FLIGHT SAFETY FOUNDATION
Aviation Mechanics Bulletin
MARCH–APRIL 2001

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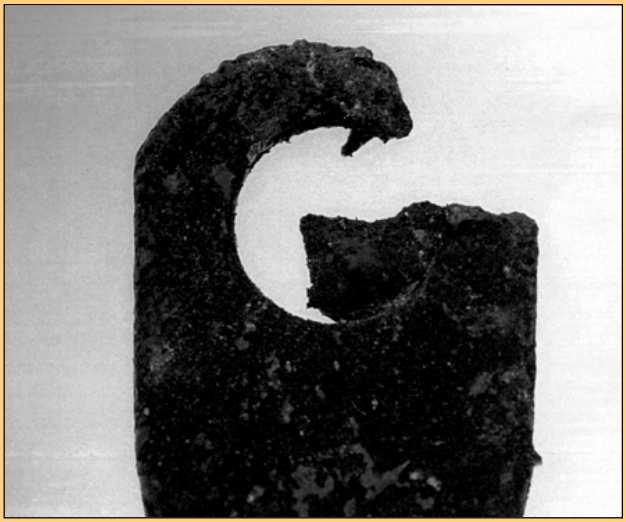

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Aviation Mechanics Bulletin

Dedicated to the aviation mechanic whose knowledge, craftsmanship and integrity form the core of air safety.

Robert A. Feeler, editorial coordinator

March–April 2001 **Vol. 49 No. 2**

On the Cover: A close-up of the connector end of the unattached battery cable that was blamed for a fire that destroyed an Aerospatiale AS 355F1 helicopter April 28, 1999. (Source: Transportation Safety Board of Canada)

Aviation Mechanics Bulletin
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Incorrect Installation of Battery Cable Blamed for Fire That Destroyed Helicopter

The accident report said that the auxiliary battery paralleling cable was not attached to the positive post of the main battery after maintenance and that later, during flight, the current arced from the unattached cable through the battery compartment to ignite flammable material in the adjacent baggage compartment.

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FSF Editorial Staff

The pilot of an Aerospatiale AS 355F1 Twinstar[1] helicopter had completed a routine patrol of natural gas pipelines on April 28, 1999, and was returning to Fairview, Alberta, Canada, for landing. During the descent, when the helicopter was about 800 feet above ground level (AGL), the battery-temperature warning light illuminated. The pilot observed normal voltmeter and ammeter indications, then turned off the battery.

Three minutes later, when the helicopter was about 500 feet AGL, electrical power failed and the cabin filled with smoke and fumes. The pilot and his only passenger opened side windows for ventilation, and the pilot conducted an emergency landing in a field and shut down the engines. They exited the helicopter before the fire intensified. The helicopter was destroyed by fire; the pilot and passenger were not injured.

The aviation investigation report by the Transportation Safety Board of Canada (TSB) said that the helicopter "sustained an in-flight fire that occurred as

a result of the auxiliary-battery-to-main-battery paralleling cable not being attached to the positive post of the main battery. The maintenance error was not detected before the flight."

Information from witnesses and laboratory tests prompted investigators to conclude "that the unattached cable contacted an unpainted area of the battery compartment forward bulkhead, arced through the bulkhead and ignited the survival gear in the adjacent baggage compartment," the report said.

"Several system defenses that may have prevented this accident were missing or inadequate. The auxiliary-battery-to-main-battery paralleling system provided no cockpit indication that the auxiliary battery was unattached, the company maintenance system guidelines were outdated, the daily operating checks were not being performed in accordance with the manufacturer's recommendations and the AME [aviation maintenance engineer] who had most recently performed the battery compartment maintenance did not note that the auxiliary battery paralleling cable was unattached."

The accident helicopter was one of four twin-engine Twinstar helicopters owned and operated by a natural gas transmission company, which had merged with another natural gas transmission company in July 1998, nine months before the accident.

The other company operated several Bell 206 JetRanger helicopters, and a manager of helicopter services had been named in November 1998 to supervise the merged helicopter operations. Among the manager's first actions was to order an independent operational safety review of the helicopter division, which praised the "highly qualified maintenance and flight personnel" and the "excellent maintenance standards," the TSB report said.

"The report also identified numerous safety concerns, including inefficiencies in maintenance communications, unapproved modifications on helicopters and outdated company manuals," the report said.

The manager of helicopter services addressed some of the issues discussed in the report but postponed action on others until the corporate reorganization was completed. Five days before the accident, on April 23, 1999, helicopter division employees met to discuss the safety review and other topics related to the merger; their meeting was described as "charged with emotion," the TSB report said.

The merger "had raised significant concerns among the … helicopter group regarding their future employment and economic security," the report said. Such forms of stress and anxiety may cause individuals to "concentrate on the difficulties that

are creating the stress rather than on the practical aspects of the present situation. Hazards that may result include the distraction of attention and the failure to recognize errors. Emotional stresses, such as those resulting from the anticipation of future difficulties, are among the most disturbing distracters of attention."

