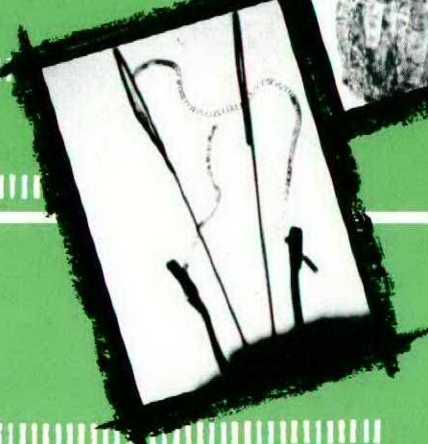
FLIGHT COMMENT

MAY · JUNE · 1967

FLIGHT SAFETY SCIENCE



Comments

A commercial pilot took off for a sky-diver drop in VFR weather. One of the sky-divers later reported the takeoff had been normal but for some unknown reason the pilot extended full flaps at liftoff. The aircraft barely cleared a powerline at the end of the runway. The pilot then climbed to 3000 feet where the first parachutist jumped, and then to 5500 feet where the second jumped. Shortly after the second jumper opened his chute (at about 2500 feet) he and other witnesses on the ground saw the aircraft go into a high-speed power-off dive. During the dive it rolled once to the left then struck the ground with great force. Examination of the wreckage showed no evidence of malfunction of the aircraft prior to impact but post mortem examination of the pilot revealed antihistamine, plus an alcohol value of 36 mgs/100 grams which was not indicative of ingestion of alcoholic beverages. It was medical opinion that the amount of antihistamine exceeded a normal amount which a doctor would prescribe, and would cause dizziness, nausea, rare hyperpyrexia and drowsiness. A medical authority stated, "the drowsiness can be a particular hazard because it may not be recognized by the patient and because it may recur after seeming alertness". From the overall evidence, it was concluded that the excessive amount of medicating drugs caused incapacitation of the pilot. (FSF)

An emergency signal on 243 mc was recently reported by several pilots to the West Coast Ocean Air Traffic Controller. Although no aircraft had been reported overdue or in distress, a Coast Guard search and rescue aircraft was sent out to investigate the area given in the pilots' reports. In less than three hours from the initial report the SAR crew had zeroed-in on a crash position indicator (CPI) floating in the water about 100 miles off San Francisco. The indicator was recovered and traced to an inadvertent loss of the CPI from a USAF aircraft. This occurrence serves to focus attention on the advantages of the CPI – not only in the saving of lives, but of the waste of resources which occurs on lengthy fruitless searches for downed aircraft.

G-suits, in storage for about ten years, have been tested and found acceptable for use. The vigorous tests were done to find if the suits – and particularly the inflatable rubber bladders – were still sound. Of the forty-five suits tested, all met EO specs. (From IAM report 66-RD-3).

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SCIENCE AND FLIGHT SAFETY

These days, we are made constantly aware of the enormous advances in aviation science and technology – many of which may have flight safety implications. In this issue we extend recognition to a few of a category of developments, inventions and technical improvements designed specifically to make maintenance better, flying safer and detection of impending failure easier.

You would expect everyone at this point to rise and cry "Bravo! Let's get on with it; we are all in favour of improved maintenance and safer flying – just like motherhood and more pay." But progress means change, and change is sometimes difficult to accept. After all, in almost any phase of human activity, there are contending viewpoints. Consider, for example, VASIS – acquired at considerable expense for all major airports. The initial reaction to this valuable landing aid by some pilots was to say the least lukewarm, yet the undershoot was a continuing problem for pilots. Our first CF104 suffered this fate. Undershoots have dropped markedly of late (from 58 in 1955, to 4 in 1966); draw your own conclusions. We give a large measure of credit to the VASIS.

Still in its infancy in the Canadian Forces is the Spectrometric Oil Analysis Program (SOAP), yet more sophisticated techniques are in the offing. Maintenance recorders have come of age, and with them the capability to intercept impending failures. The aircraft technician will still be with us, of course, his work eased and improved – and the failure rate in the air decreased.

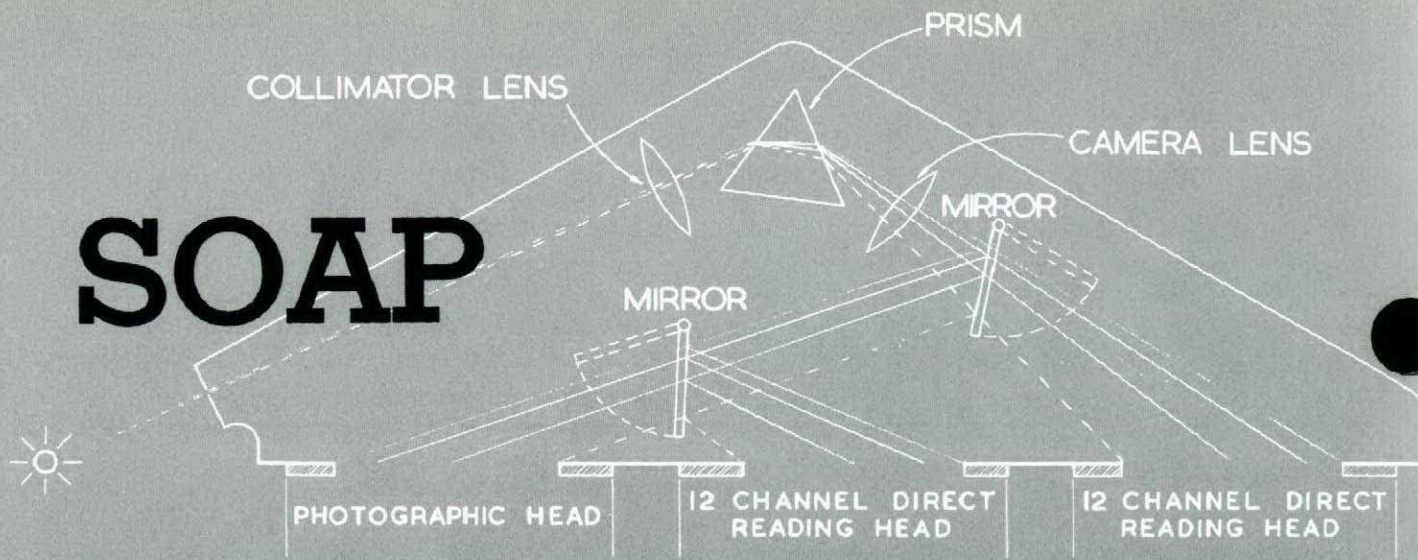
We hope that runway friction measuring devices will so inform and forewarn the pilot that "nil braking" will seldom be seen in accident reports. We would be remiss in failing to mention developments in bird avoidance procedures – the scientific advances were discussed in previous issues of this magazine.

Accident prevention requires definitive accident investigation. Today's aircraft are often destroyed on impact; this is why we continue to press for accident data recorders which may well become our chief source of information.

Scientific aid to the safety of flight is no panacea with which to reduce our accident rate to zero. Machines cannot be economically foolproofed; the contributions of our competent tradesmen are increasingly vital to flight safety. Human error can still occur – even deliberate human errors such as unauthorized low flying – but even here the recorder will monitor and so, may deter! We ask for neither blind over-optimism nor out-of-hand resistance to the new devices and techniques. We should remember that today's equipment and techniques stem from yesterday's radical ideas. Aviation is destined to vast changes for some time to come. To conserve our valuable crews and costly complex aircraft we must exploit the tools and techniques given to us by science.

Group Captain AB Searle
Director of Flight Safety

SOAP



Spectrometric Oil Analysis Program in Air Div

F/L R Thacker

Last October, a small bag containing little brown bottles of oil samples was received at a Shell research laboratory, in England. Submitted for examination by spectrometer, these oil samples were the opening shipment in a program now underway in Air Division. This Spectrometric Oil Analysis Program – SOAP – was the culmination of much effort by many persons at CFHQ, MATCOM and 1 ADHQ. Its inception is evidence of an increasing awareness and acceptance within the Canadian Forces of the value of scientific devices and techniques to monitor the performance of military equipment. The demonstrable value of spectrometric oil analysis, in this writer's opinion, augers well for its ultimate adoption for all Canadian Forces aircraft.

The condition of an enclosed oil-lubricated mechanical system can be evaluated by analysing samples of the lubricating oil, and spectrometric oil analysis is a particularly suitable method of determining the presence of metal particles in the oil-wetted sections of a gas-turbine engine. Jet engines contain aluminum, iron, chromium, silver, copper, tin, magnesium, lead and nickel. Friction between the moving metal parts causes erosion; the eroded particles become suspended in the oil. The oil is then a source of information on the condition of the engine because:

- The chemical characteristics of the particles do not change – they are therefore reliably identifiable and will reveal the components from which they originated.
- The rate of production of each type of metal particle can be measured and through experience, a standard can be established against which subsequent oil analysis results are interpreted.

When the concentration of certain particles in an oil sample exceeds the standard, the identity of these particles will, in turn, identify the engine components being abnormally worn.

Lubricating oils used in aircraft contain no metallic compounds, so any metal particles in the oil must have originated from somewhere in the system. The spectrograph will measure all important wear metals with good accuracy down to a concentration of two to three parts per million.

So far, so good – but is SOAP a success? Yes – but only to the extent that technicians and supervisors give wholehearted support to the program. Most of SOAP's limitations (listed here), involve people:

Type of Failure The program is designed to detect an incipient failure, that is, a failure on its way. A failure preceded by an abnormal increase in the wear metal contents of the lubricant oil, can be intercepted if the failure proceeds at a rate slow enough for the unit to act on an adverse report from the laboratory. Bearing wear, gear wear, and progressive fatigue failures add to the wear metals content of the oil system. The latter may be produced directly by the actual mating surfaces of the failing component, or indirectly from a failure causing misalignment or mismating of other contacting surfaces. Those engine failures which do not produce wear metals directly or indirectly, and instantaneous catastrophic failures are not detectable by oil analysis.

Sampling Intervals As the operating time between incipient and total failure depends on many factors, the shorter the sampling interval the greater the probability of detecting the incipient failure. The greatest probability of detection would, of course, be obtained by sampling after each flight. However, available resources limit the frequency of testing to every 10 operating hours for jet engines.

Sampling Integrity The accuracy of any oil analysis depends on:

- ▹ Has the oil circulated in the system long enough to accumulate wear metal concentration to reflect the condition of the whole system?
- ▹ Does the sample truly represent the oil circulating in the system?

Ordinarily, about five hours operation is necessary for engine oil to reach a representative level of wear metal content. Samples taken immediately after oil change or oil addition will therefore be useless. Too, contamination from poor sampling techniques or improper handling or identification renders the sample useless.

Time Lag from Sampling to Analysis Report The longer the delay between the taking of an oil sample and the oil analysis warning to the unit, the less the chance of timely corrective or preventive action.

Accuracy of Analysis The oil analysis program can be successful only if acceptable accuracy is available. For this fundamental requirement the spectrometer must be maintained in perfect condition, and calibrated for each of the wear metals to be detected. Further, all questionable results must be verified by additional analysis. Results indicating a malfunction in an aircraft mechanism must be verified by additional analyses.

Interpretation of the Analytical Results Threshold limits, ie, the maximum permissible concentration of wear metals, have been established. These limits, however, are derived from experience; we are reluctant to fix a sharp line of demarcation between normal and abnormal concentrations. A marginal wear metal concentration may or may not be indicative of trouble. In such cases the safe approach is:

- ▹ Take samples at shorter intervals to validate the original observations, to more closely monitor the progress of the possible failure.
- ▹ Examine the suspected mechanism to confirm an incipient failure.

This will result in taking extra samples and making inspections when nothing is apparently wrong with the mechanism.

First sample being taken. The SOAP team at 1 Wing. From left to right: Cpl NS Justus – snag crew NCO; S/L KW Joy – SAEO; FS BA Rhindress – SOAP monitor; Cpl DW Porteous – SOAP recorder; WO1 WH Kinnon – maintenance controller TCC.

Responsiveness of the Operating Unit The attitude of persons at the unit towards the program is the decisive factor determining its success because the unit is responsible for, and has control over, key factors in the program:

- ▹ Taking good samples which truly represent the engine condition. Properly identifying the samples, adding any pertinent information, and forwarding samples and information promptly to the laboratory.
- ▹ Conscientiously complying with laboratory recommendations on suspect mechanisms.

Feedback Information from the Overhaul Contractor Establishing and refining the patterns of normal and abnormal wear metal concentration depends upon correlating oil analysis data with the actual conditions found in the mechanism at the time of disassembly (called "strip"). It is therefore imperative that the contractor provide the laboratory with adequate descriptions of the condition of the engine on their strip report.

The Air Division Oil Analysis Program

Fundamental to any oil analysis program are these requirements:

- Unit support to ensure that properly identified representative samples are forwarded quickly to the laboratory.
- A transportation system capable of delivering samples to the laboratory in the minimum of time.
- An effective communication system between the
- SOAP monitor and the operating units.
- A professional testing organization to ensure quick and accurate oil analysis.
- Reliable interpretation of the analytical results by the SOAP monitor.

Approval of the oil analysis program occasioned a flurry of activity by 1 ADHQ staff. For a while we had the benefit of the USAF and USN statistics, procedures, training material, threshold limits, etc – all of which gave considerable assistance in the development of the RCAF program. There existed, nevertheless, the need to satisfy certain requirements which are unique to the RCAF program. An engineering order (EO 45-10A-2/AD1) had to be prepared; a Used Oil Analysis form (SOAP1), and Laboratory Engine Record Card (SOAP2) had to be designed and printed; oil sampler kits had to be procured; a laboratory had to be found for Quality Control approval and, after approval, a contract negotiated; shipping bags had to be produced; a transportation and a communication system had to be arranged; and above all, technicians had to be trained to take oil samples. Clearly, the rapidity with which this program was introduced is a testimony to the excellent support provided to 1 ADHQ by such diverse staffs as: CDLS(L), CFHQ/DAE, and CFHQ/DFS, MATCOM (QAD and J79 Log Cell), and DDP.

To keep down costs it was necessary to employ RCAF resources whenever possible. Today, we can deliver an oil sample to the Shell Laboratory in England within hours of the sample being taken at the operating unit. Here's how the system works:

- A unit delivers samples to the AMU for pick-up by the inter-wing scheduled flight operated by 109 KU Flight.
- On arrival at 1 Wing all samples are put into one bag with the samples from 1 Wing and Decimomannu.

- The combined shipment is then loaded on the next aircraft flying to Gatwick, UK.
- On arrival at Gatwick the shipment is given priority clearance by British Customs.
- Once cleared by Customs the shipment is immediately taken by vehicle to the Shell laboratory.

Weather or unserviceabilities may interrupt this timetable; then, a T33 will fly samples direct to the UK. So far, this back-up system has not been needed.

To be fully effective the SOAP monitor requires adequate communication with units to quickly pass any recommendations arising from the oil analysis. Here, maximum use of Canadian facilities has achieved the dual aims of economy and efficiency.

At the laboratory each sample is numbered. This number appears on the Used Oil Analysis form (SOAP1). A triple record entry system ensures identification – the sample is treated like the numbered prescription at the druggist.

The day's work begins with the lab technician preheating the machine for 30 minutes and verifying the calibration of the spectrograph. Then the analysis of the samples commences. First, the special samples are analyzed; next, the routine samples (ie, the 10-hour samples) are processed. The readings for each element are annotated into the spectrographic log book. Any relatively high reading is rechecked to confirm the accuracy of the analysis.

Interpretation of the analytical results is based on their relationship to the threshold limits, and also on a comparison with previous analyses. As the criteria are not absolute there is a need for caution and judgement. For example, J79 engines with large differences in operating hours and different configurations from modification, are being assessed as a common population.

Discrepancies which suggest corrective or preventive action or special sample test results are reported to the unit immediately by telephone and follow-up message. The unit may be advised to take one of these courses:

- **Take another oil sample as soon as possible, and do not change oil.**
  This will be the most frequent recommendation.
- **Take an oil sample after every flight, and do not change oil.**
  Used when sample in (1) above shows high but not excessive metal content.
- **Take sample at five hours operating time since last sample, and do not change oil.**
  Made after check sample indicates high but not excessive metal content, and the analyst suspects something may be wrong.
- **Change oil, and sample after five hours operation.**
  This request is made when sample shows high metal content, but there is evidence that the oil may be contaminated.
- **Ground the aircraft, do not change oil, and take sample after ground run.**
  Made when sample contains excessive wear metals and the analyst considers grounding the aircraft warranted. Suggested ground run time will be given.
- **Ground the aircraft and examine for discrepancy. If discrepancy not found send engine to overhaul contractors for strip.**
  This recommendation is made when after two or more checks, samples indicate excessive wear metals. If possible, the analyst will indicate area of discrepancy for local examination.
- **Return aircraft to flying status, and take an sample every five hours of operation.**
  Made after aircraft has been grounded and the discrepancy has been found, and check sample indicates the engine is normal.
- **Return engine to normal sampling schedule.**
  Made after an aircraft has been placed on a special sampling frequency and the samples returned to normal.

