FLIGHT COMMENT

JULY · AUGUST · 1967

...for flight safety

Comments

Group Captain Searle's six years as the Director of Flight Safety ends a long military career. Speaking tours to Canadian Forces commands and bases brought him into contact with thousands of servicemen. The Group Captain's tenure at DFS spanned the introduction of supersonic aircraft to the Canadian Forces, the dramatic shifts in flying operations in response to Canada's changing role in world affairs and, of course, the integration of flight safety staffs. These changes – as well as the myriad day-to-day problems – were met with an earnestness and judgement that earned him the respect of us all. We sincerely wish him good fortune in his new career.

New ideas need publicizing. NDT is not exactly new but for the Canadian Forces it is coming of age as it solves an increasing number of problems relating to aircraft inspection and testing. F/L Chamberland, in his article on NDT in this issue, makes the point that NDT has arrived but that more familiarity with its capabilities is needed. Full recognition of its importance is given in CFP144 Aircraft Maintenance Policy which says (article 417) "It is the ultimate aim of the Canadian Forces to have effective NDT facilities available to aircraft maintenance organizations". With that sort of support it can't miss!

Contaminated hydraulic systems are of continuing concern to those who fly and to those who buy. Apart from the flight safety aspect which remains of prime importance, consider this quote from F/L Glydon's article in this issue: "... hydraulic pumps installed in civilian airline jet transports are normally reaching a life in excess of 2500 hours. The same model pump installed in an RCAF fighter aircraft has a mean time between replacement of less than 500 hours". Hydraulic system contamination, then, is not only a hazard but a cause of unnecessary equipment waste.

When the altimeter setting given to a pilot is below 1000 millibars, only the last three figures may be relayed. This altimeter setting could be interpreted to be in inches of mercury instead of millibars. Used as such, this could cause a dangerous error in altitude flown. If a pressure of 940 millibars was transmitted simply as 940 and assumed to be 2940, an error of 1064 feet would occur! All aircrew should be alert for this hazard.

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ROGER DUHAMEL, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, 1967

SWAN SONG

No doubt many of our contemporaries about to sample the green or not-so-green grass of the retirement pasture would welcome an opportunity such as is afforded us who finish out our term of service in DFS. For most, the quiet handshake or the not-so-quiet gathering of buddies and the stories of mixed feelings, but for us – a chance for the last word.

Six years of flight safety could have been a belly-full. We started out with an all too frequent ringing of telephone bells, in and out of office hours, to listen to the sad tale of another CO or squadron commander as he explained his latest occurrence.

Fortunately – and perhaps there is more than luck involved here – the calls have become widely spaced. True, the armed forces fly fewer hours, although it can be argued that we fly more miles. It is also true our aircraft systems have become more reliable. But the major gains as reflected by our statistics analysers have been achieved by our pilots – professionally trained and with a professional attitude; and the maintenance cause factor has become startlingly low.

However, (have you noticed or counted the "howevers" that follow a congratulatory remark) much credit must go to those who indoctrinate, brief, organise and monitor pilot and maintenance activities – the much maligned supervisor. At all levels the results of good management are showing through.

There remains much to be done. No one by any stretch of an optimistic imagination would believe that safety, ie – professional, practices are followed at all times by all people. The 61 serious accidents we had last year are ample proof of that. We are still afflicted by many of the old causes ranging from improper procedures to forgotten split-pins, and the odd different cause such as the complete extinguishing of the flame in high speed jets owing to bird ingestion. But, on the whole, the portents are good.

We would be remiss if we did not extend our warmest thanks for the friendly reception and hospitality which has been shown to us in our meanderings around the Commands and Bases. It is no cliche to say – "it has been a real pleasure".

AB Searle

Group Captain AB Searle
Director of Flight Safety

Non-Destructive Testing

NDT

F/L M Chamberland
6 RD, Trenton

NDT facilities for all aircraft maintenance organizations.

This goal, clearly stated in December 1965 (CAP 78, Aircraft Maintenance Policy, Art 6102), opened up new vistas for NDT growth in the Canadian Forces. How far have we progressed toward the goal? The answer lies in this article, which is frankly aimed at:

- disseminating a basic knowledge on NDT methods in current use in the Canadian Forces
- publicizing existing NDT capability at 6RD and plans for establishment of regional NDT Detachments
- reporting on NDT contributions to the field of aircraft maintenance and flight safety
- promoting interest in greater use of NDT by field units.

The RCAF's first flirt with NDT was in 1959 when two technicians were trained in radiography. In the ensuing years NDT steadily increased in popularity; new equipment, new methods, and more personnel were brought into the RCAF NDT Centre at 6 Repair Depot, Trenton, Ont. Today, 26 technicians are on strength at the Centre, providing NDT service to the Canadian Forces.

NDT consists of inspection methods which employ electronic, sonic and other devices to assist the technician in his maintenance and inspection tasks. The aim of all this is, of course, to reduce the NOR (not operationally ready) time of aircraft.

Five methods of non-destructive inspection are in current use:

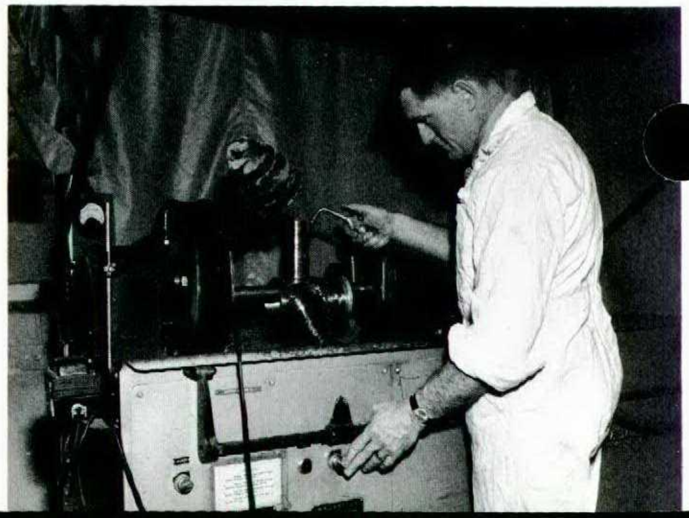
- Magnetic Particle Inspection
- Dye Penetrant Inspection
- Radiography
- Ultrasonics
- Eddy Current

These methods are all based on well-established scientific principles. There is no magic, no black-box wizardry; the NDT devices used by our technicians are nothing more than straightforward application of physics - much like your radio and TV sets. The brief outlines of each method will familiarize the reader with the capabilities and limitations of several commonly employed test methods. Those interested in more detailed descriptions are referred to the bibliography at the end of article.

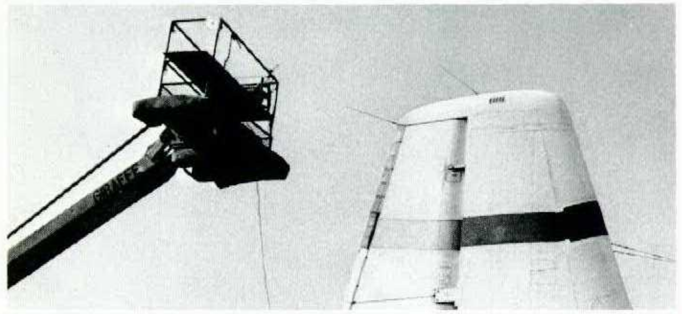
Magnetic Particle Inspection (MPI)

This method is widely used to detect surface discontinuities in ferro-magnetic (iron-based) materials. It operates on the principle that, under the influence of a magnetizing current, leakage of magnetic flux at the lips or edges of a defect will cause extra poles to appear at each side of the crack. If the part is sprayed with magnetic ink (suspension of iron filings), the iron filings will adhere to the extra poles developing at the discontinuity, making it more readily detectable. The sensitivity of this method is greatly enhanced by employing fluorescent magnetic particles and black (ultra-violet) light, causing the defects to actually glow under the light. Magnetic particle inspection is simple to use, inexpensive, and reliable. Unfortunately, it is limited largely to surface discontinuities – although it can be used for sub-surface defects when special precautions are observed. Components must be dismantled and the surfaces carefully prepared.

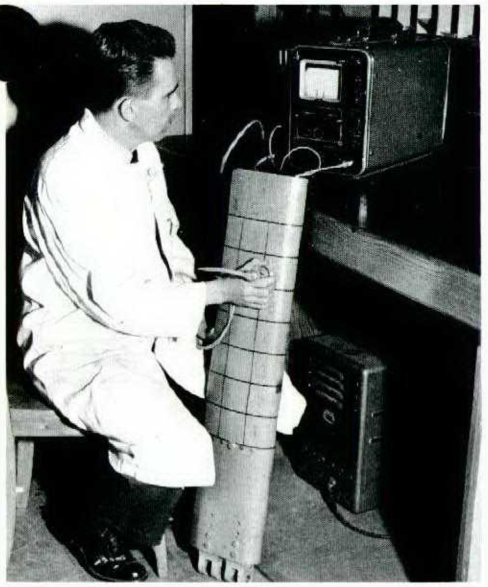
Magnetic particle inspection of a spider of a Dakota propeller. Note black light unit above the part. Technician directs flow of magnetic ink.



Dye penetrant inspection of a section of the housing of an Argus nosewheel gear.



An Argus tail ready for X-ray exposure. The X-ray source is in the giraffe, and is aimed at an area where film is taped to the skin.



An Otter strut is mapped during the development of an ultrasonics inspection procedure. The equipment response in each area is recorded for comparison later [illegible] suspect struts.

An Otter's landing gear strut is examined by ultrasonics for internal wear.

Dye Penetrant Inspection (DPI)

This method is also limited to the detection of surface discontinuities. It is based on the capillary action of liquids, ie, fluid tends to "creep" along and into, fine cracks, etc, – like water into a cracked sparkplug. The excess dye is removed from the surface under inspection, and a developer is spread to act as a blotter (to draw the dye out) and to provide a contrasting background. Wherever a discontinuity exists, dye absorbed by the developer will form an easily detectable outline of the defect. Comments made on magnetic particle inspection generally apply to this method. Dye penetrant can be used for non-ferrous alloys, eg, aluminum and magnesium, whereas magnetic particle inspection is limited to ferrous materials only. Both methods are widely known in the field; avionics technicians use them to increase the sensitivity of visual inspection.

Radiography

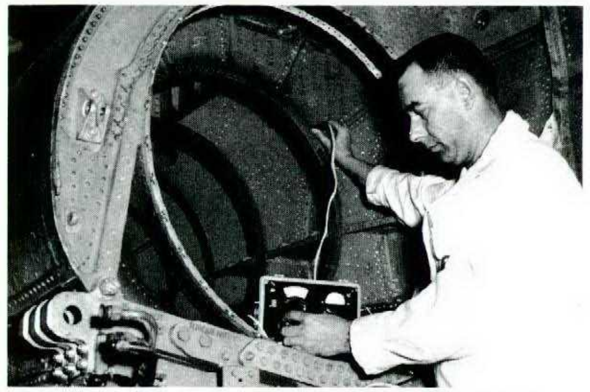
Few people escape being exposed to medical radiography, even if their experience is limited to periodic chest X-rays. Radiography enables the doctor to look through your body to help diagnose the condition of various organs without having to cut you open to peep in. Industrial radiography applied to inspection of aircraft performs the same function. It enables internal inspection to ascertain the soundness of the skeleton - rips, spars, stringers – without removing outer coverings. Much of the NDT work in the RCAF is done by this method. Radiography is expensive both in terms of consumables (films and chemicals used for processing), and labour. On the bright side, radiography eliminates costly, time-consuming dismantling, thus increasing the availability of aircraft.

Ultrasonics

When sound energy is propagated through solid materials, its predictable path of travel can be converted into a visual read-out on a cathode-ray oscilloscope. A defect in the material will cause deviations from the normal path; this can be seen by the technician. Ultrasonics is a very sensitive method, requiring a highly-trained technician to interpret the visual traces on the oscilloscope. It can be either a brief or long task depending on the complexity (particularly the geometry) of the structure to be examined. Ultrasonic examination is economical because no consumables are involved except for wear and tear on the equipment. The RCAF has employed this method on several jobs, resolving difficult inspection problems in a fraction of the time that dismantling and visual check would require.

