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

Robert A. Feeler, editorial coordinator

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Loose Cylinder Nuts Cited in Fatal Ditching

The U.S. National Transportation Safety Board said that the engine failure preceding the ditching of the Cessna 402C resulted when the nuts backed off the studs after 'the application of insufficient torque … during undocumented maintenance.'

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FSF Editorial Staff

Inadequate maintenance led to an engine failure in an Air Sunshine Cessna 402C that was ditched in the Atlantic Ocean on July 13, 2003, the U.S. National Transportation Safety Board (NTSB) said.[1]

The ditching occurred about 1530 local time, 7.35 nautical miles (13.61 kilometers) west-northwest of Treasure Cay Airport (MYAT), Treasure Cay, Great Abaco Island, Bahamas. Two of the nine passengers died after evacuating the airplane, the pilot and three passengers received minor injuries, and four passengers were uninjured. The airplane was substantially damaged.

In the final report on the accident, NTSB said that the probable cause was "the in-flight failure of the right engine and the pilot's failure to adequately manage the airplane's performance after the engine failed. The right-engine failure resulted from inadequate maintenance that was performed by Air Sunshine's maintenance personnel during undocumented maintenance."[2]

The accident occurred during the fourth flight on the second day of a two-day trip sequence. The pilot said that he conducted a preflight inspection of the airplane before takeoff from Fort Lauderdale, Florida, U.S., for what was to have been a 70-minute flight to MYAT.

About 45 minutes to 50 minutes after takeoff, during a descent to 3,500 feet from a cruise altitude of 7,500 feet, the pilot "heard a bang and saw oil coming out of the right-engine cowling," the report said. The airplane was about 20 nautical miles (37 kilometers) to 25 nautical miles (46 kilometers) from MYAT.

"Several … passengers reported seeing white smoke coming from the right engine," the report said. "These passengers stated that the smoke was followed by a stream of oil and a loud bang. They reported seeing parts falling from the engine after they heard the loud bang."

The pilot said that, after hearing the bang, he reduced power on the right engine. He said that he tried to feather the propeller (i.e., to rotate the propeller blades to a position parallel to the line of flight to reduce drag) and to shut down the engine, but the propeller continued to windmill (i.e., to turn slowly). He observed that the engine magnetos had penetrated the engine cowling and were hanging from wires.

He was unable to maintain altitude and slowed the airplane to its best single-engine rate-of-climb airspeed of 105 knots, which resulted in a descent of 200 feet per minute (fpm) to 300 fpm. He said that, after a radio conversation with the Air Sunshine station manager at MYAT, he slowed the airplane to 95 knots in an attempt to maintain altitude; after the airplane descended to about 1,500 feet to 1,000 feet, he "realized the airplane could not make it to the airport and that he would have to ditch the airplane," the report said.

The station manager alerted authorities, and a U.S. Coast Guard airplane arrived at the site 55 minutes after the accident, followed 27 minutes later by two Coast Guard helicopters and a private fishing boat whose personnel were called by the Bahamian police.

Operations Center on Florida, Caribbean

Air Sunshine was formed in 1982 and began operating charter flights under U.S. Federal Aviation Regulations Part 135; the following year, scheduled Part 135 commuter flights began. At the time of the accident, the flights — in South Florida and the Caribbean — were conducted with seven Cessna 402C airplanes and one Embraer 110 airplane; three flights to four flights were operated from Fort Lauderdale,

and six flights to eights flights were operated from San Juan, Puerto Rico, U.S.

Air Sunshine typically employed three airframe-and-powerplant (A&P) mechanics and one or two assistant mechanics in San Juan and four A&P mechanics and three assistant mechanics in Fort Lauderdale. Most inspections of the Cessna 402C airplanes were performed in San Juan because most of the flights involving those airplanes were conducted to and from there.

Since March 26, 1987, Air Sunshine airplanes had been involved in four incidents and six accidents, including three fatal accidents in which a total of six people were killed. No mechanical malfunctions were associated with either of the first two fatal accidents.

Six Years on the Job

One month before the accident, the airplane's engines were inspected by the company's director of maintenance and an assistant mechanic.

The Air Sunshine director of maintenance had been employed in that position since October 1997, seven months after he was hired as a mechanic.

Previously, he had been hired in March 1985 as an assistant mechanic for a charter operator in Miami, Florida, working on Cessna 402 airplanes. In mid-1990, he became a mechanic at the same company, where he worked until mid-1996, when he became a mechanic for a Pembroke Pines, Florida, company, working on Cessna 402s, 210s and 206s; Piper Cherokees; Britten-Norman Islanders; and Beechcraft 55 and 58 Barons. He also worked part-time from January 1988 until March 1989 as an assistant mechanic on Lockheed L-1011 and McDonnell Douglas DC-10 airplanes.

