aircraft was damaged in a collision with a parked vehicle. The reason for the failure of the brakes to restrain the aircraft was not determined.

This occurrence raised some questions on the degradation of ropes when exposed to the elements, and prompted some discussion on the care and maintenance of ropes used for aircraft tie-down. The article 'Tie Down Sense' in *Aviation Safety Digest 110/1980* discussed aircraft tie-down procedures but did not address this subject.

The deterioration of ropes when exposed to rough treatment and the elements can be significant without the damage being obvious in a casual inspection. The following notes condensed from the Australian Standard Specification for Fibre Rope (AS 1504-1974) should provide pilots with some guidance on the selection and maintenance of tie-down ropes for their aircraft.

Care of ropes

Ropes made from any material are liable to wear and mechanical damage, and can be weakened by various agencies such as chemicals, heat and light. Regular inspection is necessary to ensure that the rope remains serviceable.

It must also be emphasised that no matter what agency has weakened the rope the effect will generally be more serious on the smaller sizes than on the larger. Consideration should, therefore, be given to the relationship between the surface area of the rope and the cross-section.

Examination at intervals of about a metre at a time is desirable, the rope being turned to reveal all sides and untwisted slightly to allow examination between the strands.

To define a standard of acceptance or rejection is much more difficult than to describe the method of inspection. There can be no well-defined boundary between ropes which are safe and those which are not, because this depends on the stresses imposed in service. The decision whether to use a rope or to replace it must depend on an assessment of its general condition. If after examination there should be any doubt about its safety, it should be withdrawn from service.

The nature of a fibre rope is such that damage is easily sustained and the consequent weakened condition is not always visibly evident. Constant vigilance throughout the life of the rope is therefore necessary.

Storage of rope

Proper storage is essential. Ropes should be stored in a dry place, but never in closed containers which do not permit the circulation of air. They should not be stored directly on the floor or ground; use wooden gratings or racks, or special coil pegs on stands.

Never store rope in the weather or in direct sunlight and avoid storage near racks of heavy objects whose inadvertent fall may result in damage.

Ensure that sparks from any source cannot reach stored rope and store well away from chemicals or other agents which may cause damage, especially liquids which may leak from containers.

Causes of damage

General external wear. External wear due to dragging over rough surfaces can cause filamentation. This is the most readily noticeable cause of weakness, particularly if a new rope is available for comparison. In the extreme, the strands become so worn that their outer faces are flattened and the outer yarns severed. In ordinary use some disarrangement or breakage of the fibres on the outside of the rope is unavoidable and harmless if not too extensive. Synthetic ropes have good abrasion resistance.

Local abrasion as distinct from general wear may be caused by the passage of the rope over sharp edges whilst under tension and may cause serious loss of strength. Slight damage to the outer fibres and an occasional torn yarn may be considered harmless, but serious reduction in the area of one strand, or somewhat less serious damage to more than one strand, should warrant rejection. Protection at points where excessive abrasion may occur is economic.

Cuts, contusions, etc., or careless use may cause internal as well as external damage. They may be indicated by local rupturing or loosening of the yarns or strands.

Internal wear caused by repeated **flexing** of the rope, particularly when wet, and by particles of grit picked up may be indicated by excessive looseness of the strands and yarns or the presence of powdered fibre.

Overloading. Repeated overloading may cause permanent deformation of the fibres which reduces the ultimate strength of the rope. Vinyl ropes are less prone to gradual loss of strength than natural fibres.

Mildew or other micro-organisms do not attack synthetic ropes; however, growth can occur on manila and sisal ropes under damp or humid conditions. If a rope should become wet, carefully dry it out under natural atmospheric conditions, clean it if necessary and store again in the correct manner.

Chemical action.

- Natural fibre. Acids, alkalis, other chemicals, fuel gases, industrial dusts, ashes, and similar hazards will reduce the strength of natural fibres.
- Synthetic fibre. A wide range of synthetic materials may be used in rope making. Each of them can be affected to a greater or lesser extent by various chemicals such as organic solvents, acids and alkalis. No attempt will be made in this article to describe the effects in detail; suffice it to say that if such contamination is known or suspected to have occurred, expert advice should be sought as to the identification of the fibre and the effect of the contamination.

Heat or excessive surging may cause fusing of synthetic rope. Any signs of this would obviously warrant rejection, but a rope may be damaged by heat without any such obvious warning. Manila and sisal ropes should not be stored under conditions of high heat or excessive drying atmospheres. Once again, the best safeguard is proper care in use and storage. A rope should never be dried in front of a fire or stored near a stove or other source of heat.

Sunlight. Excessive exposure of all textile fibres to sunlight will weaken the fibres and unnecessary exposure should be avoided. Polyethylene and polypropylene ropes are more susceptible than others. Degradation is marked by breakage of the fibres into small pieces which gives the rope a hairy appearance as a result of the broken ends tending to stand up from the surface. As degradation proceeds the fibres may even break down into a coarse powder. The effect extends progressively below the surface of the rope and, because it is primarily a surface effect, small ropes will become unserviceable quicker than large ropes.

At many aerodromes tie-down ropes are left lying on the ground attached to the tie-down anchor while the aircraft is flying. This is a convenience that facilitates subsequent tie-down, but it exposes the ropes to damage from abrasion, sunlight and weather. Operators who follow this practice should inspect the ropes for damage at frequent intervals and be prepared to replace them periodically. The cost of a replacement rope is small compared with the cost of aircraft repairs following failure of a tie-down rope in heavy winds ●

Improper assembly of glider causes loss of control

At the start of operations for the day, four members of a gliding club were detailed to assemble a Skylark glider. After the assembly, one of the members, who was appropriately qualified, carried out and signed for the daily inspection of the aircraft.

The pilot who was to fly the Skylark arrived at the club after the assembly had been completed. He ascertained that the daily inspection had been done and completed his pre-flight inspection before the aircraft was towed to the taxiway intersection where the Pawnee tug was waiting. After completing the cockpit checks the pilot closed the canopy and signalled for the tow rope to be connected and the tow to commence.