Eddy Current

If a coil, through which an alternating current is flowing, is placed near material capable of conducting electricity, "eddy currents" are induced. These eddy currents are strong or weak, depending on the electrical conductivity characteristics of the material under test and these currents always oppose the AC current in the coil. Therefore, if we know the magnitude of the original coil current when it is placed near a "good" component, we can measure the difference when the coil is near a defective one. Since heat treatment, thickness, surface condition and defects such as cracks all affect the



Eddy current conductivity check for strength reduction on aging structure – a CF100 tunnel liner.

A Yukon wheel is checked by eddy current for cracks. These short-supply items were kept in service only because constant surveillance of existing cracks was available.

electrical conductivity characteristics of a material, the eddy current method of inspection has a very wide range of application. Some instances of eddy current application by the NDT Centre:

- determination of heat damage to CF100 tailpipe tunnel liners
- T33 control shelves
- inspection of Yukon wheels for cracks in the locking ring groove.

NDT Expansion

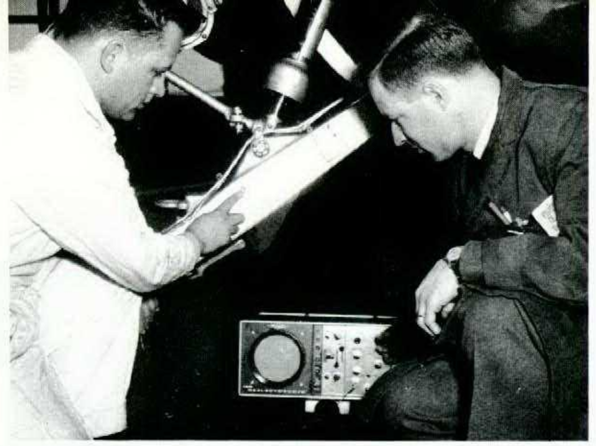
So far, the NDT Centre's main responsibilities have been:

- to develop inspection techniques
- to apply these techniques by sending mobile repair parties (MRP) to field units
- to train NDT technicians.

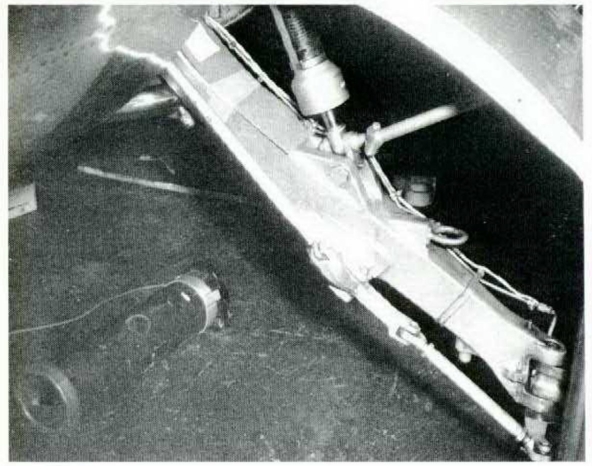
These functions are about to change when four bases – Greenwood, Namao, Uplands, and an Air Division wing – will have NDT sections. These bases will cater to the NDT needs of units within their assigned region. Summer 1967 will see the Namao and Greenwood NDT shops in business; the Uplands and Air Division shops should be operational in early 1968 at the latest. The MRP workload of 6RD NDT Centre will be lessened permitting concentration on developing techniques for detachment use, and training NDT technicians to man future detachments. The mere fact that NDT capability is planned for each major flying station reflects a full appreciation that it has more than paid its way many times.

The contributions which NDT has made to the field of improved maintenance and flight safety are many and varied. The C119, CF101, CF104, Yukon, Otter, Caribou have all presented problems where NDT provided the needed assurance to maintain operational commitments – even though a serious problem existed with a component or system of these aircraft. Going back to the years when the C119 was still operational, monthly X-ray monitoring of the mainplanes permitted extension of their service life until replacement aircraft became available. Cracking of Yukon wheels created a serious spares problem which ultrasonic and eddy current inspection helped alleviate. NDT inspection permitted use of cracked wheels until the total crack length exceeded a critical limit established by the designer and RCAF Materiel Laboratory. CF101 main undercarriage legs were susceptible to cracking in the axle-to-fork radius. A regular inspection program was made mandatory from December 1964 to July 1966 when final retro-fit of modified legs was completed. In this instance, ultrasonic and magnetic particle inspections were complementary methods to provide crack-free assurance.

In recent months the CF104 has presented technicians of the NDT Centre with several challenging inspection problems. Failures were reported to the drag-strut assembly, the main landing gear forging, the speedbrake actuator, and hydraulic servo units. Calls for help were received by the NDT Centre. So far, NDT has provided a quick, reliable method of inspection for the drag-strut assembly and MLG forgings. On-the-spot ultrasonic inspection of the drag-strut assembly has been done by MRPs at Cold Lake and the Air Division wings.



A CF104 main landing gear forging is inspected by ultrasonics.



A CF104 main landing gear forging is X-rayed. The film envelope is taped to the gear; the radiation source is below.

Operational capability of CF104 squadrons would have been affected if these inspections had not reduced the two-day inspection time of the conventional "strip and look" to one hour by ultrasonics. At the time of writing we are busy developing an X-ray technique for use at the unit, to determine the position of a damper nut on the hydraulic servo. If successful, we can reduce the pressure on repair-and-overhaul of these components.

These examples are related to aspects where flight safety is foremost. Although it is true that NDT enrolled its staunchest advocates from those who have found that it can sometimes provide the alternative to grounding of the fleet, maintenance personnel have also gradually learned that NDT can often be an important ally.

The NDT Centre has developed a series of X-ray programs for the Yukon, Argus, Caribou, Tutor and CF104. These cover areas of the primary structure which the manufacturer considers critical. Such areas are usually the highly-stressed structural components where cracks or discontinuities can result in grave hazard to the aircraft. These X-ray techniques permit maintenance programs such as DLIR, PMO and Sampling Inspection to be far broader in establishing aircraft structural integrity within the time allotted. To illustrate this time-saving aspect:

- X-ray inspection of CF104 stabilizer results in a net saving of 480 manhours over visual inspection by strip-down and reassembly, and also eliminates the possibility of error associated with reskinning.
- Radiography enables a three-man crew to inspect the Yukon flap-track support tubes for corrosion (a periodic check item), in six hours; this includes the two hours to develop and interpret the photographs. Visual inspection would involve removal and re-assembly of the twelve tubes – two to three days' work.

Money savings are obvious but the most important benefit is that radiography enables broadening most third-line maintenance programs – impossible without increasing the aircraft down time beyond the permissible limits.

To all those involved in the tremendously important task of keeping our aircraft safe and serviceable, we can only ask them to remember that Non Destructive Testing technology puts at their disposal methods of inspection to check areas of the structure hitherto unreachable, and for flaws previously invisible. A familiarity with NDT by our technicians – and particularly the supervisors – will lead to an easing of their work while making them more effective. The "Ops" boys will be happier since they will have their birds more reliable and in better condition.

NDT technology has placed at our disposal a means of enhancing safety and at the same time reducing maintenance costs, inspection manhours, and aircraft NOR. The extent to which these objectives are attained rests, in part, to intelligent exploitation of NDT. But being a relative new-comer to aviation technology its broader use cannot occur until NDT is a household word to all of us - at every level of command. ■

For those whose curiosity about NDT has been aroused, the writer strongly suggests that they ask their Base Library Fund Committee to procure the books listed below. These books constitute a very sound investment for any technical library.

REFERENCE TEXTBOOKS

Self-Study Course – Magnetic Particle Inspection P1-4-3. Price $10.50 US funds. Publisher: Society for Non Destructive Testing, 914 Chicago Avenue, Evanston, Illinois 60202.

Self-Study Course – Liquid Penetrant Inspection P1-4-2. Price $10.50 US funds. Publisher: Same as (1).

Radiography in Modern Industry. Price $5.50. Publisher: Eastman Kodak Company, X-ray Division, Rochester 4, NY, USA.

Techniques of Non Destructive Testing by Hogarth and Blitz. Publisher: Butterworths, London. Available from Society for Non Destructive Testing for $8.00 US funds.

F/L M Chamberland obtained a BA in 1953 and a BSc (Metallurgy) in 1958 from Laval University. As an ROTP graduate, his first assignment was to 12 TSU, Weston, Ontario, which he left in 1961 for RCAF Materiel Laboratory, Rockcliffe. In August 1963, he won a Canadian Welding Bureau scholarship and attended Cranfield College of Aeronautics, UK, for postgraduate work in welding metallurgy. In October 1964, he was posted to 6RD where he has been NDT staff officer since August 1965.

GOOD SHOW

Cpl DK Frederick

F/L JGA Normand and F/L JLL Roy

F/O DM MONTIE

Just after takeoff on a night target mission the port engine "gave a mighty thump, a short scream, and stopped cold", followed by a thirty-foot burst of flame out the tailpipe. The pilot, F/O Montie, immediately stopcocked the engine and the crew declared an emergency. Using full power on the starboard engine the aircraft was climbed into cloud to get clear of mountains in the area. As safety altitude was attained the aircraft was vectored by RATCON into the fuel dumping area and the tips were emptied overboard. Later, investigation showed that the main bearing probably failed; considerable blade damage was evident.

A GCA in the rain and a high gusting wind ended the brief flight. F/O Montie's response to this emergency was a fine example of airmanship. We join with his navigator in commending him for his competence as a pilot.

CPL DK FREDERICK

The Expeditor had flown more than two hours since inspection and was declared serviceable. There was no reason, therefore, to doubt that it was completely airworthy. During start-up, after the starboard engine was running, Cpl Frederick was not satisfied that all was normal; too much fluid appeared to be coming from the propeller anti-icer. His curiosity aroused, Cpl Frederick motioned the pilot to shut down so that he could carry out a check of the anti-icer. This check revealed that the anti-icer and the fuel primer lines had been cross-connected during reassembly after inspection.

The aircraft crew understandably expressed great appreciation and praise for this groundcrew member who alertly discovered a rather obscure fault. This Murphy could have had serious consequences; Cpl Frederick's alertness is commendable, indeed.

F/L JGA NORMAND, F/L JLL ROY, AND CREW

While carrying out an operational patrol in an Argus, F/L Normand the captain, and F/L Roy the co-pilot, discovered that the aircraft elevators had jammed. Quickly assessing the situation, the pilots kept the aircraft under control, using the elevator trim system. An emergency was declared immediately and the aircraft was headed toward land.

Throughout the two hours until the aircraft was safely landed, the crew acted as a team – preparing themselves for any eventuality. Excess stores were dumped and everyone prepared for either a ditching or bailout. The aircraft was intercepted and escorted by another Argus and a Tracker – also receiving excellent [illegible] operation from Maritime HQ and Moncton ATC. A ski[illegible] flapless landing was carried out at Chatham (due to adverse winds at Summerside), using elevator trim only.

F/Ls Normand and Roy displayed sound technical knowledge and cool judgement in controlling their aircraft for the two hours of the emergency. There can be no doubt that the successful conclusion to this flight was brought about by the calm yet decisive action on the part of the aircraft captain and by the competence and support of the experienced first officer.

CPL LM OGILVIE

While performing a visual check of the flight controls during a periodic inspection, Cpl Ogilvie, an airframe tech, discovered a badly-cut fuel line. While inspecting the CF104's starboard aileron control cable for excessive play and freedom of movement, Cpl Ogilvie was sure he felt the cable rubbing against something within the fuselage beyond his line of sight. Extending his inspection through a small access panel in an a[illegible] obscured by cables, pulleys and plumbing he was a[illegible] with a flashlight to locate the cause. The aileron control cable was rubbing across a fuel transfer line, which was nearly cut through, leaving a 3/4" gash. (See Gen from 210 for story).

In the 150 hours flying time before the next inspection there is little doubt that this fuel line would have been cut through, permitting tiptank fuel under pressure to be sprayed over a very hot engine area. The

consequences of this would have been fire and a possible explosion.