The maintenance department staff comprised four helicopter AMEs, each of whom had at least 20 years of experience in aviation maintenance and each of whom was trained and was endorsed to perform maintenance on Twinstars. They had worked for the company for between eight years and 17 years.

When the director of maintenance left the company, before the merger in 1998, the department adopted "a three-role maintenance department structure that was based on the company philosophy of shared leadership and shared accountabilities," the report said. "The policy called for each AME to rotate, for an indefinite term, through the supervisory [responsibilities], parts and materials procurement [responsibilities] and line maintenance responsibilities. The maintenance organizational structure would not have met Transport Canada (TC) standards for a maintenance control system."

Canadian Aviation Regulations (CARs) do not require operators who transport passengers in helicopters to maintain the helicopters under an approved maintenance control system. CARs 604.02, however, requires operators who transport passengers in turbine-powered, pressurized airplanes or in large airplanes to maintain the airplanes in accordance with an approved maintenance control system.

The company's aircraft maintenance manual was developed in 1988 in accordance with requirements of the Air Navigation Orders VII, which were in effect at the time; the manual made no reference to the CARs, which were adopted in 1996. The manual had not been amended since 1991 and did not reflect the composition of the helicopter fleet at the time of the accident, or the maintenance organizational structure.

When the accident occurred, the maintenance department and maintenance personnel at the merging company were working to establish common organizational standards and procedural standards. Action to correct several discrepancies that were identified in the operational safety review had been delayed because the merger was expected to result in further changes.

The accident helicopter was purchased new and was operated by the company since 1981, one of a fleet of four Twinstar helicopters — two were AS 355F1 models and two were AS 355F2 models. The accident helicopter was maintained as a private aircraft in accordance with the manufacturer's

hourly maintenance schedule for AS 355F1 helicopters. The helicopter was equipped with a dual-battery, cold-weather start kit (part no. MOD 350AOP0699) with two Saft 1601-1, 16-ampere hour, 24-volt nicad batteries mounted one above the other in the battery compartment in the right side of the fuselage behind the cabin.

"The batteries are connected to the electrical system by direct-current cables that are attached individually to the positive and negative battery posts," the TSB report said. "In the AS 355F1 dual-battery installation, the positive post of the top — or auxiliary — battery is connected in parallel to the positive post of the lower — or main — battery by a cable, through a paralleling relay. A 400-[ampere] fuse is installed in the negative lead of each battery to protect the cables and wires in the circuit and the master electrical boxes. The batteries are fitted with sensors that activate the battery-temperature warning light when the battery temperature exceeds 71 degrees Celsius [160 degrees Fahrenheit]. The warning system is designed to alert the pilot to a battery thermal run-away.

"The AS 355F1 models incorporated two cables on the positive post of the main battery and utilized one battery master switch to control the circuit. The AS 355F2 models incorporated only one cable on the positive post of the main battery and utilized a separate master switch for each battery."

On both helicopter models, the right baggage compartment is in front of the battery compartment, separated by an aluminum bulkhead that is 0.050 inch (1.3 millimeters) thick. In all four helicopters, the right baggage compartment contained required survival equipment and emergency equipment, including a survival shelter for five people and a survival kit with emergency flares.

"The bags that housed the survival shelter and the emergency kit were made of flammable nylon, and the survival shelter was also packaged in a waxed cardboard box," the report said. "The bags were not required by regulation to be flame-resistant, and, during testing, the packaging materials ignited quickly, melted, dropped and were totally destroyed by fire. The burning characteristics did not meet the requirements of any existing flame-resistant textile specifications."

On the accident helicopter, all six flares stored in the survival kit ignited and discharged during the fire.

The proximity of the survival equipment to the cables in the battery compartment "contributed to the initiation of the fire," the report said. "Propagation of the fire was rapid because of the burning qualities of the packaging material and equipment."

In the company's three other helicopters, the emergency flares were wrapped in newspaper or cardboard.

"The flares are packaged and transported as dangerous goods when shipped from the manufacturer; however, current *Transportation of Dangerous Goods Regulations* do not apply to products identified as dangerous goods if the dangerous goods are necessary for the safety of the persons on board the means of transport," the report said.

Illumination of the battery-temperature warning light was the pilot's first indication of a problem. Nevertheless, because the warning light is intended to alert the pilot to a battery thermal run-away — not to the presence of an in-flight fire — his initial response was to turn off the battery and to descend slowly to a precautionary landing site rather than to conduct an immediate emergency landing.

The nicad batteries in the accident helicopter were changed March 21, 1999, at 13,217.0 hours airframe time, and the winter-heater blankets were removed from the batteries April 24, 1999, at 13,313.3 hours. The accident occurred at 13,333.1 hours.