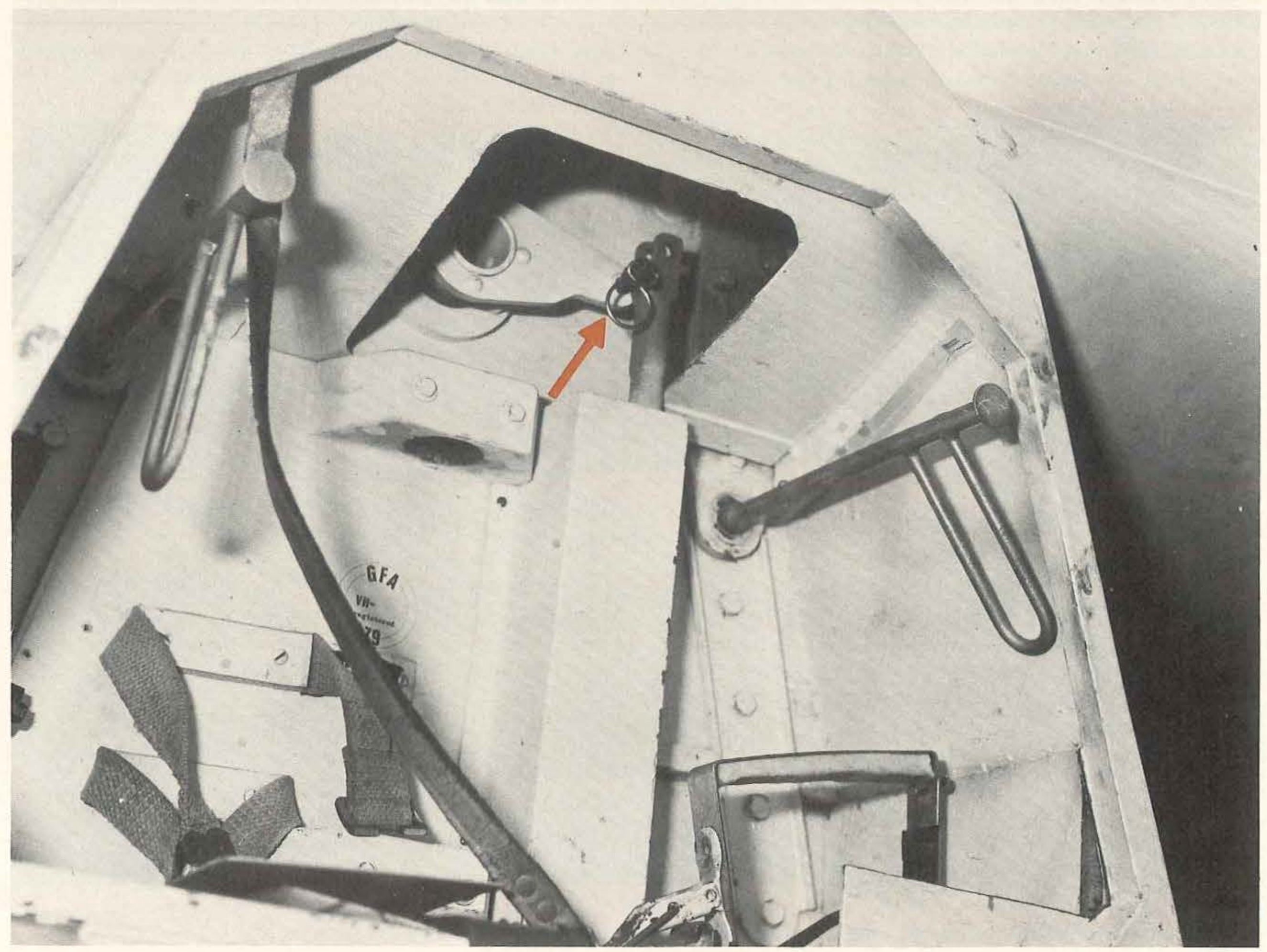
As the ground roll began, the left wing of the glider dropped and contacted the runway. The pilot applied full right rudder and, as the wings levelled, the glider lifted off. The right wing then started to drop and the pilot released the tow rope at an estimated height of 15 to 20 feet. By then the aircraft was turning to the right and heading off the runway towards the grass. The right wingtip contacted the ground, the glider swung further to the right and the fuselage struck the ground heavily. The aircraft slid sideways and came to rest pointing back along the flight path. The main and left wingtip skids broke off and the cockpit area and tail unit were substantially damaged. Fortunately the pilot was not injured. Investigation revealed that the pin which normally connects the aileron rod to the operating arm had been omitted during assembly.

The daily inspection of the glider included a check of the controls. The person responsible had checked that the ailerons moved freely and in the correct sense by moving the control surface and observing the correct movement of the other aileron and control stick. He had also checked that control stick movements were reflected by full and free aileron surface movement. The pilot also carried out a cockpit check of the controls and did not detect any abnormality. Apparently the aileron operating arm was resting on the control rod and there was enough friction between the two to provide continuity of the control run (without them being pinned together) while the aircraft was static. However, when airloads provided an external force the friction was overcome and the aileron control became disconnected.

The glider was assembled without reference to rigging instructions or the inspection checklist. Although there is a detailed description of the assembly sequence and an inspection checklist in the pilot's notes some club members were not aware of this. The pilots were well-practised in the assembly procedure and apparently believed that reference to the rigging instructions or the inspection checklist was unnecessary. That is, unfortunately, a common human frailty. When a task is simple or becomes well-practised the use of checklists tends to fall into disuse. A checklist can perform a valuable function in reminding us to do certain things and assisting us to do those things in a logical sequence; but to be effective it must, obviously, be used conscientiously.

Responsibility for the prevention of occurrences such as this one lies, in the first instance, with the aircraft designer. He should make such an assembly procedure as 'pilot proof' as possible. In addition, the operator needs to identify potential trouble areas and devise ways of preventing errors being made. In many cases simply making 'safety critical' areas obvious may suffice. This can be achieved by the use of flags or tell-tale markings. Ideally, the device used should not only be obvious but should also prevent operation of the system or aircraft until it is removed. (For example a control lock that also locks the throttle in a powered aircraft). Further, those areas that are critical, such as control system connections, can be identified and listed on the daily inspection certificate for individual signature and, if appropriate, independent inspection.

While none of these measures is infallible any measure taken to reduce the reliance on human memory for the execution of critical steps or tasks will be reflected in a safer operation ●



Lower right.
Aileron operating arm and control rod were not pinned together.