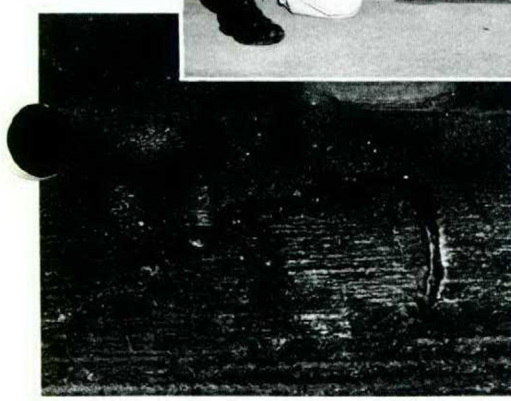
Cpl Ogilvie's alertness and integrity in persuing his investigation led to a special inspection in which four other cases of this condition were found. We often speak these days of the important and responsible role of our technicians – his was an action which speaks louder than words.

CPL OW GORMAN AND LAC DE CLARKE

After a routine start, the crew – Cpl Gorman and LAC Clarke – removed the chocks and signalled the pilot that all was clear to taxi. As the CF104 started to roll, Cpl Gorman noticed a cut in the nosewheel tire. Immediately, the pilot was signalled to stop, and to shut [illegible]wn the engine.

The nosewheel was cut deep into the tread and was [illegible]t detected on an earlier inspection, being hidden at the bottom of the tire.

It takes not only a good lookout to notice such a hazard but the professional enthusiasm to sustain the alertness we must have if we are to prevent accidents.



GOOD SHOW

F/L CY SMITH

F/L CY Smith, an RCAF officer on exchange duties with 11 Sqn was briefed to carry out a 10-hour antisubmarine training exercise in a Neptune. After two hours flying... fuel fumes were noticed and fuel was seen to be streaming into the fuselage from the port side in the vicinity of the main spar.

F/L Smith, who was out of his seat at the time, immediately warned the crew as he moved back to the cockpit where he turned off all fuel booster pumps, generators, alternators and batteries. He also changed from centre to main tanks. The aircraft was turned towards the closest airfield. The co-pilot briefed, the captain again went aft to warn the crew of the extreme fire and explosion hazard, and to ascertain the cause and extent of the leak. The inrush of fuel had intensified and was now entering the aircraft as though from a full-on household tap. The flow of fuel lasted for three or four minutes, leaving two inches of fuel on the floor of the aft section!

Crew members were stationed to pass messages in lieu of the inter-com system which was switched off. Ten miles SE of Sydney one call was made after which the electrics were again turned off. Ten miles from base a further call was made requesting fire tenders and advising which escape hatches would be used by the crew.

Jets were not lighted for the landing, and brakes and reverse thrust used cautiously. All electrics were switched off at 60 kts and the engines were shut down before the aircraft cleared the runway. A rapid exit was made by all concerned.

The basic cause of F/L Smith's problem was a faulty float valve in the port centre tank. It is considered that he handled the situation with that professional skill, knowledge and leadership which typifies a really "Good Show".

– adapted from "Flight Digest" Royal Australian Air Force

Hydraulic System CONTAMINATION Control

F/L JD Glyd
MATCO

Are poor maintenance techniques and human-factor deficiencies responsible for high contamination in aircraft hydraulic systems?

Can hydraulic components tolerate contamination?

What effect does contamination have on system reliability?

Can hydraulic component life and reliability be increased by reducing contamination levels?

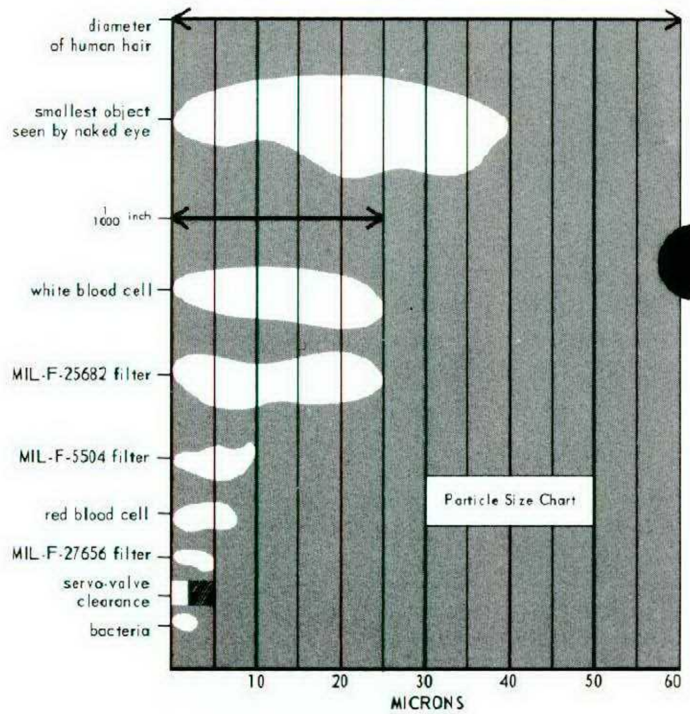
These are some of the questions which deserve serious thinking by those of you who service and maintain aircraft. At present, strip reports on failed components reveal one glaring common factor – CONTAMINATION. It is therefore obvious that tremendous savings and improved reliability would result if an effective contamination control program were applied. Future thinking must be channeled in this direction.

There are many aspects of a contamination control program: fluid handling, component care, maintenance techniques, system and component design, technical data, maintenance instructions, filtration and flushing procedures. All these areas are vital, but today the profound lack of knowledge on contamination control and its vital importance is our biggest problem.

What is DIRT?

Contamination is really suspended animal, vegetable, mineral or synthetic matter originating within the system or introduced from an external source. It may be liquid or solid, any size or shape, soft, hard, fibrous. Particle material may be analyzed by spectrographic analysis, and described by size and quantity (through particle counting), or as fibers (if their length is at least ten times the diameter and they are over 100 microns long). Particle size is specified in Microns – a micron being one millionth of a meter. A one-thousandth of an inch is 25.4 microns long. Superfine matter less than five microns in size is known as Silt; the silt level in fluid samples is described as a Silting Index. There is a direct relation between silt and larger particles in the fluid. As silt is really broken-down particles, the silting index changes with the particle level.

Theoretically, if internal moving parts in a hydraulic component are suspended in clean lubricating fluid there will be no erosion or wear of the moving surfaces – and no self-generated contaminant. If this is so then the prime source of contamination in hydraulic systems is dirt introduced from external sources and the resulting self-generated wear or erosion.



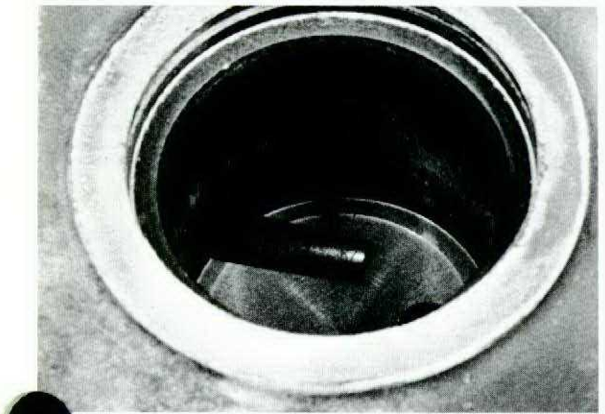
Contamination means wear

Wear and erosion releases particles; progressive wear causes flakes of material (that is, more particles,) to break away from the surface. The particles, in turn, collect in low-pressure areas of turbulent flows or in the electric fields of wet electro-hydraulic components, a... harden into a scale. This scale can break away ... larger pieces of hard material to clog orifices and screens, cause moving parts to stick, progressively wear, score and erode surfaces – in general, create havoc in the entire system. Fibers contribute by trapping solid contaminants thereby increasing the magnitude of the problem.

Of course, wear and erosion means increased clearances. Many moving parts have a clearance of less than five microns, therefore the minute particles which can enter between surfaces are the prime problem. And clearances permit leakage. In fact, leakage varies as the cube of the clearances; eg, if a 3-micron clearance gives a leakage rate of 5 CCs, doubling that clearance through wear, etc, to 6 microns will cube the leakage rate making it 5 x 5 x 5, or 125 CCs. This is a particularly serious problem in pumps, spool valves and servos.

A further consequence of contaminated fluids is ...tion and cavitation on high-speed moving surfaces. This produces excessive heat, increases fluid oxidation and reduces the maximum allowable fluid operating temperature. Oxidation can occur in dirty fluid at 50 degrees below that of clean fluid.

Understanding contamination control in hydraulic systems requires a basic knowledge of filter design and operating characteristics. Filter units are designed to



...se-up of CF101 brake cylinder scored by contamination. This minute damage was tell-tale sign of failure; the brake pistons – no longer free to travel – imparted a braking force sufficient to blow the tire (below). The aircraft ran off runway, coming uncomfortably close to being a write-off.

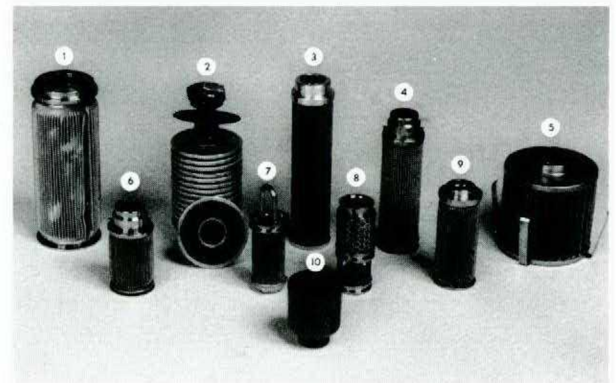
have specified flow capacities, filtration ratings, clean pressure drop, maximum differential or element collapse pressures, and dirt capacity. Elements are disposable or re-usable. Housings may incorporate element by-pass ...lves, shut-off valves (to shut off flow when bowl is ...oved), or pressure differential indicators to indicate ...en an element needs replacing.

Filtration rating is normally defined as nominal and/or absolute; a nominal rating means that only a percentage of the spherical particles, larger than the rating quoted are removed. An absolute rating means it will remove 100% of the spherical particles larger than the rating quoted. Any quality filter will specify both ratings and quote the test specification used. The test specification is important because two filters with the same rating may have quite different filtration capabilities according to the test procedure used.

Types of filters

Different dirt-loading materials, flow rates, pressure differentials and test conditions will result in entirely different dirt capacities. Of interest, are the different types of filtering media. Wire mesh is a surface-type re-usable element media, and although it can have an absolute rating if the mesh is bonded to avoid spreading, the dirt capacity will be limited. Fiber elements have random depth-type voids and are in general, a disposable filter. Dirt capacity is higher, but unless ideal fiber and bonding materials are used they are prone to rupture, fiber loosening, and are not always adapted to absolute ratings. Another type is the semi-depth filter which will have fine metal particles bonded on top of wire mesh. This is an excellent re-usable filtration media; it has an absolute rating, provides a torturous path for fluid flow to trap particles and fibers, and can absorb more dirt than wire mesh.

Wire mesh elements can be designed to withstand very high collapse pressures; fiber elements normally have a collapse pressure of 100-300 psi, making them prone to collapse or rupture when subjected to high surge pressures or dirt loads.