Results of the Air Division Program

At the time of writing, approximately 1000 samples have been analyzed at the Shell Laboratory. Forty-two recheck samples were requested by the SOAP monitor. This figure of 1000 is higher than would be expected from the present flying rate, but all Category 3 engines are on a 5-hour sampling frequency (SI 10B-10C-5V/24).

Nine engines were grounded and units asked to examine for a malfunctioning component. If the discrepancy was not found the engine was returned to the factory for inspection.

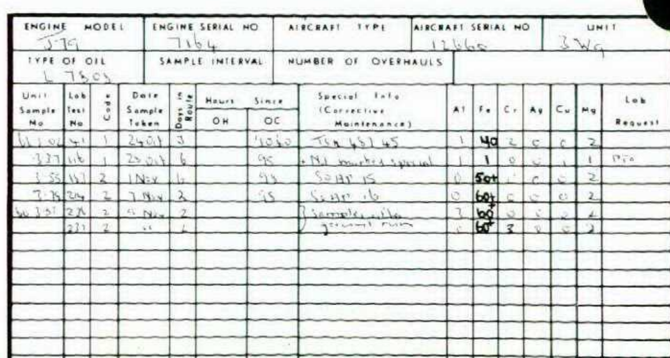
The case histories of some engines are given below. Four of the recommendations for unit action were based on the presence of JP4 in the oil (although testing for JP4 was not originally envisaged as part of the SOAP program). Testing for JP4 is not done routinely and is usually spotted when an oil sample catches fire during the arcing cycle on the spectrograph. Needless to say, approval is being sought to have each oil sample tested for JP4 – a program which will relieve the unit of trying to detect the presence of fuel in the oil system.

These engines had JP4 in oil samples. This new phase of the program has already produced positive results:

Case Histories

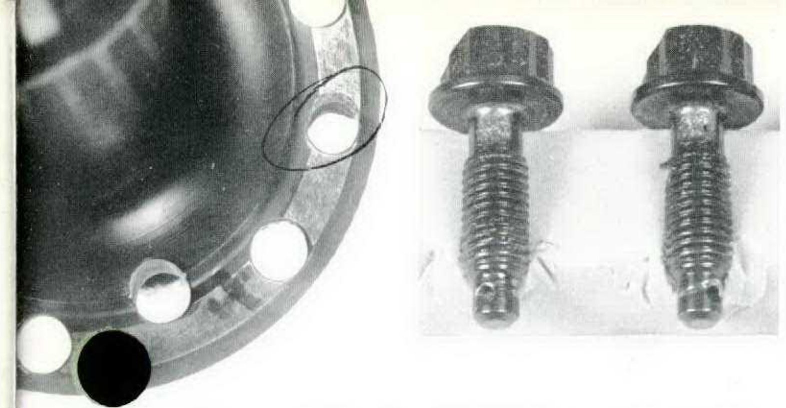
7164 Returned to contractor – high iron content in the oil. Lockwire failure on bevel gear retaining bolts in the gear transfer box. The strip of the engine revealed that failure was imminent. This could have had disastrous results. Identification of the discrepant engine was a clear success for the SOAP program. (Note the high iron reading in the "Fe" column; the threshold limit is 18!)

7206 Engine grounded because of significant increase in iron and aluminum content of oil. A loose spanner nut in the front gear box had permitted the thrust bearing inner races to rub on sh



ENGINE MODEL	ENGINE SERIAL NO	AIRCRAFT TYPE	AIRCRAFT SERIAL NO	UNIT
J79	7164		12660	3 Wg
TYPE OF OIL	SAMPLE INTERVAL	NUMBER OF OVERHAULS		
L 7808				

Unit Sample No	Lab Test No	Code	Date Sample Taken	Days in Route	Hours Since OH	Hours Since OC	Special Info (Corrective Maintenance)	Al	Fe	Cr	Ag	Cu	Mg	Lab Request
[illegible]	41	1	24 Oct	3		[illegible]	[illegible]	1	49	2	0	0	2	
[illegible]	[illegible]	1	25 Oct	6		95	[illegible]	1	1	0	0	1	1	[illegible]
[illegible]	[illegible]	2	1 Nov	6		95	[illegible]	0	50+	[illegible]	0	0	2	
[illegible]	[illegible]	2	7 Nov	2		95	[illegible]	0	60+	0	0	0	2	
[illegible]	[illegible]	2	[illegible]	2			[illegible]	3	60+	0	0	0	4	
	[illegible]	2	[illegible]	[illegible]			[illegible]	0	60+	3	0	0	2	



Excessive wear at dowel and bolt holes – and two of the worn bolts

It was the rubbing of the components which created metal particles. This is considered to be the most significant SOAP result to date. Not only was a defective mechanism identified but units were alerted to the possibility that other gear boxes could be in similar condition. SOAP findings, then, have found their way into maintenance procedures.

7356 Engine grounded and returned to contractor for high iron content in oil. Oil sample was later found to have been taken from scavenge filter line instead of oil tank.

7121 Engine grounded for high iron content in oil, engine returned to contractor. Strip inspection revealed a broken tab washer in the transfer gear box.

7162 Oil analysis revealed high iron but at a level below the threshold limit. Subsequent filter inspection revealed metal particles present. Engine returned to contractor; strip revealed a broken tab washer in the transfer gear box.

[illegible] Engine experienced a severe overtemp due to nozzle locking in the closed position. A special oil sample showed high iron and copper indicating bearing failure. This was later confirmed on strip.

7368 Engine grounded for high iron. Inspected by unit, and most of the oil-wetted components replaced. Engine returned to service after four satisfactory samples obtained from ground running. Later, the engine was found to have sustained the same fate as 7121; in this case only the gear box was returned. The engine ran satisfactorily after the gear box was changed.

7170 Increasingly high iron content observed, engine grounded. Unit inspected the engine. Filter inspected and oil changed. Six samples taken during ten-hour ground run-up, all samples essentially normal so engine returned to flying status. Sample after first flight indicated increase in iron content of oil, this confirmed by sample after next flight. Engine grounded and returned to contractor for strip inspection. A broken lockwire was found to have caused the rise in the iron content of the oil.

7148 Engine grounded for high iron content in oil. Engine placed on inspection and most of the oil-wetted components changed. Components returned to contractor for strip inspection. Subsequent oil samples were normal.

[illegible] JP4 residues in two oil samples increased from 1.2% to 1.6%. The unit confirmed excessive leaking in fuel pump.

7285 Sample revealed 4% residue in oil. The fuel pump was replaced and subsequent sample revealed 1.8% residue. Aircraft on deployment to Deci where nil leaks were found. Further checks requested and additional samples to be submitted.

7140 Sample revealed 4.5% residue in oil. Pump leakage check confirmed main fuel pump shaft had excessive leak.

7238 Only .1% residue in oil sample; however, unit advised that AB fuel pump was being replaced for excessive leaking.

JP4 contamination of the oil was found on other engines; however, these were discovered by the unit before notification of oil analysis. These include: 7362 (AB and main fuel pumps changed), 7181 (main fuel pump changed), 7234 (main fuel pump changed).

Thus far, we have had three confirmed successes for the SOAP program. Only the future will tell the accuracy of the predictions on the engines and components now being returned for inspection. However, to regard all SOAP laboratory findings as "hits and misses" obscures the many other contributions that the program directly or indirectly provides to the engine maintenance people:

- *High wear metals found, but well below threshold limits. Unit advised and sampling frequency increased. Unit increases filter inspections and greater depth of BFIs and PFIs performed. Unit finds metal in filter and engine removed for inspection which results in defect being located.*
- *High wear metals found. Sampling frequency increased and unit advised of possible oil system malfunction. Pilot reports fluctuations in oil pressure during flight. Unit inspection reveals defective oil pump. Oil pump replaced and engine ground-run to confirm no damage to bearings from possible oil starvation. If wear metals content is normal, engine returned to flying without further maintenance. If wear metals high, engine is re-inspected.*
- *Engine compressor suspected of FOD or perhaps aircraft suffered a birdstrike close to the inlet ducts, but visual inspection reveals no damage to engine. Engine grounded until oil analysis indicates no damage to bearings.*
- *Pilot reports engine vibration, possibly attributable to bearing failure or improperly rigged airframe components. Engine grounded until oil analysis results indicate no bearing damage.*
- *Scheduling of engines to overhaul contractor or into maintenance on the basis of oil analysis history.*
  Visual inspection of the oil samples under the trained eye of a chemist, resulting in further testing. The presence of minute bodies in the oil can be readily detected in the laboratory. This can be confirmed by putting the sample in a millipore and, using a photographic plate spectrograph, a qualitative analysis of the debris in the oil can be obtained. This information can then be used to locate the cause.
- *Accident investigation. This may appear to denigrate a program which is designed to prevent accidents. However, negative evidence, ie, what did* not *fail, is of vital importance to the accident investigator. For example, a sample taken from an engine of a CF104 which crashed last year was compared with the analysis of an oil sample taken from the same engine two or three hours before it crashed. This comparison gave the investigator reliable information on the serviceability of the oil-wetted parts of the engine immediately prior to the accident.*
- *Selection of aircraft for deployment to Decimomannu. The deployment of aircraft from the Wings to Deci requires considerable flying over water. In recogni-*

tion of exposing the pilot to higher hazard from bail-out over the sea, an aircraft with an engine undergoing special sampling due to wear metal contents in the oil, is not deployed.

Already, the program has demonstrated oil analysis can increase safety and reduce maintenance costs. The effects of this on weapon system effectiveness and operational readiness are obvious.

The potential savings arising from the oil analysis program cannot be estimated unless the savings cost is placed on events that did not occur! An engine discrepancy not detected in time to prevent a failure, costs us a known amount in life and material. On the other hand, if a failure is averted, then who can say what the consequences of the failure would have been? Would the failure have been partial or total? Would it have occurred on the ground or in the air? If in the air, would the aircraft have landed safely? Would the defective condition have been detected by other means before final failure occurred? These factors prevent an accurate assessment of the specific values of the program in terms of economy of resources, but our limited findings so far in Air Div are in line with other forces' experience – strong and clear evidence of the value of the spectrometric oil analysis program. The success of an NDT program such as the SOAP should alert us to the considerably more sophisticated techniques now becoming commonplace in other services and industry. We cannot afford to ignore or reject these advances – their promise is too great.

F/L Thacker attended the University of British Columbia under the provisions of the serving airman plan. On graduating in 1960 he was transferred to the staff of the Chief of Quality Control, Air Materiel Command HQ. In 1964 he was transferred to 4 Wing and later that year, moved to the staff of the Staff Officer Flight Safety at Air Division HQ. In October 1966 he was attached to the Canadian Defence Liaison Staff in London, England, as monitor of the Air Division's spectrometric oil analysis program.

Who left my shaving cream on the radiator?

This high-flyin'll be the death of me!

Quick, tell the tower - negative touch-and-go; we'll make it a full stop.

Gulls are Bums

Seventy-odd years ago, the herring gull was on the verge of extinction . . .

We put them on the protected list. We gave them easy pickings in the form of garbage dumps, raw sewage effluxes, etc. As Dr Drury, a prominent US biologist says: "Man's untidy habits have given the gulls a life of ease". To make things worse, we gave them open grassy airports and paved runways where they can loaf, warm their feet, and think about more than just making a living. But we haven't figured out just how to slip them the pill.

The gull population is exploding. And to quote Dr Drury again: "Only about 10% are making an honest living gleaning along the beaches – the rest are bums".

By 1963 you (Air Canada) were having almost six times as many strikes per thousand takeoffs and landings as you had in 1959 and most of the corpses were gulls (herring and ringed-bill), plus a few engines. Fortunately, none of the corpses were humans – in Canada.

About that time (1963), the National Research Council's Associate Committee on Bird Hazards to Aircraft started operations. Some of their efforts have already produced results. Last year you had only four times the rate in 1959. So far this year, despite more aircraft, more hours, more movements, and many more gulls, we are managing to just about match 1965's figures.

In 1963, about 80% of the strikes were on or very near airports – last year only 55%. This year, the airports have scored just over 60%. Changing the airport environment seems to be one angle which is paying off.

The DOT has dumped over a million yards of fill in the water holes at Dorval, the borrow-pits at Edmonton, the sloughs at Winnipeg. Hundreds of acres of bush and trees have been cleared at Malton, Dorval, and Vancouver. Miles of shoreline ditches and hedgerows have been cleaned up or removed at Vancouver. The Canadian Wildlife Service has several biologists continually investigating and advising on conditions, and with the help of the RCAF and the DOT, are now able to file flight plans for some of the migrant flocks of ducks, geese, hawks, etc.

But there is a tremendous amount to be learned.

In addition to filing your birdstrike and bird-sighting reports, you can help by:

- Reporting congregation of birds on or near the airport, to the tower as soon as possible.
- If you have a strike or a near miss on or near the airport, advise the tower as soon as you can.
- If you see birds at unusual altitudes (say, over 5000 ft), or in abnormal weather or cloud conditions, a report would be appreciated. (It is thought that migrants fly VFR – but don't count on it.)

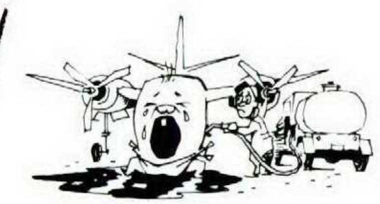
Filing reports is a nuisance – but they are one of the most effective means of pinpointing problem areas and measuring the work of all concerned. They have helped not only Air Canada but have aided in making Canada internationally known for its research into the bird problem. Groups similar to the Associate Committee have now been set up in a number of countries, (UK, Netherlands, New Zealand, to mention a few) and some of our findings have been applied around the world – even to aircraft carriers.

With the increasing severity of the gull problems, your help is vital – and gratefully appreciated.

Mr WH Bird

- Air Canada "Grapevine"

Fill'er Up!



After landing at another base the pilot proceeded to transient servicing and wrote in the fuel requirement on L92, the vague word "full". The servicing crew (who were unfamiliar with this aircraft) filled both wingtanks and had pumped about 5 gallons into a fuselage fuelling point when fuel was noticed dripping from the torpedo-bay doors.

"Inspection showed there was no torpedo-bay fuel tank installed in the aircraft" reads the report. Further, the decals cautioning to open the doors before refuelling, were partly worn away. No damage was caused but a fire hazard was created.

A moment's attention to several of the details of this occurrence could have prevented the mistake:

- The pilot filled out the transient servicing form inadequately by using merely the word "full"
- Better marking at the fuelling point is required
- The pilot, knowing the servicing crew to be unfamiliar with his aircraft, should have taken special care to point out any precautions necessary.

It would seem questionable in the first place to have a fuelling point left unsealed when the tank it leads to is sitting in a hangar at home base.

Amen!

The garbage dump on the approach to runway 10 will be closed... The new location should alleviate the bird problem.

– extract from Flight Safety Meeting

GOOD SHOW

F/L HC MacGREGOR

While performing an acceptance test flight in a CF104, F/L MacGregor experienced a low oil warning and a nozzle failure to the full open position. An immediate landing was imperative.

F/L MacGregor's immediate response was to secure radar assistance. He set up an emergency spiral descent into cloud, breaking out visual around 4000 feet overhead an airport. The 104 was expertly flown to a successful landing, and the aircraft engine was stop-cocked on the runway. An incorrectly assembled scavenge pump had permitted oil to escape.

F/L MacGregor's competent response to a hazardous emergency in less than ideal weather conditions and with a crippled aircraft, was a fine job of good judgement and flying skill.

S/L RW SPENCER

Leading a two-plane formation takeoff, S/L Spencer noted a flock of large birds flying across the runway just at nosewheel lift-off speed. At this speed – about 200 knots – a power loss was felt. Immediately S/L Spencer began the abort procedure. As soon as the nosewheel was returned to the runway he applied hard braking to ensure the aircraft being below dragchute failure speed. With about 2500 feet to go from the barrier, the hook was

extended. The aircraft engaged the barrier at about 120 knots and was successfully arrested about 50 feet from the end of the concrete overrun.

The engine had sustained very severe damage from ingesting a partridge probably about one pound in weight. S/L Spencer's quick thinking and good judgement salvaged a near-disastrous mishap. Aircraft damage was kept to a minimum in a fine display of flying skill.

F/L WV PEPPARD

F/L Peppard was on a low-level exercise in a CF104 when at 500 feet above ground he experienced a sudden loss of thrust; the tailpipe nozzle had opened to 0.6. As he increased power the oil low-level light illuminated. He decreased power and employed the emergency nozzle closing system which returned the exhaust nozzle to cruise position. By this time oil fumes in the cockpit necessitated a landing at the closest airfield. Fortunately, the German Air Force base at Lechfeld was only 15 miles away. F/L Peppard's MAYDAY call was answered by Lechfeld; he was given heading to steer and all pertinent airfield information. Despite being well above normal landing weight, he accomplished a successful precautionary landing. There was only a pint of oil remaining in the oiltank; a bearing scavenge pump had failed.