Encounter with flutter

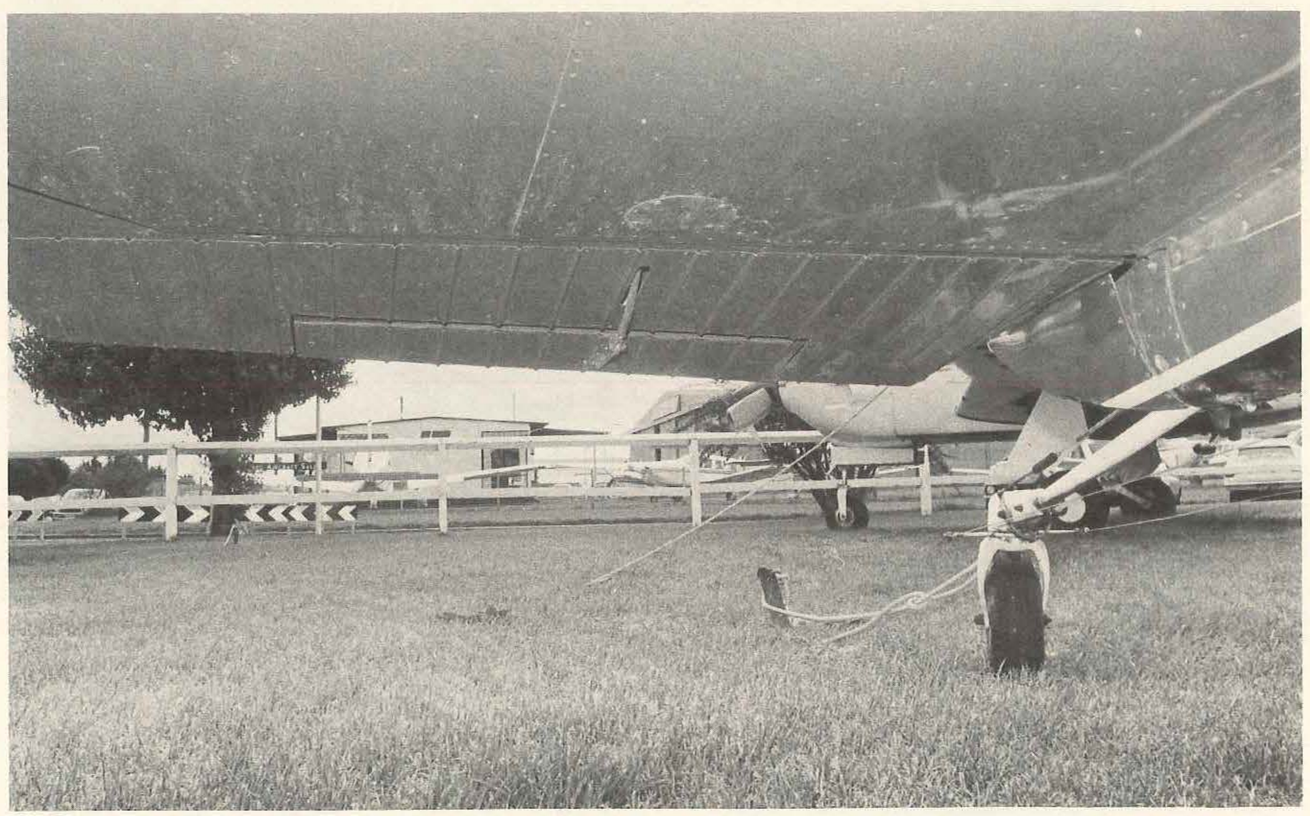
While engaged on superphosphate spreading in hilly country the pilot of a Cessna A188B Agwagon experienced severe buffeting of the elevator control. He closed the throttle and the buffeting ceased as the speed reduced through 110 knots. The pilot flew the aircraft back to the strip about a kilometre away and landed safely.

Inspection revealed that the elevator trim tab actuating horn had separated from the tab, tearing out a ten centimetre by seven centimetre piece of the tab's lower skin around the horn attachment point. This allowed the elevator tab to flutter, causing the violent buffet. The pilot's action in reducing speed below the flutter threshold enabled the flight to be completed safely.

Subsequent examination revealed that stones thrown up by the main wheels had dented the lower skin of the tab. The dents acted as stress raisers and the skin began to crack. The principal skin crack grew in a chordwise direction above a flute adjacent to the horn attachment. As the skin crack developed horn loads were transferred to the internal stiffener which also cracked. Finally the reduced stiffness allowed elevator/tab flutter to occur and the section of skin around the horn attachment tore out. The crack along the tab skin flute had been propagating over a considerable flight time.

The pilot acted correctly in reducing the air speed as soon as the buffet was experienced and, in fact, this was the only action that would have stopped the flutter. The driving force for any flutter is obtained by extracting energy from the airflow. Obviously a high air speed will enable more energy to be extracted and hence increase the severity of the flutter. Therefore when flutter is experienced speed should be reduced immediately (as much as is safely possible.) Use of landing gear and flaps, power reduction and trading speed for height should be employed to achieve a rapid speed reduction. Should the flutter threshold be below the stalling speed of the aircraft, there is a good chance the aircraft will become severely damaged or uncontrollable before a landing can be made.

The lower surface of the elevator trim tab of the Cessna Agwagon and other tailwheel aircraft is close to the ground and may be rather awkward to inspect. But remember, trouble does not come only from the easily accessible areas of an aircraft. ●



The lower surface of the elevator trim tab is close to the ground and may be awkward to inspect.

Decision making

All pilots are subjected to pressures from many different sources in their daily operations and these must influence the pilot's decision-making processes to some extent, either consciously or subconsciously. The following article is a typical example of how such pressures can affect the operation of an aircraft.

A helicopter pilot engaged in survey operations recently made a series of decisions which culminated in engine failure due to fuel exhaustion. In his report he made a number of comments regarding the psychological pressures which affected his decisions. An account of the events contains a valuable lesson for us all.

The pilot lodged a flight plan by telephone from his temporary base in the Northern Territory, nominating an ETD of 0830 hours local and a SARTIME of 1830 hours. The flight plan indicated that the aircraft would be engaged on survey operations all day. Last light was 1853 hours.

The Bell 206B departed for the survey area which was centred some 50 nautical miles from the base. A fuel dump of 200 litre drums of Avtur was to be established at this point. During the morning survey operations the pilot discovered that the fuel drums had not been delivered but were still on the way by truck.

Fuel was obtained at another point for the day's operations. The last refuelling was during the lunch break in the afternoon. Because of the heavy payload the fuel uplift was limited and the aircraft was fuelled by reference to the fuel gauges to give an estimated endurance of 150 minutes. The pilot intended to operate back through the survey area to his base without refuelling, as he could not rely on the arrival of the truck carrying the fuel. He anticipated 30 minutes flight time back to the survey area and 40 minutes flight time from there back to base. Carrying a reserve of 30 minutes, this allowed 50 minutes for operation in the survey area.

Towards the end of that 50 minute period the pilot realized that he would not complete the task and decided to extend the time he had allocated for the survey. The extension of time meant a reduction in reserves to less than 30 minutes. The pilot accepted this and decided to rely on his experience on this type of helicopter to cut the reserve to between 10 and 15 minutes. Although he had some 500 hours experience on the Bell 206B, he had only flown this particular aircraft for a few hours. During previous employment in cattle mustering operations, the pilot had frequently operated his helicopter with reserves less than 30 minutes and as low as 10 minutes. In those operations he had been working close to his fuel supply and had been very familiar with his machine and its fuel gauge.