	DIA (inch)	LENGTH (inch)	APPLICATION	TYPE OF MEDIA	VALUE $	FILTRATION RATING (microns)	
						ABSOLUTE	NOMINAL
1	1¾	4	CF101 hydraulics	woven stainless steel mesh	50	25 approx	10
2	2	3	CF101 CSD (engine oil)	woven wire mesh – biscuit or wafer element	100	80 approx (suspect)	
3	1	4	general – hydraulics	resin-bonded fiber	3	–	10
4	1	3½	CH113A SAS hydraulics	woven stainless steel mesh with sintered steel particles on outer surface	150	15	1.5 (MIL-F-8815A: a very tight spec)
5	2¼	2¼	Tutor fuel	woven wire mesh	35	–	80
6	1	1½	CH113 hydraulics	woven wire mesh	75	25	10
7	¾	2	Tutor engine oil	woven wire mesh	35	80 (suspect)	–
8	¾	2¼	CH113 – T58 engine oil	wire mesh screen	35	150 (suspect)	–
9	1	2½	CHSS2 hydraulics	woven stainless steel mesh	100	25	10
10	1¼	1½	Tutor reservoir air filter	sintered monel metal particles	20	–	25 approx

By-pass valves

Filter by-pass valves will route the flow past the element when a set pressure differential is reached. Their serviceability is important; technicians must know the by-pass full flow rate, allowable leakage, cracking, full flow, and re-seating pressures. By-pass valves themselves are a problem:

- they are prone to stick in partial or full-open positions
- they allow continuous leakage of unfiltered fluid to pass through the filter
- they are prone to by-pass on pressure surges or cold starts.

Although by-pass is considered an essential feature on hydraulic system return line plumbing, or where low collapse pressure elements are used, it has little value in high pressure lines using high collapse pressure elements, particularly if pressure differential indicators are used. Elements which withstand a 4,500 psi collapse pressure are now available; if these elements are used in pressure line filters, adequate flow will be assured, and better filtration will be accomplished without a by-pass valve.

Pressure differential indicators

Pressure differential indicators – pop-up button, light switch, or pressure gauge – indicate when a set pressure differential has been reached between filter inlet and outlet ports. Pop-up buttons, commonly used on aircraft filters, should be given regular inspection. Button popping does not necessarily indicate that a critical pressure differential has been reached; the element is still usable but this is the time to replace that filter. These indicators are not prone to failure, and must not be dismantled in the field. Some pressure differential indicator installations are prone to give false readings from pressure surges or excessive flows; it is wise to find out whether these readings are, in fact, false. False readings may suggest the need for either a higher capacity filter, or a restriction in the indicator inlet pressure orifice to retard pressure peak to the indicator. Pressure differential indicators have a bi-metallic spring which prevents button movement until fluid warm-up, preventing a false indication on a cold start.

Cleaning and testing

Efficient filtration requires proper filter cleaning and testing; dirt left in the element reduces its capacity. Chemical soaking, back flushing, ultrasonics, or any combination of these three methods are commonly used. The only way to determine element cleanliness is testing; the naked eye can barely see 40-micron particles, so visual inspection is out.

There are two common methods of testing:

- the *bubble point test* which detects damaged, ruptured, or clogged areas in the mesh, and separation of end caps.
- the *pressure drop test* which determines if fluid flow is blocked by dirt left in the element.

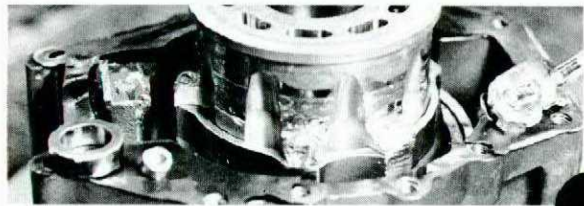
When cleaning and testing:

- a clean environment is mandatory
- contaminated fluid, and air, must not get into the element
- handle all filter equipment as you would care for a delicate instrument
- clean elements should be properly packaged to avoid the ingress of dirt during handling.

Pumps most prone

When you think of contamination, you think of pumps. Fluctuating pressure or excessive peak pressure indicates sticky stroking and compensating pistons or pressure control mechanisms, which in turn, indicates dirt, or wear caused by dirt. Displacement or wear of pumping pistons causes internal leakage and higher case pressures; this blows shaft seals or even crack housings. Further pump wear causes flaking and ultimate disintegration of moving parts, thus contaminating the entire system.

Hydraulic pump failure – the aftermath.



Catastrophic failure of hydraulic pump. Contamination and the resulting wear causes ruptured or blown seal; fluid starvation causes disintegration.

Ultra-fine filtration

To combat the pump wear problem and the self-generation of contaminant in hydraulic systems, a refinement in system filtration has now been developed. An ultra-fine filter is installed in the case drain return line to prevent contamination returning to the reservoir. This keeps the reservoir fluid super-clean. Fluid added to this system is injected at a point where it must first pass through the return line filter. Thus, the pump receives only super-clean fluid – reducing to a minimum the prime cause of internally self-generated contamination. With this added protection the other filters need only provide a nominal rate of filtration. The size of this ultra-fine filter unit is kept reasonably small by using a dual-type filter:

- *the primary element* – a disposable 3-micron absolute fiber element, capable of filtering normal system flows.
- *the secondary element* – a re-usable 15-micron absolute element capable of carrying total system peak flows and removing any fibers from the primary element flow.

Illustrating the benefits of this filtration technique, hydraulic pumps installed in civilian airline jet transports are normally reaching a life in excess of 2500 hours. The same model pump installed in an RCAF fighter aircraft has a mean time between replacement of less than 500 hours. The hydraulic system in the jet transport is as complicated as any jet fighter aircraft therefore it is obvious there is negligible internal generation of contamination in a system when reservoir fluid is maintained in a super-clean condition.

Decreased maintenance is an additional benefit derived from this new filtration technique. The primary ultra-fine disposable element has a normal life in excess of 3000 hours; the coarser re-usable elements have an expected life of 10,000 hours. (These times are based on use of pressure differential indicators on each filter installation.) As no contamination is allowed to return to the reservoir, when a pump fails there is no need to flush the system, change filter elements, or even to replace an associated system pump as a precautionary removal.

The human factor

This article has been written to create a better appreciation of filter capabilities and contamination control. While the human factor is probably the most practical immediate method of attacking the contamination problem, it must be admitted that a limiting factor is the equipment provided for maintenance, and the procedures or techniques employed.

Two important equipment changes have recently been adopted to improve the maintenance man's capability; 3-micron absolute filtration on all powered hydraulic test stands for more efficient ground flushing of aircraft systems, and silting index determinators for use in the field analysis of hydraulic fluid contamination levels. However, to obtain the most benefit from this equipment new flushing procedures and representative fluid sampling methods must be developed. This will be the responsibility of all levels involved with hydraulic system maintenance. Fluid sampling and analysis will be a periodic requirement, and ground flushing will be dictated by the analysis results. This development is a major step in the current system clean-up program. Again, the results will be limited by the effort applied in using the new equipment and techniques.

Contamination can be controlled and to a large extent prevented. But control and prevention is where the technician's care and competence come into the picture. An article in the USN "Approach" magazine states:

> There is no known amount of contamination that a hydraulic system will accept and still keep going. Contamination control depends on maximum system cleanliness at all times. Any outside contamination should be considered too much. Govern your maintenance actions accordingly.

Always be prepared to learn more about filtration, and contamination control. It is a developing field of engineering and will be continually subject to change. Be prepared to assist in the contamination control program by submitting ideas, comments or criticism to an appropriate authority for evaluation.

ANTI-CONTAMINATION CHECKLIST

- Use clean tools and keep hands clean.
- Cap all ports (plumbing and component) whenever they are opened during replacement or maintenance operations. Work should not be performed in a windy or dusty area. The caps must be kept clean.
- Ensure flushing rigs are serviceable and the fluid is clean. This may require static operation to flush the test stand before use.
- Handle all hydraulic components and parts with great care. They are prone to damage – a slight burr, dent, or chip can create serious hazards to system reliability.

Flash-back

So the CO says, "Sergeant, this will be the last ground accident on my station".

- Try to assess problem areas in system operation or component failure. Don't always blame the component; consider all possible reasons for failure including contamination. Remember, the component has been designed and tested to perform a specified function; failure is normally due to outside causes.
- Ground flushing procedures are probably the most important method of contamination control. There is no point in doing an incomplete flushing job, therefore:
  - Be sure the test stand is serviceable and clean, and the 3-micron absolute filter is serviceable.
  - Flush all areas of the system. This may require the use of valved jumper lines to create and control fluid flow in dead areas such as flight control regions, where cycling of components creates only limited flow.
  - Determine a cycling sequence which provides maximum and practical flows for flushing, and rotates the cycling sequences throughout the system until flushing is considered complete.
  - Verify fluid condition by obtaining a representative fluid sample and performing a silting index.
  - If the condition of the fluid is doubtful, get a laboratory analysis.
  - Do not step on, or allow vehicles to run over, test stand flexible lines. Be cautious of flexible rubber lines; they generate contamination.

F/L JD Glydon enlisted in the RCAF in 1942 as an airframe mechanic. In 1947 he trained on the first post-war Para Rescue course and subsequently re-mustered to the safety equipment trade. Until being commissioned in the Technical Aerospace Engineering branch in 1963 he filled Para Rescue team positions at a number of Search and Rescue units in Canada. He was transferred to Materiel Command in July 1963 and since that time has been in charge of aircraft pneudraulic accessories and engine filter equipment.

◆

(In his present position F/L Glydon has been very closely associated with aircraft hydraulic system problems, and invariably has found the prime problem to be contamination. To rectify some of the problems he was instrumental in having new filter equipment and maintenance procedures adopted to achieve cleaner hydraulic systems. However, the firm attitude by many that contamination is something we will have to live with, is a serious matter. F/L Glydon wrote the article to provide basic information on the subject to stimulate thinking and interest.)

PROTECTIVE CLOTHING

the new generation

The man on the left wears a khaki (or jungle green) combat-style tropical coverall; the man on the right models the new winter Type IV. They are examining the latest version of the aircrew jacket. The jacket design is basically unchanged. The heavier brass zippers are without the outer covering flap. The dark-blue fabric is similar to that of the Type IV (right) and will also complement the dark blue summer weight combat and transport flying coverall now in service.

The colour of the tropical flying suit (right) is not compatible with the aircrew jacket (left) but they are not likely to be worn together.

The man is donning groundcrew "windpants" made from a blend fabric to minimize static build-up. The material is a closely-woven blue fabric and is relatively windproof. Wear patches cover the seat and knee areas. Since they are to be worn over working trousers, a simple waist-tie of light flexible webbing on the drawstring principle is used to support them from the waist. An experimental quantity of 1300 will be equitably distributed to operational units for evaluation.

The dynel/nomex blend's porosity is demonstrated; the light rectangle is a piece of paper held behind the cloth.

This is the new experimental tropical flying coverall in the combat design, made from a dynel/nomex blend. First reports indicate an appreciable passage of air can be felt when the wearer moves around. The garment will char in a fire but will not support flame and there is a complete absence of hot-melt. In its present state of development, the only known dye that will not fade or damage the fibres is jungle green – although research is well underway and a breakthrough on the colour difficulties is imminent.

Several years ago, it was necessary to introduce a special parka with an outer shell material of blend fabric to minimize static-build-up. The safe parka was distinguished by a triangle-shaped yellow shoulder patch. With the introduction of this new parka, this distinction will no longer be necessary. The colour and material is similar to that in the new Type IV flying suit. The man is also wearing the groundcrew windpants.

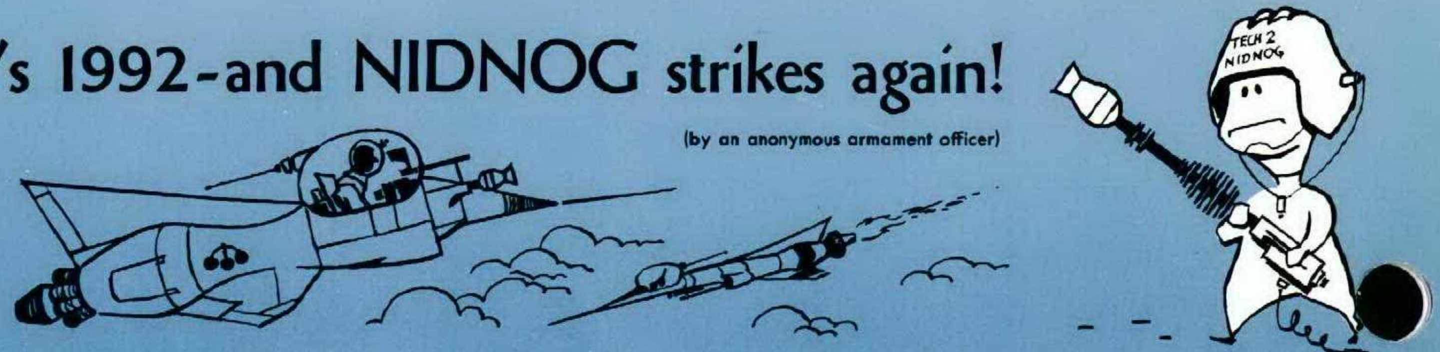
The re-designed and streamlined trousers and jacket, flying, winter, Type IV. New features are:

- a collar of mouton fur instead of nylon
- less restriction at the neck
- jacket lengthened,
- waist zippers removed; these formerly held the suit together in the Type III
- the trousers have an extended "bib" to eliminate chill in the chest area,
- a "drop seat" for convenience.