In October 1989, he applied for an A&P certificate based on his work experience. On Oct. 24, 1990, he took the required oral examination and practical examination and failed portions of the practical exam involving weight and balance; completion of U.S. Federal Aviation Administration (FAA) Form 337 (for reporting major aircraft repairs and alterations); and troubleshooting turbine engine problems. After additional training in these areas, he passed the practical exam Oct. 30, 1990, and received his A&P certificate.

A search of FAA records showed no enforcement actions involving the director, the report said.

The assistant mechanic was hired in June 2000 in San Juan and was transferred to Fort Lauderdale in March 2003. He did not have an A&P

certificate. In March 2003, the director of maintenance signed a certificate of training to indicate that the assistant mechanic had completed 30 hours of basic indoctrination training. In April 2003, the director signed another certificate of training to indicate that the assistant mechanic had completed 200 hours of on-the-job training for the "entire aircraft, airframe, engine, propeller, accessories, etc.," the report said.

Extensive Maintenance

The accident airplane was manufactured by Cessna Aircraft Co. in 1980 and was operated by several airlines before being sold in August 1997 to Tropical International Airlines, which was owned and operated by the same people who own and operate Air Sunshine. Extensive maintenance was performed on the airplane at the company maintenance facility in Fort Lauderdale from 1997 until late 2000; in November 2000, an inspection was performed in accordance with Air Sunshine's FAA approved aircraft inspection program (AAIP), and the airplane was found to be airworthy. It was added to the Air Sunshine operations specifications in December 2000.

The airplane was equipped with two Teledyne Continental Motors (TCM) TSIO-520-VB reciprocating engines, which are turbocharged and fuel-injected. The engines are rated at 325 horsepower (242 kilowatts) up to 12,000 feet under conditions including a power setting of 2,700 revolutions per minute and manifold pressure of 39 inches of mercury.

The engines have six horizontally opposed air-cooled cylinders in an "overhead inclined-valve design," the report said. "The cylinders have updraft-intake inlets and downdraft-exhaust outlets mounted to the underside of the cylinder heads. Each of the six cylinders is attached to the engine case by a series of threaded studs, through bolts and nuts. Six 7/16-inch [11-millimeter], 20 threads-per-inch studs are threaded into the case half for exclusive use at each cylinder location and are held down by six-point [castellated] nuts. Additional studs are positioned between the cylinders and are shared by adjacent cylinders. Two 0.5-inch [13-millimeter] through bolts, which are located at the engine crankshaft main-bearing positions, are either shared by opposed cylinders or the opposite crankcase half and are held down by 12-point nuts."

The right engine was manufactured by TCM in February 1991, and the left engine was manufactured in January 1997. Both engines were overhauled by Airmark Overhaul in Fort Lauderdale in December 1999; at the time of overhaul, the right engine had 3,583 operating hours since new and the left engine had

2,400 operating hours since new. The engines were installed on the accident airplane in October 2000; when the accident occurred, both engines had 2,271 hours since overhaul. The last routine engine maintenance was performed July 8, 2003, and included an oil change, oil-filter inspection, a search for leaks and a ground run-up.

The airplane had two McCauley Propeller Systems 3AF32C505-C three-blade, dual-acting, constant-speed propellers that were equipped with counterweights to help in feathering the propellers.

Airline Used Six-phase AAIP

Beginning in 1992, Air Sunshine received FAA approval to operate its own aircraft-inspection program. The initial AAIP was a three-phase, 60-hour program in which a different phase was performed every 60 operating hours, and a full inspection cycle was completed every 180 operating hours; in addition, at every phase, an engine oil change, a ground run-up and a visual inspection of the airframe were performed.

During subsequent years, the AAIP was revised several times, and in November 2002, Air Sunshine submitted revision no. 10, which proposed a six-phase, 60-hour inspection program (so that a full inspection cycle was completed every 360 operating hours). This inspection program, which was approved by FAA in January 2003, was in effect when the accident occurred.

In accordance with the six-phase AAIP, a phase 1 inspection — covering the powerplants and including a focused engine inspection and a differential compression check of engine cylinders — was performed June 12–14, 2003, in Fort Lauderdale. At the time of the inspection, each engine had 2,189 hours since overhaul.

Differential compression checks are intended to identify leaks in engine cylinders. TCM Service Bulletin (SB) 03-3 says that leaks can be caused by abnormal wear or excessive wear inside an engine cylinder or an engine-cylinder component, problems with valves or valve seats, and cylinder cracks. SB 03-3 says that differential compression checks should be conducted "at each 100-hour interval, annual inspection or when cylinder problems are suspected," and outlines a seven-part process for performing the checks.

During the differential compression check that was included in the June 12–14 phase 1 inspection, the director of maintenance performed the checks on the left engine "while the assistant mechanic watched and then recorded the readings in the inspection record," the report said.

"The director of maintenance stated that, after completing the checks on the left engine, he asked the assistant mechanic if he felt capable of performing the checks on the right engine without supervision. The director stated that the assistant replied that he could perform the checks; as a result, the director left the assistant to perform the checks by himself without supervision."

