Transport Canada Transports Canada

Aviation Safety Maintainer

Learn from the mistakes of others and avoid making them yourself... **Issue 1/2000**

Mechanical Happenings

The following significant aircraft incidents reported to TC from September 1, 1999, to December 1, 1999, are a heads-up for AMEs; they 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 a service difficulty report (SDR) was submitted.

Whether large or small, all aircraft types require maintenance to keep them flying safely.

Airbus A340-313 —The crew reported a power problem with one engine during the flight. Maintenance discovered a faulty T12 sensor, which was replaced. As a precaution, the hydromechanical unit was also replaced.

Airbus A320 —The pilot declared an emergency because of venting fuel shortly after takeoff. Maintenance found the air release valve for the fuel tank on the right wing was malfunctioning. The valve was replaced and the aircraft was returned to service.

Airbus A320 —During cruise flight, the No. 2 engine oil quantity decreased to 2 qt. and, approximately 10 min later, the oil quantity registered as 0 and the oil pressure on the No. 2 engine began to decrease. The No. 2 engine throttle was selected to idle but the engine was later secured in flight. Maintenance traced an oil leak to the No. 2 integrated drive generator (IDG) case drain. The No. 2 IDG carbon seal and both O-rings were replaced.

Beech 1900 —A circuit breaker popped when the gear was selected down. The crew was able to extend the gear manually. Maintenance found a chafed wire beside the PC board mounting plate, under the floor at station 143, and repaired it.

Beech D95A Travelair —As part of the training sequence, the instructor shut down an engine, but when a restart was attempted, the engine would not start. Maintenance found that the propeller did not unfeather because the unfeathering link on the propeller governor became detached. The operator is investigating to determine how this occurred (i.e., cotter pin worn through or left off).

Beech E95 —After a cargo door coming ajar after takeoff was reported twice, the aircraft was grounded and maintenance subsequently located and replaced an unserviceable microswitch in the cargo door.

Bell 206B —The helicopter had departed on an instrument flight rules (IFR) flight when the crew experienced a “fire warning light” and returned to the airport. Maintenance found two separate electrical problems that occurred sequentially. The first involved a fuel filter light that illuminated (warning of an impending bypass failure). An investigation determined that a microswitch located in the top of the airframe fuel filter had shorted out internally and failed. The second problem was the failure of the instrument lights (they went out). This problem was determined to be the failure of a transistor that controls the light intensity.

Boeing 737-2E1 —The left main landing-gear light remained illuminated (green) after takeoff. The aircraft returned for an overweight landing. Maintenance found that the landing-gear accessory unit connector was wet, possibly caused by contamination from loaded wet cargo containers. The connectors were cleaned, dried, and the aircraft returned to service.

Boeing 727-225 —The crew noted high oil temperature, low oil pressure and decreasing oil quantity on the No. 1 engine (Pratt & Whitney JT8D) followed by illumination of the oil filter bypass warning light. At this point the engine was secured. Maintenance found the oil filter plugged by carbon. The filter and oil were both replaced, the engine was ground-run for an hour; the filter was

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then rechecked for contamination and the aircraft was returned to service. The source of the carbon appeared to be a seal that had been previously replaced on this engine.

Boeing 767-38E —The flight crew declared an emergency because of an unsafe landing gear indication. Maintenance replaced the nose landing-gear light bulb, cleaned the socket and the aircraft was returned to service.

Boeing 727-51C —The crew reported a steering problem, and, following the occurrence, maintenance found that the apex pin had become dislodged, allowing the nose gear scissors to disconnect. The apex pin was reinstalled and the aircraft was taxied to the ramp. The apex pin is about five inches in length and is used to secure the scissors in place; on installation, the end portion of the pin rotates 90° to hold the pin in position. Additionally, the aircraft is equipped with a safety clip that is used to hold the end of the apex pin in its rotated position. This safety clip was missing on the occurrence aircraft. A fleet-wide inspection revealed no similar problems.

