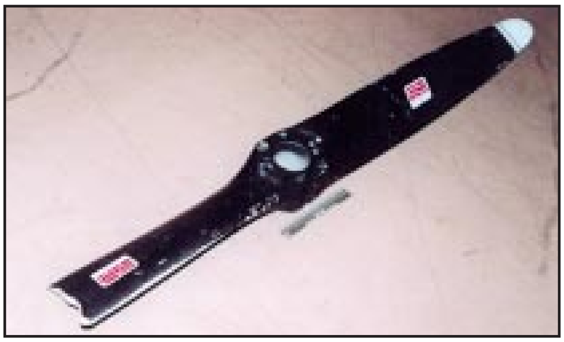
Transport Canada Transports Canada

Aviation Safety Maintainer

Learn from the mistakes of others and avoid making them yourself . . . **Issue 2/2001**

McCauly Propeller Blade Flawed



Propeller blade as received, missing the tip.

View of fracture surface showing the failure progression and start of the shearing (arrows).

The pilot of a Cessna 172 was undergoing some flight training when the propeller blade tip separated. The pilot shut down the engine and managed a successful forced landing on a road with no further damage to the aircraft or injury.

The director of maintenance, upon examining the aircraft, found 18 in. of one blade missing and extensive damage to the engine mount from excessive vibration.

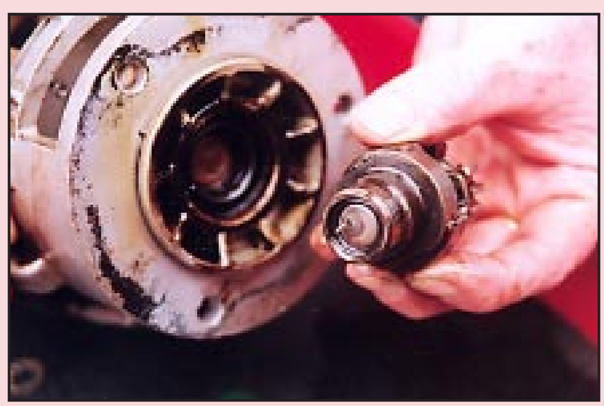
The U.S. National Transportation Safety Board (NTSB) advised that they were also investigating a similar propeller failure that had a very low time of approximately 300 hr. since new. There was also mention in this communication that another propeller had failed, but that case was outside the U.S.

Although there was no visible evidence of pre-existing damage to the propeller, a metallurgical examination conducted by the TSB Laboratory (LP 88/00) revealed the following:

* The blade failed as a result of fatigue cracking, which propagated under normal service loads until the crack became critical, at which time the remaining metal failed in overload.
* The crack initiated at a precursor defect located at the trailing edge of the blade. The defect was most probably introduced during manufacture.

Failed Alternator Shaft

Sometimes parts just fail. This photo illustrates a failed alternator shaft on a recently overhauled Continental engine installed in a Cessna 150. The shaft failed in shear for undetermined reasons, possibly because of a pre-crack. The failure was no immediate threat to continued engine operation, although the pilot landed as soon as practicable to report an alternator failure. The engine was returned to the overhaul facility, where it was stripped down and checked for metal contamin-ation or other damage before it was returned to service.



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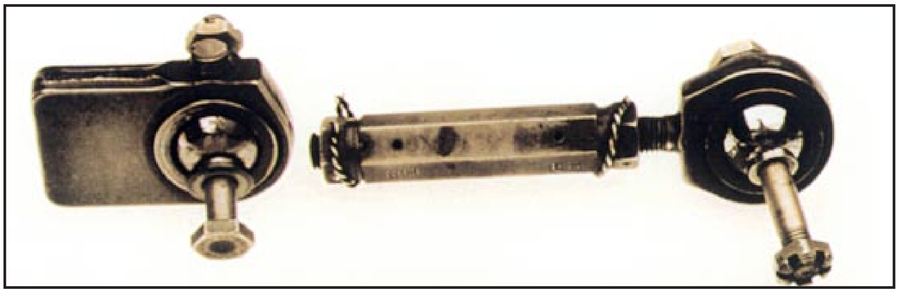
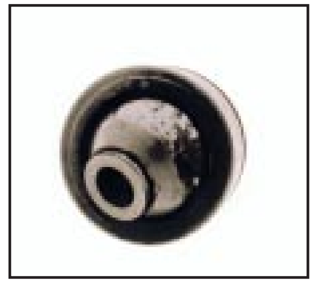
Tail Rotor Pitch Link Failure



Failed tail rotor control rod assembly as received.