F/L Peppard's response and skill throughout this emergency saved a valuable aircraft. The controller on duty, Sgt AR Roegner of the German Air Force's 32nd Fighter Bomber Wing, Lechfeld, did a commendable job of assistance during a serious inflight emergency. The decisive action of both men was indeed exemplary.

F/L KR STACEY

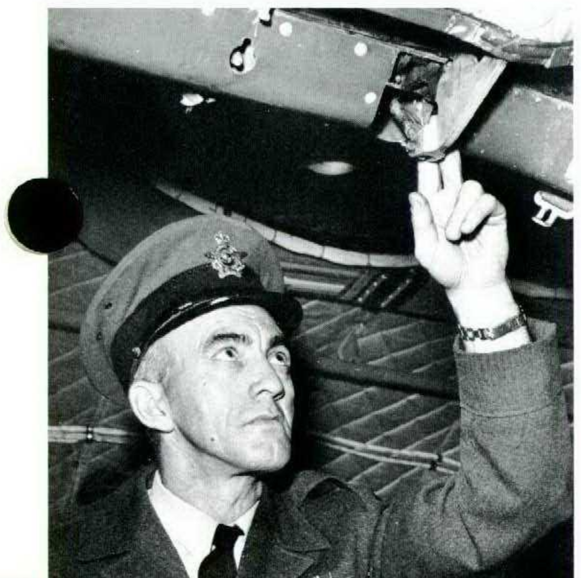
F/L Stacey, first officer on a flight that had landed for an overnight at Thule, later returned to the aircraft to get his baggage. Entering the cockpit, he heard a hissing and surmised that it could be caused only by oxygen leaking. Rather than turn on any electrical power and risk the danger of a spark, he investigated in the dark. None of the regulators were faulty. Not having determined the cause of the noise he returned to the mess and alerted the aircraft captain.

The fire department was notified and the crew returned to the aircraft. There was no evidence of any hissing and all appeared normal, however F/L Stacey persisted in the investigation. He discovered that when the clamp of the co-pilot's walkaround oxygen bottle was fastened, the bottle regulator exerted pressure on the refiller hose coupling causing oxygen to leak. The clamp was released and the oxygen system turned off.

F/L Stacey, by his keen observation, and persistence in his follow-up search, averted a potentially dangerous situation that could have resulted in serious damage or even loss of an aircraft.

LAC JF BLACQUIRE

On a post-flight inspection in an Argus, LAC Blacquire detected several cracks in the main entrance door hinge attachment brackets. The inspection of these brackets is not required on a PFI. A special inspection, based on LAC Blacquire's discovery, revealed other Argus aircraft in the same condition.



The discovery of cracked or damaged components has contributed significantly to the flight safety effort over the years.

LAC Blacquire's alertness and his attention to detail led to prevention of a possibly serious accident.

CFN RE THOMPSON

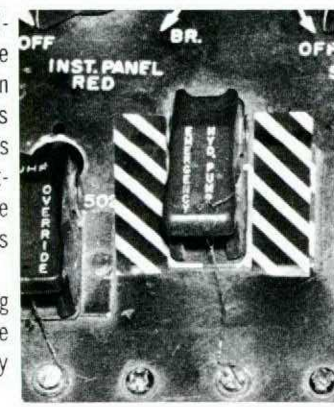
While conducting a between-flight inspection, Cfn Thompson detected a hairline crack in the brake housing of an L19. He recommended the aircraft be grounded for further inspection. Dye checks confirmed the crack to be deep and one of several in the brake assembly.

Some weeks before this, an L19 pilot had experienced a brake seizure during landing. Cfn Thompson's alertness averted a similar condition which may have resulted in a serious accident. His commendable thoroughness during a "routine" job is the mark of the professional technician – a valuable asset in aircraft operations.

Timely UCR

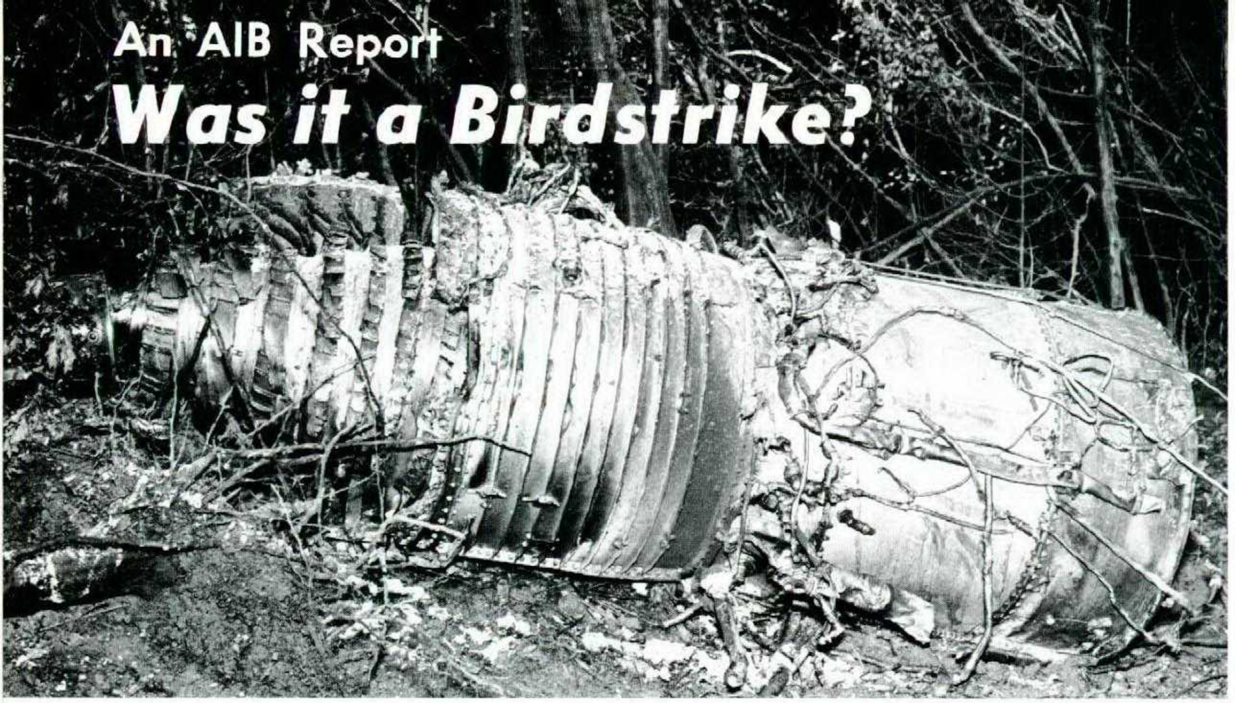
A modification detailing the application of black-and-yellow striped tape to certain emergency switch covers in the T33 cockpit, created a hazard. This tape, if placed on the switch covers would obscure the identification lettering on the cover – hardly compatible with flight safety. Emergency switches must be readily identifiable.

The UCR recommended positioning the warning tape on either side of the switch, and the suggestion was promptly adopted.



An AIB Report

Was it a Birdstrike?



Scientific Breakthrough Aids Investigators

Investigations into the causes of CF104 engine failure accidents have been for the most part successful, however, one perplexing type of failure did baffle the investigators for some time. In these cases the sequence of events began when, without warning, a loud bang occurred in flight followed immediately by a total loss of thrust. After unsuccessful attempts to obtain a relight the pilots were forced to eject.

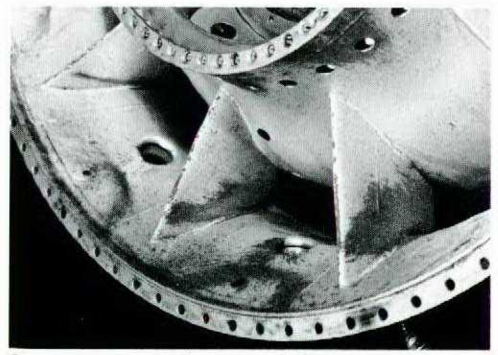
Meticulous technical investigation in these cases failed to establish the cause of engine failure. The compressors were massively damaged in a manner suggesting that the damage had occurred before impact with the ground, but there the trail ended. In these cases, this was the only technical defect identifiable as "pre-impact" so investigative effort was concentrated in this area. All possibilities were considered, ie,

a. a failure of a part of the compressor itself
b. failure due to the entry of a foreign object from another part of the aircraft, eg, a loose panel, nut, bolt, etc,
c. failure due to entry of a foreign object from outside the aircraft, eg, bird.

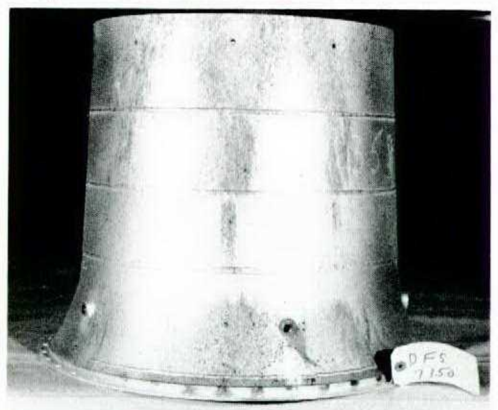
Metallurgical analysis of the affected parts indicated that the causes were not due to a. or b. above, and no trace of bird remains identifiable as such could be found. Consequently, the cause of several of the accidents remained unsolved.

Although the possibility of these failures being due to birdstrikes was considered, there did not seem to be any link to identify them as such. It became imperative therefore that some way of identifying bird ingestion as a cause of engine failure had to be found. Inconclusive investigations are time consuming, expensive, and generally unsatisfactory.

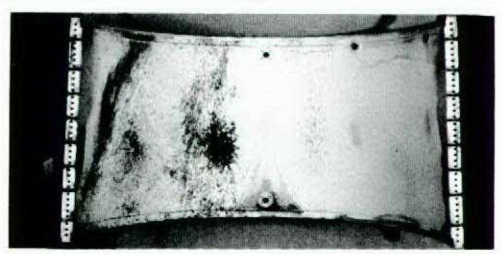
Tell-tale signs of bird ingestion appeared in several areas of the engine:



Compressor rear frame – diffuser



Inner combustion casing



Half-section of outer combustion casing

At about this time a crash occurred where it was possible to establish, on the basis of evidence provided by the pilot, that the cause of engine failure was due to bird ingestion. The engine from this crash was carefully examined and it was noted that the damage pattern was remarkably similar to that of the unsolved cases – massive damage to the compressor with no visible sign bird remains. Other than that however, there did not m to be a positive link between the two.

Thus, armed with these engine damage patterns a search was made through the RCAF Materiel Laboratory for qualified personnel who could assist in the development of a positive investigative technique. Results were initially disappointing. The first big break came during examination of an engine at Orenda which had ingested a bird but had not failed. Certain distinctive dark, crusty, thin splotch marks with definite patterns were noted aft of the compressor and in the combustion zone by Mr A Brigstocke of Orenda. A cross-check of the failed birdstrike engine revealed somewhat similar but smaller and much less distinct markings. It was now evident that the investigation had reached the point where it should be placed on a scientific basis.

Mr Paul McLean of the RCAF Materiel Laboratory approached the University of Ottawa for help, and succeeded in interesting Dr Quentin LaHam of the Biology department in the problem. Dr LaHam made visits to the Materiel Laboratory and Orenda where he took scraping samples from engines known to have failed because of dstrikes, engines suspected to have failed because of dstrikes, and from engines simply returned to Orenda or routine overhaul. These samples were examined microscopically (up to 2000x) and were subjected to amino acid analysis. The research took several months to complete, and in the end a positive technique for identifying engines which had failed due to birdstrike was established – the missing link had been found.

The following are some excerpts from Dr LaHam's report:

"*. . . It is the purpose of this report to outline 1) the methods employed in conducting investigations of engines known to be victims of birdstrikes, those suspected to be birdstrikes, those that failed for unknown reasons and engines brought in for routine servicing with no history of engine failure; 2) the results obtained from the investigations; 3) recommendations.*

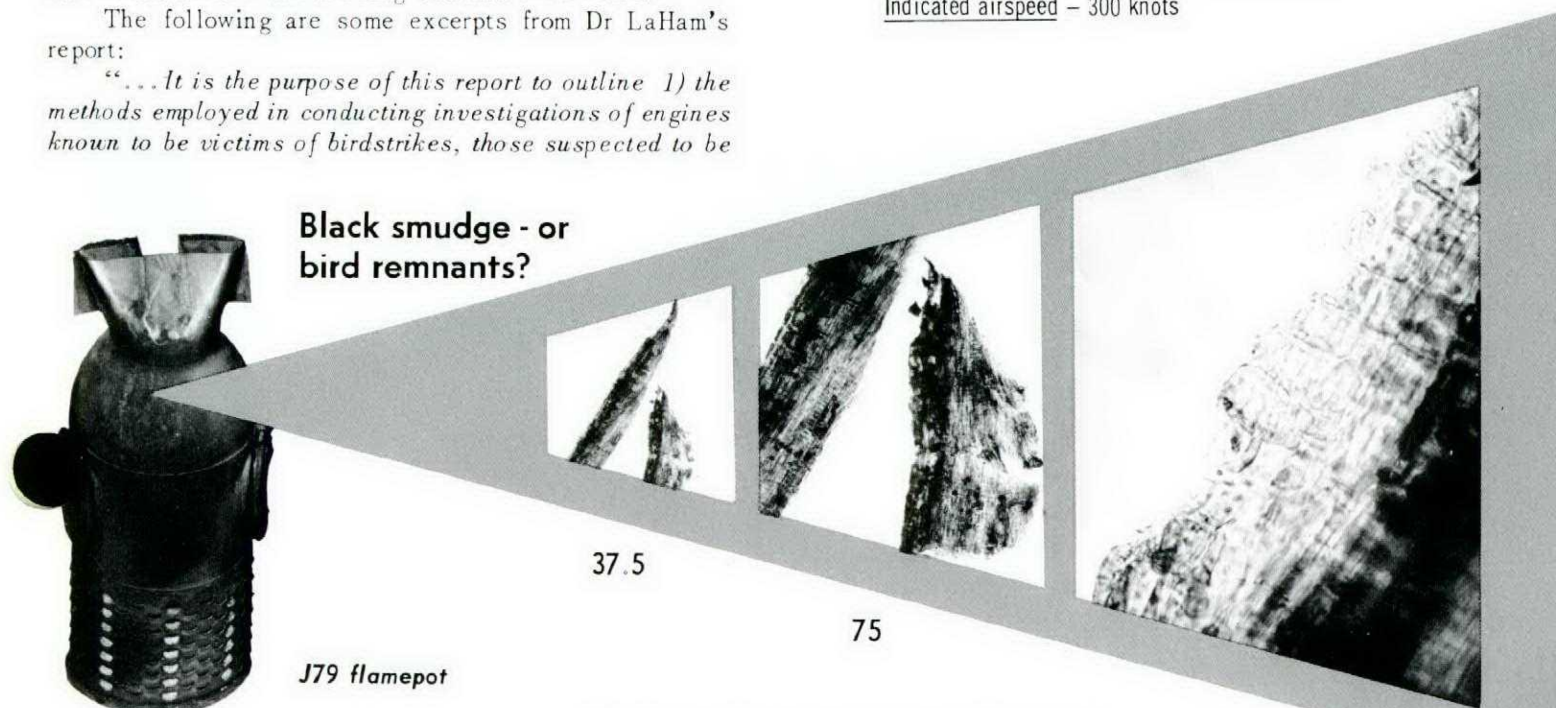
Materials and Methods

Scrapings are taken from all parts of the engine, but of chief importance are those from the outer and inner combustion casings, blades from various stages, turbine shroud support ring, fuel nozzles and burners. The scrapings from each area are suspended in distilled water and filtered through a Gelman cytology membrane. The membrane and its contents, stained or unstained, are cleared in xylol and examined under the phase-contrast microscope. With this screening technique all cells, bone and feather fragments, engine and extraneous debris can be observed. With a general histological background and particular knowledge of the blood cells, bone and feather structure of the bird, the experienced observer is able in most cases to make a diagnosis. Despite the intense heat of the engine it is rare that even microscopic fragments do not remain.

A further analysis, that of the amino acids, is undertaken to confirm the microscopic findings and has yielded excellent results even in the rare case when a birdstrike is suspected but unequivocal microscopic findings are not present. This is based upon the fact that if any animal material remains it will be primarily protein. Since the proteins are composed of smaller chemical units, the amino acids, we can by chemical means identify these and thereby ascertain not only the presence of protein but knowledge of its composition . . .