The garments are secured together by elasticized webbing straps which return the jacket waist to its proper position after forward bending. The two components of the Type IV are not compatible with the french-grey Type III either in design features or colour. The Type IV is of dark blue fabric blended to minimize static build-up. Three thousand suits are on order.

It's 1992-and NIDNOG strikes again!

(by an anonymous armament officer)



Klip Klopper, orbiteer 2nd class, gave his ground-crew a thumbs up and a grin as he taxied away from the line. Reaching the end of the runway he got clearance from the tower, placed the throttles of his Q50 into full ionization – the engines whispered a moment, and he was off on his mission. Climbing through 90,000 and accelerating through Mach 5 he thought of the progress of the war – now 20 days old – and his own part in it. From the start, the Q50s had easily out-performed the enemy's Drakvert fighters. The Q50s were equipped with the 220XL series automatic gun; with 20,000 explosive micro-rounds per minute and hypersonic muzzle velocity, the guns could bring down any aerospace vehicle – at close range. The Drakverts, despite their inferior performance, were a real menace with their long range air-to-air missiles. Up to now the Q50 role had been reconnaissance; if Drakverts showed up, the SOP was to run for it.

Today, mused Klip, it's going to be different. The boss, Planeteer Sharpschuter, had consented to let Klip try a new tactic – sneak up fast on a Drakvert's tail, give him a short burst of the 220XL and beat it home before any of the Drakvert's fellow travellers showed up. Straightforward and simple, it sounded great.

Minutes later, wonder of wonders, he spotted a bogie – a lone Drakvert cruising below at about 95,000 feet. Klip carefully searched the sky noting with pleasure that except for that "loner" down below, the sky was empty. He advanced the power lever to super-ionization, master armament switch "on", gun switch to "guns", and dived.

Closing fast, he switched to "automatic" and waited for the computerized burst of the guns. He had whizzed past the Drakvert before he realized that the guns hadn't fired! A moment later a fireball nearly encompassed his port stub. The propulsion unit ceased.

The plan had backfired. He had been hit by a missile from the Drakvert. Amazingly, he still had control. By trading altitude for airspeed he was soon back over his homeland, but gliding through 40,000 Klip realized he would never make base. He prepared the cockpit capsule for ejection and pulled the lever. Nothing happened. He pulled again and repeated all ejection sequences – NOTHING!

At 25,000 feet Klip took the frozen liquid food bottle out of the survival kit and attacked the canopy. By 8,000 feet he had smashed an escape hole. He quickly strapped on the moon-jumper rockets from the survival kit, positioned himself beneath the hole in the canopy and fired himself out. Fortunately, the rocket control system worked and he was soon down on terra firma. Within minutes, he was talking to the base commander on his ejection radio, giving him the story and detailing his position for the helicopter rescue flight.

Meanwhile back at the base, Nidnog, space-gun technologist 2nd class, waited in the line shack for his pilot, Orbiteer Klopper. He was a little bored with the war. The only thing he had done was to carry out a special before-flight-inspection on the gun to make sure that the rear sear retainer adjustment spring had not rotated from the 360° position. Only last week Klopper told him it wasn't likely the guns would ever be fired as the policy was to run away from trouble. He hadn't done the check this morning. "What's the point?" he had thought.

He was a little worried however, about the ejection capsule safety pins. He had forgotten to remove them this morning. He had remembered them as Klopper was taxiing out but he was embarrassed and afraid to let ground supervisor Exacta know about it. After all, wasn't Klopper the best pilot in the outfit and wasn't the Q50 the most reliable of any fighter in existence?

A scurry of activity erupted at the servicing building; Exacta had been called in by the servicing officer. Later, Nidnog was front-and-centre in Exacta's mobile office – a glass-lined cubicle on wheels commanding a complete view of the servicing area. Supervisor Exacta was brief, blunt and brutal. In three short minutes Nidnog had admitted all and was dismissed. It was an angry, frightened – but most of all – ashamed young man who emerged.

Just then Nidnog saw a helicopter landing and out stepped Klopper with the rescue team. Exacta was the first man to pump Klopper's hand in congratulations over his fortunate escape. They had time for a hurried talk before the other crew members, including Nidnog, arrived. They patted Klopper on the back and shook his hand – Klopper obviously enjoying their welcome and concern for his welfare.

Nidnog, forcing his way through the crowd, extended his hand and voiced his congratulations along with the rest. At this gesture Klopper dropped his hand. His smile faded and turning his back on Nidnog, he continued in animated conversation with the remainder of the crew members.

Nidnog was shocked.

Imagine, making such a fuss over a couple of pins – anyone can make a mistake. You'd think his life depended on it, the way he rejected me!

A TRICKY LIFT

How do you lift nearly 18 fragile tons out of a swampy bush?

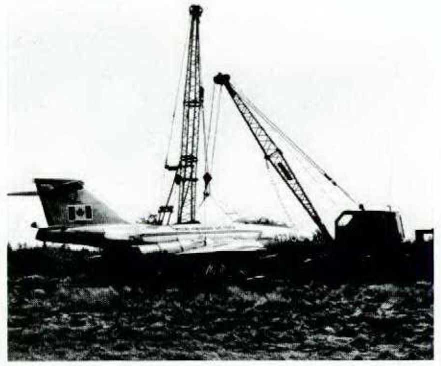
A blown tire on landing sent a Voodoo careening off the runway into soft ground overgrown with shrubs and saplings. The nosewheel broke off and the oleo collapsed rearward, leaving the aircraft nose-down, its main wheels buried to the axles. After the accident investigators had done their work the aircraft was turned over to F/O MAW Clermont and WO2 JF Frost for recovery.

The F45 crane – the station's primary lifting device – can lift 21,000 lbs at the required 20-foot safe working radius – about 14,000 lbs too weak. Another similar crane belonging to a construction company was on the base at the time and it was pressed into service.

Lifting a fragile aircraft off soft ground with two cranes was a challenging problem in coordination and manouvering.

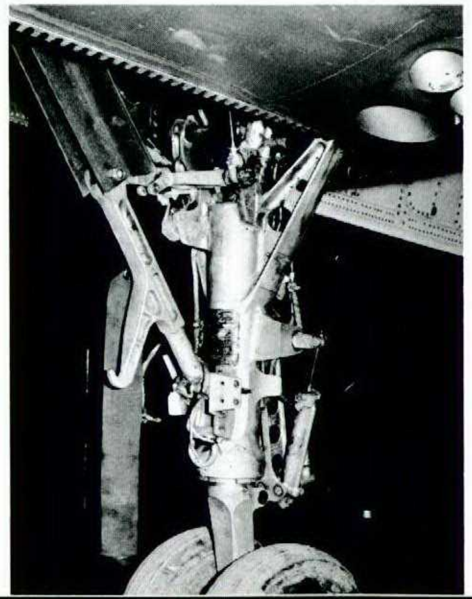
First, the aircraft was raised to permit installation of a new nosewheel and nosegear. The oleo was rigidly braced by angle iron (visible in the photo); this put the aircraft in reasonable shape to be moved. A bulldozer was then employed to tow the aircraft rearward out of the boondocks over a platform of heavy plywood boards. Steering was accomplished by "a hastily manufactured hand-operated attachment".

A very tricky and delicate operation it was. A misjudgement in any phase of the move would have damaged a very costly aircraft. Both F/O Clermont and WO2 Frost are to be commended for exercising the good judgement and ingenuity in salvaging this Voodoo under very difficult circumstances.



Two cranes raise the 101 permitting nosewheel repairs. The aircraft is now ready to move along a plywood roadway.

F/O Clermont and WO2 Frost examine repaired nosewheel.



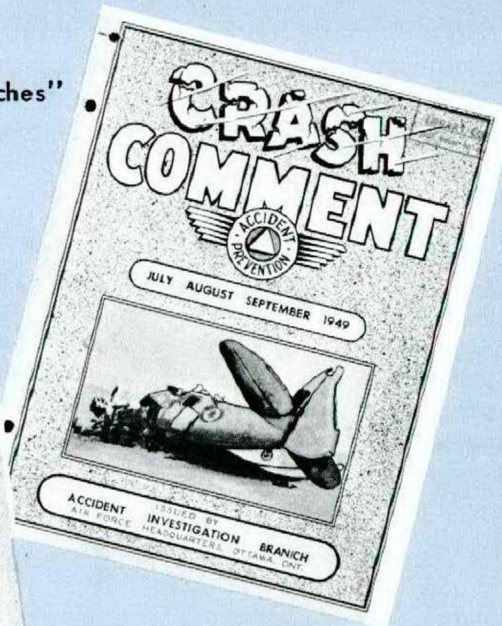
Angle irons braced the nosewheel for the journey from boondocks to hangar.

Looking back

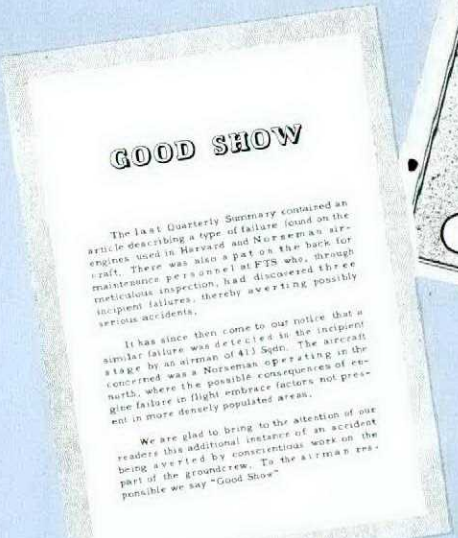
In the intervening three years before the first post-war flight safety publication saw the light of day in 1949, there were too few crashes to fill out a magazine – even a quarterly. But by 1949 flying activity had picked up, and the response of the Accident Investigation Branch was the creation of a quarterly booklet with the ominous name Crash Comment.

CRASH COMMENT

In 1946 it was realized that resurrection of Mentioned in Dispatches was desirable . . .



The AIB's successor to the wartime "Mentioned in Dispatches" – Crash Comment's first issue.



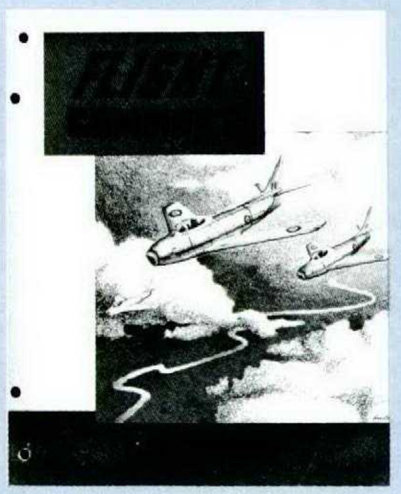
GOOD SHOW

The last Quarterly Summary contained an article describing a type of failure found on the engines used in Harvard and Norseman aircraft. There was also a pat on the back for maintenance personnel at FTS who, through meticulous inspection, had discovered three incipient failures, thereby averting possibly serious accidents.

It has since then come to our notice that a similar failure was detected in the incipient stage by an airman of 413 Sqdn. The aircraft concerned was a Norseman operating in the north, where the possible consequences of engine failure in flight embrace factors not present in more densely populated areas.

We are glad to bring to the attention of our readers this additional instance of an accident being averted by conscientious work on the part of the groundcrew. To the airman responsible we say "Good Show"

The first Good Show – unfortunately to an unknown recipient.