Right-hand rod end showing some pitting and wear on the ball.

As the pilot of the Sikorsky S-76A helicopter decelerated for landing, he experienced a high-frequency vibration in the collective pitch lever.

Maintenance found that the vibrations were the result of a broken tail rotor pitch control rod assembly (Sikorsky part number 76103-05003-041, serial number A063-00899). The broken pitch control rod assembly was forwarded to the TSB Engineering Branch for inspection and analysis. The mode of failure was determined to be high-cycle fatigue; the fracture propagated under normal service loads from fatigue-generated pre-cracks originating from the region of the thread root, close to the corners of the keyway. The crack initiated in the first full thread outboard of the bearing housing—an area that is exposed. Similar failures have been recorded by Sikorsky, although this assembly is maintained “on condition.” The TSB report contained the following findings that may be of interest to AMEs who maintain S-76 helicopters:

* The rod end (part number 76103-05002-102) failed as a result of high-cycle fatigue under normal service loads. Fatigue was found to be coincident with the stress concentration provided by the thread roots in the presence of corrosion pitting.
* The exact total time since new (TTSN) and service history of the rod end could not be determined.
* The tail rotor pitch control rod assemblies are maintained as an “on condition” item.
* The integrity of the rod end cannot be accurately determined unless the entire threaded area is inspected.
* Sikorsky Alert Service Bulletin (ASB) 76-65-45, first issued March 11, 1994, and reissued June 8, 1994, as 76-65-45A, highly recommends that an inspection be performed on the exposed threaded areas of the rod ends.
* The inspection requirements of Sikorsky ASB 76-65-45 and ASB 76-65-45A are specific to the rod ends; however, the documentation showing compliance is specific to the helicopter records.
* The *Sikorsky S-76 Maintenance Manual* (Revision 31) does not identify a unique requirement to inspect the tail rotor pitch control rod assembly rod ends for cracks.
* The tail rotor pitch control rod bearing radial play was found to be within Sikorsky’s published limits; however, the metal-to-metal contact between the inner and outer bearing races appears to meet the Maintenance Manual requirement for replacement of the rod end.
* The exposed threaded portions of the broken tail rotor pitch control rod did not have either of the required corrosion preventative compounds applied, as required by the Maintenance Manual. The absence of these compounds could have been a contributing factor.

Ref.: TSB A98P0156 and LP 81/98

Tail Rotor Input Shaft Breaks

The Hughes 369 helicopter was being used in a heli-logging operation. While in a 150-ft hover, the pilot heard a bang and experienced a sudden, uncommanded right turn. The pilot released the load and carried out an emergency landing. The helicopter remained upright and was substantially damaged; the pilot sustained serious injuries in the ensuing hard landing.

Examination of the wreckage revealed that the tail rotor gearbox input shaft had failed in fatigue mode. The TSB Lab concluded that the fatigue crack was propagated under normal service loads with no evidence of overload and no unusual metallurgy indication or cause of the fatigue initiation. One week prior to the accident, the gearbox had been removed, disassembled, inspected and reassembled because of a flake of metal on the chip detector. Only minor corrosion and pitting was found and corrected. The shaft had been purchased from McDonnell Douglas. McDonnell Douglas had received it from the military for some rework. It is known that the shaft had been over-torqued at some point in its history. After being reworked, the shaft somehow found its way into the civilian parts market and was sold to the owner of the accident helicopter.

This accident highlights the question of how a military part came to be sold to a civilian company. The input shaft is the same on the military aircraft as it is on the civilian one; however, the military operations do not follow civilian regulations, so the nature of the loads imposed on this part during military operations are unknown. The total air time for the helicopter was about 7450 hr. at the time of the accident.