Case 2 (of seven)	J79	7163	CF104	12853

A possible birdstrike with engine failure – "A" crash 16 September 1965 – 3 Wing
Altitude – 3000 ft above ground, in solid cloud
Indicated airspeed – 300 knots



J79 flamepot

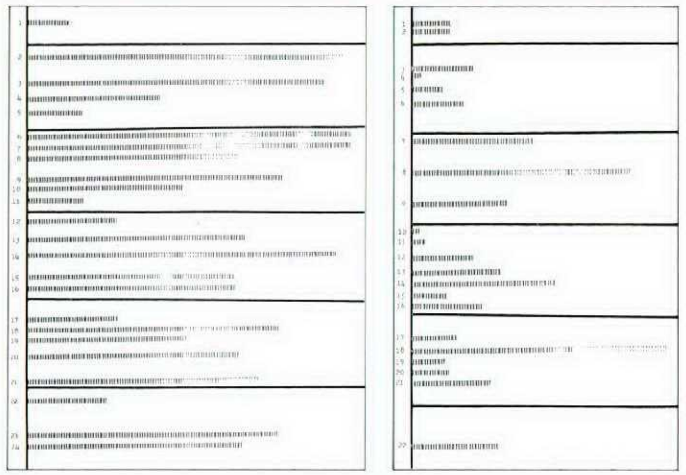
(Numbers indicate microscopic enlargement)

Origin of Scrapings:
1) outer combustion casing
2) inner combustion liner
3) transition area on shroud support ahead of burner (diffuser – compressor rear frame)
4) burners
5) fuel nozzle

Results:

a. Microscopic
Despite extensive damage to the engine the various scrapings did yield numerous feather fragments which were easily identified microscopically. (See page 11.)

b. Amino acid analysis
Seventeen different amino acids can be identified in all recordings regardless of the source of the scrapings. The patterns are identical and all show a high concentration of arginine, as compared to the others. Glycine and alanine are reluctant to separate. Ornithine appears to be abundant as well. There are five unidentifiable peaks...



Amino acid readout – "birdprinting" may be possible as distinct patterns have emerged from each birdstrike tested so far.

Discussion

After examining samples from several engines, including some not reported on here, there is not the slightest doubt that we can determine with certainty whether or not an engine failure has occurred as a result of a birdstrike. As this was the original frame of reference under which the investigation was begun, we feel safe in reporting 100 percent success.

In all cases it has been possible to find microscopic bird remnants. As the absolute criterion we have insisted on feather fragments, since this is a unique feature of birds. Bone fragments are also present, and in one case blood cells have been observed. Bone and blood cells have not been submitted as final proof because of their sidespread occurrence in nature, although certain bones in birds have specific structural modifications for flight and the red blood cells of birds are nucleated ovals.

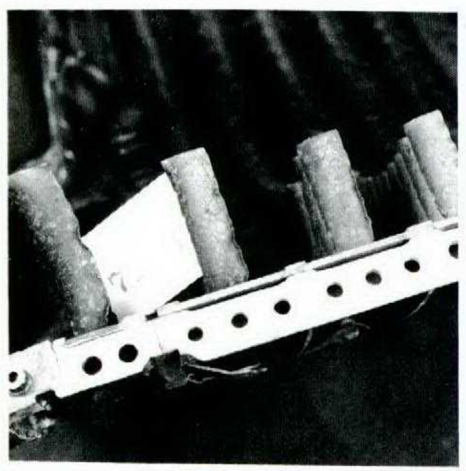
The amino acid analysis while originally conceived as a means of substantiating the microscopic evidence and whose value would be of prime importance where unequivocal microscopic findings could not be obtained, may turn out to be the important phase of the investigation, ultimately resulting in the identification of the specific bird type and possibly the genus and species! We base this on the evidence at hand which, although not representing a large sample strongly suggests that we may have found a definitive method for bird identification.

If one carefully studies the amino acid recordings of the different engine scrapings, it becomes evident that there are major differences between them where scrapings from different areas of the same engine are remarkably similar, differing only in the quantity of protein present. The implication is that the protoplasm of different birds has protein structures which are specific to their kind. There is sufficient ecological, morphological and physiological evidence to warrant this possibility.

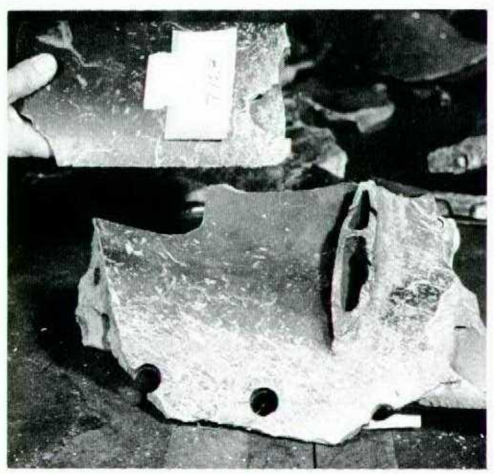
If one considers the diversity in habitat, food chains, pigment patterns and flight in birds, it becomes obvious

cont'd on page 30

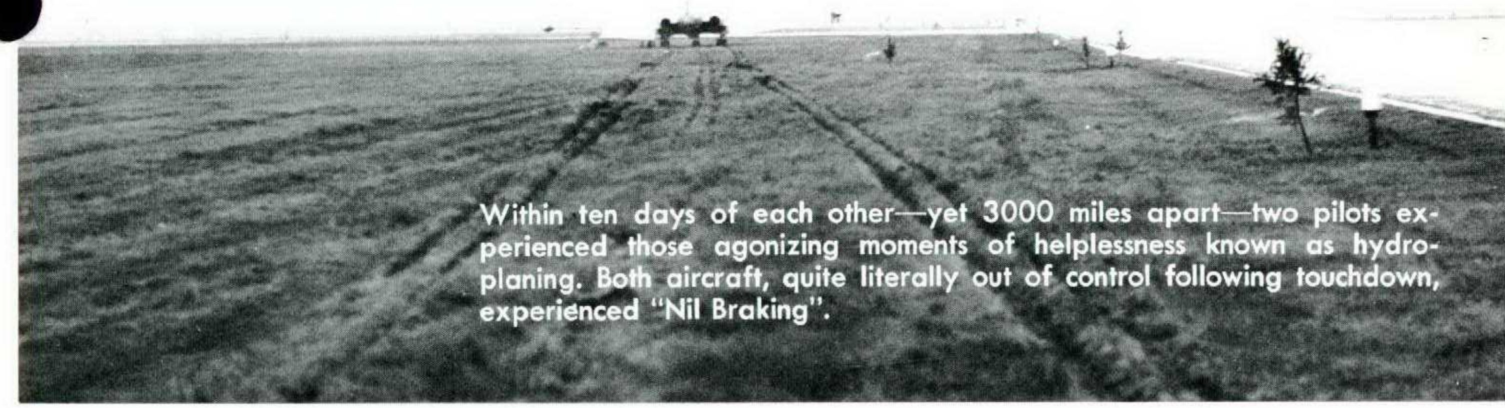
The sequence of events begins when an inlet guide vane is dislodged by a bird. The IGV then becomes a foreign object entering the engine which is turning about 7000 rpm – truly a monkey-wrench in the works. More IGVs are dislodged and disintegrate as they are drawn into the compressor. The resulting massive damage to the compressor fails the engine.



Compressor stator blade damage.



Parts of an engine front frame showing severe scoring.



Two Off the Side

Within ten days of each other – yet 3000 miles apart – two pilots experienced those agonizing moments of helplessness known as hydroplaning. Both aircraft, quite literally out of control following touchdown, experienced "Nil Braking".

Both runways were rain-wetted at the time; one by "moderate rain", the other by a "rain shower". Both aircraft ran off the side of the runway and were damaged.

If, as the pilots claimed, the approach speed was normal, then two important facts emerge:

- The landings were made outside the "ground envelope" for the aircraft – in both cases this was created by the runway conditions.
- Either a crosswind, or misalignment of the flight path prior to touchdown, set up the direction of the ground run.

WATER *MELT* RUBBER?

Two sections of two Tutors, each in formation, returned for landing within five minutes of each other. Steady light rain had been falling in the area for the previous six hours – not sufficient to pool water on the runway. At the time of the landings, however, a heavy rain shower was passing over the station and the surface wind was shifting back and forth from east to west at approximately five to ten miles per hour.

The heavy rainfall covered the runway with a layer of water faster than it could drain off; the shifting winds created a 5-10 mph tailwind. Add to this, the likelihood that the pilots were using a higher approach and landing speed for the formation stream landing – and hydroplaning is a distinct possibility.

A Tutor tire, with a pressure of 150 lbs will hydroplane to 88 knots although it requires a speed of 106 knots to initiate the condition. Normal threshold speed is 95 knots and touchdown speed is approximately 90 knots. The circumstances – rain, tailwind and formation speed – were ideal for hydroplaning.

Fortunately, the pilots had no control problems, and normal braking techniques were used. But the melted tire treads illustrate what had occurred – the photo is one of four in similar condition.

A close look at the water depth would have revealed that the runway conditions precluded a safe landing for these aircraft; a diversion could have then been ordered. If a diversion was impossible or undesirable, the pilots should have been alerted to the two points mentioned above, and take great care not to aggravate an already delicate situation:

- Approach speed should be pegged as accurately to the safe minimum as possible.
- The flight path of the aircraft just prior to touchdown must be perfectly in line with the runway. You might consider landing on the upwind side of the runway, although a landing in even a light crosswind will mean running off the side.

One of the reports suggests that the pilot had attempted to terminate the hydroplaning by aerodynamically placing increasing weight on the aircraft undercarriage. Tire pressure (and to a lesser degree, tread wear) determine hydroplaning speeds. Weight doesn't enter the picture. For this reason, once you're hydroplaning, your best bet is to reduce speed as quickly as possible by aerodynamic means. Hydroplaning will continue to 7.2 times the square root of your tire pressure. A CF100, therefore, will hydroplane to 95 knots. A little arithmetic shows that hydroplaning can mean an out-of-control conditon for the first 5000 feet of the landing roll. During this time you'll derive almost no deceleration and no directional control from ground contact. The figure of 5000 feet is the best you can expect; it could be quite a bit longer. Some more arithmetic will show how easily you can increase this hydroplaning distance. An increase of 10 knots from 120 to 130 will extend the hydroplaning distance to over 6700! (The figures apply to the CF100).

Unless we substantially widen – and lengthen – all our runways, looks like the aircraft will have to be flown within the operating limits defined by the laws of physics.

An Instructor's First Lesson

When teaching safety to technicians the things that come to mind are always the results of poor safety practices, such as accident statistics, films showing crashes, and personal experiences or "goofs". They say that experience is the best teacher. It is in the field of personal testimony where one can hold the attention of trainee technicians and best instill the importance of safe acts and safe conditions. This anonymous account proves that you can learn about your job the hard way – or learn from someone's error:

The day finally came when the NCO entrusted me with my first job. After weeks and weeks as a helper I was finally going to perform a cylinder change by myself. It was number one cylinder on an R1830 engine installed on a Dak, so it was an easy one as cylinder changes go. Like an old hand I rounded up all the equipment and laid it out on the work stand and nacelle. Clean engine oil, cylinder barrel seal, ring compressor, valve depresser, and tools, were all at hand. I even hung the barrel seal on number two cylinder rocker box where I wouldn't forget it. I worked hard that day and went carefully step by step. At the end of the day the last nut was in place.

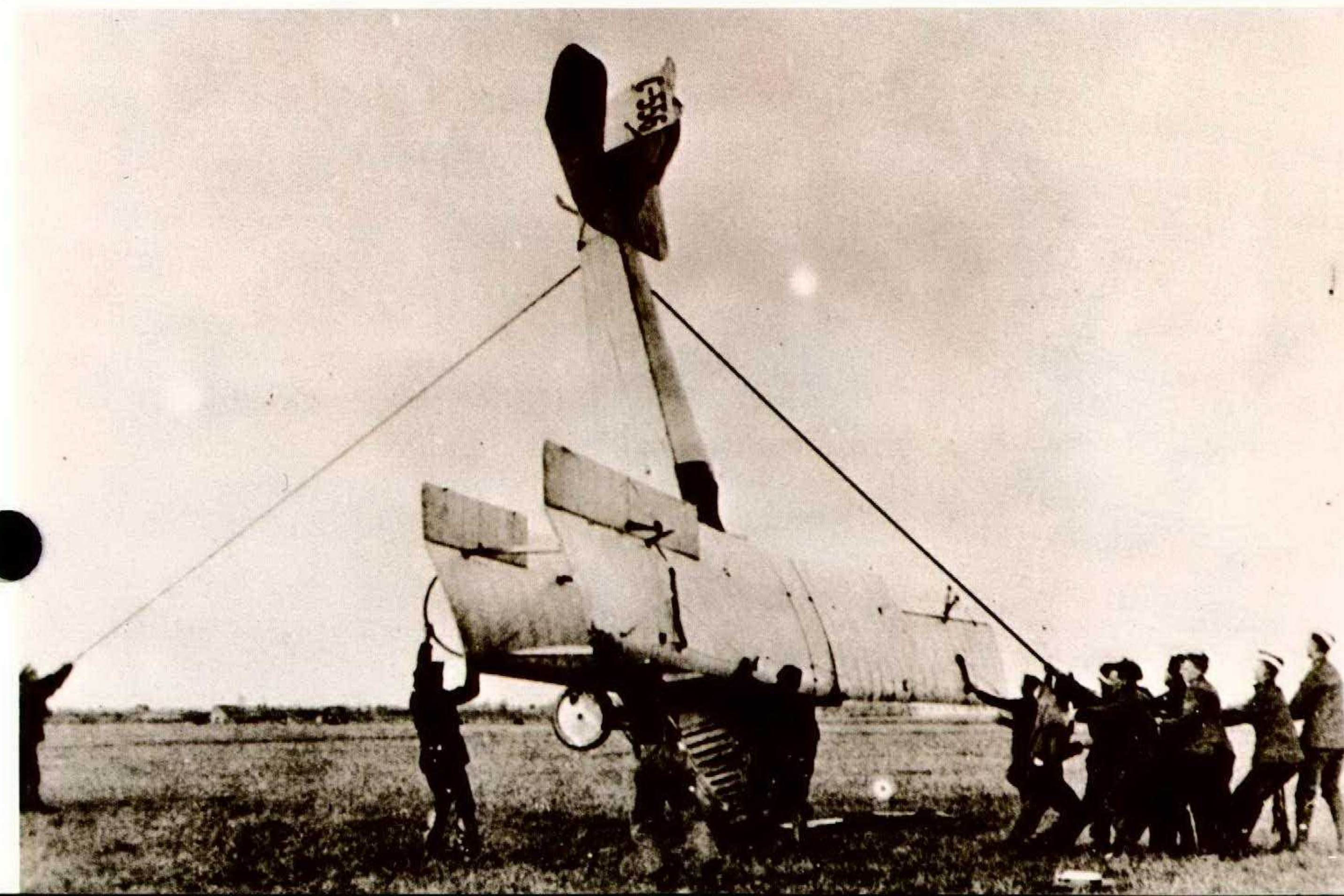
I was beat, but the feeling of accomplishment was burning inside me as I summoned the NCO to inspect my work. As he reached the top of the maintenance platform he picked something off the engine and said, "What about this?". As I looked at the "O" ring barrel seal it took on the proportions of a deadly snake. The sight of a real reptile could not have shocked me more. I had goofed. Without that small bit of rubber to keep the seal against the case, the cylinder I had just installed was useless.

"We need this aircraft in the morning, so do the job again and don't quit until it's done – and done right". I worked long into the night. Sometimes tears of bitterness mixed with sweat got in the way but I finished my work and the aircraft flew its mission. It was a hard lesson, but the impression it left with me never faded, and the service got a better technician out of it.

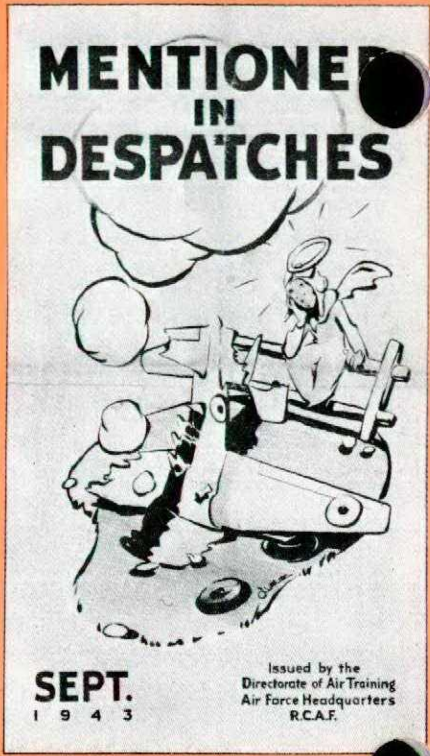
Camp Borden

Flash-back

Still a maintenance headache – the quick turnaround.



Looking back



Flight safety reporting a quarter-century ago was characterized by a boisterous club-wielding approach... Cartoons and crashes appeared on every page of "Mentioned in Despatches"- a wartime bulletin from the office of the Air Member for Training at Air Force Headquarters

For contributions against the common cause

That vital link...

technician TRUST aircrew

Cpl ML Flemington

"... The author, an *aero-engine* technician, convincingly illustrates a cardinal principle of flight safety ..."

Much has been written on flight safety, however, I would like to approach the subject from a slightly different angle using a few examples from Flight Comment. Flight Safety as I see it, is a two-fold matter: good maintenance and professional flying skills. I shall refer mainly to the maintenance half. And, as you know, good maintenance is never achieved without trust and confidence in the signature of the technician by his senior NCOs and tech officers.