The report said that, during post-accident interviews, "the assistant mechanic stated that he had never performed a differential compression check before conducting the checks on the accident airplane's right engine. The assistant stated that his normal duties included changing oil, tires, cables and spark plugs and cleaning the airplane. When [an NTSB] investigator asked the assistant how to perform the compression check, he stated only that the spark plugs had to be removed from the cylinders and that the piston had to be at top dead center on its compression stroke." (These were the first two parts of the seven-part process described in SB 03-3.)

The director of maintenance said that when he reviewed the pressure-leakage information recorded by the assistant mechanic, he observed that two readings — zero pounds per square inch (psi) for the no. 2 cylinder and 20 psi for the no. 4 cylinder — were "highly questionable" and told the assistant mechanic that the differential compression checks on the right engine cylinders had to be repeated, the report said. (The report said that NTSB had determined that, considering the equipment used to perform the checks, the acceptable pressure-leakage limit was 54 psi; the director of maintenance said that he considered any reading below 58 psi "too low, and that low readings would require that the cylinder be rechecked.")

The report quoted the director of maintenance as saying that, when he repeated the checks, the readings for each cylinder were "in the 70-psi range." If the readings had remained low, he would have grounded the airplane, he said.

"The director stated that he recorded the corrected readings on a new cylinder differential compression check form; however, company personnel did not locate the corrected form," the report said. "The director stated that he did not conduct cylinder borescope inspections on cylinder nos. 2 and 4 because the repeated compression checks yielded readings that were within acceptable limits."

During the investigation, no documents were found for the repeat of the differential compression check, and no records were found to indicate that other inspections or corrective maintenance had been performed on

the right engine cylinders after the low readings were obtained. In addition, no records were found to indicate that any of the right engine cylinders had been removed since the 1999 engine overhaul, the report said.

Warnings on Use of Anti-seize Compound

The director of maintenance said that the company had removed and replaced engine cylinder assemblies five times or six times during the three years preceding the accident and that, as replacement assemblies were being installed and "before applying torque to the cylinder studs, maintenance personnel coated the studs with an aluminum-copper-graphite, lithium-based anti-seize compound manufactured by Permatex," the report said.

"TCM SB 96-7B specifies that clean 50-weight aviation-grade engine oil should be applied to the studs and through bolts before applying torque. Permatex does not recommend using anti-seize compound in high-vibratory environments because such use could contribute to the loss of torque."

Extensions Granted For Time Between Overhauls

TCM recommends, in Service Information Letter 98-9A, that TSIO-520-VB engines be overhauled every 1,600 operating hours, and Air Sunshine initially operated in accordance with that recommendation. In 1992, after the Air Sunshine AAIP was approved, the company received approval from the FAA flight standards district office (FSDO) in Fort Lauderdale for a 200-hour extension. Between late 1992 and late 1995, FSDO approval of four additional requests resulted in extending the time between overhaul (TBO) to 2,400 operating hours. The company's operations specifications were changed to reflect the 2,400-hour TBO, with the condition that the engines be rebuilt by TCM at TBO.

The report said that soon after Air Sunshine transferred its operations certificate to the San Juan FSDO in late August or early September 1999, the company asked for removal of the requirement to use TCM rebuilt engines. The request was granted by the FAA principal maintenance inspector (PMI) for Air Sunshine on Sept. 9, 1999, with the following conditions:

- Air Sunshine was required to monitor the performance of the overhauled engines and report abnormal conditions to the San Juan FSDO;
- Air Sunshine was required to use FAA-approved overhaul facilities; and,
- Air Sunshine was required to establish standards for parts to be used in the overhaul process.

The PMI said that if engine performance was unsatisfactory, Air Sunshine operations specifications would be revised to require a 1,600-hour TBO.

Inconsistent Cylinder Markings

The accident investigation revealed that the right engine no. 2 cylinder assembly had separated from the engine crankcase and that the no. 2 cylinder skirt area (the inboard portion that projects into the crankcase) was "damaged and deformed" in several places.

The investigation also revealed that the cylinder assemblies for cylinders no. 1 through no. 5 were marked with the letters "EC," which were steel-stamped into the cylinder heads; this indicated that the cylinders were manufactured by Engine Components Inc. (ECI). Each of the five cylinders also was marked with steel-stamped numbers 29689-1 through 29689-5; these numbers corresponded with the work-order number for the last engine overhaul performed by Airmark Overhaul, and the position of the cylinder (no. 1 through no. 5).

The markings on the no. 6 cylinder "were not consistent with those on an ECI-manufactured cylinder," the report said. Instead, the letters "DET" and "E" and the number "99" were steel-stamped into the cylinder head, and the number "33258-3" was steel-stamped into one of the valve rocker bosses. That number corresponded with a work-order number for a propeller-strike inspection performed on another of the company's engines with the serial number 816113-R. Another valve rocker boss was vibro-etched with the number "7-99." (Other than the "33258-3" on the valve rocker boss, the report did not discuss the likely meanings of the letters and numbers stamped on the cylinder.)