On departure from the last field landing point the pilot estimated the remaining endurance as 50 minutes, and the time interval for the 57 nautical mile flight back to base as 40 minutes allowing for a 10 knot headwind. He passed a departure message to Flight Service with an ETA for the base. The track passed close to the point where the fuel dump was to be established so the pilot diverted to overfly the site. He saw that the fuel drums had now been delivered but gave little consideration to landing for fuel to provide a safe reserve. He felt he had made a mental commitment when he advised the FSU of his estimate, and felt it was not worth the trouble of landing and spending about 30 minutes refuelling from drums when the aircraft could be refuelled by tanker at the base. It would also have been necessary to remove quite an amount of equipment from the helicopter to gain access to the hand pump.

The pilot realised that the headwind was stronger than he had allowed for and shortly after passing the fuel dump site he had second thoughts about his decision to proceed. However, he decided that he would look foolish and indecisive to his passengers if he turned back. The three persons on the aircraft were all tired after a long and hot day in the field and there was still all the trouble associated with refuelling from the drums. The flight continued.

Some 10 nautical miles from the destination the pilot became alarmed about the dwindling reserves. Although he was over terrain suitable for landing, and completely accessible for road transport, he persisted with the flight knowing he was dangerously low on fuel. There was no low fuel quantity light in the aircraft, but the fuel tank contained two pumps. The pressure warning light of one of these began to flicker about seven miles from the destination. The pilot believed he had 20 litres of fuel remaining. On final approach the pressure dropped to zero and the engine failed. The pilot was able to effect a run-on autorotation onto the grass within the aerodrome boundary.

To quote the pilot's own words '. . . the incident was the culmination of my own misjudgement, stupidity, inflexibility and negligence. I was too inflexible to change my plan even when it became patently obvious to me that my decision to continue was wrong.' In letting his judgement be influenced by the extraneous factors covered in this account, the pilot neglected the primary responsibility involved in operational decisions — the safety of passengers, aircraft and pilot. He is, however, to be complimented on one decision he made — to submit a full and frank account of the incident and the circumstances which led to it. Hopefully others will benefit from the lesson which this pilot learned the hard way ●

Induction icing

Every year, accident and incident records contain a number of occurrences in which induction icing was considered to be the probable cause of engine power loss. In recent years much has been written on the subject of induction icing, (refer *Aviation Safety Digest 103, 106, 108*) and Owner's Handbooks and Operations Manuals contain appropriate advice and warnings. Yet even experienced pilots still fall victim to this insidious phenomenon.

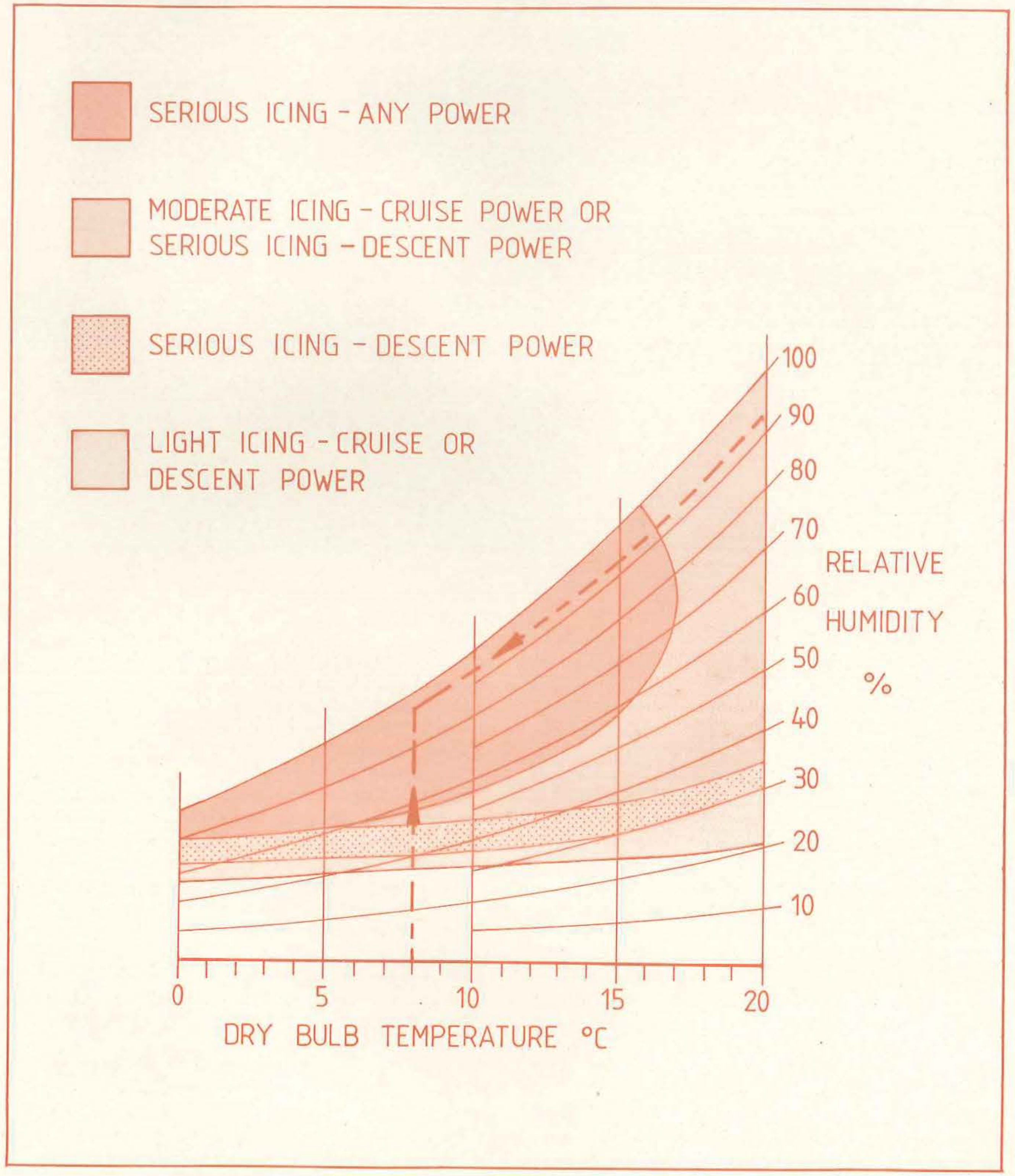
After a one hour delay due to fog the pilot started the engine and prepared for take-off with three passengers in his Cessna R182. By then most of the fog had cleared; only small patches remained in the gullies and valleys around the strip. The temperature was 8°C with a relative humidity of about 93 per cent. The pilot completed an engine run-up, which included a check on the operation of the carburettor hot air system, but he did not specifically check for the presence of induction ice. After completing the before-take-off checks the pilot closed the throttle and got out of the aircraft to remove condensation that had formed on the outside of the windshield. This completed, he strapped in, re-checked hatches and harnesses, then taxied a short distance to the strip and started the take-off roll.