The first Flight Comment – first quarter, 1954.

The first issue contained "the usual crop of groundloops on Harvards . . .", several fatal crashes, and some trenchant comments on pilot error:

> During an armament exercise a pilot had complete power failure while flying at 800 feet... The engine gave a short surge of power but again died out... Again the engine surged and died. The pilot then attempted to select flaps down in preparation for a forced landing but selected wheels down instead. The little error kept our friend so busy pumping the wheels back up and the flaps down that he couldn't give any further attention to the wobble pump. It seems that the pilot made a very good job of landing the aeroplane, which is something in his favour.

Or this one:

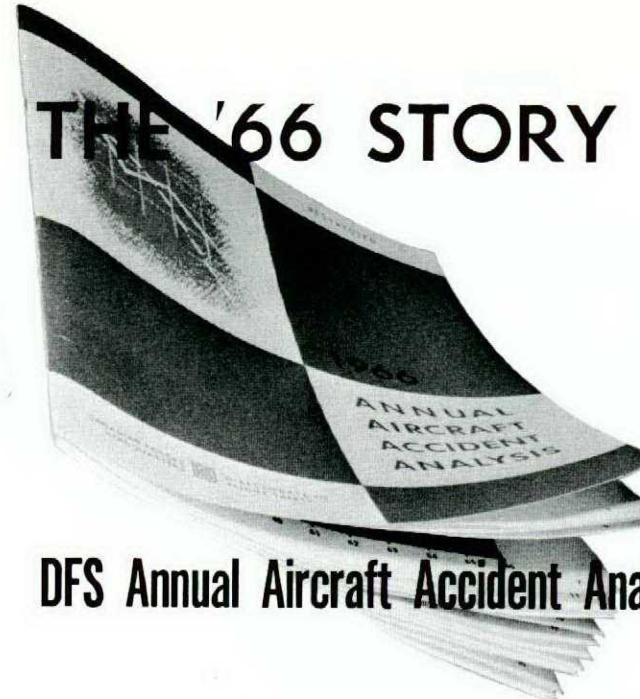
> After completing an exercise the pilot returned to base and prepared to land. On final the pilot operated his divebrakes on several occasions to control his approach speed. Finally however, he raised his undercarriage instead of the divebrakes and made a wheels-up landing. The undercarriage and divebrake levers have handles of a different shape and are located some considerable distance apart and have unequal distances of travel. Such incidents are commonly termed "finger trouble" and there appears no reason to describe this one in alternate phrasing.

And so it went, with "...the emphasis on presenting the accident record in a digestable and interesting vein". Each issue became fatter as the RCAF's flying activity expanded. The fourteen pages of the first issue became in four years a fifty-page book – paving the way for the introduction later (1955), of a bi-monthly. With the arrival of artist John Dubord the magazine began to exploit illustration and cartoonery to get the message across.

In January 1954 the first Flight Comment appeared, with a more professional format. The emphasis was now on flight versus crash as the magazine emerged as a prevention device. The quickening pace of aviation activity dictated a need for something more than just after-the-fact reporting. Articles by experts, and accident reporting in depth, appeared.

Thus, the Flight Comment of today is the successor – through Mentioned in Dispatches and Crash Comment – to a venture in flight safety journalism begun over twenty-five years ago.

THE '66 STORY



DFS Annual Aircraft Accident Analysis

"Helicopters, as in the previous year, had the highest accident rate."

"The Tutor was the only aircraft to experience an increase of more than one write-off from the previous year."

"Over half of the year's fatalities occurred when pilots attempted to proceed visually into deteriorating weather conditions."

"...of all air accident causes, personnel accounted for 69% of the total."

"There were 61 air accidents in 1966 compared to the previous low of 65 in 1964."

"Materiel failures were responsible for approximately 50% of the air incidents."

"Sixteen people died in 9 fatal accidents in 1966."

"Loading and towing accounted for 50% of the ground accidents."

Another edition of the Annual Accident Analysis is off the presses. Written and published by DFS, the Annual is an account of the losses sustained by the Canadian Forces during 1966's flying activities. If you haven't seen it as yet it is available from your Base Flight Safety Officer. The Annual is recommended reading for eveyone connected with flight operations and aircraft maintenance. The message contained between the covers is still relevant – despite unavoidable delays in publication and distribution.

On the second day of January 1966, an entry was made in the records – "Hercules 001, number two propeller feathered, generator failure". On the twenty-ninth day of December, 1624 entries later, the final item was written in – "Neptune 121, starboard inner undercarriage door found buckled during the preflight inspection". Between these two entries is the story of 61 air accidents, 23 aircraft destroyed, 1476 air incidents, 87 ground accidents and 16 fatalities. The Annual tells this story.

Flight Safety is accomplished primarily by acting on the experience of previous years, so if The Word is circulated, read, and heeded, it will be reflected in next year's publication.

TOPS* in Texas

* To Promote Safety

F/L AC Brown, an exchange officer with the 3510 Flying Training Wing, Randolph AFB, Texas, was presented the TOPS performance award in the operational category, for his contribution to base flight safety.

The citation reads "... During the two and one-half years you have been at Randolph, you have pursued assignments with a professional awareness of the importance of safety. Your competence in properly analyzing three in-flight emergencies and effecting a safe landing in each instance, attests to your professionalism as a pilot."

F/L Brown has been instructing at Randolph since June 1964.

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 an[d if] not answered in print we shall attempt to give a personal answer. Please di[rect] any communications to the Commander, CANFORBASE Winnipeg, Westwi[n], Manitoba, Attention: UICP Flight.

The term "enroute descent" is becoming more frequently heard these days particularly with aircraft flying in the high level structure and arriving at terminals which are radar equipped. Aircraft can, of course, be cleared for enroute descents at other than radar equipped terminals. There are several advantages for flying the enroute descent rather than remain at altitude and perform the full published approach, however, certain problems arise which are worth your consideration.

A large number of the aircraft flying the high level structure carry only high level terminal procedure publications (GPH 201). Since it is not always possible to complete the flight with a hand-off to a radar approach facility for a precision or surveillance approach to minimums, the pilot must be prepared to utilize the high level letdown plates from other than the published initial approach altitudes. Ideally, the most expeditious way to complete the enroute descent is to be vectored to a position which will permit interception of the final approach track approximately ten miles from touchdown. This will allow sufficient time to place the aircraft in landing configuration and get established on the final approach track prior to descending to the landing minimum. This type of approach is the one most commonly used when an aircraft can be radar vectored for a straight-in ADF, VOR, TACAN or ILS approach.

Prior to reaching the final approach track, the altitudes on these approaches will be given by the controlling agency depending upon traffic, terrain clearance and distance from the final track interception. The pilot should, of course, know his position and the minimum safe altitude for the quadrant or area he is in. Once the aircraft is released from the radar vector and cleared to the airport for a straight-in approach, the pilot may descend to the published altitude for that portion of the approach. If in doubt, the minimum safe quadrantal altitude is the one to use.

What occurs when the aircraft has done an enroute descent and radar vectors are *not* available? In this case the aircraft arrives over the approach facility at an altitude lower than the published initial approach altitude. Upon being cleared to the airport for an approach, the name of the game is as before – to position the aircraft on the final approach track at the published altitude, and at a distance from the airport to allow the aircraft to be placed in the landing configuration prior to descending to the landing minimum.

Each published approach conforms to the criteria for that particular approach facility. (For specific dimensions see "Manual of Criteria for the Development of Standard Instrument Approach Procedures and Holding Areas"). The published track and altitudes assure the required terrain clearance – as long as the aircraft remains within the defined airspace. Outside this defined airspace the minimum safe altitudes are listed as either quadrantal minima or 100 nm emergency safe altitudes. The safest bet then, is to fly the published approached tracks ensuring the aircraft is within the letdown airspace before descending to the published altitudes. If in doubt, the minimum safe quadrantal altitude is the one to use.

Positioning of the aircraft on the final approach track, as previously mentioned, does not always require the pilot to fly the full approach pattern. In some cases this unnecessarily prolongs the approach and causes traffic delays. Where TACAN is available exact positions can be determined and procedures shortened – provided that a safe terrain clearance altitude is maintained. Other traffic will sometimes affect the procedure and it's a good idea to keep the controller in the picture on the procedure being used.

The speed at which the approach pattern is flown and the position at which descent is made to the appropriate altitude will depend upon aircraft type, pilot preference, and terminal restrictions. Remember, that since the aim is to get the aircraft safely on the ground the latter part of the final approach should always be as standard as possible. Pre-positioning prior to interception of the final approach track should be safe and expeditious.

You have been cleared to hold at a specified fix. At what position should you report in the holding pattern?

Air traffic control expect an aircraft to remain within the holding airspace once he has initially crossed the holding fix. On an NDB a pilot should therefore report in the hold after he first crossed the holding fix. This does not mean that he must cross the fix initially on the inbound holding track; however, he must manoeuvre the aircraft so as to remain within the holding airspace while positioning to the inbound holding track. When holding on a TACAN fix the information available to the pilot (bearing and distance) permits him to enter the holding pattern at any position. He should report in the holding pattern when he is established in the pattern even if this occurs prior to initially crossing the holding fix.

Tutor 027's

"Unusual Flying Characteristics at High Mach"

"The test flight revealed a highly undesirable and unacceptable problem existed, in that the aircraft tended to roll to the left and yaw right at Mach 0.78. When the throttle was retarded and speedbrakes extended an uncontrollable slam negative G resulted."

A test flight certainly confirmed suspicions that 027 was an oddball aircraft at high mach. Its behaviour was clearly unacceptable in a training aircraft, so without delay a test program was organized to solve the riddle.

The problem first came to light after a student and instructor encountered a decided nose-down pitch during recovery from a high-mach demonstration run. To corroborate the instructor's account, the aircraft was test flown and sure enough, it produced a roll to the left and yaw to the right at 0.78 mach. The pilot retarded the throttle and extended the speedbrakes and experienced an uncontrollable slam negative G resulted to a reading of -2.5G.

Later, the aircraft was carefully inspected for any condition or defect that might account for its unusual behaviour. The wing leading edges had no apparent deformation. Tutor 027 was essentially sound with only a few seemingly minor defects. The outboard end of the right aileron had been deformed by constant popping in and out – like the base of an oilcan. This was corrected in workshops. The extensive airframe inspection uncovered several discrepancies – all within factory limits:

- The aft section was approximately 3/10 of an inch off centre which would account for the slight yaw to the left. The rudder trim tab was bent to counter this lack of airframe symmetry.
- The right wing had a greater incidence angle than the left wing.

A panel on the horizontal stabilizer undersurface (lower access, RH), protruded into a critical airflow zone. A screw of incorrect length was causing this defect. Three other Tutors on the station were in the same condition. The starboard speedbrake breakout pressure which should be normally 125 psi – and never above 350 psi – was 450 psi. This fault was corrected by a simple adjustment.

Fully serviced, and accompanied by a T33 chase aircraft, the Tutor was flown into the same speed range but no abnormalities were felt. Apparently the adjustments had worked but just to be sure another two test flights were made in which the earlier discrepancies were re-introduced. The inspection plate on the tail was returned to its original out-of-position state. This caused the aircraft to nose-down at 0.76 mach – similar to its earlier behaviour. The fourth flight was made with this inspection panel returned to flush position but with the original differential in speedbrake breakout pressure. The result was that at mach 0.78 at 20,000 feet the aircraft went into a slam negative G flight when speedbrakes were extended.

The test program gave 027 a clean bill of health.

The chairman advised the meeting that there is some movement of the cargo in the aircraft when carried on rollers. When passengers and cargo are carried, captains and transtechs should brief the passengers to keep their feet from between the pallets and cargo particularly for takeoff and landings.