"Air Sunshine's general manager stated that, according to company records, the [no. 6] cylinder … was a cylinder previously installed in the no. 3 position on another one of the company's engines, serial no. 816113-R, which was installed on [another airplane]," the report said. "The general manager stated that, from January to July 2001, engine serial no. 816113-R was not installed on [the other airplane] and that, during that time, the engine 'was basically sitting in (the company's) parts room.'

"He added that the no. 3 cylinder from engine serial no. 816113-R must have been installed on the accident engine at some point during that time. However, the maintenance records for [the other airplane] did not indicate that the no. 3 cylinder had ever been removed or replaced from engine serial no. 816113-R. Further, a review of Air Sunshine's maintenance records

revealed no reports to the FAA that any of the company's engines were running unsatisfactorily from the date that its operations specifications were amended (Sept. 9, 1999) to the date of the accident."

Studs, Bolts Were Fractured

The investigation showed that the right engine no. 2 piston was broken into two large pieces and numerous smaller pieces. The fractures revealed "features consistent with overstress separations" but no indications of pre-existing cracks, the report said.

Both the left half and the right half of the right engine crankcase were damaged adjacent to the no. 2 cylinder connecting rod; the report described the damage to the left half as "consistent with continued rotation of the engine and flailing of the connecting rod after the complete separation of the cylinder."

The report said that, of eight hold-down studs and two through bolts that held the no. 2 cylinder to the right engine crankcase, "three of the studs were found intact in the crankcase without nuts, four of the studs and the two through bolts were found fractured, and one of the studs was not found."

Examination of fractures in four hold-down studs and two through bolts found indications of high-stress, low-cycle fatigue propagation, the report said.

"Initiation was from multiple locations in a thread root along one side of the fastener," the report said. "The fatigue propagated in a high-stress manner with parallel fissures and striations until ductile overstress occurred at about 50 percent of the fastener's cross-section. Some spots of corrosive material were visible at random areas across the fractures; however, little or no oxidation or corrosion was apparent in the fracture origin areas. A comparison of height measurements of the no. 2 cylinder studs' features with features on other cylinder studs in the engine crankcase revealed that the studs had been installed to similar depths."

Examination of the cylinder hold-down nuts from the no. 1, no. 3, no. 4, no. 5 and no. 6 right engine cylinders found that the nuts were of two types: Seven nuts had a "concave transition from the wrench flats to the enlarged washer flange" and were "consistent with an exemplar cylinder hold-down nut manufactured by Superior Air Parts with 7/16-20 UNF-3B thread form," and 23 nuts had "a convex transition from the wrench flats to the enlarged washer flange and were embossed with two opposed sets of parallel lines. These nuts were consistent with TCM flanged nuts with

the optional, nonstandard Spiralock thread form."[3]

The report said that TCM has "exclusively procured cylinder hold-down nuts with the Spiralock thread form" since about 1990.

The Airmark Overhaul quality assurance manager said that the company uses original equipment manufacturer (OEM)-specified hold-down nuts or nuts provided by Superior Air Parts.

"The manager stated that, since he began working at Airmark in April 1984, if the company was overhauling an engine and 36 six-point cylinder hold-down nuts were needed, and 24 with a TCM part number and 12 with a Superior Air part number were in stock, both types of nuts would be used to complete the overhaul rather than hold up production," the report said. "He stated that this procedure was 'accepted in industry.'"

Post-accident Inspections Found Maintenance Discrepancies

The FAA PMI for Air Sunshine planned to conduct 18 inspections (facilities inspections in Fort Lauderdale and San Juan, ramp inspections, spot checks, aircraft-records inspections and maintenance-records inspections) during the fiscal year that began Oct. 1, 2002. By July 8, 2003, 13 of the inspections had been conducted.

In a letter to Air Sunshine after a March 2003 inspection of the Fort Lauderdale facility, the PMI said that he found five discrepancies related to the maintenance manual. After a July 2003 inspection of the San Juan facility, the PMI wrote that he found three discrepancies related to the maintenance manual and three discrepancies related to aircraft records. (The report said that "none of the aircraft-records-related discrepancies involved the accident airplane.")

After the accident, the Fort Lauderdale FSDO conducted two facility inspections, which resulted in findings that scales were out of calibration and cargo was not secured; 21 ramp inspections, which found numerous maintenance-related discrepancies with Air Sunshine's Cessna 402C airplanes; and five spot inspections, which found numerous maintenance-related discrepancies," the report said.

In addition, the San Juan FSDO increased its surveillance of Air Sunshine with 45 inspections of the company between July 14, 2003, and Feb. 25, 2004.