Let's review a few of the unpleasant and time-consuming side effects of an accident or incident:

- Consoling the family and friends when death or injury occurs.
- Loss of income through injury to crew members.
- Time-consuming paperwork such as accident/incident reports and UCRs.
- Loss of flying hours due to unserviceable or destroyed equipment, reducing operational capability.
- Pay deductions or rank reduction to the technician or technicians involved.

It is of utmost importance that an aircraft technician should sign a major entry or PI only when he feels that the work he did will ensure the safe return of aircraft and crew from its flight. Even though pilots do a walk-around and cockpit checks before each flight, they cannot be expected to know every detail of work done to make the aircraft airworthy. Occasionally, work on an aircraft has not been entered in the L14; the pilot therefore may be unaware of some small component adjustment or such. A minor adjustment, however, could make itself quite apparent in the air, possibly at an inopportune time or awkward flight attitude.

Take, for example, an adjustment to a throttle Idle & Max stop-plate, which is secured by two Phillips screws. Small adjustments on the stop-plate are done occasionally on PIs and major inspections. If the AETech adjusting the stop-plate forgot to tighten the Phillips screws, it could have disastrous results when the aircraft is airborne. During a rapid throttle movement on a touch-and-go the stop-plate could move rearward. With the throttle at "idle" position in the cockpit the engine in actuality would be below idle setting, causing a flameout.

Another problem inherent with aircraft – jet aircraft in particular – is FOD. All technicians should ensure that their systems and areas checked on PIs are free of equipment-damaging material. Two very good examples of foreign object retainers are the kick-steps and the foot-support bars on Tutor aircraft. These should get special attention during wet weather due to the possibility of carrying pebbles and various debris to the aircraft on one's shoes. Even though the aircraft has been checked in these areas during a PI, the technician should check again for foreign objects before any engine start.

Foreign objects in the cockpit area, such as split-pins, metal chips, filings, and lockwire, besides constituting a hazard, are annoying and dangerous distractions during aerobatics. Fluids spilled in the cockpit should be thoroughly mopped up prior to flight. These two – vacuuming of foreign objects and mopping up fluids – are essential for a tidy and safe cockpit during flight. The pilot and crew trusts that these things have been done reasonably well by the technician prior to his signing the L14.

A brief visual check of equipment not connected with your trade is also a good practice in the interest of flight safety. Between completion of the PI and flight time an item may have become unserviceable. One such item of equipment is the jet aircraft seatpack. A seatpack could be serviceable at PI and yet be u/s by flight time; they are often moved from aircraft to aircraft or left in other places. Therefore, a general visual inspection, especially emergency oxygen pressure should be carried out when re-installing them. Panels with only one or two fasteners undone are the hardest to spot but often cause the most trouble.

An alert AFTech spotted an engine u/s, averting an almost certain aft-section fire at start-up:

> ***"On a T33 start-up, while the two pilots were strapping into the aircraft, LAC RS Harvey observed scorch marks around a small panel on the upper starboard plenum area. He immediately removed this panel and discovered that a bolt associated with a flame tube assembly, was missing. The trip was aborted."***

LAC Harvey's alertness and initiative is another fine example of how flight safety is achieved.

If you notice something which looks suspicious but is not connected with your trade, get a tech of the trade concerned and have him confirm or deny your suspicions. If no one is available at the time, place a major entry in the L14 as a precaution. Never let the suspect part or area go unheeded. Your entry in the pink sheets can be checked and rectified or, if not deemed hazardous, re-transcribed.

Here's an example of an improperly secured nut on the throttle linkage which could have had bad results for pilot and crew:

> ***"Nearing the completion of a routine mission in a T33, F/L JR McCullough, was doing a practice flapless GCA. Power was set at 65%, but as this turned out to be a little high, it was reduced to 58%. When the airspeed reached the desired level F/L McCullough attempted to increase the power again but found the throttle rigidly stuck. The rpm began to slowly decrease and height could not be maintained. F/L McCullough, demonstrating a thorough technical knowledge of his aircraft, selected the TOE switch on. The rpm increased to 65%, paused, increased to 85%, paused, and finally stopped at 94%. By this time the throttle could be moved but it had no effect on the rpm which remained at 94%; the airspeed increased to 350 kts. F/L McCullough reduced speed with tight turns so that the undercarriage could be lowered, flew to low key position and flamed out the engine. He then performed a faultless dead-stick landing. A check on the ground revealed that a nut had come off the throttle linkage making the throttle inoperative. F/L McCullough, through his pilot skill and knowledge of his aircraft saved an expensive jet trainer with an exemplary display of professionalism."***

I have quoted this write-up to point out what could have occurred had the weather been marginal and/or the pilot been of less experience than F/L McCullough. The disconnected throttle could have meant the injury or death of a man and loss of an aircraft.

Webster's Concise dictionary defines the two key words, trust and confidence:

> **TRUST** A confident reliance on the integrity, or justice of another; confidence, faith, also the person or thing so trusted. Something committed to one's care for use or safekeeping; a charge, responsibility.
>
> **SIGNATURE** The name of a person, or something representing his name, written, stamped or inscribed by himself or by a deputy, as a sign of agreement or acknowledgement.

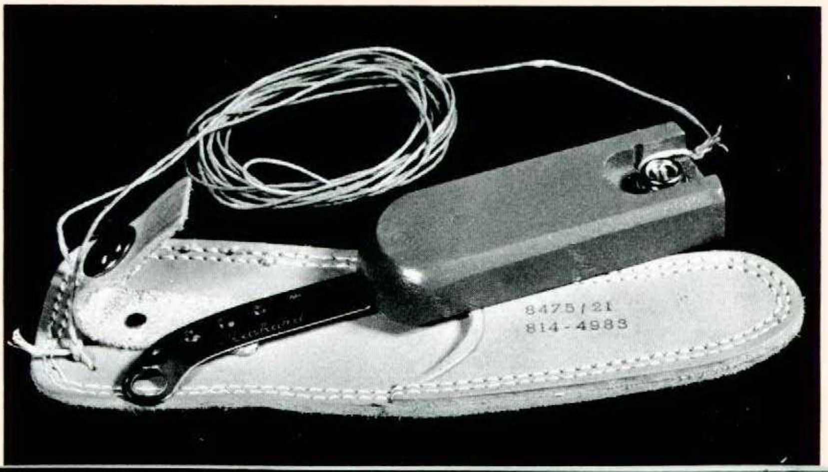
These two words – trust and signature – link the technician and aircrew. The technician's signature is the written acknowledgement that he has completed to the best of his ability, the task for which he signs. The aircrew place in that signature the trust and faith that the technician has completed the task to the best of his ability.

It is this faith in the person's signature that binds together not only aircrew and groundcrew, but is the foundation of all transactions conducted within a civilized society. ▪

Cpl ML Flemington, a native of Dauphin, Manitoba joined the RCAF in 1954. An aero-engine technician, he has served at Portage, Trenton and Gimli where he is presently employed on T33 maintenance. Cpl Flemington, with his western background, is understandably "active in curling".

He is to be commended for the time and effort he took to prepare this article.

Aircrew Knife - Shroud Cutting



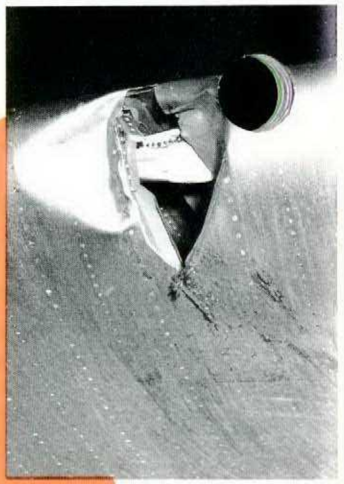
The shroud cutting knife seen here is now available for jet aircrew. Note that it is similar in appearance to the dinghy knife; this knife, however has a sharp edge extending to the rounded tip of the blade.

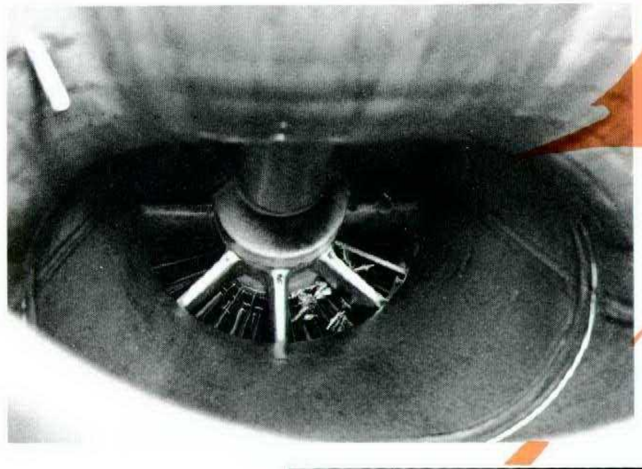
Very light, this knife is designed to be worn in the groin pocket of the combat suit.

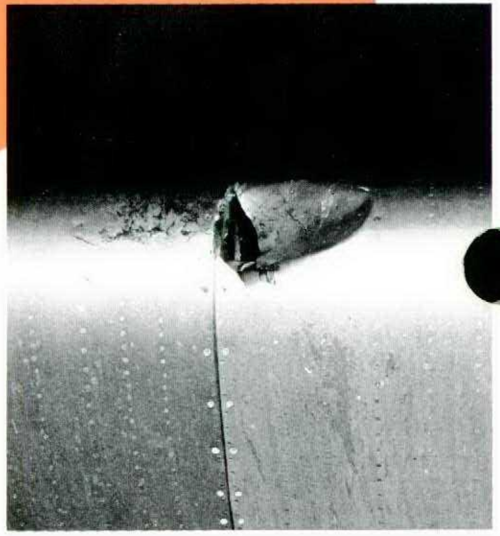
At about 700 feet after take-off "a loud bang was heard throughout the aircraft". The pilot states that no evident malfunctions resulted and so he continued the flight. This was incautious of him, to say the least, for after landing at an enroute base he elected to have repairs made to his damaged aircraft.

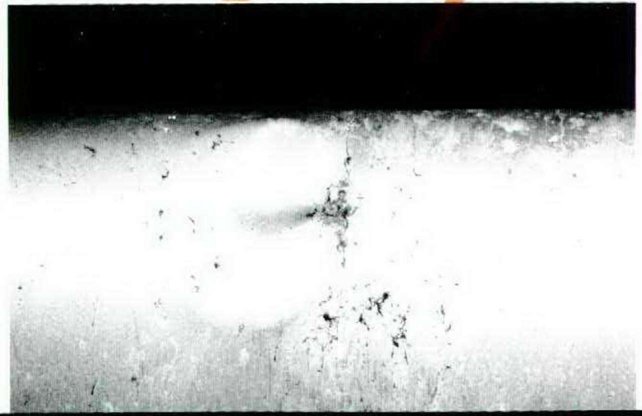
Incautious indeed, considering the extent of the damage shown in these photographs.

Press On after Birdstrikes?









On the Dials

In this column we hope to spread a little new gen and try to answer your questions.

And we do get questions. Our staff members in their travels are often faced with, "Hey, you're a UICP, what about such-and-such?" Rarely is it a problem that can be answered out of hand. If it were that easy the question wouldn't have been asked in the first place. The required answer is often found only after some research and consultation. Also, often the follow-up of a particular question reveals aspects which would be of general interest to all airframe jockeys. We hope to answer this type of question, and any can of worms opened up in the process can be sorted out for everyone's edification.

Any questions, suggestions, or rebuttals will be happily entertained and if not answered in print we shall attempt to give a personal answer. Please direct any communications to the Commander, CANFORBASE Winnipeg, Westwin, Manitoba, Attention: UICP Flight.

In the past months you have submitted several questions in response to "On the Dials" articles. We welcome these questions. Although we do not profess to have all the answers, we will attempt to publish the questions and answer them with the applicable references.

Are aircraft flying within DOT controlled airspace required to transpond on a specific SIF code if not requested to do so by ATC?

A recent change in Air Navigation Orders (DOT) and in GPH 205, Special Notices Canada, requires:

1 Except in special circumstances as listed in the referenced publications, no person shall operate an aircraft within DOT controlled airspace above flight level 230 unless –
  a. the aircraft is equipped with a serviceable coded transponder; and
  b. the coded transponder is:
    i. operated as directed by the appropriate air traffic control unit; or
    ii. where no such direction is given, adjusted to reply to Mode A/3 Code 21.

2 No person shall operate an aircraft at or below flight level 230 with a coded transponder replying to mode A/3 interrogation unless that coded transponder is –
  a. operated as directed by the appropriate air traffic control unit; or
  b. where no such direction is given, adjusted to reply to mode A/3 code 06.

In the event that a pilot wishes to alter – or must alter – his aircraft's filed true airspeed, what action must he take with regard to air traffic control?

When filing an IFR flight plan a pilot is proposing to fly a particular route, altitude and airspeed according to the particulars on the flight plan form (CF76). This becomes a contract when the pilot accepts the clearance issued by ATC. ATC expects the pilot to fly as cleared which includes his filed intent to maintain a specific TAS, upon which longitudinal separation is based. A pilot therefore, should notify ATC of the requirement for any appreciable change in TAS. Normally, ATC will approve any change but in circumstances where longitudinal separation is affected they may require that he endeavour to maintain his filed TAS. If an emergency arises where an immediate change is inevitable, eg, turbulence, icing, engine loss, ATC should be notified as soon as possible. Pilots intending to fly more than one TAS should signify their intent in the remarks section of the CF76.

On the Winnipeg High and Low Altitude TACAN-1 approach plates to runway 36, what is the significance of the 2.9 nm and 2 nm fixes?

In accordance with the Manual of Criteria, TACAN final approach radials are selected so as to cross the extended centreline of the landing runway one mile from the threshold. In the Winnipeg TACAN-1 approaches this position is 2.9 nm from the TACAN beacon. If the weather is within published limits, the pilot should be able to see the runway from the 2.9 nm fix. A turn would have to be made to line up with the runway. If, however, the pilot is not visual he continues to track on the 173° radial until the 2 nm fix at which point he commences a missed approach.

Ideally, TACAN final approach radials are selected to cross the extended centreline of the runway 1 nm from the threshold, but the angular difference between the approach radial and the runway heading can be as much as 20 degrees at 1 nm for a straight-in approach. The point of interception of the radial and extended centreline of the runway should always be shown as a distance from the TACAN beacon.

THIS MAY EXPLAIN THAT PAY RAISE . . .

"A pilot must possess the innate faculty of selective and instinctive discrimination of stimuli of the sensory-motor apparatus to harmoniously adjust metabolic changes in physiological and psychological equilibrium in such manner to comprehend and assimilate instruction in the attributes essential to perform the intricate and complex operations which constitute the details of pilotage."

from The South African Pilot

Well, it was this way...

For those of us who recall that a wheels-up approach meant washing aircraft that evening, it may come as a surprise to find that students may be required to perform a loftier penance – write a convincing response to the simple question – WHY? This one by a red-faced student comes nicely to grips with the truth.

This treatise is simply intended to be a defence of a pilot's psychological reactions during a critical stage of the landing procedure at which point an external distracting element is introduced into the already overworked brain channels. We are not supposing that the pilot is completely blameless for not lowering his landing gear at the precise moment called for because a well-known verse is always heard opposite the button.