Acceleration appeared sluggish to the pilot so he checked that the hand brake was off. The airspeed had increased to about 45 knots half-way along the strip and the aircraft just got airborne but would not accelerate any further. At this stage the pilot started a shallow turn to avoid some trees at the end of the strip and to take advantage of low ground to the left, but the aircraft settled back on to the strip. The pilot abandoned the take-off and closed the throttle, but he was unable to stop the left turn and the aircraft ran off the side of the strip. It passed through two fences and nosed over after encountering soft ground.

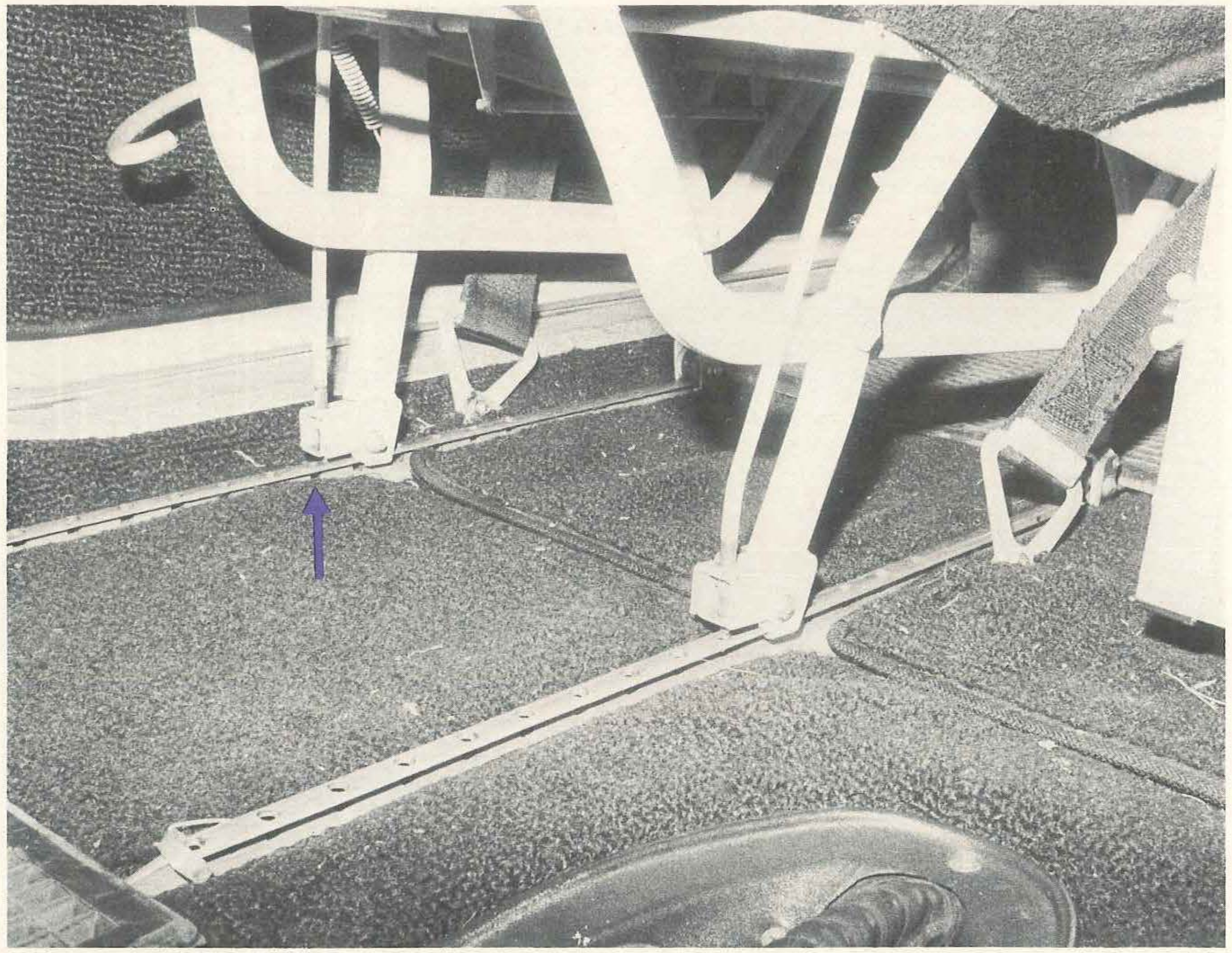
The pilot and passengers climbed out of the inverted wreckage uninjured but the aircraft was destroyed.

The investigation did not reveal any mechanical defect in the engine or airframe to explain the lack of performance; but atmospheric conditions at the time of the accident were certainly conducive to the formation of induction icing. With a dry bulb temperature of 8°C and a relative humidity of about 93 per cent, the probability of serious induction ice formation would be high at any power setting. (Refer to *Aviation Safety Digest 108* lift-out chart). The formation of ice at low or idle power would then almost be assured.

Most owner's handbooks and operations manuals warn against prolonged engine operation on the ground with alternate or hot air selected — as the air source is unfiltered. However, during run-up (and in icing conditions immediately before take-off) hot air must be applied for sufficient time to ensure that any ice that may have formed is removed. The technique will vary with different aircraft types so check your owner's handbook for the correct procedure for your aircraft. Generally, application of hot air will cause an RPM drop. If no ice is present the RPM will remain steady at the lower figure. If ice is present the RPM will initially decrease, then increase as the ice is removed, and stabilize at a higher reading. The RPM will then increase further when cold air is again selected. This is a worthwhile check following any prolonged period of operation on the ground in possible icing conditions. Make it your habit to check for the presence of ice as well as checking the serviceability of the carburettor hot air system ●



More on unlocked seats



Aviation Safety Digest No. 111/1980 contained an article titled 'Unlocked seat — loss of control during ground manoeuvre'. That article prompted a number of pilots to relate airborne experiences in which the seat unlocked and moved rearwards at a critical stage of flight. One of those incidents is described in the following reader contribution:

'The article "Unlocked seat" (*Aviation Safety Digest 111/1980*) brought back to me frightening memories.

'On entering a Piper Cherokee 140E for a solo flight I adjusted the seat and thought it had locked. All checks were normal and I took off. Shortly after leaving the ground the seat suddenly shot back. The nose immediately flew up and I had to push with all my strength on the control column to prevent the aircraft stalling. Any attempt to let go of the control column in order to adjust the seat would have been fatal, so I held on and attempted to gain height. A bit higher up I made a grab at the trim control while holding on with one hand and, after several attempts, managed to wind it down so that the strain came off the control column. I was then able to let go momentarily while, with one hand on the dashboard and the other on the seat lock, I got the seat forward and locked.

'Fortunately for me I have long arms. If the incident had happened to someone shorter a stall may well have been unavoidable. Could this be the explanation of the accident in which one reads "shortly after take-off the plane was seen to assume a steep nose up attitude followed by a dive to the ground"?

'I now check the seat lock carefully on entering and again at the "controls free movement, hatches secured" stage of the pre-take-off check.'