Boeing 737-275 —After pushback with the engines running, the left-hand No. 2 spoiler actuator O-ring failed, allowing hydraulic fluid to run out between the flap bearing and the hot engine, causing smoke. Maintenance replaced the O-ring.

Boeing 727-24 —The aircraft experienced hydraulic problems, and, after landing, the ground crew noticed what appeared to be a hydraulic leak in the left main gear. Maintenance found that the leak originated at the No. 4 slat actuator in the leading edge of the left wing and replaced it.

Canadair CL-600-2B19 —The crew made a flapless landing when the flap selection failed. Maintenance investigation revealed a faulty flap control lever and replaced it.

Cessna 210 —The aircraft was observed on final with the gear not properly down. Maintenance found the main landing gear was resting on the gear doors in the "up" position. When a previous modification to remove the gear doors was incorporated, the gear would not stay locked in the "up" position. Additional rigging and testing of the gear solved the problem.

Cessna 402 —After an in-flight shut down, maintenance found a catastrophic internal failure, which broke the engine crankcase and created the oil leak. A strip report is pending.

Cessna 172M —The float-equipped aircraft flipped over on takeoff because of control problems. Upon inspection of the aircraft after the accident, it was realized that the elevator control cables were installed and operating in reverse. Apparently the pilot flew the machine without the log entries being completed after maintenance, and a dual inspection of the controls after replacement had not been completed.

de Havilland DHC-8-311 —Maintenance found that a hydraulic pressure and quantity decrease was due to the nose gear drag strut actuator supply line leaking, which required replacement.

de Havilland DHC-8-102 —The aircraft experienced an oil pressure problem during two different flights, the latter required an engine shutdown. Maintenance changed the No. 1 prop oil seal on the first occasion and on the second occasion replaced the prop actuator and returned the aircraft to service.

de Havilland DHC-2 MK I —The pilot returned for a precautionary landing because of a rough-running engine. The problem was due to an unserviceable right magneto. The time on the component since overhaul was 700 hr. The magneto was replaced and the aircraft was ground run and checked serviceable.

de Havilland DHC-8-311 —The flight returned to the airport because the No. 2 hydraulic quantity depleted in flight. Maintenance found the No. 2 hydraulics reservoir leaking and replaced it.

de Havilland DHC-8 —The crew performed an in-flight shutdown shortly after takeoff. Maintenance inspection found the No. 2 nacelle covered in engine oil. The oil was coming from the rear inlet case engine oil pressure line fitting. The No. 2 engine rear inlet case oil pressure line was loose—the line had been loosened to access the fire detect loop during maintenance the night before the incident occurred and now required securing to repair the problem. The airline is looking into revising the fire loop access procedures.

de Havilland DHC-8-311 —The crew experienced hydraulic pressure problems during flight. Maintenance discovered a crack in the bend radius on a pressure line to the spoilers. They replaced the line, the No. 1 engine hydraulic pump and the No. 1 system filters.

de Havilland DHC-8-102 —The crew heard a loud bang when the gear was selected down on approach. They conducted a go-around to execute their checklist, then landed the aircraft without incident. Maintenance found the No. 1 main landing gear retraction actuator cracked and leaking hydraulic fluid. The actuator was replaced.

de Havilland DHC-8-301 —Shortly after takeoff, the crew advised that they had power fluctuations in one of the engines and the smell of burning rubber in the cockpit. The source of the smell was a defective relay. Apparently, similar problems have been found on other Dash 8s in the fleet. The company has issued an SIO (Special Inspection Order) to remove any suspect relays on all other aircraft in the fleet.

de Havilland DHC-8 —The pilot reported the No. 1 engine fuel pressure warning light "flickered" on climb and returned to the airport. Maintenance inspection revealed that the fuel pressure switch wire (2821-11D20) was chafing on the back side of the fuel heater assembly. The wire was repaired and additional spiral wrap was installed on the harness to prevent recurrence.