"The AME who removed the heater blankets observed that the wing-nut connector on the positive terminal of the main battery was loose and heat-damaged and replaced the connector," the report said. "The AME who changed the batteries believed that he attached both cables to the main battery; however, the AME who replaced the wing-nut connector believed that only one cable was attached to the battery at that time."

Aircraft maintenance records contained no mention of replacement of the wing-nut connector.

The report said that both maintenance tasks were conducted at midday in a quiet, well-lighted hangar and that there was "no evidence that the AME was either fatigued or interrupted while performing the task. The investigation did not identify a specific circumstance that would explain why the cable was not properly attached, and it was not determined whether the cable was left unattached initially during the battery change or later when the damaged connector was replaced."

Both the maintenance manual and the *AS 355F1 Flight Manual* say that daily operating checks should be performed by a maintenance technician or a "suitably trained" pilot before the first flight (BFF) of the day and after the last flight (ALF) of the day to ensure that the helicopter is serviceable. The BFF inspection requires that the battery connection be checked; the ALF inspection requires a check of battery security.

"Each inspection requires removal and reinstallation of the battery compartment side-access panel," the report said. "The pilot and the AMEs

were not aware of the requirement for the … checks, and the checks were not being performed."

Nevertheless, the pilot said that he had removed the battery compartment side-access panel three days before the accident "and had not noticed any discrepancies," the report said.

The pilot said that the requirement for daily operating checks of the battery compartment was not discussed during initial flight training and recurrent flight training conducted by the manufacturer. Representatives of the manufacturer's training facility said that maintenance personnel performed the daily operating checks before the helicopters were released for training flights.

A post-accident examination of the nicad batteries showed that they were "severely fire-damaged" and that the paralleling cable had been attached to the positive post of the auxiliary battery but not to the positive post of the main battery.

A short length of unattached battery cable was found near the batteries in the fire-damaged wreckage. Visual [examination] and laboratory examination of the cable identified that the copper end terminal was arc-damaged and that there were areas in which the copper had alloyed with aluminum — an indication that contact was made at high temperatures for a long enough period for the aluminum to have diffused into the copper. Examination of the 400-ampere fuse in the negative lead of the auxiliary battery showed that the fuse link failed "because of mechanical overload when the battery tray collapsed during the ground fire."

The report said, "A battery compartment/baggage compartment mock-up was constructed to determine if the unattached battery cable could have contributed to or caused the in-flight fire. … The battery compartments in all of the company Twinstars had been painted with Endura [plastic] paint. Testing determined that the paint functioned as an insulator and that the end terminal of an unattached battery cable would not arc when it contacted a painted area of the forward battery compartment bulkhead. If the cable end terminal contacted an area in the compartment where the paint was missing, it would arc quickly through the bulkhead and ignite the survival shelter bag and waxed cardboard box." The 400-ampere fuse did not melt during testing despite intermittent short-duration current flows as high as 1,361 amperes. A simple heat-transfer analysis was performed on the fuse, part no. 135000A. The analysis determined that the fuse was a 400-ampere slow-blow unit and that momentary surges in current draw, such as might occur on contact with the ground, would not cause the fuse to melt unless the current draw was approximately five times the rating for

the fuse and it lasted for more than one second."

Because civil aviation regulations did not require the maintenance department to operate according to TC standards for an approved maintenance organization, the maintenance department was without "several checks and balances that normally exist in an approved aircraft maintenance system," the report said.

"The maintenance department was staffed by four highly experienced AMEs, but they lacked the organizational and procedural guidelines and the assigned leadership to operate in accordance with long-established aviation maintenance standards," the report said. "The guidelines that did exist in the form of the company aircraft maintenance manual were inadequate and outdated by seven years. The policy of rotating supervisory, procurement and line-maintenance responsibilities that had existed in the maintenance department for approximately one year was ineffectual, lacking in continuity and unsuitable for an aviation maintenance department. Since there was no requirement for TC to perform audits on the company, and due to the changes and remedial actions that were expected to occur within the helicopter division as the merger proceeded, the deficiencies that had existed in the maintenance department for some time remained uncorrected.

"The daily operating checks that may have identified that the maintenance error had occurred were not being conducted, and the maintenance was, therefore, not being performed in accordance with the manufacturer's recommendations. Since there was no cockpit indication to identify that the auxiliary battery paralleling cable was unattached, the helicopter was flown for some time with a serious maintenance discrepancy. In fact, the engineer who performed the work became the single line of defense in the system."

The potential for having an unattached auxiliary battery cable was increased because of the composition of the four-helicopter fleet, in which two helicopters had one battery cable attached to the positive post of the main battery and the other two helicopters had two battery cables attached to the positive post, the report said.