Investigation of an accident in the United States recently disclosed very similar circumstances, but in this case the results were fatal. The following account is adapted from an NTSB Safety Recommendation on this subject.

'A Cessna Model 172K crashed during take-off. The pilot, a commercial flight instructor and the only occupant of the aircraft, was killed. According to witnesses, the aircraft pitched up to a steep nose high attitude, about 60 or 70 degrees, and the sound of engine power reduced abruptly from take-off power to idle. The aircraft then pitched down and rotated about 160 degrees to the left before crashing on the edge of the asphalt runway.

'Investigation revealed that the pilot's seat was not locked and had slid rearward on the seat rails during lift-off. Acquaintances of the pilot stated that she flew the aircraft with her seat in the full forward position. Because of her relatively short stature she could not reach the throttle or rudder pedals, nor could she fully manipulate the control wheel, with her seat in its rearmost position. Consequently, once the seat slid aft, she was not able to maintain control or regain control when the pitch angle increased abruptly. The pitch up of the aircraft to a steep nose high attitude and the reduction in power would be the expected consequences of the pilot's holding on to the control column and the throttle as her seat slid aft.

'If the pilot had attempted to position and lock her seat in the full forward position in the aircraft, the left front corner of the seat would have contacted and wedged against the door jamb. This interference, which is typical in this aircraft model, can prevent the seat locking pins from reaching the forwardmost locking holes. More importantly, the wedging of the seat can lead the pilot to believe that the seat is locked when, in fact, the locking pins are actually positioned between locking holes. Any subsequent forces on the seat, such as those occurring during take-off or landing, can cause the seat to release abruptly and slide aft.'

The pilot's operating handbooks for some popular aircraft types include the pilot's check of the adjustment and locking of seats, belts and shoulder harnesses in the 'before starting engine' checklist but not in the take-off checklist. Others do not include a check of the seat itself, mentioning only seat belts and harness. Because some pilots may find it necessary to readjust the seat before take-off or in flight a check to ensure that *front seats*, belts and harnesses are adjusted and *locked* should be included in the 'before take-off' and 'before landing' checklists. The security of the seat should be tested with firm back pressure after checking that the adjusting mechanism is in the lock position.

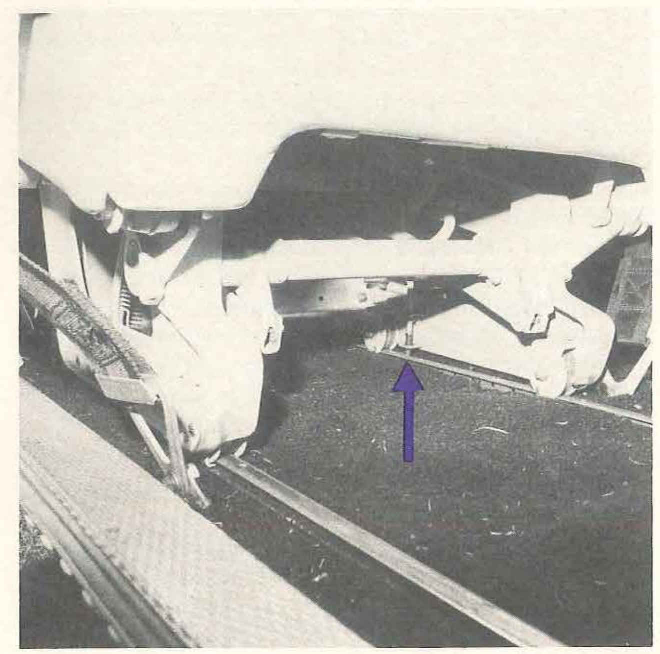
While not a part of a standard before-flight inspection, a look under the seat once in a while is a good practice, noting how the mechanism works and whether it all appears to be in good condition. In most of today's light aircraft, floor mounted tracks are used in the adjustment of the front seats, which move forward and back on rollers bracketed to the seat. The seat is stopped in the desired position by a locking device linked to a bar or handle for use by the pilot in releasing or locking the seat in place. Most seats are locked by pins which slip down into holes in the track, although a few use other devices such as clamps or 'shoes'. A security stop at the end of the rails prevents the rollers from overrunning the tracks.

The adjustment mechanism is usually springloaded, so that when the handle is released the pins drop automatically into the locking slot. However, in some cases there is no spring and the pins must be manually positioned or the seat will slide under pressure.

A rental or club aircraft, flown by pilots of varying size, will have its front seats shunted back and forth frequently, subjecting the movable mechanism to considerable wear and occasionally abuse by an impatient person. This may lead to the end stops becoming weak and susceptible to overriding, or to the intermediate stops becoming enlarged and prone to slippage. For these reasons, a periodic check of the seat adjustment mechanism is included in the maintenance requirements. This inspection should include the following:

- The metal framework of the seat, particularly the joints.
- The rollers and roller brackets — check for proper alignment and wear.
- The locking mechanism, including the actuating arm, linkage and locking pins — make sure the release spring, if there is one, is intact, and the action is positive.
- The floor-mounted rails — make certain they are tight to the floor and tracking true; the rail stops should be clear and not distorted, and the end stops solid.

While you have your nose down on the floor, this is a good time to remove any foreign or loose objects hidden under the seat. Coins, combs, keys and other abandoned miscellany take a malicious delight in jamming vital mechanisms at the worst possible time ●



Opposite page and above.
Typical light aircraft seat adjustment mechanisms. In both examples the seat is unlocked.

Fuel specific gravity

The article beginning on page 14, which describes the circumstances surrounding an accident in which an Aero Commander crashed following fuel exhaustion, raises some points concerning the effect of fuel specific gravity variations on range and endurance performance. This article briefly discusses the significance of fuel specific gravity as it applies to aviation gasoline, and compares practical range and endurance performance with published data.

The volume of fuel consumed during a given flight, i.e. for a given amount of work performed by the engine, depends ultimately on the net heat of combustion per unit volume of the fuel. That property varies with the specific gravity. Put simply, if the specific gravity is low a greater volume of fuel will be required to perform a given amount of work.

Specific gravity was, at one time, the only measure of the energy potential of aviation fuel. It still appears in specifications for aviation turbine fuel but not in respect of aviation gasoline, although the specific gravities found in practice are effectively limited by heat value specifications.

The specific gravity of AVGAS 100 and 100LL varies typically between about 0.69 and 0.73 at 15 degrees Celsius. Temperature variations from standard introduce further variations, and it is the combined effect of these two factors which will be examined.