Fairchild SA227AC —The pilot was unable to retract the gear after takeoff. Maintenance discovered that the left oleo was flat but did not show any signs of leakage. When the aircraft was placed on jacks, the left oleo did not fully extend; therefore, the air/ground squat switch did not activate. Maintenance serviced the oleo and returned the aircraft to service.

Fokker F28 MK1000 —The crew was unable to retract the gear after takeoff and returned to the airport. Maintenance found the gear test valve in the "ground/pressure" position. The valve was returned to normal position and the aircraft returned to service.

Fokker F28 MK1000 —The crew noticed that the utility hydraulic caution light was illuminated and that there was no hydraulic fluid remaining in the utility system. The No. 2 utility pump was shut down and the flight continued to the airport. Maintenance discovered a rupture on the input line to the No. 2 pump for the utility system. The line was replaced and the fluid brought up to normal level.

Hawker Siddely HS 748 —The

Transport Canada / Transports Canada

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

crew declared an emergency because of a total hydraulic failure. Maintenance traced the problem to a faulty hydraulic up line on the retraction jack. The line was replaced.

Learjet 55 —The crew secured an engine and returned to land because of oil pressure and quantity problems. Maintenance discovered that an unsecured oil cap was the source of the problem.

McDonnell Douglas DC 9 —During descent, the left engine oil-pressure warning light illuminated and the oil pressure indicated less than 35 psi, the minimum required. The crew carried out the low oil pressure drill and secured the engine. Maintenance found that the left engine-driven pump seal had leaked and replaced it.

Nanchang CJ6A —The pilot reported smoke in the cockpit and returned to the airport. The aircraft had just had maintenance where an adjustment was made on the governor. The adjustment cap screw was thought to have been overtorqued and the sleeve below it cracked, causing an oil leak.

Pietenpol Aircamper —The pilot reported a loss of some power after takeoff and returned for a landing. The pilot later reported that a spark plug had backed out of one of the cylinders. A new plug was installed and the aircraft declared serviceable.

Piper PA-31-350 Navajo —The pilot shut down the right engine after he observed a manifold pressure drop and received a report of smoke coming from the engine by a passenger. Maintenance discovered that the turbocharger shaft failed between the turbine and compressor support bearings. The engine and turbocharger had a total time of 515.1 hr. since overhaul and the cause of the premature failure was not determined.

Piper PA-31-350 Chieftain —The pilot reported an undercarriage indication problem. Maintenance found that dirt and contamination prevented the landing gear down lock from fully engaging. Cleaning and lubrication of the gear fixed the problem.

Piper PA-23-250 Aztec —The aircraft experienced a brake failure and incurred some damage. Maintenance revealed that the brake reservoir was found empty after the aircraft sustained damage hitting the fence. No leaks could be found in the brake system, where a loss of this magnitude could have occurred.

Piper PA-31-350 —The pilot was unable to get the left gear down and made a successful one gear down landing and with minimum damage. Maintenance has determined that a broken linkage on the actuator prevented the downlock from engaging.

Piper PA-18A-150 —The pilot and instructor set up for a precautionary landing when a loss of engine power occurred. No damage or injury occurred during the forced landing. Maintenance found the throttle cable kinked in its casing, which eliminated all throttle movement by the pilot. Apparently, the throttle had been stiff for some time, but on this occasion, when the pilot advanced the throttle to overshoot, the throttle cable seized, possibly because of internal fraying.

Piper PA-31-350 —The crew reported that they had an electrical failure during flight and used a cell phone to contact ATC. Maintenance found that the left alternator lead wire failed at the alternator. The right alternator was also found to be defective in that it did not produce the rated amperage. The left alternator could not supply the demand. Both alternators were replaced.