The report said, "From July 22 to August 29, 2003, the San Juan FSDO conducted a focused inspection of Air Sunshine. During this inspection, the FAA determined that the company's record-keeping system was inadequate, its maintenance program was deficient, its passenger-briefing card

and overwater-safety briefing needed to be revised, its pilot training needed to be revised, and its engine compression check interval was too high."

The report said that, as a result of the FSDO inspections and subsequent FAA actions, the deficiencies in Air Sunshine's record-keeping system were corrected, corrective actions for maintenance discrepancies were documented in the company program-tracking and recording system, and the interval for differential compression checks was lowered to 120 operating hours from 360 operating hours.

In addition, the FAA PMI reduced the TBO to the manufacturer-recommended 1,600 operating hours and said that the company's operations specifications would be amended to allow only TCM to rebuild the company's TCM TSIO-520-VB engines. In a subsequent letter to FAA, Air Sunshine's general manager asked FAA to reconsider the requirement that only TCM-rebuilt engines be used and said that the AAIP was being revised to include cylinder inspections every 1,600 hours, including replacement of valves, rings and gaskets.

"The manager also stated that the cylinder inspection would include, if necessary, replacement of valve seats, guides and pistons," the report said. "He added that the company would revise its compression check interval and place additional constraints, such as replacing cylinders if the compression levels fell below the limit established in accordance with TCM SB 03-3. The manager stated that the company had already revised its AAIP to require three compression checks during a [360-hour] inspection cycle. (Compression checks would be conducted once every 120 … hours.)"

The general manager also said that Air Sunshine was "willing to conduct cylinder inspections on the four engines in its fleet that had more than 1,600 … hours" and that the company had ordered a new TCM engine to replace another engine with 2,200 hours.

"The manager also stated that the company had followed all of the guidelines to obtain the TBO extension to 2,400 … hours … and that the company had operated for 11 years and for more than 100,000 … hours under the extended TBO."

'Insufficient Torque' Was Likely Cause of Engine Failure

The report said that the small raised ridges on the forward side of the cylinder mounting face indicated that "the cylinder was rocking on the engine crankcase, pivoting around the through bolt on the forward side of the base flange." One cause of this

rocking motion might have been loose nuts opposite the through bolt, the report said.

"On the basis of the metallurgical evidence, [NTSB] concludes that two or more of the right engine no. 2 cylinder hold-down nuts became loose and backed off of the studs, which resulted in the remaining studs and through bolts fracturing in high-stress fatigue, allowing the cylinder to separate from the engine," the report said.

"The probability that two or more cylinder hold-down nuts would simultaneously loosen is very low. Therefore, an outside influence, such as the application of insufficient torque to the nuts during maintenance, likely occurred."

Because a nut that has been insufficiently torqued typically loosens soon afterward, the report said that the problem probably did not originate during the June 12–14 differential compression checks, which occurred 83 flight hours before the accident.

"Therefore, the [NTSB] concludes that the simultaneous loosening of two or more of the right engine no. 2 cylinder hold-down nuts resulted from the application of insufficient torque, which was applied by Air Sunshine maintenance personnel during undocumented maintenance," the report said.

Although the Permatex anti-seize substance was not found on the threads of the right engine studs and through bolts, the report said that NTSB was concerned that the substance was being used on Air Sunshine engines and that NTSB "concludes that, at the time of the accident, Air Sunshine's maintenance record keeping and [maintenance] practices were not adequate."

In addition, the report said that the assistant mechanic, who performed the differential compression checks 14 days to 16 days before he completed on-the-job training for the airplane, "should not have been working unsupervised during on-the-job training, which indicated that the company's on-the-job maintenance training was not adequate."

When an accident investigator questioned the assistant mechanic about the differential compression checks, the assistant "did not appear to be familiar with [how to perform] the entire test," the report said.

The Air Sunshine maintenance manual said that two people should conduct differential compression checks, and the report said that, "for the compression checks to be conducted safely and properly, the two people who conduct the checks should have adequate training and experience."

FAA's oversight of Air Sunshine was "in accordance with standard guidelines" but nevertheless "insufficient to detect inadequate maintenance record keeping and [maintenance] practices at the company," the report said.

As a result of the investigation, NTSB issued the following maintenance-related safety recommendations to FAA:

- "Review the procedures used during [FAA] oversight of Air Sunshine, including those for the surveillance and evaluation program and regional aviation safety inspection program, to determine why the inspections failed to ensure that operational and maintenance issues that existed at the company were corrected. On the basis of the findings of this review, modify Part 135 inspection procedures to ensure that such issues, including maintenance record keeping and [maintenance] practices, are identified and corrected before accidents occur."

  (In response, FAA said that relevant sections of FAA Order 8300.10, the *Airworthiness Inspector's Handbook*, would be revised "to enhance inspectors' awareness of inadequate record-keeping systems, timely correction of record-keeping discrepancies and potential risk factors that may indicate undocumented maintenance, deficient maintenance programs and ongoing systemic operator deficiencies that warrant additional follow-up surveillance. The revisions will serve to address the [NTSB's] concern regarding improvement of inspection oversight procedures of … Part 135 … operators to correct maintenance record-keeping [deficiencies] and systemic operator deficiencies.")