Ref.: TSB A98P0135

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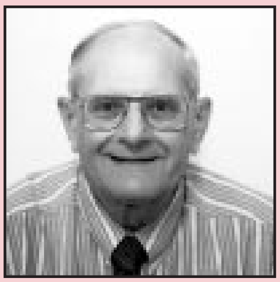

Joe Scoles

Reprints are encouraged but credit must be given to the **Maintainer**. Please forward one copy of the reprinted article to the Editor.

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Sécurité aérienne — Mainteneur est la version française de cette publication.

Dear Readers, No More Barbs!

For the past 16 years I have researched accident and incident reports for areas related to maintenance, and as a result I have condensed many lengthy reports into mini-articles to provide you with a steady flow of opportunities to learn from the mistakes of others. So after more than 50 years of maintaining, navigating, piloting and writing about airplanes, I have decided to retire from Transport Canada and hand over the reins of this rewarding part of my work.

I appreciate your many letters indicating support and satisfaction with the Maintainer. I will miss the negative barbs when you remind me of an error, which by the way, I usually discover about the same time you readers do—when I open my own copy received in the mail. Mistakes are about negative information, and that is why we all need to be reminded about mistakes—it is necessary and it is healthy for the industry. Some mistakes we cannot eliminate; for example, the ones created by lack of training or attention to detail or carelessness. The worst accidents are often caused by events that may be completely "out of character" for the person responsible, so we have to guard against this human deficiency that tempts people to take shortcuts and ignore the correct procedures.

The Maintainer has grown from an early four-page letter to eight pages that capture many maintenance, safety, and human factors issues, with over 500 articles about accidents and incidents involving air operators, general aviation and helicopters. I hope the expanded interest helped those of you who have the grave responsibility of certifying aircraft that are expected to, and must, perform flawlessly for each flight. Therefore, the very low number of accidents where maintenance is a factor compared to the vast number of aircraft that fly daily without incident is a tribute to the excellent work of all of you who certify and ensure that thousands of aircraft fly safely each day.

At this point, I would like to add that the success of the Maintainer is also due to the support received from Transport Canada management at all levels and, particularly, the immediate support staff who perform a host of functions related to editing, translating, reviewing, promoting on the Web and generally making certain that high standards of quality and format comprise each issue. Without these people, publication of the quality product you receive would be impossible. Thanks also to the TSB for sharing the results of investigations—a very important part of this publication.

It has been a pleasure to serve your interest in safety over so many years, and I will miss you. I also wish the new editor, whomever that might be, a long and continued success in the publication of the Maintainer and in promoting whatever form or changes the future may hold for this valuable safety initiative in aircraft maintenance. *Goodbye, Joe Scoles*

Hughes 369D Blade Debonds

Preliminary reports of a fatal helicopter crash indicate the possibility that blade debonding contributed to the blade failure. The data plate identified the blade as an FAA-PMA product identified as part number 500P2106-101, serial number A076. Total time on the blade was approximately 2600 hr. Striations, or beach marks, emanating from a small pit to about 75% of the spar cross section in the area of separation indicate that the spar may have been cracked for some time. There is evidence of skin-to-spar bond separation.

Mechanical Happenings

The following aircraft incidents reported to TC from Nov. 30, 2000, to Feb. 1, 2001, mainly focus on the maintenance outcome of the incident and do not include all the circumstances of each flight. In most cases of component failures, it can be assumed that an SDR was submitted. There were a number of undercarriage, fire and flap warning system problems, such as failed sensors or out-of-rig adjustments. Take note and correct these widespread nuisance problems that affect all aircraft and you may save your company some money and bad press if you can eliminate rejected flights by good preventative maintenance.

Airbus A320-211—While climbing through 3000 ft, the crew noticed that the No. 2 engine (CFM 56-581, serial No. 731380) low-oil-pressure light illuminated. The crew shut down the engine as a precaution, then diverted to a nearby airport. Company maintenance determined that a defective electrical connector part of the oil pressure transmitter was the cause of the low oil pressure light.

BAe Jetstream 31—The pilot reported the failure of the No. 1 engine, declared an emergency, then made a safe landing. Company maintenance determined that the engine gearbox drive to the high-pressure fuel pump had failed. The engine required removal for repair.