Sikorsky S-61N —During logging operations, the No. 1 engine quit. On investigation, metal was found on the forward chip plug. The engine was removed and inspected by a General Electric Technical Representative, who noted that the engine flameout was due to failure of the front frame accessory drive, radial drive shaft, and the pinion bevel gear at the top of the accessory gearbox. The pinion gear drives the accessory drive gear, which, in turn, drives both the engine oil pump gear and the fuel pump. Failure of the radial drive shaft and pinion gear assembly resulted in fuel starvation. The engine had approximately 20 hr. of operation since overhaul, and the reason for this failure was not determined at the time of writing.

Sud Aviation SA 341G —The engine was shut down in flight because of vibration. Maintenance subsequently discovered that the freewheel bearing appeared about to fail.

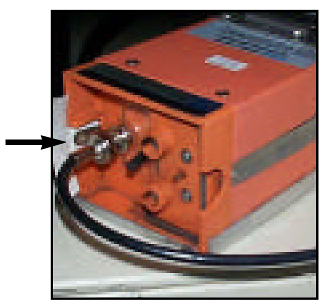
Swearingen SA227 —The crew experienced an engine overheat light indication during the climb and returned for a landing. Maintenance found and replaced a defective temperature sensor.

Dual Antenna Connections will Foil Narco 10 or 10C Transmissions

by *Chris Blanchard, Aviation Safety Inspector, Pacific Region, Transport Canada*

A recent ramp check of a Bell 206 revealed that the Narco 10 emergency locator transmitter (ELT) installed in the cabin would not be able to transmit a signal strong enough to be received by Search and Rescue Satellite Aided Tracking (SARSAT) or another aircraft.

The problem was that the ELT had two antennae connected at the same time. The external antenna was connected to the coax connector and the integral (portable) antenna was touching the finger tab protruding from the top of the ELT. On this installation there was no insulating tab installed to disconnect the portable antenna.



The ELT in the photograph has already had its T-handle reversed to insulate the portable antenna from the transmitter (arrow).

Unfortunately, this is not a new problem. This subject was last addressed in issue **3/92** of *Feed-Back* and previously by "Notice to Aircraft Maintenance Engineers and Aircraft Owners" (**N-AME-AO) 10/83** .

It seems that the aviation industry has a short memory, so in order to refresh everybody's memory, and since N-AME-AO 10/83 has been cancelled, the following is an adaptation of the information contained in that publication.

"The Narco ELT 10 and ELT 10C units are approved for both automatic fixed and portable installations. To meet the requirements of both fixed and portable categories, the units have a connector for an external, fixed antenna together with an integral extendible antenna for portable operation. For correct operation of either antenna, the other one must be disconnected from the output of the unit. The integral antenna is connected by means of a spring metal finger pressing against the antenna blade (arrow).

For use with the fixed antenna, a plastic contact separator, which is attached to the antenna coax cable connector, is inserted between the spring finger and the integral antenna when the external connection is made. Problems have been experienced in service with the plastic contact separator breaking and not being replaced. Additionally, the large plastic tab attached to the end of the flexible integral antenna is prone to breakage, allowing the plastic contact separator to be inserted on the wrong side of the integral antenna.

If either of these conditions exist, the integral antenna will remain connected and will draw a significant portion of the output power, thus resulting in degraded performance from the fixed antenna. This would not be detected by the ELT functional test, as the ELT antennae are sufficiently close to the aircraft VHF communications antenna that even a very low power output will be picked up by the VHF receiver."

Newer ELTs manufactured since release of this N-AME-AO and the *Feed-Back* article would not have this problem because Narco has changed the set up of these integral antennae. The "large plastic tab" attached to the extendible antenna has been redesigned to become the separator between the integral antenna (as shown) and the transmission finger. The plastic tab attached to the aircraft antenna is no longer used in new installations.

Unfortunately, **older ELTs with the old-style T-handles are still in use and the aircraft antenna cables are not equipped with plastic tabs** .

In addition, with the promulgation of the new *Canadian Aviation Regulations* (CARs), air crew and other non-licensed personnel are now allowed (if authorized by the company) to install line replaceable units, which this ELT is, under CAR 625 Appendix A.