- "Develop specific criteria regarding the number of accidents and/or incidents that would cause an increase in oversight of an operator."

  (In response, FAA said, "The focus of FAA's oversight program is to verify that air carrier systems comply with regulatory standards and to validate that those programs perform as intended. FAA surveillance programs are not quality control programs — quality control is an air carrier function. Analysis for the identification of systemic causes of accidents and incidents is important. The FAA factors these systemic causes into adjusting its surveillance programs. The FAA will amend FAA Order 1800.56, *National Program Guidelines*, for fiscal year 2007 [which begins Oct. 1, 2006] to require principal inspectors to consider accident/incident trends, patterns and factors when developing their planned surveillance programs.")

- "Review and revise the process through which the transfer of a Part 135 air carrier's operating certificate from one [FSDO] to another is granted to ensure the adequate oversight of such carriers. Further ensure that, before granting an operator's request to transfer an operating certificate, appropriate geographic oversight is in place at the new office and that the justification for the transfer has been adequately documented and reviewed."

  (In response, FAA said that it would issue a handbook bulletin for airworthiness to revise the process.)♦

Notes

1. U.S. National Transportation Safety Board (NTSB). *In-flight Engine Failure and Subsequent Ditching, Air Sunshine Inc., Flight 527, Cessna 402C, N314AB, About 7.35 Nautical Miles West-northwest of Treasure Cay Airport, Great Abaco Island, Bahamas, July 13, 2003*. Aircraft Accident Report NTSB/AAR-04/03. Oct. 13, 2004.
2. NTSB said that a contributing cause of the two passenger fatalities was "the pilot's failure to provide an emergency briefing after the right engine failed."
3. The Spiralock thread form, in which the internal threads of a nut engage the external threads "at the crests of the stud threads" was developed by Spiralock Corp., a subsidiary of Detroit Tool Industries Co.

MAINTENANCE ALERTS

Contaminated Grease Cited in Nosewheel Detachment

The left nosewheel detached from an Airbus A320-200 during takeoff from London (England) Gatwick Airport. The flight crew was notified of the problem by air traffic control. After flying the airplane in a holding pattern for two hours to reduce fuel, the flight crew landed the airplane at Gatwick. There were no injuries to the seven crewmembers and 177 passengers in the Jan. 15, 2005, accident.

"The nosewheel assembly [of the accident aircraft] consists of two wheels, each running on an inner [bearing] and outer bearing that sits on a sleeve fitted over the axle," the report by the U.K. Aircraft Accidents Investigation Branch (AAIB) said. "A circlip secures the bearing[s] in the wheel hub during transportation. Grease seals are fitted on the outside face of both bearings and the wheel is secured to the axle by the nosewheel-securing nut, which has a right-hand thread. Secondary locking of the nosewheel-securing nut is achieved by two locking bolts fitted with castellated nuts and split

pins. The hubcap is secured by three securing bolts."

The left nosewheel was found near the runway.

"[While] the inner bearing cone and securing circlip were missing, the inner bearing cup was still attached to the wheel," the report said. "The hubcap was still in place, and the three securing bolts were correctly wire-locked. It was noted that a small quantity of grease had been thrown out from under the hubcap across the outer face of the wheel."

Both nosewheels, including their bearings, had been installed in the airplane at the same time, said the report.

"The damage to the left outer nosewheel-bearing roller large end and rib face indicates that the initiating action was roller-end scoring," the report said. "Roller-end scoring could have been initiated by excessive bearing-end load or a breakdown in the lubrication film."

A high water content in the grease suggested that the most likely cause of the failure of the nosewheel bearings was a breakdown in the lubrication film, said the report.

"Consideration was given as to how the water entered the bearings," the report said. "The operator's maintenance organization hand-wash[es] the undercarriage and [has] a procedure in place to ensure that pressurized water is not applied to the wheel areas; moreover, none of the wheels sampled from six of the other aircraft in the operator's fleet had excessively high levels of water in the grease."

Washing and handling during maintenance were a possible source, but not a likely source, of the contamination, said the report.

"However, the aircraft had been operating to several European destinations during a particular[ly] wet period, and it is possible that it was during this period that the bearing grease was contaminated with water," said the report.

FAA Targets Fuel-tank Explosions

The U.S. Federal Aviation Administration (FAA) has proposed a rule that would make aviation "significantly safer" by reducing the flammability of vapors in airplane center fuel tanks. The notice of proposed rule making (NPRM) would affect more than 3,200 transport category jets, as well as new large-airplane designs, in the U.S. aircraft fleet.

The proposed rule is designed to reduce the possibility of fuel-tank explosions. Four fatal explosions have

occurred since 1989, with a total of 346 fatalities, FAA said.