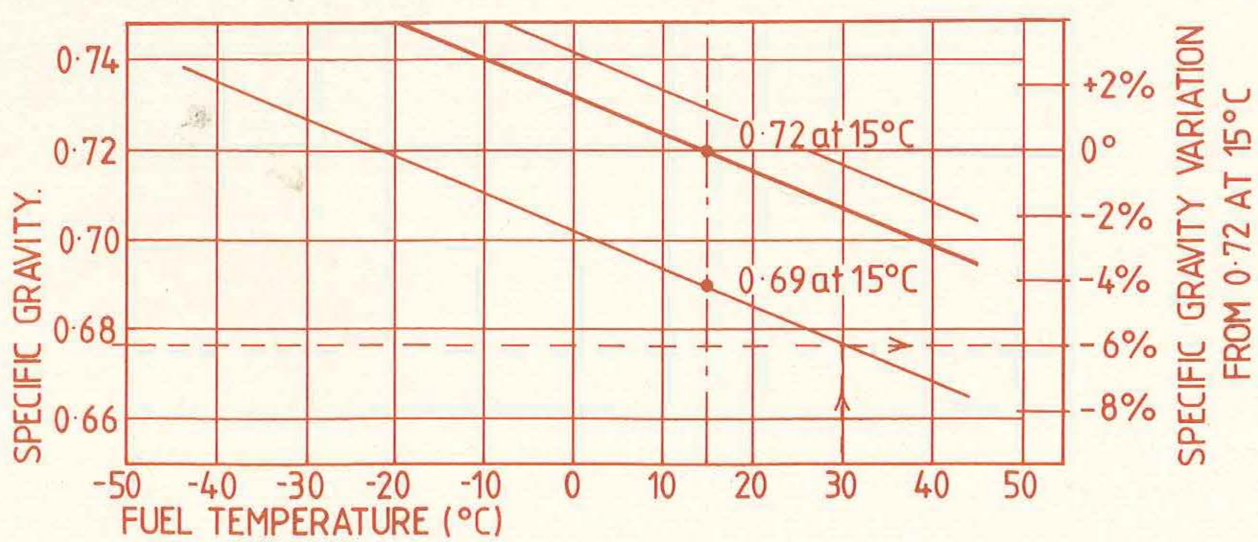
For all practical purposes performance varies directly with fuel specific gravity. For example, a fuel of specific gravity 0.69 will give about four per cent less range and endurance than the same volume of fuel at specific gravity 0.72.

Most aircraft operating handbooks assume a specific gravity of 0.72, usually expressed as a density (eg six pounds per US gallon) for the presentation of range and endurance data. A problem obviously arises if flight planning is conducted with reference to that data and the actual specific gravity of the fuel loaded is significantly lower than 0.72. Normally the effect is relatively insignificant — a performance penalty of three to four per cent, for example, over a short flight may go unnoticed. But when the penalty extends over a long flight, or when high fuel temperatures introduce large reductions in fuel specific gravity, the effect may seriously erode the calculated endurance. A six per cent reduction, for example, would equate to a penalty of almost 22 minutes for a flight requiring an endurance of six hours. This is nearly half of the statutory fixed reserve. While the conditions required to achieve such a penalty may not be typical of normal operating conditions, they can occur.

The following figure illustrates the effect of temperature on performance. By entering the graph with ambient temperature and the specific gravity at standard temperature (or with a known specific gravity at ambient temperature) the effect on performance calculations made against an assumed specific gravity of 0.72 can be readily extracted. As the example shows, a specific gravity of 0.69 at 15 degrees Celsius will drop to a little under 0.68 at 30 degrees, incurring a total penalty of some six per cent against performance figures extracted from published data.

Specific gravity readings for each fuel batch are recorded on the Release Note held by the airport authority or agent to whom the fuel company delivers the fuel. That information is normally available to pilots, but there may be times when it is not. In those instances the safe thing to do is assume the normal figure (0.72) for loading purposes but take account of a possibly lower figure in estimating endurance.

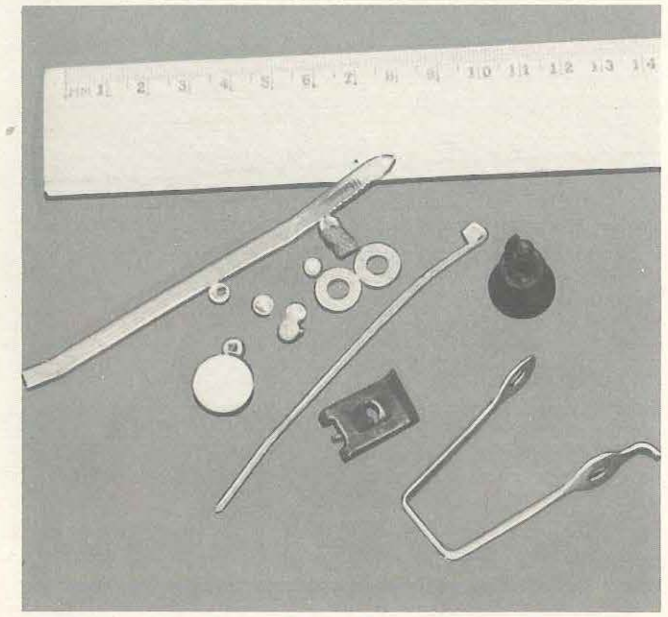
Although pilots will rarely have the means at their disposal to determine fuel temperature, an informed estimate can usually be made. Fuel stored underground will probably be close to standard temperature, while that stored above ground, drum stock for example, may reach or even exceed ambient temperature ●



Loose foreign objects

The pilot of a Cessna 152A was engaged in a period of solo aerobatic flying when the ailerons jammed in the right wing down position during recovery from a slow roll. By applying a large amount of force the pilot was able to centralise the ailerons and level the wings. She then returned to base from the training area and made a safe landing in gusting wind conditions with the ailerons still unusable.

Subsequent inspection of the aircraft by maintenance engineers revealed that the malfunction had been caused by a drilled-off rivet tail being jammed between the aileron drive sprocket and chain on the pilot's control wheel. The aircraft had flown only 20 hours since new, and radio equipment had been installed recently. It could not be established if the rivet had been drilled out during manufacture or the radio installation. Thorough cleaning of the aircraft floor produced the assortment of foreign objects displayed in the photograph.



Loose foreign objects are a potential hazard in any aircraft, but the possibility of interference occurring is much greater in aircraft involved in aerobatics. The unusual attitudes, negative 'g' and sudden manoeuvres of aerobatic flying will dislodge objects from their resting place when normal flight would not necessarily do so. The maintenance organisation which recovered the objects from this aircraft also advised that they frequently found plastic fasteners on the cabin floor or under the instrument panel of aircraft. These fasteners are used to attach inspection panels in the cabin. They fit into a grommet and are held by plastic legs. These legs are very brittle and fail frequently, thus allowing the fastener to fall out.