The training given to these people may not be sufficient to cover all possible configurations of these ELTs. For example, in a company with several aircraft, a pilot may be trained to install a Narco ELT 10 on one aircraft. This aircraft had a correctly installed T-handle. The next ELT that this pilot installs in an aircraft may have an old-style antenna. The pilot would conduct the function test and the VHF receiver would pick up the ELT signal, but it would not be received by SARSAT or any overflying aircraft. Yet he would feel confident that if he ever had an accident, he would be found by Search and Rescue homing in on the ELT signal.

Therefore, AMEs should brief aircraft owner/pilots with Narco ELT 10 units installed to check for correct installation and integrity of this plastic separator between the integral antenna and the spring finger.

AMEs should check the integrity of Narco 10 installations any time maintenance is conducted. Also, AMEs conducting Elementary Work Training should ensure that persons trained are made aware of the possible installation problems with Narco 10 or 10C ELTs and the seriousness of the situation because the ELT must transmit to bring help in event of an accident.

And one last word of caution that applies to all ELTs: **ensure that it is armed before you close the panels** !

To The Editor

Dear Mr. Scoles,

Your Article in Maintainer, Issue 4/99, "Tires Need Maintenance Too," accompanied by a photo of a large aircraft tire system really sends a message home to us all on this subject.

It is quite obvious (after aircraft departed with these tires) that the operator had very little concern for safety because had a situation arisen causing a rejected takeoff (RTO), a potential for an incident or accident could exist resulting from both loss of braking friction and loss of directional control of the aircraft, especially on a wet runway (3 out of 4 tires on the same bogie being marginally in limits and questionable on this aircraft).

Another thought that comes to mind is the possibility of subsequent tire carcass and tread failures with every likelihood of causing damage to aircraft structures (flaps, etc.), hydraulic, brake (anti-skid) systems and engines.

I believe when it comes down between safety (airworthiness) of aircraft and the economics of running an air operation, safety should take the number one spot.

A. J. Butt, AME
Calgary, Alberta

Marshall Gordon, a Transport Canada Airworthiness Inspector, Pacific region, writes: I have often found tires that are worn beyond the manufacturer's stated limits. The ones depicted in your photo are obviously well past retirement. All large and most small aircraft tires have wear indicators in the centre groove or grooves. With one exception that I am aware of, the manufacturers state that when the groove is worn down smooth the tire is to be retired. The exception is the tires on the BAE 146, as they have an extra layer of fabric, which allows for more tread wear than normal.

Incorrect Windshield Installation

During October 1999, the windshield replacement on a Fokker F-28 went very wrong. There were a number of different maintenance personnel, including supervisory personnel, involved in this human factors fiasco or maintenance fowl-up. The story begins at an eastern Canadian base where the windshield was installed and subsequently, during a re-inspection after flying to a western base, a number of deficiencies were found that could have resulted in a very serious accident had the windshield blown out during flight.

Here is a list of most of the deficiencies noted later as a result of the improper installation. The intent is not to condemn the maintenance personnel involved but to draw attention to the lack of due care during a maintenance procedure that involved a critical task. The following deficiencies were found and corrected during a block check of the aircraft:

* Numerous loose screws.
* Screws that were too short.
* Some screws were shanked out, allowing outward movement of the windshield.
* Improper screws resulted in improper torque application.
* Use of improper frame-sealing compound.

How could this happen? We can find the answer in a series of maintenance posters entitled "The Dirty Dozen." These posters list many of the factors that result in maintenance errors. This is what the report on this incident noted:

* Generally not following the maintenance manual.
* Heavy workload at the time.
* Apprentice performed the work.
* All the steps performed by the apprentice not supervised.
* Inspectors only applied final torque to the screws, which was not verified.
* Some screws bottomed out, causing improper running torque application.
* The only maintenance manual reference to different lengths of screw was in the removal instructions.
* Installation instructions were silent on requirement for different length screws.
* Insufficient down time allotted for PRC compound, if used, to cure.
* Supervisor instructed the use of PRC compound and raised a different snag so departure time could be met; pressure to meet the flight departure schedule.