Beech B1900—The crew noted fumes in the cockpit shortly after takeoff and returned for a landing. Maintenance found a seized vent blower for the air-conditioning system. This was the second time that the operator had experienced this problem with the B1900. The vent blower was returned for overhaul.

Beech 1900—The crew experienced problems with the flight instruments/en route flight information service (EFIS) and returned to the airport. Maintenance found that the data processing unit was causing the EFIS to flicker and replaced it.

Beech King Air—The crew advised of an illuminated fire indication light, shut down the affected engine and landed safely. Maintenance found that the in-flight fire warning had been a false indication.

Beech 1900D—After takeoff at a foreign airport, the pilot was notified that a tire had been found on the runway. Maintenance discovered that the wheel had fallen from this aircraft as a result of a bearing failure. The bearing failure resulted from a lack of lubrication caused by the use of a degreasing fluid to clean the landing gear. The degreasing fluid had been used on numerous other aircraft. These aircraft were checked following this occurrence, and it was discovered that some of the bearings required lubrication.

Five days prior to this incident, the same aircraft had a main wheel on the opposite side not function properly (it gave improper feedback/feel to the flight crew). The company investigated and discovered that the outboard bearing was dry and "self destructing." The bearing was replaced. The investigation also revealed that the company had hired groomers who had taken it upon themselves to select a product to clean the "greasy" wheels; the product was a degreaser. The groomers were found to be using this product to clean the wheels and wheel wells on all the company's aircraft. After this incident the company conducted a fleet-wide campaign to inspect and regrease or replace, as condition warranted, all the bearings and any items in the wheel wells that could be affected. The fleet inspection showed that 75% of the bearings were dry. The groomers were instructed on the correct products and methods for cleaning the affected areas.

Boeing 737—The crew declared an emergency after an apparent total loss of hydraulic pressure. The hydraulic pressure was restored before landing, and the crew landed the aircraft without a problem. Company maintenance suspects that ice may have formed in the air pressure lines from the hydraulic reservoir. The system was purged, the reservoir repressurized and the aircraft returned to service.

Boeing 737-296—During approach, the No. 2 engine (right side) oil quantity and pressure indicators alerted the crew to a problem that required the engine to be shut down. Maintenance observed a large oil leak that originated from a banjo fitting that screws into a boss on the gearbox housing (P/N 667488). This is the boss that carries the rigid line to the main oil-filter-bypass switch. A repair was attempted, in accordance with *Overhaul Manual 72-61-01/8401*, to replace a helicoil insert (P/N 99B83-27457) that the banjo fitting threads into. A void in the housing casting that precluded a repair was also noticed at that time, so the engine was removed.

Boeing B727—The crew reported a traffic alert and collision avoidance system (TCAS) alert during an approach at Calgary. Subsequent investigation revealed that transponder maintenance was being performed on an aircraft located on the ground at a nearby airport.

Boeing B737—The crew turned off the system after noting that the No. 2 "B" hydraulic pump over-heat indication had illuminated. About 30 seconds later, the No. 1 "B" low-oil-pressure indication illuminated. This pump was turned off. The system quantity dropped to 1.2 gal. The crew elected to return to the airport. Maintenance found a steady hydraulic fluid drip from the "B" system aileron power control unit (PCU) output shaft. It was suspected that a seal rolled in the PCU, resulting in "B" system fluid loss in flight.

There was no filter contamination and new filters were installed.

I noticed another similar B 737-275 report on March 27, 2001 where the aircraft diverted because of a drop in hydraulic fluid quantity. In this second case, maintenance also found a defective aileron PCU to be the cause of the hydraulic leak. —Ed.

Boeing 757—The crew returned because of a malfunction that precluded flight in known icing conditions, which were present. Maintenance found that a defective engine heat probe electrical relay caused the malfunction and replaced it.

Canadair CL-600-2B19—The crew found that the pressurization system was not maintaining the cabin altitude within acceptable parameters and returned to the airport. Maintenance found that a faulty passenger door switch had caused the outboard exhaust valve to fail in the open position. The switch was replaced and the aircraft returned to service.

Cessna 414—The crew executed a missed approach for an unsafe gear indication. Maintenance discovered a mis-rigged nose-landing-gear position switch and re-rigged it correctly.