The report's "findings as to causes and contributing factors" said that:

- "The auxiliary battery paralleling cable was not attached to the positive post of the main battery during routine maintenance;
- "The in-flight fire occurred when the unattached battery cable arced through the battery compartment forward bulkhead in flight and ignited the flammable nylon survival gear bags in the adjacent baggage compartment;

- "The proximity of the highly flammable nylon survival gear bags to the battery compartment electrical wiring represented a hazard and contributed to the initiation and propagation of the in-flight fire; [and,]

- "The battery compartment daily operating checks, which may have identified the error, were not being conducted by either pilots or AMEs."

Other findings said that:

- "Because the helicopter was being operated as a private aircraft, helicopter maintenance was not required to be performed by an AMO [approved maintenance organization];

- "The recently evolved rotating organizational structure in the helicopter maintenance department was inappropriate and would not have met TC requirements for a maintenance control system; [and,]

- "The risk that AMEs would make errors in their work was elevated by the stress and anxiety related to employment and financial security concerns associated with the merger."

After the accident, the operator:

- Briefed all aviation staff members about the importance of conducting daily operating checks specified in the aircraft flight manual;

- Replaced the flares carried in helicopter survival kits with updated products stored in suitable containers; and,

- Checked the flares on the Bell 206 fleet operated by the merging company to ensure that they were updated products stored according to operational specifications.

As a result of the accident investigation, TSB recommended that TC "ensure that air operators store aircraft survival gear on aircraft in flame-resistant material and package emergency pyrotechnics and other highly flammable survival equipment at least to the standards required by International Air Transport Association (IATA)." (IATA Dangerous Goods Packing Instruction 905 says that signal devices that are transported as dangerous goods must be packaged in plastic or fiberboard inner containers.)

Existing dangerous goods regulations in Canada do not apply to products needed for the safety of people on board the aircraft; nevertheless, TSB said, "any condition that unnecessarily increases the potential for the initiation or propagation of a fire on board an aircraft is hazardous, putting passengers and crew at risk."

In response, TC said that the TSB recommendation would be incorporated into a Commercial and Business Aviation Advisory Circular and into an amendment to the CARs. The Notice of Proposed Amendment was to be submitted in June 2001 to specialists for review, TC said.[2]

TSB also recommended that TC "ensure that helicopters used by private operators to transport passengers receive a standard of maintenance equivalent to that for fixed-wing aircraft for the same type of operation." TSB said that the recommendation was a result of concerns that "passengers are regularly being carried in helicopters that are not subject to the more stringent maintenance standards required for fixed-wing aircraft that carry passengers."

In response, TC said that its safety oversight policy "is based on risk-management principles, with consideration given to the size of the aircraft, the number of passengers carried on board, the technical sophistication of the aircraft and the complexity of the environment in which the aircraft operates." Twinstars, which carry a maximum of five passengers, would not be considered to meet the criteria that would require their maintenance to be conducted according to a maintenance control system, TC said.[3]

"There [have] been no demonstrated systemic safety deficiencies in this type of helicopter operation that would justify increasing regulatory requirements and the level of oversight by Transport Canada," TC said. "Transport Canada believes that enhanced safety awareness of the necessity to follow proper maintenance procedures would be the best approach to addressing the safety concern raised by the TSB in this recommendation."♦

Notes and References

1. Aerospatiale (now Eurocopter) AS 355s are known in North America as Twinstars and elsewhere as Ecureuil 2s. The Aerospatiale helicopter division and the MBB (Messerschmitt-Bolkow-Blohm) helicopter division merged in 1992 to form Eurocopter.
2. Transport Canada (TC). *Response to Transportation Safety Board Recommendations: 2000 Air Recommendations*. www.tc.gc.ca/tcss/tsb%5F0221/Air/2000ATOC_E.htm.
3. TC.

[FSF editorial note: This article, except where specifically noted, is based on Aviation Investigation Report No. A99W0061 of the Transportation Safety Board of Canada.]

Inspections Recommended for MD-80, MD-90 and DC-9 Static-port Heaters

The U.S. National Transportation Safety Board (NTSB), citing two incidents involving malfunctioning static-port heaters, has recommended that operators of McDonnell Douglas MD-80, MD-90 and DC-9 airplanes be required to inspect the heaters for evidence of electrical arcing or thermal damage.

NTSB said that the U.S. Federal Aviation Administration (FAA) should issue an airworthiness directive to require inspections of the primary static-port heaters and alternate static-port heaters. If the inspections reveal evidence of electrical arcing or thermal damage, the heaters should be replaced, NTSB said.

NTSB also said that FAA should:

- "Issue an airworthiness directive requiring the replacement of metalized-Mylar-covered insulation blankets near primary and alternate static-port heaters on all MD-80 and MD-90 airplanes with approved metalized Tedlar-covered insulation blankets at the earliest maintenance opportunity"; and,
- "Initiate a design review of the primary and alternate static-port heaters on MD-80, MD-90 and DC-9 series airplanes and, if feasible, require design changes to reduce the potential for arcing."