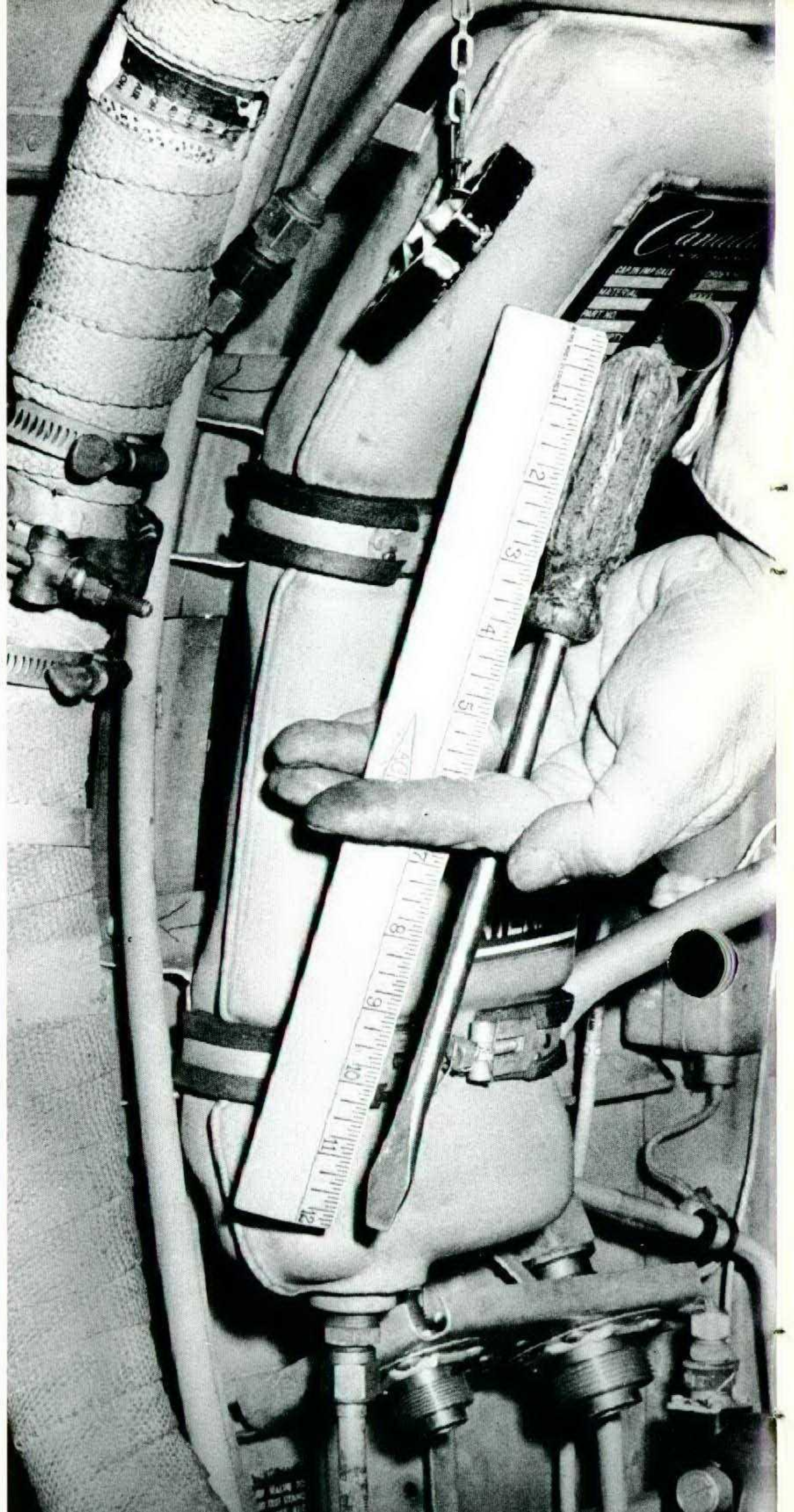
At this point we have set up the first and most important fact – that which requires the pilot to lower his gear because it won't go down by magical command from the empty back seat. This itself raises an interesting point. It seems that powers above, namely the instructors, have an ingrained belief that some students are determined to try a wheels-up landing once in their careers. Nothing more has to be said on that point. Rather, should there not be a study of the conflicting external influences which shatter the state of mind of a pilot about to lower his gear?

Now, let us return to that victim of circumstance, the student pilot about to lower his gear. Suddenly there is a new piece of information being fed into his computer, information which requires him to search the sky to find the other aircraft with which he is about to collide. At first it cannot be seen, but with sharp eyes the pilot picks up the intruder and quickly his computor begins to calculate the ballistics of a rather wide final turn. And a new element, jetwash, causes the pilot to take further corrective action while rapidly approaching the button. Alas, because of inexperience the student pilot's overworked computor cannot digest all available information but he rapidly catches up.

As the now wheelless and flapless aircraft approaches the button, without the aid of the great shepherd, Tasker, he prepares to land. However the onboard computer, once taxed to the limit, has caught up to the fast-moving chain of events and flashes an alarm signal causing the pilot to throw on full power to the cries of "overshoot!" emitting from the tower. A little late, may I add.

Well, enough of the dialogue for this is supposed to be a dissertation on the factors contributing to a wheels-up approach. Although a very well built aircraft the T33 has a few drawbacks. The one we will dwell upon (although not common as there are few errors because of it) is the position of the landing gear lever. Now, under normal circumstances the pilot has enough time to divert his attention from flying his aircraft to put his hand down into the dark recess beside his seat and be completely sure of what he is grabbing. Honestly, it takes a separate thought to lower the undercarriage on a T33. In more advanced designs a mere flick of the wrist is all that is required, and attention is not diverted from more pressing problems such as maintaining a lookout. This is not a condemnation of the aircraft but only one plausible way of pointing out how aircraft accidents are merely the culmination of contributing factors.

In conclusion, it should be mentioned that the pilot saved the aircraft himself as a result of the high quality of training he has received!



Deadly Dipstick

A partially-dissolved issue screwdriver is shown beside the fuel deicer fluid tank in which it has obviously been for some time. Contaminated fluid found in the tank could have caused an accident. An alert technician retrieved the deadly weapon – could this screwdriver have earlier been used as a dipstick?

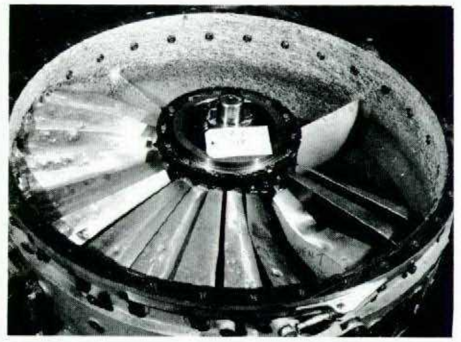
From AIB files

Airport Bird Control - a Must

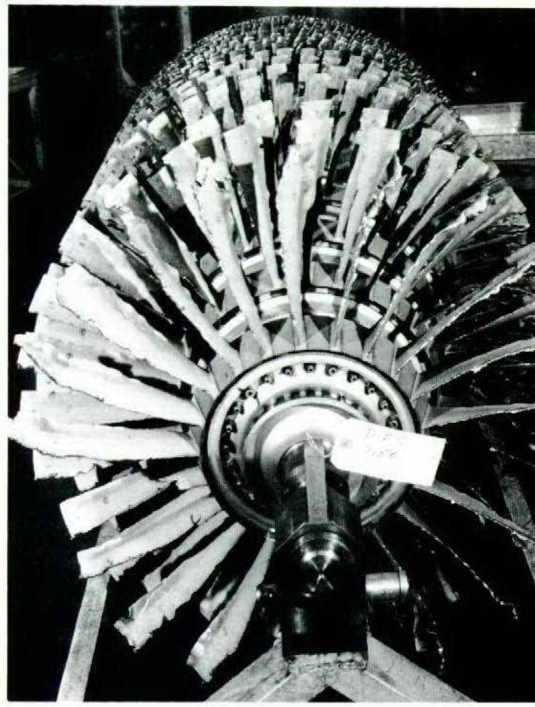
On the takeoff roll a CF104 passed through a flock of partridges at about 200 knots. One entered the engine with the resulting damage shown here. Fortunately the pilot was able to get the aircraft stopped without further damage (see Good Show).

The pictures speak for themselves, another graphic illustration of the need for airport bird control.

Member of the flock of partridge causing birdstrike. This one succumbed to a bulletstrike.



Engine front frame showing severely damaged and missing inlet guide vanes.



The compressor

Bulbs may tell the Story

Lightbulb filaments deformed in a crash will indicate, on close examination, whether or not they were lit at the moment of impact. Mr FH Jones of the Royal Aeronautical Establishment, Farnborough, described this discovery in an address to the Canadian Aeronautics and Space Institute in 1962. Today, it is a well-known and commonly employed investigation technique; the RCMP have already applied it to automobile bulbs.

The proliferation of warning lights on aircraft instrument panels – particularly in the annunciator type of display – gives the aircraft accident investigator a built-in crash facts indicator. DFS investigators felt that more specific information was needed on the subject. RCAF Materiel Laboratory was requested to test various bulbs in simulated aircraft operating and crash environments. The complete story is in their report: "Report Gen Test 13/66 – Lightbulb Analysis as an Aid in Accident Investigation". Below is an outline of their findings.

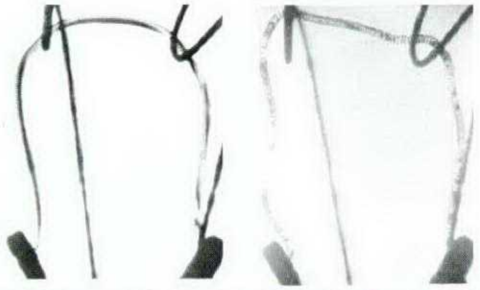
Several factors determine the condition of the bulb when it comes into the hands of an accident investigator. These are, chiefly:

- the type of bulb
- the number of hours it has been lit
- the voltage fed to it
- the intensity and duration of shock on impact
- the attitude of the bulb when it was shocked.

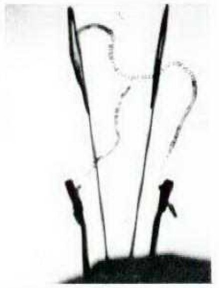
Experiments with the two commonest types of bulbs used as warning lights and in annunciator panels led to a number of findings:

- A bulb which has been illuminated for much of its life will have a tungsten deposit on the inside of the glass envelope causing the glass to look slightly smoked. The filament of such a bulb will be abnormally brittle when cold.
- An illuminated filament is very much more ductile than one which is cold, and consequently will deform when subjected to shock while illuminated.
- The orientation of the bulb at impact does not materially affect the deformation, although the manner in which the filament is deformed may give an indication of the direction of the shock.

- Although the burning history of the bulb affected the reaction to shock when cold, filament deformation under shock when illuminated was no different in an old bulb than a new one.
- Although it had been expected that vibration would affect the final appearance of a bulb, in fact, vibration did not seem to make any significant difference.



Bulb type P313 – left, original; right, after 5 hours of vibration and shock at 55 G.



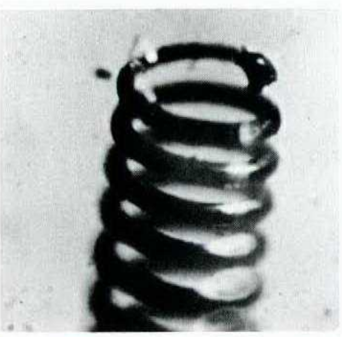
From all indications, the fuselage fuel tank light was on at the time of impact of the aircraft. Extreme filament distortion and widespread coil stretching are seen in the photograph of the lightbulb.

- Bulbs shocked at over 50 G while illuminated showed marked filament deformation with stretching of the coil structure. Between 30 and 50 G both these effects were less apparent, although some deformation had occurred.
- Most bulbs survived shocks of less than 30 Gs with little or no deformation.

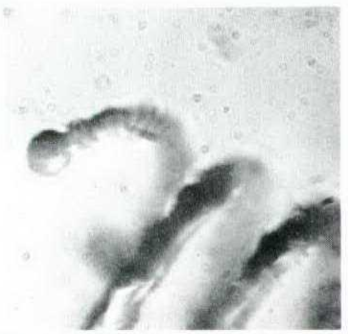
A broken filament will indicate to the investigator whether it broke:

- while illuminated, with the glass envelope intact
- while illuminated, after the breaking of the glass envelope
- when not illuminated.

Filaments broken while illuminated and with the envelope intact have a tiny ball of fused filament material on both ends at the break. Such a condition indicates that either the filament broke while illuminated in normal service, or as a result of the crash. No conclusion can be reached without a secondary indication of shock such as filament stretch or deformation.



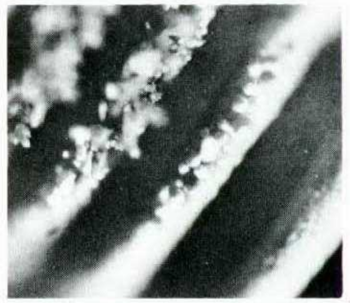
A fractured filament. The tips showed the ball shape of a hot break, indicating that the bulb was on when the filament broke.



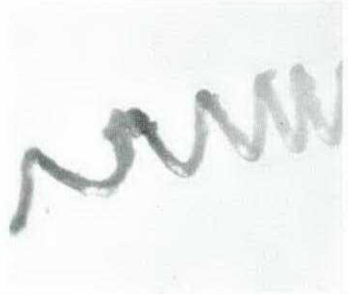
When a filament separates while illuminated, either in normal usage or when shocked, and the glass envelope is intact, a ball of melted tungsten is formed through electrical arcing at the filament tip. This is a type 313 filament. Note the pitted condition of the filament, an indication of a well-used lightbulb.

If the glass envelope shatters when the bulb is lit the filament is exposed to oxygen and it burns out, creating characteristic spear-shaped ends at the break. Often, small particles of glass become fused into the filament. Being exposed to oxygen while incandescent, the material of the filament acquires a layer of oxidation products which appear as a discolouration or as a scaly material.

The filament which breaks cold will have square jagged ends at the point of break.

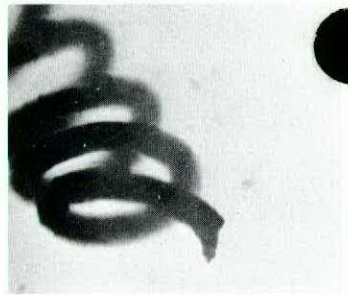


When an illuminated lightbulb is shattered, the sudden exposure of the hot tungsten filament to the atmosphere produces two oxide layers. One is in the form of a greenish-white "snow" covering the filament, (shown here), the other as a discolouration of the filament into bands of silvery interference colours.



Small shards of glass adhere to the filament; a third characteristic of bulbs shattered while illuminated. This bulb, a type 313, was also shocked while on.

Whereas a ball-shaped filament tip is formed when a hot filament breaks with the glass envelope intact, a pointed tip is formed when the hot break occurs with the glass envelope shattered. (RCMP photo)



The trim lightbulb presented one unusual feature. The filament coils were regularly spaced throughout the length of the filament except for one small region. Despite this anomaly, the conclusion was that the trim light was off at the time of the crash. This was borne out in the examination of the filament tips; they were jagged, indicating a cold break.

Lightbulbs may reveal vital information; it is imperative that this evidence be handled with the greatest of care.

The Materiel Laboratory recommends a procedure for lightbulb analysis:

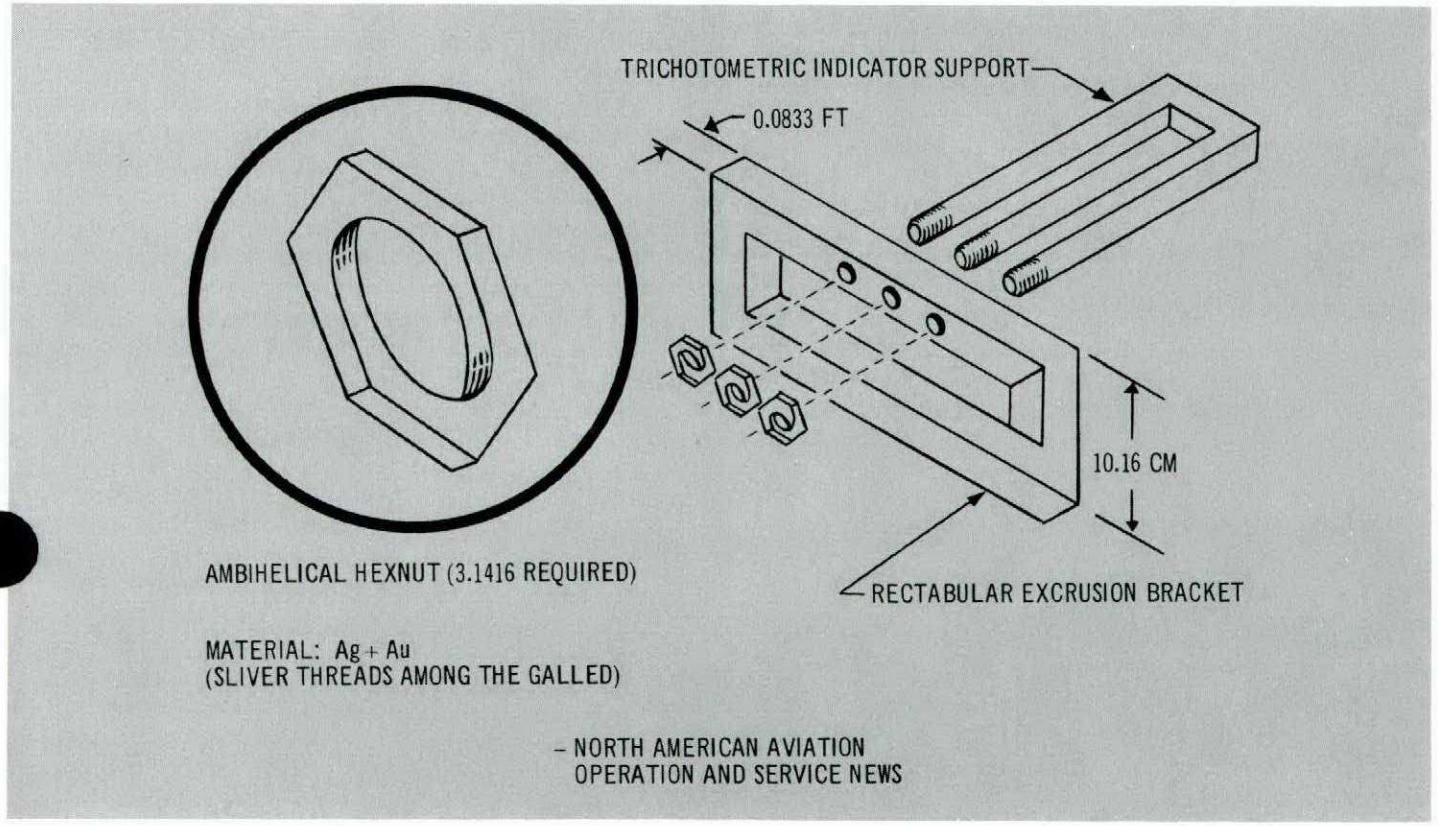
Procedure for Lightbulb Analysis

1 Crash Site Investigation
   a. Determine the crash circumstances, eg, the speed at impact, angle of impact, depth and length of impact impressions, area of wreckage scatter and type of terrain.
   b. Carefully remove all annunciator panels and individual lightbulbs from the wreckage noting where they come from and whether they were vibration-isolated or not. Individual bulbs should be placed in individually labelled containers so that no damage will be done to them especially if the glass envelope is broken. (Plasticine and millipore containers were used in the laboratory).
   c. Collect all glass fragments where a broken bulb is involved.