The responsibility for cleanliness of the aircraft cockpit and cabin lies both with pilots and maintenance staff. The latter should make certain that no tools or small items such as rivets or washers remain in the aircraft after service has been completed. Pilots should conscientiously check the aircraft internally for foreign objects during the pre-flight inspection. They should also be aware of the possibility of themselves or passengers bringing pebbles into the aircraft on the soles of shoes. The pre-flight inspection should be even more scrupulous following any maintenance or prior to a period of flying involving greater manoeuvring than normal ●

Aircraft lifting procedures

At page 19 of *Aviation Safety Digest 111/1980* we published a photograph of a Beech A36 Bonanza being lifted after a wheels-up landing.

It should be pointed out that the lifting procedure used was incorrect and could have inflicted additional damage to the aircraft. The photograph shows the aircraft being lifted by the propeller and what appears to be a belly sling aft of the wing trailing edge. Such a configuration could subject the engine mounts and associated structure to loads for which they were not designed.

The Beech 36 Shop Manual describes two methods of lifting the aircraft. In the first, a sling is attached to the upper forward wing attachment bolts on the main spar, with a strap attached to the propeller. In the second, the lifting sling is attached to the main spar carry through in the cabin and a line is attached to the engine hoist fitting. In both methods the lifting load is carried by the main spar with the propeller or engine hoist fitting carrying only light levelling loads.

Personnel involved in the recovery of aircraft after accidents must guard against inflicting secondary damage, particularly through the application of inappropriate procedures. The danger lies not only in the likelihood of incurring additional repair costs, but also in the chance of the damage going undetected with possible later catastrophic results.

In this particular case, the aircraft and engine underwent extensive inspection, repairs and rebuild following the accident and were returned to an airworthy condition ●

Bird strike reporting

In July 1978 the Department launched a bird strike reporting and analysis system with an aim to improving the collection and analysis of bird strike data in this country. The system was introduced in *Aviation Safety Digest 102/1978* concurrent with the release of the now familiar bird strike report form. Since then, the quantity and quality of bird strike reporting has markedly improved. For example, between 1969 and 1977 the average number of bird strikes reported each year was 276. In 1979 the figure more than doubled to 571.

In May 1978 the system was presented to the first ICAO Regional Workshop on Reducing Bird Hazards to Aviation. Following this presentation, an ICAO Working Group was formed to develop an international bird strike data analysis system based on the Australian model. The result was the ICAO Bird Strike Information System (IBIS), which is now ready to accept world-wide bird strike data.

IBIS will facilitate direct international comparison of many aspects of the bird strike hazard. This will, among other advantages, enable the effectiveness of various bird hazard reduction techniques to be evaluated and assist in a study of the vulnerability of particular aircraft engines and airframes to bird strike damage.

To provide the desired information for input to IBIS, and to apply lessons learned since 1978, the Australian bird strike report form has been revised. The new form (shown opposite) has been designed to be easily and rapidly completed. It is single-sided and can be used to report a bird hazard as well as a bird strike. The form embodies a number of minor changes to the content and presentation of the information required. For example, the height at which the incident occurred should now be reported with reference to ground level instead of sea level as on the previous form. Thus, a bird strike or hazard encountered during the take-off run or landing roll would be at zero feet AGL.

The new forms are available at flight briefing offices. Completed forms may be lodged at any Airways Operations Unit or sent to the Director (Attention ASSU) of the Region in which the incident occurred.

To be effective, the Bird Strike/Hazard Report must provide all known data relating to the incident. Information that, at the time, may seem insignificant or irrelevant may, in combination with other reports, reveal important information on many aspects of the problem, including the behaviour, migratory habits and habitat of birds; the effectiveness of bird dispersal and hazard reduction techniques; and the ability of aircraft structures to withstand damage, to name a few. All aircraft damage, however insignificant, should be reported. For example, a small dent in the aircraft skin should be reported, at least as minor damage. Other important information required is the height at which the incident occurred and the IAS at the time. Unfortunately, that information was often not reported on the old form.

The reduction of bird hazards will result only from a continued co-operative effort on the part of everyone involved in aviation, including pilots, aerodrome groundstaff, ATC and Flight Service personnel, aerodrome licensees and planners, and the aviation industry in general. A wide data-base is required to permit identification of the hazards, develop countermeasures, and assess the effectiveness of hazard reduction methods. Without accurate and comprehensive data the bird strike hazard reduction programme cannot be effective. So, please, report all bird strikes and hazards — not just those from which damage results ●

PILOT BIRD STRIKE/HAZARD REPORT

DEPARTMENT OF Transport Australia

Normally this report should be mailed to the Director in the Region, Attention ASSU, in which the incident occurred.
If more convenient it may be lodged with the OIC of any ATC or Flight Service unit.

BIRD STRIKE ☐ BIRD NEAR-MISS ☐ BIRD CONCENTRATION ☐

OPERATOR	AERODROME NAME
AIRCRAFT MAKE/MODEL	
ENGINE MAKE/MODEL	RUNWAY USED
AIRCRAFT REGISTRATION	LOCATION IF ENROUTE
DATE	
LOCAL TIME	HEIGHT AGL
DAWN ☐ DAY ☐ DUSK ☐ NIGHT ☐	SPEED IAS
TYPE OF OPERATION: airline ☐ commuter ☐ charter ☐	flying training ☐ pvte/business ☐ other:

PHASE OF FLIGHT: parked ☐ taxi ☐ take off run ☐ climb ☐ enroute ☐ descent ☐ approach ☐ landing roll ☐

SKY CONDITION: no cloud ☐ some cloud ☐ overcast ☐

PRECIPITATION: fog ☐ rain ☐ snow ☐

PART(S) OF AIRCRAFT

	STRUCK	DAMAGED
radome	☐	☐
windshield	☐	☐
nose (excluding above)	☐	☐
engine no. 1	☐	☐
engine no. 2	☐	☐
engine no. 3	☐	☐
engine no. 4	☐	☐
propeller	☐	☐
wing/rotor	☐	☐
fuselage	☐	☐
landing gear	☐	☐
tail	☐	☐
lights	☐	☐
other (specify)	☐	☐

BIRD SPECIES ☐

NUMBER OF BIRDS

	SEEN	STRUCK
1	☐	☐
2 – 10	☐	☐
11 – 100	☐	☐
more	☐	☐

SIZE OF BIRD: small ☐ medium ☐ large ☐

PILOT WARNED OF BIRDS: yes ☐ no ☐

INJURIES TO PERSONS: yes ☐ no ☐

EFFECT ON FLIGHT: none ☐ aborted take-off ☐ precautionary landing ☐ engines shutdown ☐ other (specify) ☐

AIRCRAFT OUT OF SERVICE TIME ....

ESTIMATED COST OF REPAIRS ....

ESTIMATED LOSS OF REVENUE ....

DESCRIPTION OF DAMAGE, INJURIES, OTHER INFORMATION ____

PILOT'S NAME ____

D.o.T. 2388 (Rev. 11/80) THIS INFORMATION IS REQUIRED FOR AVIATION SAFETY