FAA Administrator Jane F. Garvey said that FAA would issue the two recommended airworthiness directives. The Boeing Co.'s Douglas Products Division in March 2001 issued alert service bulletins (ASBs) MD80-30A092 and MD90-30A023 discussing the inspections and the installation of insulation blankets. She also said that the Douglas Products Division and the component manufacturer were reviewing the design of the static-port heaters and that FAA would evaluate results of the review to determine whether further FAA action would be required. The review is expected to be completed by Aug. 31, 2001. (Boeing, which acquired McDonnell Douglas in 1997, has said that DC-9 airplanes delivered before the DC-9-80 series had insulation blankets covered by an elastomer-coated fabric that provides improved burn resistance.)

The NTSB recommendations followed investigation of a Sept. 17, 1999, incident in which a fire was reported in the forward cargo compartment of a Delta Air Lines MD-88

after takeoff from Cincinnati/Northern Kentucky International Airport in Covington, Kentucky, U.S.

"The flight attendants reported to the flight crew that there was a sulfurous smell, and then, shortly after that, fumes and smoke entered the forward cabin," NTSB said. "The flight crew declared an emergency and performed a precautionary landing. … During the descent, a flight attendant discharged at least one Halon fire extinguisher into a floor grill, through which a 'glow' was reportedly seen. After the discharge of the Halon, the glow was no longer visible."

No one was injured in the incident; the airplane received minor fire damage.

MD-88 airplanes have one primary static-port heater and one alternate static-port heater on both the left interior sidewall and the right interior sidewall. The heaters are flush-mounted against static-air-pressure sensing ports and prevent the ports from becoming blocked by ice. (The design is similar in MD-90 and DC-9 aircraft.) The heaters are controlled by a switch in the cockpit and normally are operated from before takeoff until after landing.

The NTSB investigation of the incident showed that a spark from the right alternate static-port heater started the fire, which burned the metalized-Mylar covering on the sidewall insulation blankets surrounding the heater.

After the incident, the airline began visual inspections, electrical inspections and functional inspections of the static-port heaters on all of its 136 MD-88s and MD-90s. NTSB said that the airline reported that 11 percent of the airplanes "had at least one heater installation that exhibited some type of damage. Nine of the heater installations had arced, burned or melted parts in the area of the electrical connector; two had charred and exposed heater elements on the heater surface; and seven had cracked and flaked rubber on the heater surface, which can lead to electrical arcing if a liquid is introduced [such as water that condenses on the sidewalls during flight and freezes, then melts during descent and trickles between the sidewalls and insulation blankets]."

The report said that the sharp bends in the heater elements "can concentrate the heat and cause disbonding, which can expose the heater elements."

The airline removed the metalized-Mylar-covered insulation blankets from around the heaters and said that Tedlar-covered insulation blankets would be installed in their place. The airline's engineering department recommended that all static-port heaters in MD-88s and MD-90s be replaced, that the part life be limited to six years and that the heaters be redesigned.

On Jan. 3, 2000, after the inspections had been performed and the metalized-Mylar-covered insulation blankets had been removed, a heater malfunction caused smoke in the cabin of an MD-88 after takeoff from Columbia, South Carolina, U.S. Subsequent inspection showed thermal damage to the right primary static-port heater and evidence of arcing. The airline said that the incident probably was caused by heater elements that arced near the thermostat case.

"The potential exists for additional fires caused by static-port heaters on MD-80, MD-90 and DC-9 series airplanes," NTSB said.

FAA issued airworthiness directive (AD) 2000-11-01, effective June 30, 2000, which requires replacement within five years of metalized-Mylar coverings on insulation blankets in MD-80, MD-90 and DC-9 airplanes. Nevertheless, NTSB said that the five-year compliance period is too long.

CASA Proposes Aural Alerts for Cabin-altitude Warning Systems

The Australian Civil Aviation Safety Authority (CASA) has recommended modification of turbine-powered pressurized aircraft to require installation of aural cabin-altitude-alert warning systems.

CASA said on Feb. 2, 2001, that methods of implementing the recommendation were being considered and would be announced later.

CASA's recommendation was prompted by the Australian Transport Safety Bureau (ATSB), which expressed "concerns regarding the ineffectiveness of visual cabin-altitude warning systems that are not accompanied by an aural warning." ATSB cited a June 21, 1999, incident in which the pilot of a Beech 200 King Air developed hypoxia and lost consciousness after leveling the airplane at Flight Level (FL) 250 (25,000 feet).

The ATSB report on the incident said that the passenger in the copilot seat — a Royal Australian Air Force pilot who also held a civilian license but who was not qualified to operate Beech 200 King Airs — observed the pilot performing "climb checklist" procedures as the airplane climbed through 10,400 feet after departure from Edinburgh, Australia.

"While performing these checks, he received a tracking-change instruction from air traffic control (ATC)," the report said. "This appeared to temporarily distract the pilot from the checklist as he attempted to reprogram the global positioning system (GPS). The pilot then completed the checklist. During this, the passenger in the copilot's seat saw the

pilot reposition the engine-bleed-air switches from the top to the center positions."