2 Visual Inspection
   a. If the glass envelope is intact, examine it for a silvery-black discolouration. The more discolouration, the older the lightbulb. Extreme localized discolouration indicates a probable hot break.
   b. Examine the filament. If the glass envelope is broken, check if any of the filament appears missing. Look for filament discolouration and a greenish-white snow on the filament and/or support posts indicating the bulb was on when the glass envelope was shattered. If the glass envelope is intact, check if the filament is broken and if so, carefully count the number of filament fragments inside the bulb. This is important.
   c. Look for filament deformation. A filament will still be deformed if it was on at impact even if the filament and/or the glass envelope was broken in the crash. Severe coil stretching is a definite indication that the bulb was on. In the case of type 327 bulbs, illumination may cause filament distortion and should not be interpreted as the result of the shock. Type 313 bulbs do not distort this way and any filament distortion indicates an "on" condition.
   d. Photograph the filament. This is to record the shape of the filament in case it is inadvertently damaged when the glass envelope is removed.

3 Microscopic Inspection
   a. Remove the glass envelope. This is accomplished by carefully making a cut in the metal base about 1/16" from the glass envelope. This will cause the glass envelope to break cleanly.
   b. Retain all filament fragments. Millipore containers make admirable receptacles for such small items.
   c. Check for pitting of the filament surface, an indication of a well-used lightbulb.
   d. Examine the tips of a broken filament. A jagged tip indicates a cold break, a ball-shaped tip a hot break with the glass envelope intact, and a pointed tip a hot break with the glass envelope shattered. If the glass envelope was broken, check for the snow-like and discolouration types of oxide layers, and for glass fragments adhering to the filament. Both of these indicate a bulb was on when the glass envelope was shattered. Remember that the shape of a filament tip and the presence of oxide layers and/or glass fragments does not indicate whether a lightbulb was on or off at impact. These features only indicate whether the bulb was on or off when the filament separated and/or the glass envelope shattered.

Nene Engines – Modification 10B-15B-6A/21. The installation of a magnetic chip detector in the scavenge oil line from the centre and rear bearing area, started with the issue of fifty-six kits in January. Since the increase in Nene overhaul life to 1500 hours there have been some indications of centre bearing fatigue becoming a problem. This modification will call for a magnetic plug check on the aircraft primary inspection and should disclose centre bearing deterioration well before failure.



Ode to a Blue Bag

At 0900 I went to the line
To pre-flight and leap off in Voodoo 69,
A meticulous pre-flight, a quick PE check,
I mounted the ladder of this grungy old wreck.

The cockpit was darkened with no power "on",
I hooked up my dinghy that's made out of stone.
My leader was anxious – a tiger at heart;
Ignoring the checklist, I proceeded to start.

I stuffed on my hardhat and rolled up the bag
Checked in with the lead and got a green flag.
White smoke had started to boil by my shoulder;
Through bleary eyes saw that my bag was a'smoulder.

Eager and willing, and apparently not bright;
Put my little blue bag on the thunderstorm light.
The light had been on and with power applied,
My little blue bag was amazingly fried.

A hot light and blue bag don't mix bloody well,
For smoke in the cockpit is hairy as hell.
Forty-five seconds it took to ignite –
My little blue bag and a thunderstorm light.

We've been hearing periodically of bearing damage in J79 engines in the form of impressions in the bearing races.

One report indicated the suspicion that engine main bearings are damaged during transport of engines in hard-wheeled dollys. Moving an engine in such a dolly, particularly at moderate speeds over rough surfaces, causes bearing damage.

If you're moving an engine be sure it's cushioned in some manner – soft-rubber wheels, etc. Handling bearings should be done in such a manner as to prevent contamination and damaging shocks.

General Electric
Jet Service News

That'll Fix 'em . . .

The problem of children trespassing on the airfield, crossing runways and committing acts of vandalism was was discussed. It was agreed that if a chain link fence is not available, the next best item would be a concertina barbed wire barrier . . .

– Flight Safety Committee minutes

SAFETY COMMENT

CLOSE CALL · OPERATIONAL HAZARD · SAFETY SUGGESTION

Is it OK if I take control ?

On a local training mission in a T33, I signed out as captain and climbed into the rear seat, with another qualified pilot in the front.

Shortly after takeoff with a 493 gallon fuel load, it was noted that the tiptanks would not pressurize properly. The IFR clearance was cancelled, and I decided to remain in the local area to reduce the fuel weight for landing.

The radio was switched to tower frequency and I advised tower of the problem and the action being taken, and left the radio on tower frequency.

While cruising at 5-6000 feet MSL approximately 20 miles from the aerodrome I asked "Is it OK if I take control of the tacan? I want to check the local tac channel". Part of this must have been blocked by transmission on tower frequency and the other pilot heard "Is it OK if I take control?" and he released the control column saying "You have control". I said "OK, I've got it" as I switched the tacan control to the rear cockpit, tuned in the channel in question, and remarked as to its serviceability.

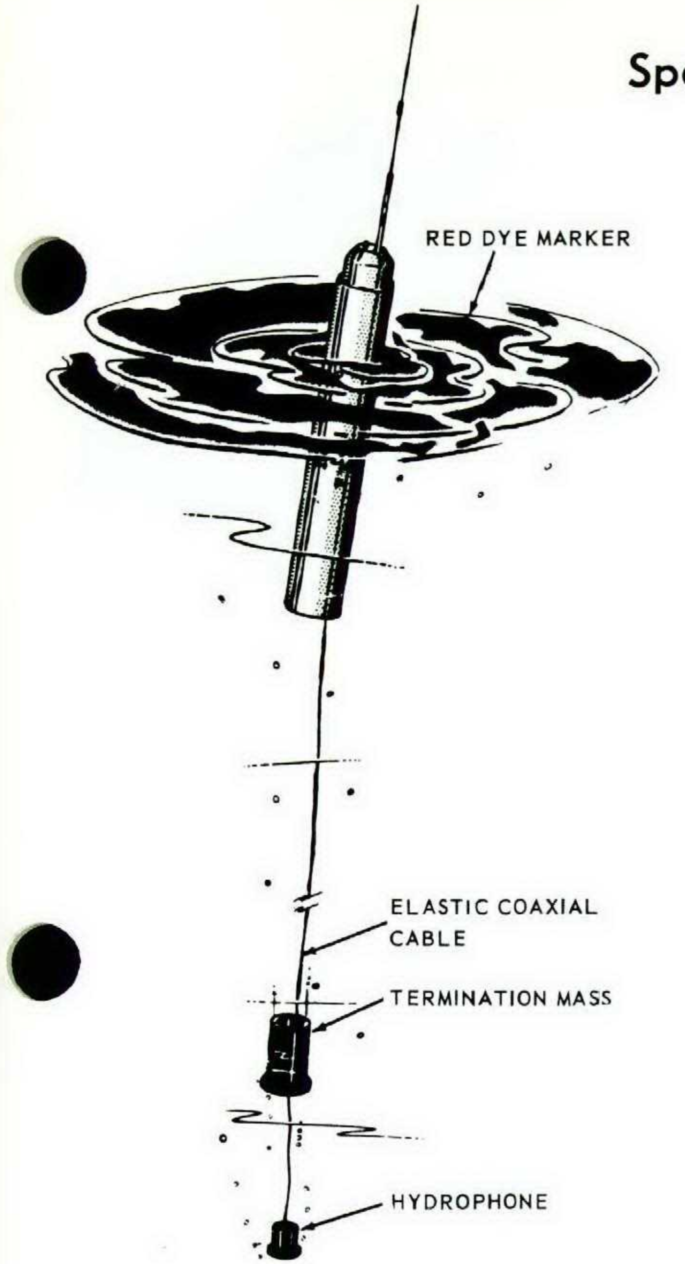
With no one at the controls the aircraft eased into a descending right turn which developed into a dangerously steep dive. As the aircraft continued in its dangerously steep attitude I thought "this is enough" and reached for the control column just as the other pilot grabbed the column and pulled the aircraft out of the dive. After recovery he asked "Did you have control?" to which, of course, I answered "No!".

This close call was caused by numerous things including:

- Mental preoccupation with the fuel problems, and approach and landing speeds and techniques with the extra fuel in the tips.
- Radio transmissions blocking out some of the inter-cockpit conversation.
- Unfamiliarity with each other's handling technique – we had not flown together before.
- The confusion which stemmed from the fact that there are radios which can be controlled from only one cockpit, and control is passed in much the same manner as aircraft control.

It is doubtful that this is the first occurrence of this type, and probably won't be the last. The lesson is there for those who want to learn.

Speak via Sonobuoy



Accident reports indicate that non-ASW-oriented pilots and aircrewmen (including those of sister services and commercial airlines) are not familiar with the emergency transmitter capabilities of the sonobuoy. A listening device used in anti-submarine warfare, the sonobuoy can be used in a SAR situation for one-way voice communication from the water to aircraft overhead.

The sonobuoy is about 36 inches long, cylindrical in shape, and weighs approximately 20 pounds. The hydrophone which is at the end of the 60 to 90 ft cable suspended from the buoy can be used as a transmitter. The buoy is equipped with a salt-water activated battery with a normal life of from one to two hours; the battery voltage will not shock. The buoy has a self-scuttling soluble plug and sinks after the battery is expended.

You can locate the sonobuoy by its small white light and the red dye marker, both of which are automatically activated when the buoy enters the water. To use the hydrophone to talk to an aircraft overhead, simply go to the buoy, retrieve the hydrophone and speak into it. The hydrophone is 18 inches below a "termination mass" on the cable. When you use the unit as a voice transmitter, all portions of the unit including the termination mass should remain under water except for the hydrophone itself.

Channel 15 (172.75 VHF) is the accepted Emergency Primary channel to be used in a SAR situation. SAR aircraft have a listening and homing capability for sonobuoys. It must be remembered that the SAR aircraft has no way of talking to the survivor in the water but can acknowledge transmissions with standard wing rock, zoom, lights, etc.

The illustration shows the appearance of the buoy when ready for use as a transmitter.

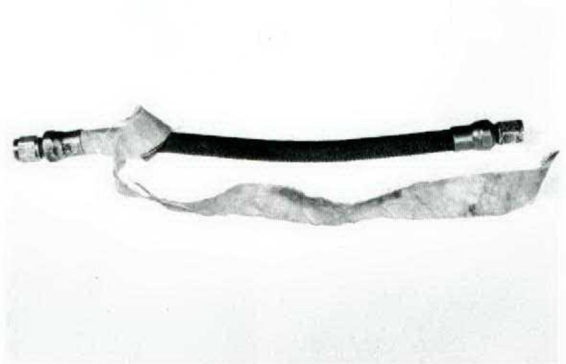
– adapted from
USN Approach

Rag-wrapped Fuel Line

The port engine caught fire during start-up for a ferry flight from an eastern base to a training station in the west. The fire resulted from fuel leaking from a fuel line – damaged earlier by exposure to excessive heat.

Someone's idea of a fix for this fuel line damage was to wrap the unsightly area with a strip of rag.

It didn't work.



A Minimum Altitude Altimeter Marker

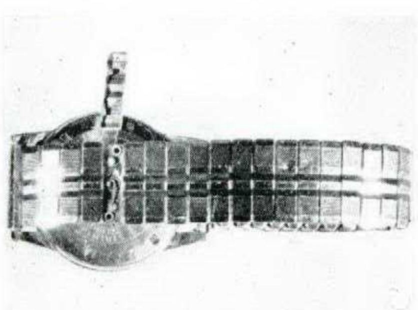
An experienced pilot completed an instrument rating test a few years ago, and for some reason, descended below the minimum instrument altitude on two occasions. Of course, he failed the ride. A month later, he tried again. This time, before commencing the approach descent he rotated an extra dial which he had mounted on the face of the altimeter. There, opposite the numbers representing the minimum instrument altitude, appeared a red-flashed shark fin. On this flight, he didn't violate his minimum altitude.

For 98¢ you too, can guarantee you will never descend too low in practice – or for real.

By the way, it's called a Minimum Altitude Altimeter Marker.

This watch strap was blamed for shorting out the radar in a Lightning aircraft recently. One of the capping strips had become detached and was found inside the Marker Unit box. The owner was traced and he knew that he had lost part of the strap. He had no idea that it could have been inside the aircraft. If you wear a similar type of strap, take it off before you start working on an aircraft or aircraft part.

– RAF Air Clues



Gas Tank Gets De-icer Fluid

The aircraft was started up for return to home base following an overnight stopover on a supply run. After the start-up and pre-taxi check had been completed the starboard engine failed. It was restarted but would run only with continuous priming. The flight was aborted and another serious inflight emergency was averted. De-icing fluid had been poured by mistake into the fuel tank.

Was it an "accident"? If you regard accidents as happening spontaneously out of the blue, this was no accident. Several circumstances set the stage weeks – even months – before.

The crewman's gross error while under training resulted from:

- lack of familiarity with the aircraft – the man had not completed his training on type;
- lack of supervision – despite the double requirement for supervision (safeguarding the aircraft and ensuring the trainee crewman knew his work) the error occurred during the supervising crewman's absence;
- lack of adequate markings – time and wear had reduced the markings around the filler caps, making them difficult or impossible to see;
- lack of standardization – this aircraft, like many others in the Canadian fleet was not marked with the approved NATO standard symbols and lettering.

The fact remains that not all our aircraft are marked clearly and in conformity with standard regulations laid down in EO 00-60-11/1C. This would be a first step toward preventing another serious error with perhaps tragic consequences.

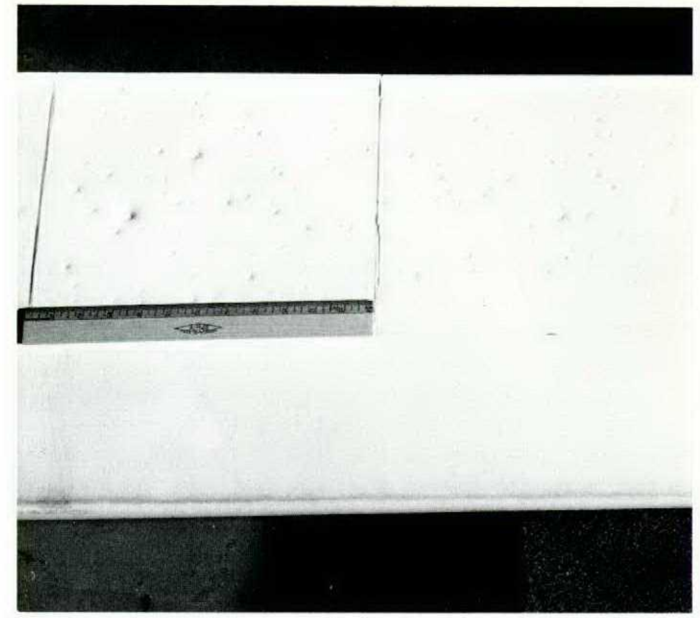
CB - Clobbered Bird

Hailstones as large as $1\frac{1}{2}''$ in diameter were reported...

The hailstones came down – fast enough and big enough to cause extensive and expensive damage to this helicopter's rotor blades. The line crew which had rushed out to rescue this hapless craft were obliged to don construction hats before braving the downpour. Hailstones as large as 1½" in diameter were reported from this storm which according to everyone's account (and this includes the Met officer) had overtaken the station quickly and completely by surprise.

Although there were severe thunderstorms in the vicinity, observations made at the Met office had suggested that the storm would bypass the station – however, it was not to be. Observers saw the thunderstorm "reverse direction" which is what had *apparently* happened.