In summary, a host of human factors, including poor training/supervision of an apprentice, substitution without reference to the manual, high workload, time pressure and the dedication of the crew to delivering the aircraft rather than considering a necessary delay to deliver a safe and thoroughly inspected aircraft after a critical maintenance action.

Modified Navajo Exhaust Results in Engine Fire

The Piper Navajo Chieftain, similar to the aircraft involved in this accident, is widely used in Canada.

On the night of Jan. 20, 1998, the pilot of a Piper Navajo Chieftain PA31-350 saw flames coming out of the right-side engine cowl immediately after takeoff.

The right engine was shut down but the aircraft could not maintain a sufficient rate of climb and suffered major damage when it crashed on flat, snow-covered ground about one mile from the end of the runway. There were no injuries.

In this accident, the report covered many related events, but for the purpose of the Maintainer, I have chosen to cover only those human factors and facts related to the improper maintenance of this aircraft.

From the following crew comments, AMEs may gain a better understanding of the importance of good maintenance and the severe restrictions faced by a pilot when the engine fails under difficult flight conditions.

The crew reported that the engines were producing maximum power on takeoff and that the accident occurred when the right engine was shut down because of the engine fire. The pilot said he observed that the propeller was not feathered after the accident, although he thought it should have been because he had carried out the feathering procedure. He also indicated that he had not observed anything unusual about the propeller on the previous flight or during the last takeoff.

Visual examination of the right propeller revealed that one blade was bent backward over 100° at a point approximately 15 in. from the hub. The other two blades were bent backward approximately 70° about 12 in. from the tip. The right propeller pitch was not determined but it was estimated to be high. The observed damage was consistent with a propeller that was feathered but still turning at the time of impact.

The manufacturer has a warning in the *Pilot's Operating Handbook*, Section 3 "Emergency Procedures":

Flight tests have indicated that as much as 100 ft. may be lost during gear and flap retraction and the transition to the best single-engine angle of climb speed (104 kt.). The altitude loss is a difficult variable to quantify and is primarily predicted on pilot proficiency; however, aircraft weight and ambient conditions must also be considered.

According to the pilot, the aircraft had attained a speed in excess of 85 kt. when he initiated rotation.

About 100 ft. above ground level, while retracting the landing gear, he saw the flames and immediately started the emergency procedure to shut down the right engine. During the engine shutdown procedure, the aircraft lost altitude and crashed.

The right engine exhibited severe fire damage to the outboard half of the engine cowl. The flames had melted through the upper outboard half of the cowl skin, creating two 10-in. diameter holes. The upper cowl skin was removed, and examination revealed that the fire damage was limited mainly to the engine cowl and the flexible air intake duct to the heat exchanger (exhaust muffler) for the cabin auxiliary heating unit. The upper outboard engine mount also showed fire damage.

The spark plug cables for Nos. 1, 3 and 5 cylinders, various electrical wires, and the ducts for the turbo air intake had been damaged by the intense heat. The damage caused by the flames had not spread to the firewall.

The exhaust muffler was found disconnected from the exhaust pipe for Nos. 1, 3 and 5 cylinders. The exhaust muffler and exhaust pipe were found butted up against each other, jammed together end-to-end, with only about half their respective diameters connecting. In this position, the exhaust gases could not be exhausted normally and were projected onto the end of the exhaust muffler then directly onto the engine cowling. The exhaust gas temperature was estimated at 1400° Fahrenheit. The fiberglass cowl skin could not withstand such high temperatures and was melted by the flames.