After the airplane reached FL 250, a controller advised the pilot that the airplane was not maintaining the assigned heading, and "the passenger in the copilot seat noticed that the pilot was again attempting to program the GPS and was repeatedly performing the same task, " the report said. ATC again advised the pilot that the aircraft was not maintaining the assigned heading, but the pilot did not respond. Soon afterward, he lost consciousness.

The passenger in the copilot seat took control of the airplane and began an emergency descent while the other passenger — a Royal Australian Air Force navigator — "unstowed the pilot's oxygen mask and took several breaths of oxygen from it before fitting it to the unconscious pilot," the report said. "Neither passenger donned an oxygen mask during the incident."

The pilot regained consciousness during the descent to 6,000 feet and conducted a normal landing at the departure airport. He observed that the "PASS OXYGEN ON" and both "BLEED AIR OFF" green advisory annunciator lights were illuminated and that the engine-bleed-air switches were selected to "ENVIR OFF." He said that he had observed no low-cabin-pressure warning indications and that passenger oxygen masks had not deployed.

Beech 200 King Air cabins are pressurized with environmental air from the compressor-bleed-air outlets of both engines. The bleed-air supply is controlled by two three-position switches on the copilot's environmental subpanel. When the switches are in the "ENVIR OFF" position, the bleed-air valve that controls the supply of environmental bleed air to the cabin is closed. In the incident airplane, the switch detents were described as worn, "and the switches could be operated without being pulled," the report said. During flight, the cabin pressurization instruments are partially obscured by the engine and propeller controls.

Australian Civil Aviation Order (CAO) 108.26, which requires a warning device to alert the flight crew when cabin pressure exceeds 10,000 feet, says that "an aural warning is strongly recommended" but is not required.

The incident airplane had red warning lights on the glareshield, and the warning system was designed to activate at 12,500 feet — in accordance with an earlier version of the CAO.

"If the cabin-altitude warning operated as required by the amended CAO, the window of opportunity for alerting the pilot would have been increased at a time when the pilot was

most able to respond," the report said. "It is likely that the provision of an audible warning device as strongly recommended in CAO 108.26 would have alerted the pilot to the developing pressurization problem."

The ATSB investigation also revealed that the oxygen-mask-deployment doors were incorrectly positioned when they were installed and that the masks therefore would not automatically deploy when needed. CASA recommended in 1999 that oxygen masks on all pressurized Beech aircraft be inspected to ensure that they were installed properly. (See " Inspections Recommended for Beech Aircraft Oxygen Masks." *Aviation Mechanics Bulletin* Volume 47 [November–December 1999] p. 9.)

Navigation-strobe Light Identified as Ignition Source for Explosion

A maintenance technician conducting a scheduled inspection of a Cessna 310Q turned on the strobe lights and heard an explosion in the left wing.

A report filed with the U.S. Federal Aviation Administration (FAA) said that the maintenance technician then turned off all aircraft electrical power and observed that the left tip-tank nose fairing had been split by the explosion and had been damaged beyond repair. The navigation-strobe light is installed in the tip-tank nose fairing; the maintenance technician's investigation showed that the light was the ignition source for the explosion and that aviation gasoline provided fuel for the explosion.

The navigation-strobe light is attached to a bracket that is attached by "spot welds" to the tip-tank access panel. (Part numbers for the tip-tank access panel and the light bracket are not included in the Cessna Parts Catalog.) The report said that the maintenance technician observed fuel fumes in the area but no fuel leak. Nevertheless, when he flexed the navigation-strobe light bracket, fuel leaked from the bracket upper-attachment-leg spot weld. He then inspected the right fuel-tip tank and found the same defect.

Airworthiness Directive 76-08-02, Revision 2, and Cessna Service Letter ME75-6 pertain to this subject, but the documents do not discuss cracked or broken light-bracket spot welds such as those found in this inspection. Both documents also list this particular navigation-strobe light installation as an exception to their requirements.

Worn Links Found During Work to Replace Bungee Spring

A maintenance technician was complying with requirements of Airworthiness

Directive (AD) 98-08-18 and Piper Service Bulletin 626C for inspection and replacement of the elevator-down bungee spring and one link in a Piper Chieftain PA-31-350 when he found an associated defect, said a report filed with the U.S. Federal Aviation Administration (FAA).

The AD said that replacement of the spring link (part no. 42376-02) with a new link (part no. 71086-03) may be necessary when replacing the bungee spring. The spring configuration, however, requires a link at each end for attachment. The report said that the other link (part no. 56981-02) was worn severely in an elongated shape at the spring-attachment hole. The report said that the AD should be modified to include replacement of both spring-attachment links.