Cessna Citation—The crew reported that the left-hand engine N1 had rolled back to 80% at altitude. They selected the ignition to on, and the N1 recovered and could be maintained with ignition selected on. Maintenance replaced the left-hand engine fuel control unit (FCU), complete with the step modulator. The unserviceable FCU and step modulator were forwarded to Pratt & Whitney to determine the fault within the FCU.

Cessna 402—The aircraft was taxiing for departure when the right-hand tire went flat. There was no damage to aircraft or wheel assembly, but the incident drew attention to the fact that the operator had been experiencing recent problems with a particular brand of tires and tubes.

Cessna 172RG—The pilot performed a manual extension to get the gear down for landing.

Maintenance found that a faulty microswitch, which operates the gear doors, was the cause of the problem. Also, they found the gear-up limit switch, located under the cabin floor, broken. This is a small switch attached to the gear transmission. It appeared that heavy pressure while loading a MEDEVAC flight might have deflected the walkway, placing pressure on the switch and breaking it.

Cessna Citation 550—The flight crew reported the failure of the aircraft's main brakes. Maintenance discovered that a leak in the brake line had caused a substantial drop in hydraulic quantity and pressure. The line was replaced and the fleet checked for evidence of a similar problem.

de Havilland HC-6-300—The crew experienced an engine failure and returned to base safely. Maintenance discovered that the engine had experienced a failure of the power turbine.

de Havilland DHC-8-202—The crew declared an emergency because of low oil pressure and shut down the affected engine. Maintenance discovered that a loose wire connection was causing intermittent readings on the pressure transducer of the PWC 123/D engine and replaced the associated wire bundle.

Fairchild SA227—The aircraft had just taken off when the crew reported a vibration of unknown origin. Maintenance found that the left main landing gear was not fully retracting because of a faulty hydraulic power pack for the main landing gear. The hydraulic power pack was replaced.

Fokker F-28 MK 1000—During the initial climb-out, the crew experienced a smoke detector warning. The crew decided to return to the airport. Company maintenance personnel discovered that the source of the smoke was oil on the exterior of the combustion chamber of the No. 1 engine.

Fokker F-28—Shortly after departure the crew advised of pitch-control problems and requested a diversion back to the airport. Maintenance found the outboard flap by-pass valve body had split apart at the flange between the valve body halves. Four screws holding the body housing together had broken, resulting in the loss of hydraulic fluid. The valve assembly and "A" pumps required replacement, in addition to other unscheduled maintenance related to the system fluid loss.

Hawker Siddeley HS 748—The crew returned to the airport after reporting smoke haze in the cockpit. Maintenance determined that the heater was the source of the problem and advised that this was the first flight after the aircraft had been parked outside and exposed to blizzard conditions without all the blanking plugs installed. The company has restated the need for proper cover/plug installation and removal of cover/plugs before flight when aircraft are parked outside.

Hughes 369—The helicopter was undergoing maintenance at a northern Alberta camp when the emergency locator transmitter (ELT) was accidentally activated. This caused the launch of a Canadian Forces' search and rescue (SAR) Hercules requiring six hours of flight time.

Metro III—The crew reported an in-flight hydraulic problem. Maintenance found that an aluminum alloy hydraulic line (P/N 27-81006-721) had chafed against a worn clamp (P/N MS21919DG4), resulting in a hydraulic leak. The clamp and line were replaced.

Piper Navajo—The pilot rejected the takeoff because of a power indication problem. Maintenance found that a faulty manifold pressure indicator was misreading the engine outputs.

Piper Navajo—The crew reported a gear problem that maintenance found to be a faulty microswitch.

Piper Navajo—The pilot reported an unsafe gear indication. Although the gear had been recently overhauled, maintenance discovered the right-hand down-lock switch was not rigged correctly and re-rigged the switch. It was suggested that these types of incidents should be fed into the company reliability program to identify the need for the development of specific maintenance procedures and/or additional maintenance personnel training.