Two stainless steel collars were found on the far aft side of the No. 5 cylinder exhaust pipe. With the two collars positioned as they were, the exhaust muffler could only be inserted less than one-quarter inch over the pipe; these parts were designed to overlap by more than an inch and a half. The installation was not in accordance with existing requirements. No other deficiency in the exhaust system was found.

The records revealed that the aircraft was certified and equipped in accordance with existing regulations and approved procedures.

A review of the aircraft journey log-book indicates that the aircraft was maintained in accordance with the inspection schedule approved by TC and the manufacturer's progressive inspection program.

An audit of the main maintenance base revealed that the facilities were adequate and that the equipment required to maintain the aircraft was available.

Inspection of the aircraft files revealed several deficiencies in records management; the record keeping and files for the subject aircraft were incomplete and inadequate.

No follow-up action was recorded to indicate that the noted deficiencies were corrected.

A review of the aircraft journey log-book revealed that the persons in charge of maintenance had authorized the aircraft to be used while some deficiencies had not been corrected, including an unserviceable fuel flow regulator. Each time, the aircraft continued to operate until the required parts were delivered.

An entry in the aircraft journey log-book on December 14, 1997, refers to maintenance work on the right engine. This work was for the replacement of the right rear exhaust pipe, the same exhaust pipe that was found disconnected after the accident.

The Transport Canada file on the company maintenance department indicates that in 1997 at least three different persons held the position of Director of Maintenance.

On December 22, 1997, the Director of Maintenance went on vacation, and on December 31, 1997, he sent a letter to Transport Canada indicating that he was resigning from his position as Director of Maintenance and would no longer be responsible for aircraft maintenance effective December 22, 1997.

At the time of the accident, the Director of Maintenance position at the maintenance base was vacant.

A post-occurrence review of the maintenance department conducted by Transport Canada from February 9 to 11, 1998, confirmed the findings of the investigation, and the company operating certificates were temporarily suspended.

The chain of events in the maintenance department prior to the accident, including the turnover of key personnel, poor record keeping, allowing the aircraft to fly with known deficiencies, lack of frequent TC inspections because of the remote area of operations and the failure to follow up on audit report deficiencies, should have alerted company management to a serious safety concern.

The final event in this chain, an improperly installed exhaust system, was not detected during routine maintenance, allowing the aircraft to remain in service until the exhaust muffler on the right side of the engine and the exhaust pipe became disconnected, causing an engine fire from escaping hot exhaust gases. This was the result of the extra stainless steel collar installed on the far aft side of the No. 5 cylinder exhaust pipe.

Apparently the extra collar was to prevent the exhaust muffler from coming into contact with the No. 5 cylinder baffle; however, the technician did not deem that there was a risk in making that modification. Installation of two collars was not prescribed in the modification for Supplemental Type Certificate SA-240. Also, the way the collars were installed was inconsistent with quality standards and the manufacturer's instructions, thus contributing to a considerably greater risk of fire.

As a result of the TSB findings in this case, Transport Canada took immediate safety action by suspending the Aircraft Maintenance Organization certificate.

How Many Faults Can You Locate? cont. from page 8

"Human Performance in Aviation Maintenance" (HPIAM) workshop is now being presented throughout the country. This course identifies and develops safety-net strategies to prevent common human errors.

2) If portable light stands are available, use them. While inspecting volatile areas, use only approved vapour-proof lights, which do not spark.
3) Organize your inspection so that no area is missed. This could be done either by using a check sheet or by highlighting areas on a picture of the inspection zone.
4) Gently touch the wires and feel if there are any cracks in the insulation. You can also determine if there are any loose terminal connections or clamps.
5) Your sense of smell can be a helpful tool when conducting an inspection. If you smell an unusual odour, investigate it; you could break the chain of events and prevent an accident.
6) Use a mirror to check all sides of the wiring loom.
7) Look for signs of strained or excessive tension on the cables.
8) Examine the cleanliness of the wires. Has the cable been soaked with hydraulic fluid, oil, or another contaminant? Are there metal filings on the wires? These problem areas usually occur at the lowest level of the aircraft's structure.
9) Look for "human-made" damage, such as the damage that results from excessively long panel screws.
10) Keep the aircraft wires clean. This may require you to clean the area with a damp cloth and a vacuum.
11) Avoid stepping on the wires when the floor panels are removed. Plywood sheets can be laid on top of the aircraft structure; this will provide a safe walkway for maintenance personnel and protection for the wiring.
12) Finally, one of the best ways to avoid electrical wiring problems is to have quality installations. But that will be another topic for another day.