Cracks Detected in Landing-gear Struts

A maintenance technician conducting a maintenance preflight inspection of a Beech King Air 200 found cracks in both main-landing-gear struts, said a report filed with the U.S. Federal Aviation Administration.

The struts (part no. 00-810028-15) had cracks about 0.5 inch (1.3 centimeters) long at the upper torque-knee attachment lug. Failure of a torque knee could result in loss of the lower strut and wheel assembly or "castering" of a wheel assembly during landing or taxiing, the report said.

Propeller Separates From Engine During Cruise Flight

A Piper PA-31P Navajo was in cruise flight at 10,000 feet on a flight from Canada to the United States when the flight crew heard "an unusual, very loud and very brief noise," said the Transportation Safety Board of Canada aviation occurrence report.

The first officer observed the right propeller break away from the engine as oil spread over the right wing. The crew performed emergency procedures, informed air traffic control of the problem and conducted a single-engine landing at an en route airport.

The report said that the propeller-shaft-driven gear failed because of increased play and fatigue caused by corrosion pitting.

"This failure in turn led to the destruction of the propeller housing case, and the propeller separated in flight," the report said.

Inspection showed that "the presence of corrosion pitting in various areas resulted from a lack of proper corrosion-prevention measures," the report said. "Examination of the technical records revealed that no action had been taken to that effect. The presence

of corrosion caused an accelerated wear, considering the relatively low number of hours of operation to the engine."

The report said that a contributing factor to the occurrence was "the fact that neither the maintenance manager nor TC [Transport Canada] took into account … [Textron Lycoming] Service Instruction 1009AJ concerning the time between engine overhauls."

Service Instruction 1009AJ recommends an overhaul every 1,200 hours or every 12 years.

The engine involved in this occurrence had been overhauled 19 years and three months (and 1,247 operating hours) before the occurrence.

The report said, "The service instruction also states that operators may increase the number of hours between overhauls if the engine is in continuous service, that is, not out of service for longer than 30 days. The manufacturer also warns about the possibility of deterioration of materials and parts during out-of-service periods. It states that the 12-year time between overhauls should never be exceeded."

The airplane was manufactured in 1972 and had accumulated 3,468 flight hours. The airplane was purchased in February 1998, and, after purchase, the new operator conducted a 1,000-hour major inspection in accordance with the approved inspection program. After the inspection, the airplane accumulated 69 flight hours.

The right engine was installed in August 1986, after accumulating 947 hours since a March 1979 overhaul. At the 1,000-hour inspection in 1998, the engine had accumulated 1,178 hours. Records showed that the engine had accumulated 231 hours in the 12 previous years.

The propeller was installed on the right engine in July 1997 after a complete overhaul. At the 1,000-hour inspection in 1998, the propeller had accumulated 15 hours since the overhaul, and at the time of the occurrence, the propeller had accumulated 84 hours since the overhaul.

The operator's approved maintenance organization (AMO) performed maintenance on the airplane in accordance with a maintenance schedule approved by TC. The original operating certificate was issued in November 1997; a new operating certificate was issued in March 1998; and the first amendment to the maintenance schedule was approved in May 1998 to allow engine maintenance according to an on-condition program instead of the manufacturer's recommended "hard-time" program. The program requires repetitive periodic inspections to determine the condition of all components and to ensure that components are removed from service before failure.

The report said that examination of the engine after the occurrence showed that the propeller-shaft-driven gear exhibited "widespread fatigue-cracking of the gear teeth, complete separation of the rim from the hub at the web and ovalization of the rim itself. Although the roots of the gear teeth were covered with a carbonaceous oil residue, there was indication of corrosion pitting. After removal of the bulk of the oil residue … the corrosion pitting became even more noticeable. Detailed examination of the fatigue crack initiation sites established a link between the corrosion pits and the cracks."♦

NEWS & TIPS

SAFE Association Announces 39th Symposium

The 39th annual symposium of the SAFE Association, whose members include developers and users of aviation safety equipment and life-support equipment, will be held Sept. 17–19, 2001, in Nashville, Tennessee, U.S.

The symposium will disseminate information about products, services and safety issues. Previous symposiums have discussed safety developments involving occupant crash-impact protection, accident investigation, search-and-rescue activities and business and commercial aircraft safety.

For more information: SAFE Association, 107 Music City Circle, Suite 112, Nashville, TN 37214 U.S. Telephone: +1 (615) 902-0056.

Transport Canada Announces Canadian Aviation Safety Seminar

The 13th annual Canadian Aviation Safety Seminar, presented by Transport Canada Civil Aviation, will be held May 14–16, 2001, in Ottawa, Canada.

The seminar, "Making Safety Management Systems Work in the 21st Century — Something for Everyone," will include one day of presentations by guest speakers and panels and two days of workshops on various aspects of safety management, human factors in aviation maintenance, the role of flight data recorders in accident investigation and accident prevention, and airport safety and security.