Piper Navajo—The pilot returned to the airport because of a radio failure. The aircraft had undergone avionics maintenance, which entailed pulling circuit breakers (CB). The CBs were not reset before the subject flight, and the battery only sustained the load until shortly after takeoff. The aircraft was landed and CBs reset, whereupon all systems performed normally. *This is probably a case of "expectancy" on the part of the pilot(s), wherein it is assumed that the breakers are OK because they are normally not pulled. These pulled CBs probably could have been detected during a proper cockpit geographic check prior to starting the engines. This incident illustrates how little things can be missed, forming a weak link in the chain that later breaks. —Ed.*

Piper Chieftain—The crew experienced communication difficulties with ATC because of severe electrical problems. Maintenance found that the alternator drive belt on the left alternator had broken and the alternator drive belt on the right alternator was loose. Although the aircraft is equipped with annunciator lights, the crew had not received any warning of either a double alternator failure or a low voltage condition.

Piper Cheyenne—The crew advised that they were returning because of a pressurization problem. According to the report, maintenance found a loose hose clamp on the aircraft combustion heater. The clamp was replaced, and the aircraft returned to service.

Saab 340B—The crew experienced a cabin loss of pressure and donned the required oxygen masks during decent to lower altitude. Maintenance found that the pressurization outflow valves had frozen open. Heat was applied to thaw the valves before returning the aircraft to service.

Saab 340—After departing a Canadian airport, the crew of a foreign-registered aircraft lost a wheel assembly. Also, upon landing, the inboard wheel assembly on the right main landing gear was missing. Company maintenance replaced the axle and wheel before releasing the aircraft to service.

Expectancy—Expect to See

The word *expectancy* (a better word might be *anticipation*) is starting to show up in accident reports describing certain human factors that can lead to an accident. I think *expect to see* best describes the problem. *In the previous issue (Maintainer 1/2001), I expected to see a Convair 580 on the front cover; however, I simply forgot to pull the incorrect photo and replace it immediately during the draft stage of production. As you readers were quick to point out, the rest is history (my apologies for this oversight).* If you go back to a story I wrote about an incorrect gear found after the crash of a Bell 206L (see Maintainer 4/98 p. 7), you'll better grasp and reinforce your knowledge and the extent of the problem.

I clipped the following paragraph from the March 5 issue of *Air Safety Week* from the article entitled "Investigation to Focus on Human Factors and Emergency Evacuation," which was used to describe some of the events that possibly led up to the crash of a Singapore Airlines 747.

Yet, in their cocoon of reduced visibility, insidious expectations were being fulfilled. The first officer said he knew Runway 05R was closed, and that a closed runway should be "black," with no lights. The captain, concerned about lining up on the illuminated center line, decided that he had adequate forward visibility, perhaps sub-consciously disregarding the possibility that the PVD was not centering simply because the airplane was lined up on the wrong runway. In the absence of active external stimuli, the brain sees what it expects. Of course, the questioning of such aberrant expectations is what crew resource management (CRM) is intended to foster.

Just as pilots must guard against insidious expectations based on information that seems to fit the picture at the time, AMEs must also guard against being trapped by seeing what they expect to see while missing the subtle difference.

Busy Starling Evicted Prior to Flight

The following story about the accompanying photo was submitted by Fraser Maclean, B737 Fleet Systems Specialist, Air Canada. —Ed.

According to the story, the B737 was being positioned for departure when an alert technician observed a starling departing the ram air inlet. Upon further investigation, he located this large nest in the air-conditioning ram air inlet. The nest was composed of corn, cedar and other debris that filled half a garbage bag when removed. This material was put there in less than 36 hr. while the aircraft was parked at the Ottawa airport and would have certainly caused temperature control problems with the air-conditioning pack if the aircraft had gone flying in that condition. This happened in the spring of 2000; at the time, everyone was surprised to see the large amount of material that had been packed into the inlet in such a short period. This illustrates that vigilance pays off. Although birds' nests are expected where extended storage is involved, they can and do infiltrate aircraft on the flight line.

Photo of the nest debris sitting on a JT8 engine inlet plug illustrates the magnitude of problems caused by birds nesting in aircraft cavities.

To the Editor

Steve MacNab, Superintendent, Procedures, Prairie and Northern Region, comments on the subject article published in Maintainer 3/2000, page 2.