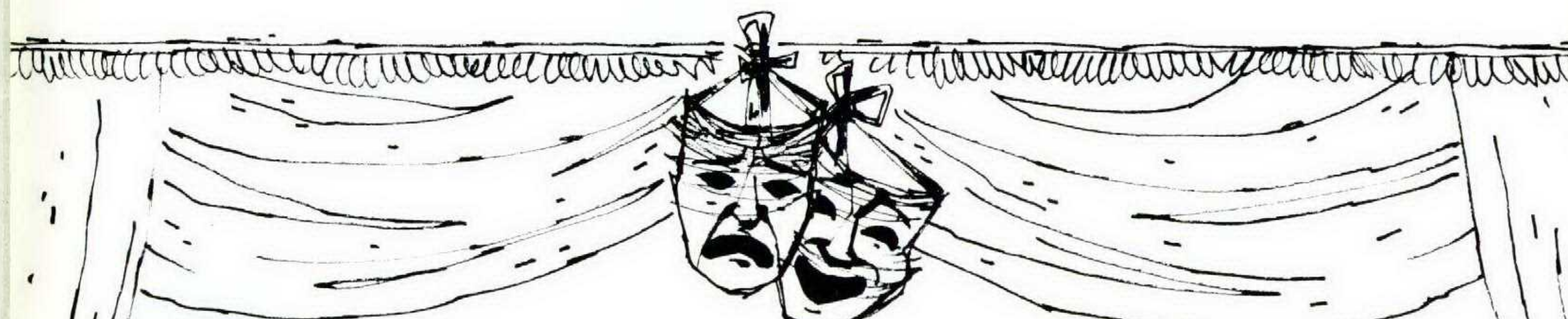
There is evidence from weather studies that suggests there's a strong tendency for new cells to develop to the south or southeast of the original cumulonimbus. The warmer and moister air normally lying south of the CB is vigorously lifted aloft when undercut by the severe downdrafts of the original storm. Frequently these new cells become extremely violent and emerge as the dominant feature of the storm.



One panel of the rotor blade shows extensive damage from hail.

Every year the men who should be alerted in time – the line crews – are given insufficient information and often too late. In this case, no weather warning was given. In others however, a weather warning has been issued but never reached the line crews.

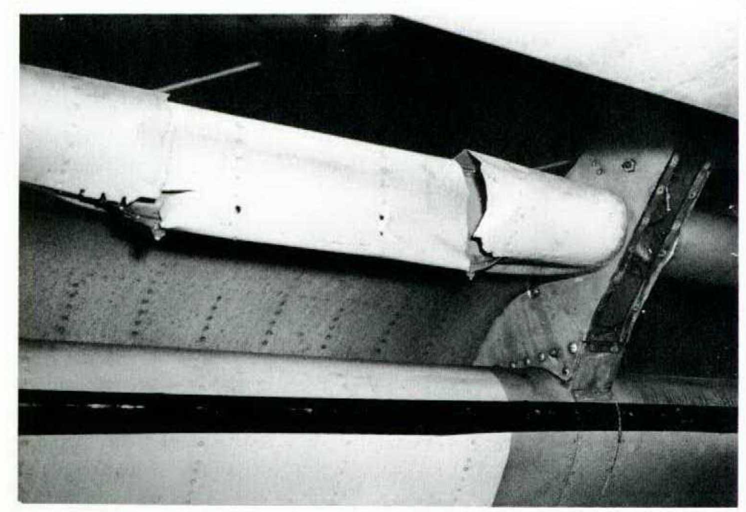
Is the weather-warning pipeline on your station functioning properly?



Interrupted Maintenance

- A minor tragedy in one act -

Scene: *Hangar. Large-type bird at centre stage.*
Cast: *Several flap adjusters.*
1st flap adjuster: *"You may as well take five, Sam, while I finish lockwiring."*
(Exit Sam, who earlier had deposited tool box tray in port flap cavity access.)
2nd flap adjuster: *"Looks like an adjustment problem; we'll have to cycle up the flaps."*
(Sam returns from 15-minute sojourn at the EO desk)
Sam (in cockpit): *"All clear?"*
All: *"All clear..." (ominous crunching sound)*
"...NO! LOWER THE FLAPS!!"



cont'd from page 12

that each species is adapted structurally, physiologically and psychologically to the conditions of its particular environment. This being the case we might well expect that each species would have its own individual protein structure. Although to our knowledge never attempted in birds, recent advances in the taxonomy (classification) of mammals has resulted from a study of blood proteins to determine inter- and intra-specific relationships. As recently as 1964, West and Todd stated, "The differentiation of tissues within the organism, as well as the differentiation of species, is basically related to the specific proteins present in the protoplasm.

It is our contention that as species relationships can be established from the analysis of blood or other proteins, the same may be the case for an homogenate of protein resulting from a bird entering a jet engine. We, therefore, suggest that in spite of the limited information currently available it is reasonable to consider compiling a gallery of 'bird prints' to be used in the identification of birds in much the same manner as fingerprints are used to identify humans...

Conclusions

Engine failure due to a birdstrike can be determined easily, quickly and with certainty.

It may be possible in due course to determine the type, possibly the genus, and ultimately even the species of the bird concerned.

Recommendations

A specific set of instructions should be compiled and distributed as working rules for the handling of engine parts, where birdstrike investigation is wanted, along the following lines:

The engine or its parts should be recovered quickly and handled as little as possible, preferably by persons wearing clean gloves, the reasons being that the sooner the material is received, the less post-mortem change in the more delicate fragments; the gloves should be used to avoid possible contamination by human skin, secretions or excrements which could interfere with the biochemical analysis. Ideally, there would be a person at the scene equipped to take initial test scrapings with clean instruments, these to be dispatched to the laboratory as quickly as possible.

If it is desirable to know the genus and species responsible for a strike, a research programme should be established with sufficient funds available to equip with the necessary instruments and technical staff a laboratory to undertake the protein analysis of whole and parts of trapped birds with a view of creating a 'Bird-print index'."

The question arises as to the possibility of a failed engine containing bird remains from a previous strike which did not fail the engine, in fact the failure being due to an entirely unrelated cause. While this will remain a possibility, it should be understood that a thorough metallurgical examination and technical analysis of the failed parts must always be made. As for the possibility of a previous birdstrike, our limited experience indicates that such an event escaping detection in the first place is improbable except in the case of small birds. Strikes by birds of significant size which did not fail the engine have been noticed by the pilot and have left many feathers on the stator and rotor blades visible from the front of the engine. On the other hand, an engine has actually been failed (on takeoff) by a bird as small as a partridge weighing some 13½ ounces (see article page 23). The quantity of bird remnants and its location in an engine is significant. Thus experience will always remain an important factor in assessing evidence. A "Birdstrike Manual", a collection of photographs showing typical markings on various parts of certain J79 engines which have received birdstrikes has been prepared in AIB and will undoubtedly prove to be a valuable aid to the investigator in the field.

In conclusion, an investigative technique has been developed for J79 engine failures due to birdstrikes, which will be applicable to all jet engines. Thus, with the aid of science a significant advance has been made in the art of accident investigation.

Those principally involved were:

- Dr QN LaHam, Dept of Biology, University of Ottawa
- Mr P McLean, RCAF Materiel Laboratory, CFB Rockcliffe (now with NRC)
- Mr A Brigstocke, Orenda Ltd, Malton, Ontario
- S/L DL Campbell, CFHQ/DFS

Dr Quentin Laham

Mr Paul McLean

Mr A Brigstocke

S/L DL Campbell

An Accident on its Way . . .

The parts referred to... are suspect by the fact that they – like so many other parts of this aircraft – have had considerable use and require a great deal of ingenuity to keep functioning.

Gen from Two-Ten

EXPEDITOR, LOW FLYING The first half of the mutual low-level navigation trip over, the student pilots exchanged seats and proceeded on the return journey to base. Soon after control was handed over, the aircraft propellers touched the snow-covered ground. The aircraft was quickly pulled up with only the propellers damaged but could not maintain flying speed. One half mile ahead, the aircraft was force-landed in a field.

The students weren't sure what constituted "minimum" altitude. Earlier on, they had also carried out the old standby of yesteryear – getting a pinpoint by reading the name of a town off a grain elevator. Witnesses stated they saw the aircraft in a slow descent towards the ground at a very low altitude.

Fact was, that to inadvertently fly into the ground, these students *both* must have flown with heads in the cockpit for *about one minute*. Fortunately, the aftermath of this escapade wasn't a tragedy. But it was only a matter of inches.

CF104, PITCH-UP From the pilot's description of the manouver, had he been in an F86 it would have been a no-sweat wingover following a climbing turn, then a tight descending turn at low airspeed. But with a clean 104 strapped to his seat, and freed from the restrictions of an operational sortie, this pilot proceeded to lose us a valuable aircraft.

He had soared into the sunshine from a wet foggy day down below, climbing to 45000 in afterburner (prohibited), and proceeded to perform what he called "general handling manouvers including climbs, decents, max rate and minimum radius turns, etc". He commenced a climbing turn and looking over his right shoulder in the direction of the turn, continued to the top of the climb with 90° of bank. The airspeed continued to drop during the 150 degrees of turn. By now, he was "descending and turning very sharply". Continuing the turn and still looking over his shoulder – he had seen another aircraft nearby – he experienced slight to moderate buffeting but no shaker.

Both the rate of deceleration and rapidity of turn were sufficient to put the aircraft, without warning, into the pitch-up configuration. The aircraft tumbled out of control; there followed 15 seconds of violent motion with both positive and negative G accompanied by large side forces. He wrestled to regain control and had to use both hands to return the stick to center.

It was now "strangely quiet" – as though the engine had flamed out. As the aircraft ceased its violent tumbling, it entered a spin to the right from which it could not be recovered. Deploying the dragchute was to no avail.

At 17000 the pilot ejected, receiving only minor injuries during the ejection. He was momentarily hung up in a tree but in less than an hour from bailout he was back at base. Fortunately, the aircraft crashed in an unpopulated area.

Here's one pilot who appreciates the limited capability of century series aircraft in tight manouvers at low airspeeds.

CF104, MURPHY AGAIN As the aircraft was being pushed backwards onto a ramp for practice bombloading the main undercarriage collapsed and the aircraft settled to the floor.

When installing the main landing gear drag struts a technician, (without knowing of their interchangeability) installed them port for starboard. Those technicians who *do* know of this Murphy, came by the knowledge from experience; there's only a part number in the EO to call attention to the interchangeability. The NCO who inspected and passed the strut installation was aware of the problem but didn't check the serial numbers. He assumed the Murphy would show up during the retraction test. He did, however, instruct the controller at the snag desk not to move the aircraft until checks were carried out; this was duly recorded on the control board. In the meantime, the snag crew went off shift.

The night shift supervisor, not alerted to the condition of the aircraft, permitted it to be used for load-crew training. This man (also unaware of the interchangeability problem) assumed that if the undercarriage safety pin was installed the aircraft was okay for towing. So, putting his faith in the safety pin, he released the aircraft for towing without clearing the outstanding entries in the L14.

That this could occur must have been known for some time. Now that the accident has finally occurred, flight safety bulletins have been produced and a UCR is underway.

Comments to the editor

The new Aircrew Survival Knife (Jan-Feb issue) is indeed a welcome addition to our flight equipment inventory. As one of those who evaluated this knife, there are a couple of points I would like to bring up.

In the photograph you show the thong with the ends obviously tied together and looped around the wrist. This may be necessary for certain operations but in general I believe it is an unsafe practice. During the period in which I was evaluating this knife I had the knotted thong twice catch on objects. The first time, the blade was drawn through my fingers (fortunately without injury), and the second time the knife was withdrawn from the sheath. I should point out that the knife I evaluated had an open-top sheath. With the closed-top sheath, I can see no reason for knotting the thong; in fact, I think it could prove very embarrassing if the thong which is attached to the buttoned-down knife were to snag when someone was attempting to make a rapid exit from an aircraft. I think the thong might well be discarded, or at least not be knotted except when necessary for a specific task.

The stainless steel blade is good for corrosion resistance, but it was difficult to sharpen. I have had and used a similar knife with a plain cutlery steel blade for several years, and found that the stainless steel blade did not hold an edge much better than the other. This survival knife was considerably more difficult to resharpen. Might I suggest that the specifications for the knife be revised to include the softer steel in the blade?

Both the above points were made in my evaluation report, but I thought I would pass them on for consideration by other aircrew.

RA Watt
Lieutenant RCN

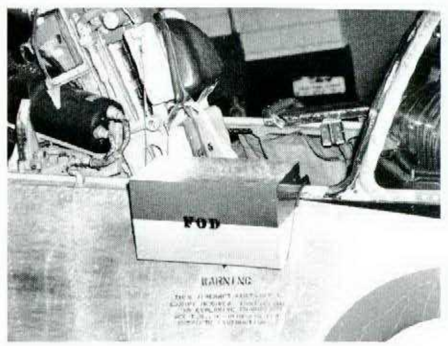
Your remarks about that thong are well taken. There is of course, an inverse relationship to ease of sharpening and resistance to dulling. Also, it's a question of how long will a survival condition exist? By the way, could it have been the dullness of the blade that spared you what could have been an embarrassing injury in a survival situation? We are told that full sharpening instructions will come with each knife.

●

I would like to take this opportunity to thank you for the many articles and ideas that have been passed along in your publication. In particular, the idea of FOD Trays submitted by LAC Williams, St Hubert, was considered to be excellent. Photographs of a local adaption for CF101s are attached.

I wish you another successful year.

F/L MF MASSART
CFB Chatham, NB



There are two comments I have regarding Gen from Two Ten in the Jan-Feb issue.

- The CF100 undercarriage selector consists of two buttons, (not a lever) one for "up" and one for "down". The "up" selection button requires a 40 pound push (not pull) to operate whenever the aircraft is on the ground.
- The C45 went off the left side of the runway prior to flipping over and not the right side as implied in the article.

I found this issue of Flight Comment most interesting as it covers many facts and situations homogeneous to the aircraft technical field.

F/O LW Elderkin
CFB St Hubert

That first point of yours really hit home!

●

The item *Yukon, Towing* from Gen From Two-Ten in the Jan-Feb issue, states that "a corporal was incorrectly assumed to be an NCO in the context of the order which reads 'the NCO will accompany the aircraft during the move and will direct the operation personally'".

This would appear to be contrary to the instructions contained in para 1 (d) of EO 00-50-19, "Marshalling, Towing and Ground Handling of RCAF Aircraft" which reads: "The senior NCO or junior NCO detailed to move the aircraft shall station the airmen . . ."

Was the NCO requirement in your article taken from a Unit Order or is EO 00-50-19 being amended to require the direct supervision of a senior NCO during aircraft towing?

WO2 J Frost
CFB Chatham, NB

Unit Maintenance Instructions in force at this base require a senior NCO to accompany the aircraft during the move and to direct the operation personally. The EO 00-50-19, which in this case was superseded by the UMI, will remain as i

FOD-Fall

The maintenance officer noted that another source of FOD was the gravel which fell from the roof and rafters in the old hangars every time an aircraft flew overhead with the afterburners on.

– extract from Flight Safety Meeting

BIRD WATCHERS' CORNER

BIRD-BATTERING BUZZARD

Perched atop its victim, tool-head surveys his handiwork, obviously pained by the FODevastation. Buzzard's mind wanders back a few days (his mind is inclined to wander), to that moment when a tool had gone missing—or had it?—he wasn't sure. Anyway, he now had no doubts; somewhere beneath his feet it lay—interred in that FOD-jammed bird-that-was. Giving voice to a somber mood, he idly blows a wisp of smoke aside and in the ensuing silence, intones the opening bars of his favourite ditty, the Tool Carrion Blues: ONLYFOOLSFORGETRULES ABOUTCOUNTINGOURTOOLS

FLIGHT SAFETY

FLASH

No ________

CANADIAN FORCES HEADQUARTERS — DIRECTORATE OF FLIGHT SAFETY

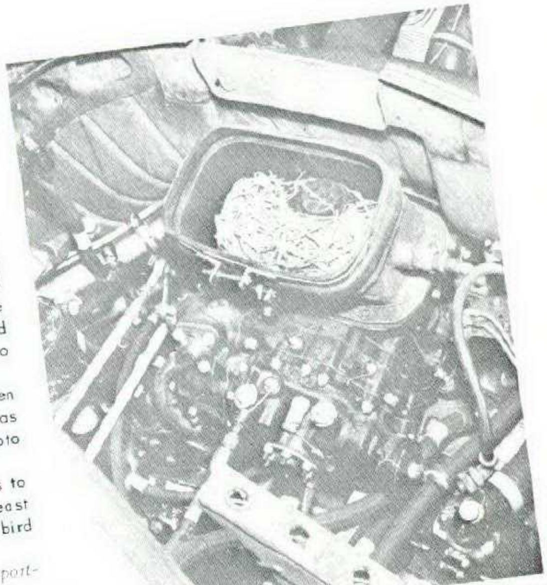
NEST PEST

You're looking at two bird bungalows built without a permit in a non-residential area. In a few hours two energetic birds can accumulate enough building material in a handy crevice to bring down one of their large aluminum brothers. A starling has been observed to build a nest and lay an egg in it – from hay to lay – in two hours!

Two years back, a Dakota aborted a takeoff when power output on one engine was insufficient. A nest was found in **the carb intake.** A similar nest in the photo occurred in the same place last year.

While not all bird parents would want their kids to grow up in neighbourhoods like these, we get at least one or two of these occurrences each year. Be a bird watcher this spring.

(Don't forget – birds nesting in aircraft are reportable as a Special Occurrence.)



Nest in Dak carb intake

The fairing on the Tracker's rudder actuator is an ideal nesting place.