– Flight Safety Committee minutes

From AIB files

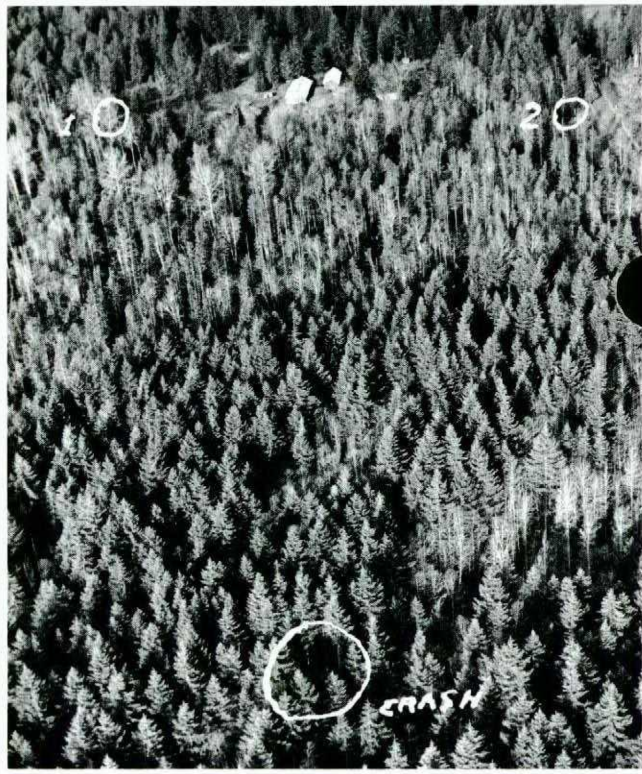
Chopper Aids AIB

A Tutor had crashed into a stand of 100-foot timber on Vancouver Island. The accident investigators were somewhat awed by the amount of logging and road building required to retrieve the wreckage before their examination could proceed. During a short conversation with F/L Al Winter, a chopper pilot with 121 Composite Unit at Comox, a quick solution was devised. The next day F/L Winter and F/L Dan Campbell, their two crewmen and two para rescue men arrived at the accident scene and made short work of recovering the wreckage.

Helicopter lowers tail section of Tutor on truck.

A CH113 helicopter extracts a net loaded with wreckage.

The crash site. Helicopter lift eliminated expense and delay of building a vehicle path to nearest road (upper right and left).



Comments *to the editor*

I began reading the article "Lighting and Limits" by F/L AF McDonald in the Jan-Feb issue, and as I read, something began 'tugging at my thoughts' that indeed something was wrong. But with what I was reading.

The weather at Chatham was given as 200-and-1/2.

"The approach and GCA went without hitch . . ." One must assume from this that it was a reasonably good, normal GCA (my experience is that RCAF GCA controllers are first class; a good, normal GCA would have had the aircraft "on the glidepath, on centreline"). F/L McDonald continues ". . . but at minimum I looked out into a black void"; then, "There was a wet glimmer (not glow) off to the right . . ." This would indicate that he was at that moment below (not in) cloud.

Now let us go to his mathematics.

At minimums he was 1380 feet from the first high-intensity lights which, if it had been a normal GCA, would have been somewhere within

cont'd on page 24

Liars' Dice, Anyone?

For one full month the boys who flew T-bird 306 were well equipped for a dicey trip! The starboard tiptank was a repository not only for fuel but a leather whats-it (a fuelling nozzle cover) ideally proportioned for bone rattling.

To determine its source, there's a square search underway. Of course, we're interested in the flight safety aspects of it, but what really chokes us up is the slur implied by someone's placing gambling equipment on board a military aircraft!

MURPHY AGAIN

After the Hercules became airborne the overheat light on number 4 engine illuminated. The pilot quite correctly carried out feathering and since the light remained on, one fire extinguisher bottle was fired. The light still did not go out and the aircraft was landed.

This incident could have been considerably more serious because it was discovered later that the panel lighting had been crosswired; it was the number 3 engine which actually overheated! Had the pilot fired both bottles into number 4 and the actual overheat in number 3 continued, a dangerous fire could have resulted.

In addition to this Murphy the cause of the overheat was re-using old gaskets which because of short supply had been re-installed contrary to orders. This incident demonstrates our continuing inability to cope with design and logistics inadequacies – resulting in hazards to crew and aircraft.

New Pate Mod on O² Mask

In the Mar/Apr issue, we commented on the USAF O_2 Mask and made some comparison with the MS22001 – the standard mask of the Canadian Forces. The article pointed out some of the reasons why the MS22001 mask is preferred over the USAF MBU-5/P but it did not mention a recently approved modification to the MS22001 mask. The metal pressure plate on the Pate suspension is to be replaced by a wrap-around fibreglass pressure plate.

The modification has several advantages:

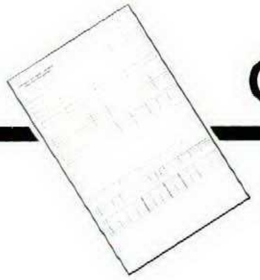
- Improves mask retention during ejection.
- Permits the use of masks with damaged retainer lugs.
- Permits the attachment of the suspension to mask configurations which do not have retainer lugs.
- Prevents distortion of the pressure plate, after handling and usage; this distortion reduces the effectiveness of the initial mask fit.

Procurement of new pressure plates has been authorized and mod kits are expected to be in the depots by Sep-Oct this year.

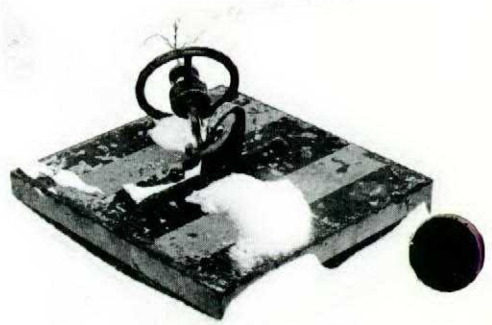
– Institute of Aviation Medicine

Modified Pate suspension – prototypes tested in 1964

Standard Pate suspension – adopted by RCAF around 1957.

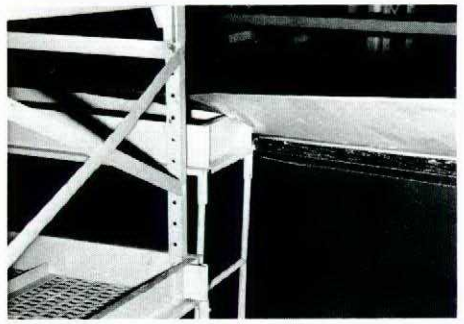


Gen from Two-Ten



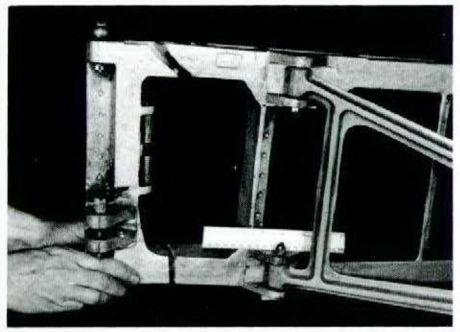
CHSS-2, WRENCHED WINCH As part of a routine acceptance flight the pilot was required to check the rescue hoist. The aircraft was positioned 40 feet above a 600 lb steel block; the hoist operator lowered the cable for hook-up. Tension was applied to the cable which promptly broke just above the hook-up mechanism. The remaining 40 feet or so snapped up and into the rotors, damaging the aircraft.

The cause? You're right if you guessed that the block was frozen to the ground. "Corrective action has been taken to prevent the steel blocks from freezing to the ground" reads the report. That leaves one problem remaining; the necessity for the winch mechanism to have overload protection. The problem is now under study at MATCOM.



DAKOTA, TOWING The man at the wingtip attested that he had recognized the possibility of impact with a nearby engine stand if the aircraft were to be swung. This man, who was monitoring the wing in question, stated that he "turned towards the tailplane to inquire on the length of travel..." then later turned around to face the wingtip which by this time was crunching into the engine stand.

If you are monitoring an aircraft being towed you have the authority – and the responsibility – to express your concern, but first cry HALT!



T33, SPEEDBRAKE SNAPPED At 3000 feet and 400 knots the pilot selected speedbrakes out. Feeling no trim change he selected speedbrakes in, reduced speed and returned to base.

The starboard speedbrake frame broke when the brakes were extended but close examination showed the cracking to have occurred at two different times, probably from overstressing by being misaligned in the up position.

This preloading is cautioned against in EO 95-50C-2A Part 6, paras 5 and 6. Fortunately no further damage occurred from this incident.

CF104, CABLE CUTS FUEL LINE An alert airframe technician, Cpl Ogilvie, *(see Good Show)*, discovered that the starboard aileron control cable was rubbing across a fuel transfer line. The cable was rubbing in an almost inaccessible place within the fuselage and only by Cpl Ogilvie's alertness was a major hazard discovered.

It is doubtful, in the intervening 150 hours of flying before the next inspection, that the cable would not have been cut through. Once punctured, this line would have sprayed fuel under pressure into a very hot engine area – certain to cause a serious fire and a possible explosion. A special inspection uncovered four more aircraft in this dangerous condition. Further, the inspection uncovered another similar condition with the outer aileron cable; there were five cases of this discovered at one base alone.

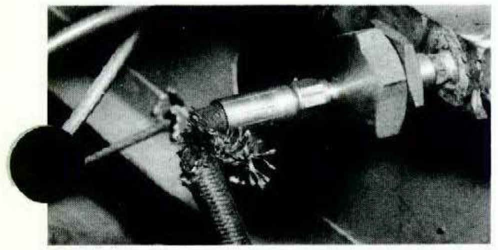
An aircraft can be counted on to malfunction in a most unexpected manner, place, or time. Only by the vigilence of men like Cpl Ogilvie can such hazards be intercepted.

ARGUS, EXPENSIVE OVER-TORQUE During a training flight a strong fuel smell was noted in the cabin. It was traced to the forward bomb bay and thence to a possible leak in the fuel line in the heaters. All heaters were shut down and because of the hazardous source of the fuel smell the captain returned to base.

A fitting on the fuel line to the heater had been carelessly over-torqued – the second such occurrence in a month.

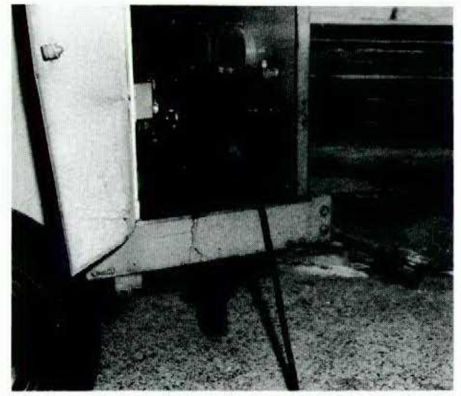
It's an old game in the services to estimate how many dollars per flying hour an aircraft consumes. Whatever your estimate may be – and it's certain to be in the thousands – it was a very expensive error.

Note black soot on underside of fuselage.



Hose burst at cart.

CF100, OXYGEN FIRE While the aircraft was being topped up with oxygen "the pressure went to 1700 pounds and was still going up when something exploded". The oxygen line caught fire near the cart and from the heavy smoke coming from the rear of the aircraft the technician assumed the aircraft also was on fire. The fire was quickly extinguished. The line which runs from the oxygen cart to the aircraft was broken at approximately the mid point. Soot was found around the replenishing point both inside and on the outside skin of the aircraft.



Scorching shows location of fire.

An excessive amount of hydraulic fluid was noticed on the underside of the aircraft; in fact, the entire area was fouled with an oily liquid. There is a high probability that oil or hydraulic fluid entered the filler valve to the extent that it would be missed by wiping with a cloth.

The placing of the filler valve in the lower portion of the fuselage makes it susceptible to contamination from the fluids which gather along the lower portion of the airframe. Nevertheless, the fact that there was excessive fuel/oil/hydraulic fluid should have suggested quarantining of the aircraft until the area had been properly cleaned.

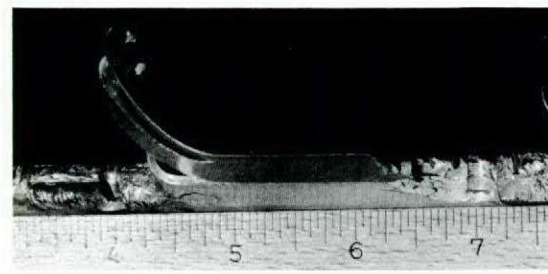
This is not the first occurrence with the CF100.