The article "Beech 90 Loss of Rudder Control" brings to mind an experience that I had with hardware some 20 years ago. The installation was in the control system of a helicopter; the installation required close tolerance bolts on each side—quite possibly AN173. The instructions provided by the company recommended replacement with an NAS bolt as a product improvement if there was occasion to remove the AN bolt. As replacement was planned in the field, the company provided the replacement NAS bolts, with release certificates, new washers and castellated nuts. It all looked good until I found it was impossible to install the cotter pins. There was not enough clearance between the nut and the cotter-pin hole in the threaded area below the shank. When the nut was tightened one or two more flats, the bolt broke at very low torque. The other side had the same problem, and examination of the NAS bolt showed that the cotter key holes had been drilled too close to the shank. The nut became thread-bound before the hole was exposed; the bolt broke at very low torque because it failed in tension across the hole and there was no practical thread engagement above the hole. Fortunately I had the AN bolts in good condition, and they were still eligible for the installation. That was before SDRs, and the bolts were not made an issue when I returned to base at the end of the season. The supplier of the bolts was known to me and had high standards.

In your Beech 90 scenario, a defective bolt with the cotter key hole too close to the bolt shank could set the stage for failure at low stresses. It is an unusual defect, but it has potentially serious consequences. It is also a subtle defect—most likely to be recognized only after a bolt breaks.

Upcoming AME Events

1. The Ontario Maintenance and Parts Conference will be held on November 8 and 9 in Thunder Bay, Ontario. The trade show begins Thursday evening. To register, contact Lindsay Niven at TC at (807) 474-2570. Register early and qualify to win a valuable prize!
2. The Ontario AME Workshop will be held on October 24 and 25 at the International Plaza Hotel, 655 Dixon Road Toronto, Ontario. Contact Cara Tweyman at:
   Phone: (905) 672-5230 Fax: (905) 672-5251.

The Maintainer Salutes the Following Individuals

This photo shows the under bracket skin cracks where the particular flap rod bracket was attached.

The Director of Maintenance of Exploits Valley Air Services, Mr. Dion Geange, would like to draw attention to the part played by two of his employees in the discovery of cracks under the flap rod attachment bracket that could have resulted in a serious accident to a Cessna 150 aircraft. Mr. Paul Feltham (left) and Mr. Stew Roberts (right) displayed exceptional inspection skills and attention to detail beyond what would be called for in a normal inspection checklist when they discovered the hidden cracks. The director indicated that these overlooked yet valuable industry skills should not go unnoticed and that these two employees deserve recognition for their part in discovering a potential flap system failure.

Gummed-up Samples

The article below was prepared by Barry Dupasquier; the TSB Investigator assigned to the project went one step further and obtained some interesting information about fuel samples. —Ed.

Barry Dupasquier

The pilot experienced a serious engine problem during takeoff, but he managed to return to the airport safely after reverting to manual throttle control.

Suspecting a fuel problem, the company sent samples from the Pilatus PC12 to the TSB Lab for analysis. Also, the fuel control unit was sent to be examined at Pratt & Whitney Canada, where a piece of gum was found in the unit. This was suspected to have caused the problem and may have come from the fuel that was used—possibly a contaminated load at some unknown previous time, but it was not indicative of the large amounts of gum that were found in the samples. Normal gum content in jet fuel is 7 mg/100mL. The readings from the Pilatus samples were 144mg/100mL. A second set of samples was obtained, and the readings were still high: 27–38mg/100mL. I thought that perhaps there may have been a problem with the aircraft model specific to the PC12, such as sealant leeching or hoses breaking down. I then went to the RCMP Air Division and obtained samples from three of their PC12s.

These samples were obtained in the sample bottles we use at the Lab. All of the readings were between 0–0.4mg/100mL, well within specifications for jet fuel.

Samples were then obtained from the company refuelling points: Thunder Bay, Sioux Lookout, Kingfisher Lake, Big Trout Lake and Pickle Lake. These samples all were well below the minimum gum content.

At this point in the investigation the proverbial light bulb illuminated. The samples provided by the operator had all been sent to the Lab in Mason jars, just like the ones my mother used for preserving. The rubber seal around the jar lid was, of course, the source of the gum. Further samples from the aircraft proved to be nearly gum-free. The safety message or lesson learned is about fuel sampling procedures, i.e., use clean containers secured with fuel-compatible seals.