How Many Faults Can You Locate?

The following article by Richard Berg, Maintenance Safety Development Program and Standards Officer, TC, who has avionics experience, is targeting both the accompanying photo and your daily maintenance practices. Richard has recently joined Safety Services and promises to write additional articles about aging aircraft wiring, the installation of new or additional avionics equipment, and the use of tools of the trade.

Richard Berg started his aviation career in 1976 working for Toronto Airways as an aircraft groomer. He then travelled to the United Arab Emirates in the Middle East where he worked as an AME for Emirates Air Services in Abu Dhabi. Later, he joined the local community college where he developed and instructed the curriculum for the AME program. Richard then returned to Canada and started working for the Transport Canada Aircraft Services Directorate in 1993. In September 1999, Richard joined Safety Services in Ottawa. Richard's role as a CASI is to co-ordinate and develop safety programs nationally and to proactively respond to the safety needs to the aviation community.

Since Richard now works for Safety Services, we look forward to many more articles and input from him on avionics topics. —Ed.

During a recent FAA study examining older aircraft with aging wiring, 11 inspectors spent close to 120 hr. visually examining "every inch" of the wire for flaws. These wires were then sent for a series of tests at an FAA lab to determine the number of flaws that were not detected. It was determined that only 75% of the wiring defects were discovered using the visual inspection technique.

When I was an apprentice, I was told that sometimes the cure can be worse than the disease. This can be true with wiring inspections. Wiring that is undisturbed will have a lower degradation than wiring that has been reworked. Excessive movement, twisting, pulling, and squeezing of electrical cables can damage, crack, or permanently remove the protective insulation coatings; the effect is further pronounced as the wire ages. Care must be taken while performing these inspections, but what can be done?

How many faults can you locate?

Risk management and mitigation

Presently, there is no device available to identify and isolate wire insulation problems in aircraft. This makes it extremely difficult to find any defects. The best thing you can do is identify and target "high-risk" areas and perform a logical and systematic inspection. Here are some areas you may want to focus on:

1) Fuel cells and other areas with flammable materials—There have been recent National Transportation Safety Board (NTSB) reports attributing aircraft accidents to electrical arcing of wires found in the fuel cells.
2) Electrical power zones, buses, and power lines—It has been discovered that these lines will produce the most damage: they could arc, resulting in more wires being damaged and providing an ignition source. This could result in a fire, which may spread to insulation blankets and other combustible material.
3) Areas vulnerable to vibration and physical damage—Airworthiness directives about wires rubbing on the rivet heads on the underside of the wire loom have been issued. A thorough inspection of the cable is necessary. Look at the support of the cables, their routing, and their relationship to the surrounding aircraft structure.
4) Wires located near flight controls—These wires could cause physical restrictions to the movement of the flight controls if they are too close to the flight controls.

How do you inspect these wires?

It's best to perform inspections as per the aircraft manufacturer's recommendations. Another good source of information to determine damage tolerance levels is the wire manufacturer. Also refer to other material, such as the Maintainer and Advisory Circular (AC) 43.13-1B. This safety material may make you aware of techniques or areas that you may not have experienced yet. Talk about your discoveries with other people, and, if appropriate, report your findings in a service difficulty report (SDR) (Form No. 24-0038). Here are some tips for inspecting wires:

1) Have the right attitude. Think that today you are going to find something wrong, and be diligent. The

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