(The four explosions included Avianca Flight 203 in Bogotá, Colombia, in 1989, in which a terrorist bomb detonated in flight, failing to compromise the airplane's structural integrity but causing an explosion in the center fuel tank that destroyed the airplane with a loss of 107 lives; TWA Flight 800, which was destroyed off Long Island, New York, U.S., in 1996, with 230 fatalities; and two other explosions that occurred on the ground, resulting in nine fatalities.)

During the past nine years, FAA has issued more than 70 directives intended to eliminate ignition sources and to change fuel-tank design and maintenance.

The NPRM does not specify a means of reducing the flammability of fuel-tank vapors, but FAA engineers have developed a method of replacing oxygen in the fuel tank with an inert gas. Boeing Commercial Airplanes has developed its own system that it will install on new models, FAA said.

Airlines would be given seven years in which to retrofit vapor-reduction systems in existing aircraft, FAA said. The first types to be retrofitted would be the Airbus A320, Boeing 737 and B-747. Other models for which compliance would be required include the A330, B-757, B-767 and B-777.

The NPRM can be accessed on the Internet at <www.faa.gov/regulations>. The 120-day comment period closes March 20, 2006.

Power-conversion Components Cause Electrical-system Failure

A Boeing 717-200 was being operated as a scheduled passenger flight from Hartsfield-Jackson International Airport, Atlanta, Georgia, U.S. According to the captain, at about 200 feet on initial climb, the no. 6 display unit on the instrument panel went blank. The engine-alert display "LEFT GENERATOR OFF" alert illuminated. A complete electrical power failure then occurred.

"Emergency electrical power was restored shortly after the electrical failure," the report by the U.S. National Transportation Safety Board said. "The flight attendants advised the captain that there was smoke in the aft part of the cabin area. The captain and first officer 'smelled an electrical burning smell' and declared an emergency."

The crew flew the airplane to the departure airport and conducted an emergency landing. The airplane

was evacuated on the runway. The two pilots, three flight attendants and 116 passengers were not injured in the March 5, 2004, incident.

"Examination of the power conversion distribution unit revealed that the tantalum capacitor and the permanent-magnet-generator input transformer [had] failed," said the report.

Malfunction of Deicing System Cracks Windshield

When a Beech 1900D's windshield deicing system was activated at an altitude of 11,000 feet during cruise flight, four cracks or five cracks began at the bottom left corner of the first officer's windshield. The cracking progressed until the cracks spread throughout the windshield.

The captain called for the "Cracked or Shattered Windshield" checklist and completed the checklist. The airplane was landed uneventfully. The pilots, the only occupants, were not injured in the April 9, 2004, incident.

The report by the U.S. National Transportation Safety Board said, "The windshield, part no. 1010-384025-18, had 2,176 hours total time since new. The windshield had been rebuilt in May 2001. An extra temperature sensor and terminal block had been added to the original windshield."

The windshield glass showed thermal damage and sooting between the glass layers where the cracks originated, at the lower edge of the heating element, said the report.

"An examination of the hub seal, around the outer edge of the glass and aluminum frame, showed evidence of deterioration," the report said. "The seal showed areas where it had come loose from the frame. Several cracks were observed in the seal material. Additionally, there was evidence of water intrusion between the glass plies. The intrusion damage extended along much of the lower edge of the windshield. The windshield heating element was corroded in the areas where water intrusion was observed."

The report said that the probable cause of the incident was "arcing of the windshield deicing system. Factors contributing to the incident were the improper inspection of the windshield's exterior seal, deterioration of the windshield seal and water penetration through the deteriorated seal."

Maintenance Manual Lapse Cited in Cowling Separation

A McDonnell Douglas DC-10-30 was en route from Naples, Italy, to Norfolk, Virginia, U.S., on a public use,

nonscheduled passenger flight. While cruising at 32,000 feet, the airplane "shuddered and bounced" for one-half second, a flight attendant heard a bang from the aft section of the airplane and the crew then felt a slight vibration. The crew noted that indicated fuel burn was about 1,000 pounds (454 kilograms) per hour higher than expected.

The crew continued the flight to the destination and landed the airplane uneventfully. There were no injuries to the three flight crewmembers, nine cabin crewmembers and 240 passengers.

Inspection revealed that the right engine cowling had separated from the no. 2 engine.

"Approximately 40 percent of the right inboard elevator had separated, consistent with the elevator being struck by the engine cowling," said the report by the U.S. National Transportation Safety Board.

Further inspection by a U.S. Federal Aviation Administration (FAA) investigator found that the engine cowling upper forward hinge, which required three bolts, had only one bolt that remained attached. The investigator found no indication that the other two bolts had separated during flight. The investigator also noted fretting in the area of the bolt holes, consistent with oscillation over time because of the absence of two bolts.

"The FAA investigator added that the airliner maintenance manual required a general inspection of the area but did not specifically mention cowling hinge bolts," the report said. "In addition, the hinges were located in an area that was not easily accessible to maintenance personnel. The investigator subsequently submitted a safety recommendation to have the cowling hinge bolts inspected [at] every 'D' check."