For more information: Transport Canada, Safety Services, Place de Ville, Tower C, 7th Floor, 330 Sparks St., Ottawa, Ontario, K1A 0N8 Canada. Telephone: +1 (613) 991-4280.

45-degree Molded Parts for Circular Connectors Allow Closer Positioning

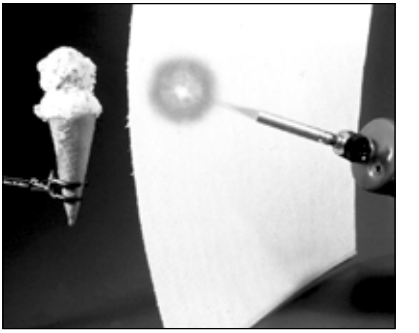
A range of 45-degree components has been introduced to allow closer positioning of circular connectors, said the manufacturer, Tyco Electronics.

Raychem Heat-shrinkable molded parts for circular connectors also are available in 90-degree parts and straight parts. The parts are designed to provide protection, strain-relief and a 360-degree environmental seal in aerospace applications, military applications and automotive applications. They are manufactured from a range of materials for use in temperatures from minus 55 degrees Celsius (C) to 200 degrees C (minus 67 degrees Fahrenheit [F] to 392 degrees).

For more information: Veronica Cormier, Tyco Electronics, 300 Constitution Drive, Menlo Park, CA 94025 U.S. Telephone: +1 (650) 361-4470.

Flame-stopping Paper Provides Fuselage Burn-through Protection

Nextel 312 Flame Stopping Dot Paper provides protection against fire in the fuselage, galleys, cockpits, cargo bays, firewalls and fire doors, said the manufacturer, 3M.



Flame-stopping Paper

Tests show that Flame Stopping Dot paper in a fuselage can increase escape time for occupants of a burning aircraft by up to five minutes, the manufacturer said. The paper does not melt, burn or shrink when exposed to fire and survives a 15-minute 2,000-degree-Fahrenheit (1,093-degree-Celsius) firewall test without flame penetration.

For more information: 3M, 3M Center, St. Paul, MN 55144-1000 U.S. Telephone: (877) 992-7749 (U.S.) or +1 (651) 737-5102.

Compact Battery Chargers Designed for Small Spaces

Guest Industrial battery chargers are compact battery chargers designed for use in small spaces, said the manufacturer.

The battery chargers are about one-third the size and half the weight of

traditional transformer chargers and are housed in waterproof, shockproof, epoxy-potted cases designed to withstand exposure to caustic chemicals and gases. The battery chargers are available in 38 standard models, from six volts, 0.5 amperes to 36 volts, 15 amperes, and other models can be ordered to meet specific charging needs, the manufacturer said.

For more information: Guest Industrial, Marinco Industrial Group, 2655 Napa Valley Corporate Drive, Napa, CA 94558 U.S. Telephone: (800) 767-8541 (U.S.) or +1 (707) 226-9600.

Compact Battery Charger

Automatic Screw Feeder Feeds Two Screws Per Second

The Quicher automatic screw feeder can feed up to two screws per second and operates with a range of screw types and screw sizes, said the manufacturer, ASG.

The Quicher operates by automatically aligning screws that have been poured into a hopper and presenting them for pick-up. The screw feeder accommodates screws from sizes #000 to #4 and screws with plain washers or lock washers and non-standard head styles.

Screw Feeder

For more information: Bonnie Kitchen, ASG, 15700 S. Waterloo Road, Cleveland, OH 44110 U.S. Telephone: +1 (216) 486-6163.

Open-head Ratchet Designed for Easy Cleaning

A 0.5-inch (1.3-centimeter)-drive open-head ratchet is designed for easy cleaning and use in grimy environments, said the manufacturer, Wright Tool Co.

The model 4480's open-head design allows the user to observe, without disassembling the ratchet, whether the ratchet teeth are dirty or are failing to engage properly. The one-hand reversible model 4480 has 30 teeth and an arc swing of 3.25 inches (8.3 centimeters). The tool's reverse lever will not accidentally reverse if the tool is bumped during work in small spaces.

For more information: Wright Tool Co., One Wright Drive, P.O. Box 512, Barberton OH 44203 U.S. Telephone: (800) 321-2902.

Open-head Ratchet

Hydration System Provides Hands-free Access to Drinking Water

The WaterPro provides hands-free access to drinking water for workers wearing protective clothing or for workers who cannot leave their workstations, said the manufacturer, CamelBak Products.

Workers can carry water in an insulated 50-ounce (1.5-liter) container in a device that resembles a backpack and can drink the water through a tube. The container can be filled from any faucet or drinking fountain and has an opening large enough for ice cubes.

For more information: CamelBak Products, 1310 Redwoods Way, Suite 200, Petaluma CA 94954-6514 U.S. Telephone: (800) 767-8725, ext. 288 (U.S.) or +1 (707) 792-9700.♦

Hydration System