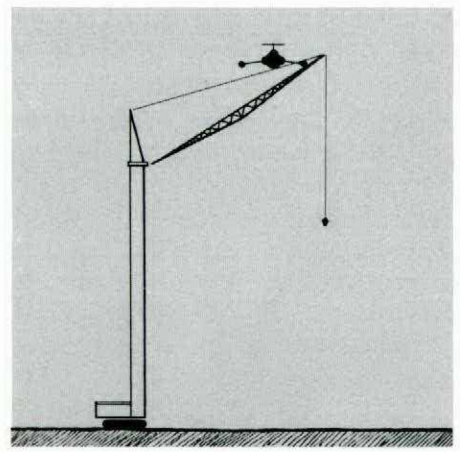
CF104, CRANE STRIKE At a point 170 feet above the ground a CF104 on a low-level navigation mission collided with a crane boom cable at a construction site. Fortunately, the sharp leading edges of the wing severed the cable with surprising ease. The boom promptly collapsed.

The leg was being flown on radar and autopilot; visual reference to the ground was intermittent. The autopilot was set to maintain a height well above any obstacle in the area. The pilot admits that he was concentrating on radar operation and had not checked the aircraft instruments for several minutes. During this time the autopilot had inadvertently disengaged and the aircraft descended in a gentle dive.

The photos show the relationship of the tower under construction and the crane. The fragile structure of the crane was certainly less a hazard than the less-yielding concrete structure beside it; it was the pilot's and workers' exceeding good fortune that the 104 was lined up with the crane.

Confidence in the aircraft and its systems is a good thing but it can lead to overconfidence. Design inadequacy let this pilot down – that is what the crosscheck's for.





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30 degrees either side of the nose. He had a visibility of 2600 feet – some 1200 feet beyond the first high-intensity lights – yet he "...looked out into a black void". Let us be generous and say that in the "drizzle" (not heavy rain), the forward visibility from the cockpit was somewhat less than that quoted by the tower – say, 2000 feet. This is still some 600 feet beyond the first high-intensity lights. As they are spaced 100 feet apart, F/L McDonald should have had five, if not more, sets of lights visible to him as he looked out. Seeing only a black void, he was indeed wise to proceed straight to his alternate.

Something really was wrong. What are the possibilities?

<u>One</u> The visibility at the approach end of the runway was far less (in this case, in the order of 45% or even less) than that quoted by the tower. This is by no means an uncommon occurrence!

<u>Two</u> The cloudbase at the approach end was somewhat lower, etc, etc. This also happens quite frequently. It is quite possible that F/L McDonald was on the glidepath, on the centreline at minimums and the "wet glimmer" was indicative of random lights seen through a momentary lifting off to the right in a ragged cloudbase *lower* than 200 feet in his immediate area – and most definitely so directly ahead. I should think this is the most likely possibility.

<u>Three</u> The high-intensity lighting was out or not switched on. This possibility is least likely.

<u>Four</u> F/L McDonald was using author's licence in his lead-in story.

His main contention is that perhaps present-day lighting is not adequate. In this instance, had the weather been as quoted when he was at minimums, the Chatham lighting should have been enough to provide him with a safe transition to visual completion of his landing.

To change the subject and make reference to another item in your magazine, namely the undercarriage retraction on the CF100... Have the buttons been replaced by a lever?

F/L A Gunter-Smith
1 Air Division HQ

F/L McDonald replies:

One of the points the author makes in Lighting and Limits is that present-day radar controllers are capable of bringing an aircraft safely down to 150 feet. At this height, a pilot carrying out an approach to a Canadian ADC base is able to use the blaze of lighting that all pilots are accustomed to seeing under good visibility conditions, since his aircraft – at 150 feet – is over the approach lighting. With limits of 200 feet, however, the aircraft is still 1380 feet from the beginning of the first approach light and at this distance could be in pitch blackness. Furthermore, it is common knowledge among aircrew that a reported ground visibility of 1/2 mile can be much less from the cockpit. The pilot views this 2500 ft from an oblique angle, through fragmented cloud at 200 feet with water piling up on the windscreen, or through a misty canopy. These may all combine to adversely affect his visibility distance. Approach lighting could show up at the far end of the pilot's visibility range as a glimmer under a combination of these conditions. A lower limit of 150 feet will eliminate this possibility.

◆

Your article in Nov-Dec 66 Flight Comment's "Big Day at Borden Sask" was well written but lacked factual punch. The front cargo door on the C130B was poorly designed; previous accidents by USAF and attempts at rectification uphold this fact. Suspected misalignment is "ipso facto" an educated guess only. The use of dye-penetrant is an elementary check and has limited use in establishing positive cracks in high tensile steel. With previous knowledge of this type of failure, it is difficult to understand why more advanced methods of NDT techniques, such as ultrasonic inspections, were not instigated for checking these bolts on every periodic. One set of spare bolts could have been made available to NDT to check at leisure. The question of a top priority fix taking several months administratively to get off the ground is not hard to understand, but has been on many occasions a bitter pill for people in the field to swallow.

The assessment, material failure or maintenance factor, is a convenient catch-all and in many instances does not go to the original cause of the accident, "Poor Design" which like a loaded gun was waiting for someone to pull the trigger!

FS V Latowski
ATCHQ

The only two other losses of a C130B forward cargo door occurred in the USAF, and both were attributed to incorrect rigging of the doors. In our own accident, analysis revealed that the forward eyebolt failed as a result of overstressing; even the original crack was a result of overstressing. It is difficult to see how this could occur other than by incorrect adjustment of the door fittings. (Stress concentration due to poor eyebolt finish also contributed to the failure.)

The limitations of dye-penetrant are well recognized. However, in this case, there is no doubt that the already present crack should have been detected by dye penetrant. We are presently extending the use of other NTD methods.

"Poor design" might be judged from several approaches:

- *ease of maintenance*
- *the latch design*
- *the fact that the door hinges would not break but tore away a near-disastrous quantity of fuselage.*

Beyond these nuts-and-bolts aspects is the basic concept of location: should the door have been placed there in the first place? In the sense that no device can be deemed perfect, it is agreed that design improvements could have been made, but Design assessments are applied only within the limits of practicality.

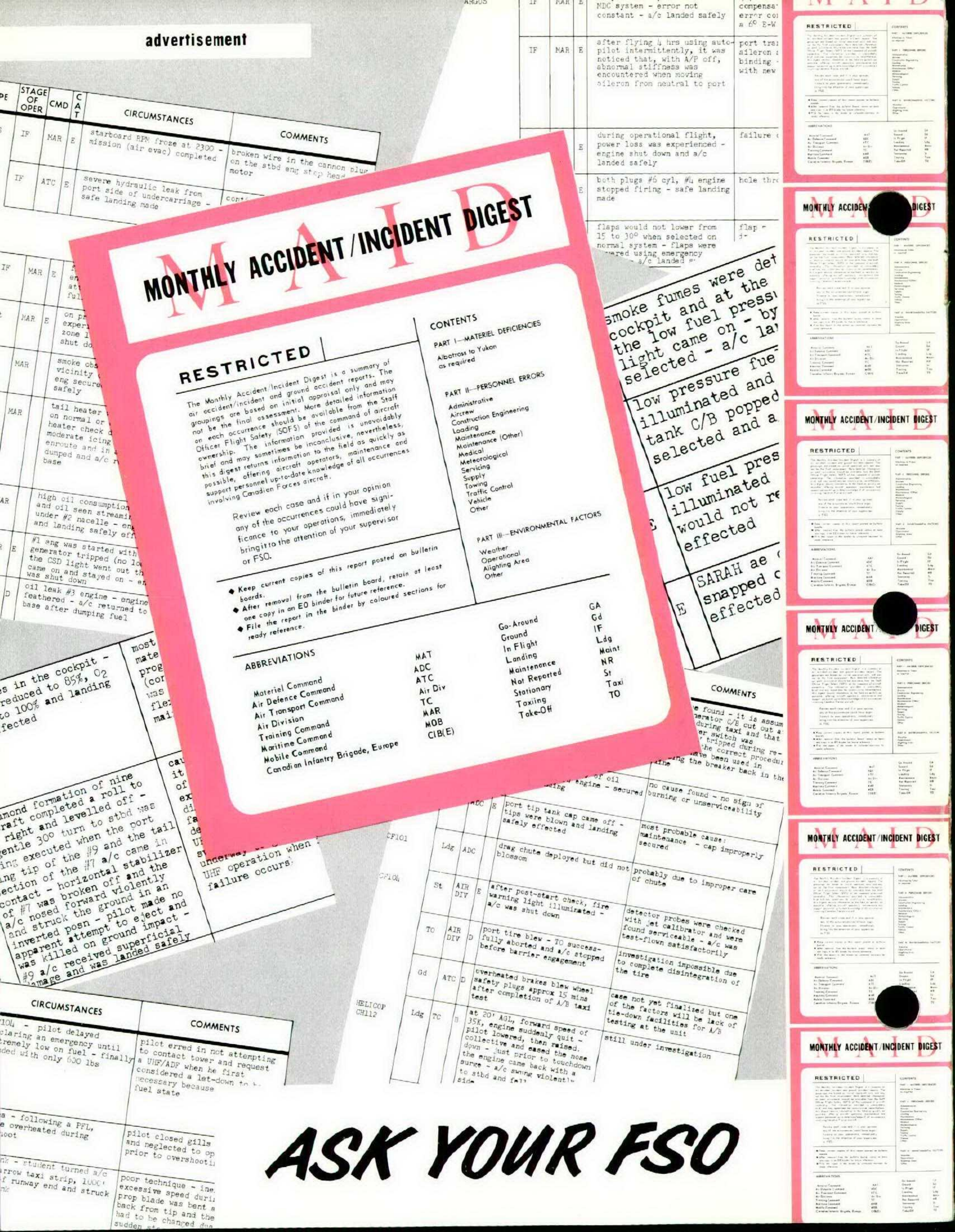
The BFSO requested that all members again brief aircrews as to the importance of accurate, detailed L14 entries. It is only with such entries that quick, permanent rectifications can be carried out by servicing personnel.
– Flight Safety Committee minutes

BIRD WATCHERS' CORNER

MURPHY MONGER

Prevalent but rarely seen, the Murphy Monger, from the cosy obscurity of his nest, perpetrates marvels of ingenious duplication. A devoted disciple and descendant of the flock's founder who was a breakaway mutation when birds first began to fly, the Murphy bird gleefully opens his Pandora's box of interchangeabilities. Long suspected of nearing extinction (only identical twins survive), his handiwork nevertheless persists to confuse and befuddle; only the vigilance of his potential victims foils this master of the perverse reverse. Meanwhile, busy at his board the maniacal monger busily pencils away while whistling his mismating call:

THENAMEOFTHEGAME ISTOMAKEBOTHPARTSTHESAME


advertisement
MONTHLY ACCIDENT/INCIDENT DIGEST
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RESTRICTED
The Monthly Accident/Incident Digest is a summary of air accident/incident and ground accident reports. The groupings are based on initial appraisal only and may not be the final assessment. More detailed information on each occurrence should be available from the Staff Officer Flight Safety (SOFS) of the command of aircraft ownership. The information provided is unavoidably brief and may sometimes be inconclusive, nevertheless, this digest returns information to the field as quickly as possible, offering aircraft operators, maintenance and support personnel up-to-date knowledge of all occurrences involving Canadian Forces aircraft.
Review each case and if in your opinion any of the occurrences could have significance to your operations, immediately bring it to the attention of your supervisor or FSO.
Keep current copies of this report posted on bulletin boards.
After removal from the bulletin board, retain at least one copy in an EO binder for future reference.
File the report in the binder by coloured sections for ready reference.
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Materiel Command MAT
Air Defence Command ADC
Air Transport Command ATC
Air Division Air Div
Training Command TC
Maritime Command MAR
Mobile Command MOB
Canadian Infantry Brigade, Europe CIB(E)
Go-Around GA
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