The report said that the probable cause was "the failure of the no. 2 upper forward right engine cowling attachment, which resulted in substantial damage to the right inboard elevator. A factor was the inadequate procedures in the airliner maintenance manual."

Fuel Blockage Starves Engine

Soon after lift-off from a farm at Naboomspruit, South Africa, the pilot of a Robinson R22 Beta helicopter noted that engine rpm (revolutions per minute) was decreasing. The engine failed while the helicopter was 100 feet to 150 feet over bush-type terrain.

At an indicated airspeed of 50 miles per hour (80 kilometers per hour), the pilot initiated an autorotation. Maneuvering to avoid the trees, he positioned the helicopter too close to

the ground to flare, and the aircraft struck the ground in a level attitude with full collective pitch applied.

"According to the pilot, ground impact did not feel excessively heavy, with the left skid touching first, followed by a bounce with the right skid digging into the soft ground, resulting in a rollover to the right," said the report by the South African Civil Aviation Authority.

The pilot, the only occupant, was slightly injured in the March 18, 2004, accident.

The report said that the probable cause was that "the engine failed as a result of fuel starvation, which was most probably caused by the presence of a vacuum that formed within the main fuel tank as a result of the blockage of the main fuel tank vent, as well as the interconnecting tank vent."♦

NEWS & TIPS

Can't Wait to Watch Paint Dry?

The StripIR series of strip heaters uses parabolic reflectors to direct infrared heat to narrow areas. Typical applications are drying paint, curing adhesive and heating shrinkable tubing.

The lamps reach 90 percent of full operating temperature within three seconds of a cold start, and the heat dissipates to 10 percent within five seconds after power is removed, the manufacturer says. The configuration and infrared energy are said to be adjustable to match the heating requirements of various applications.

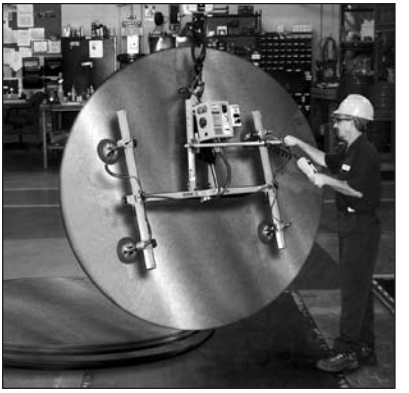
The modular design of the product allows units to be installed in a variety of configurations as needed.

For more information: Research Inc., 7128 Shady Oak Road, Eden Prairie, MN 55344 U.S. Telephone: +1 (952) 941-3628.

Need a Lift?

The Anver ETC Series Powered Vacuum Lifter/Tilter is designed to let one person easily handle, maneuver and position awkward loads. Equipped with an ergonomic gripping area, the lifter grasps objects with adjustable cross-arms and vacuum-suction pads that have spring-loaded suspensions.

A variety of suction pads in different shapes, sizes and materials are available to accommodate the user's requirements. Applications include lifting and positioning steel, plastic, fiberglass and composite materials



Vacuum Lifter/Tilter

weighing as much as 500 pounds (227 kilograms).

For more information: Anver Corp., 36 Parmenter Road, Hudson, MA 01749 U.S. Telephone: 1 (800) 654-3500 (U.S.); + 1 (978) 568-0221.

Maintenance Courses Offered at Heli-Expo

Helicopter Association International (HAI) will offer a series of maintenance courses between Feb. 22 and Feb. 25, 2006, in connection with its Heli-Expo 2006 in Dallas, Texas, U.S.

Courses will include Helicopter Maintenance Management (Feb. 22–25); Helicopter Vibration-Health-Usage Monitoring (Feb. 24–25); Human Performance in Helicopter Maintenance (Part 1, Feb. 21–22; Part 2, Feb. 23–24; Part 3, Feb. 25); and Regulatory Compliance: Airworthiness and Maintenance Issues (Feb. 25).

For more information: Helicopter Association International, 1635 Prince St., Alexandria, VA 22314 U.S. Telephone: +1 (703) 683-4646.

Let There Be LED

A light-emitting diode (LED) flashlight with a flexible, durable 14-inch (36-centimeter) cable, the JR Luxeon Reach is designed to be bent around mechanical parts to illuminate inaccessible or concealed areas.

Flexible LED Flashlight

The flashlight operates as long as three hours at maximum intensity (24 lumens), powered by two AA-size alkaline batteries. A magnetic clip holder allows the unit to be attached to any metal surface. The lamp housing, with an unbreakable polycarbonate lens, is connected to the cable by a water-resistant O-ring.

For more information: Streamlight Inc., 30 Eagleville Road, Eagleville, PA 19403 U.S. Telephone: 1 (800) 523-7488 (U.S.); +1 (610) 631-0600.♦

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