Installation Error

Inadequate follow-ups failed to identify the maintenance error cited in the crash of an AS350 on an EMS positioning flight, the NTSB says.

BY LINDA WERFELMAN

An improperly installed part was to blame for the engine failure and subsequent crash of a Eurocopter AS350 B3 during an emergency medical services (EMS) positioning flight in Tucson, Arizona, U.S., on July 28, 2010, the U.S. National Transportation Safety Board (NTSB) says.

The pilot and two medical personnel were killed when the helicopter, which had been cruising at 800 ft, entered a rapid descent and struck a 5-ft-high (2-m-high) concrete wall. The wall penetrated the fuselage and the fuel tank. The helicopter, operated by Air Methods as a LifeNet flight, was destroyed by the impact and subsequent fire.

In its final report on the accident, the NTSB said the probable causes were that "the repair station technician did not properly install the fuel inlet union[1] during reassembly of the [Turbomeca Arriel 2B1] engine, the operator's maintenance personnel did not adequately inspect the technician's work, and the pilot who performed the post-maintenance check flight did not follow the helicopter manufacturer's procedures."

Other causes were the "lack of requirements by the [U.S.] Federal Aviation Administration [FAA], the operator and the repair station for an independent inspection of the work performed by the technician," the report said.

Photos: Jim Kuhn/Wikimedia and © Les Cunliffe/Dreamstime.com

The report also identified as a contributing factor the FAA's "inadequate oversight of the repair station, … which resulted in the repair station performing recurring maintenance at the operator's facilities without authorization."

The accident flight originated at 1342 local time at Marana Regional Airport in Tucson, where the helicopter had undergone engine maintenance; the planned destination was the Air Methods base in Douglas, about a 55-minute flight to the southeast (Figure 1).

About six minutes after departure, the helicopter began a rapid descent, which became increasingly vertical as it neared the ground. Witnesses said they heard "whump, whump" sounds and "rapid intermittent popping sounds, which were followed by unusual quietness," before the impact.

Accident investigators said that the helicopter's descent rates, calculated by examining the last 10 seconds of radar data, "were consistent with an autorotation," and they theorized that the pilot had tried to conduct an autorotative approach to an open intersection about 300 ft (92 m) beyond the accident site but was stymied by a row of power lines 40 ft (12 m) above the ground; the helicopter's rotor speed decreased as the pilot maneuvered over the power lines, and the helicopter plunged to the ground.

Veteran Pilot

The 61-year-old pilot had more than 13,900 flight hours, including 9,465 hours in helicopters, 4,500 hours in single-engine airplanes and 100 hours of instrument time. He had a commercial pilot certificate, with ratings for single-engine land airplane and rotorcraft-helicopter, along with an instrument rating for both airplanes and helicopters.

He was hired by Rocky Mountain Helicopters, later acquired by Air Methods, in 2002, after he retired as a pilot for the U.S. Border Patrol. He previously had flown for the U.S. Army.

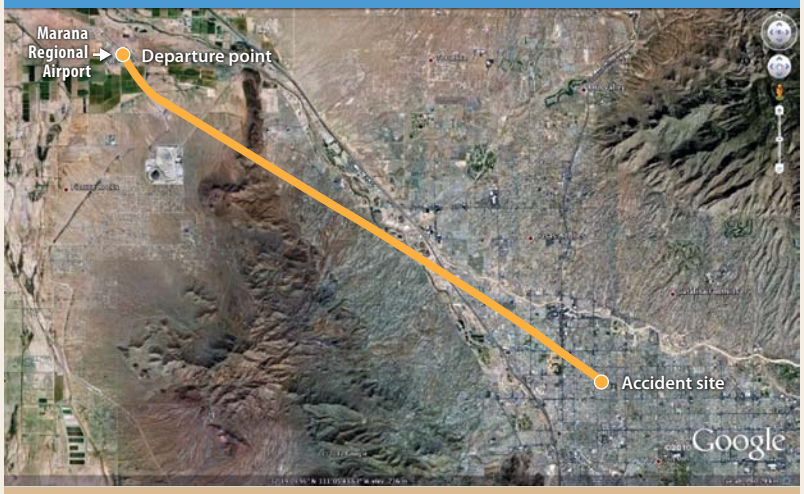
He completed AS350 transition training with Aerospatiale (now Eurocopter) and was qualified as pilot-in-command in 1989. He received training in the AS350 B3 in August 2002. He received satisfactory grades in all portions of his most recent competency/proficiency check, conducted in September 2009. The accident report said that a review of his training records for the previous four years showed 11.3 hours of training and proficiency check flights but no training flights after September 2009 during which he would have practiced autorotation.

"The lack of recent autorotation training/practice, although not required, may have negatively impacted the pilot's ability to maintain proficiency in engine failure emergency procedures and autorotations," the report said. "However, because the engine failed suddenly at low altitude over a congested area, more recent training may not have changed the outcome."

The airframe and powerplant technician who worked on the accident helicopter had worked for Helicopter Services of Nevada (HSN) since September 2009 as director of maintenance for Turbomeca engines, supervising the work of four mechanics. He previously worked at Turbomeca for 23 years and completed initial Level 3[2] Turbomeca training in 1998.

Most of the work performed by the HSN technicians was field work — repairs and Level 3 maintenance — through a contract with Turbomeca.

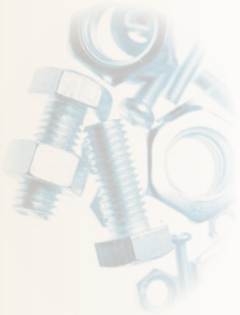
Track of Accident Flight



Source: U.S. National Transportation Safety Board

Figure 1

A duty pilot performed a 7.5-minute post-maintenance check flight.



Air Methods was founded in 1980 and now conducts helicopter EMS operations in 45 states. It acquired LifeNet in 2002.

The company's pilot training program says that recurrent training should include four hours of ground training for visual flight rules (VFR) operations and another four hours for instrument flight rules (IFR) ground training, and recommends at least two hours of VFR flight training and four hours of IFR flight training.

"However," the report said, "an instructor can recommend a flight test before the completion of the recommended hours."

Company check airmen told accident investigators that around the time of the accident, each pilot underwent a training flight every six months. A training flight typically included standard commercial maneuvers, various approaches and landings, engine failures, simulated hydraulic system failures, instrument flight and an instrument approach, and concluded with "three to five practice autorotations … [which] terminate in a 3- to 5-ft hover power recovery," the report said.

Fuel Coking

The accident helicopter was manufactured in 2009 and purchased by Air Methods the same year. When the accident occurred, it had accumulated 352 hours total time. The most recent maintenance was a 20-hour engine inspection performed the day before the accident.

The inspection followed work that was done on the helicopter because of fuel coking — a problem involving carbon deposits on the injection manifold[3] that does not affect flight performance but can interfere with engine starting, the report said.

Replacement of the injection manifold is categorized as Level 3 maintenance, and because Air Methods maintenance personnel were authorized for only Level 1 and Level 2 maintenance, the replacement was performed by the HSN technician. The HSN technician then reassembled the engine, including the fuel inlet union (Figure 2).

Inspections

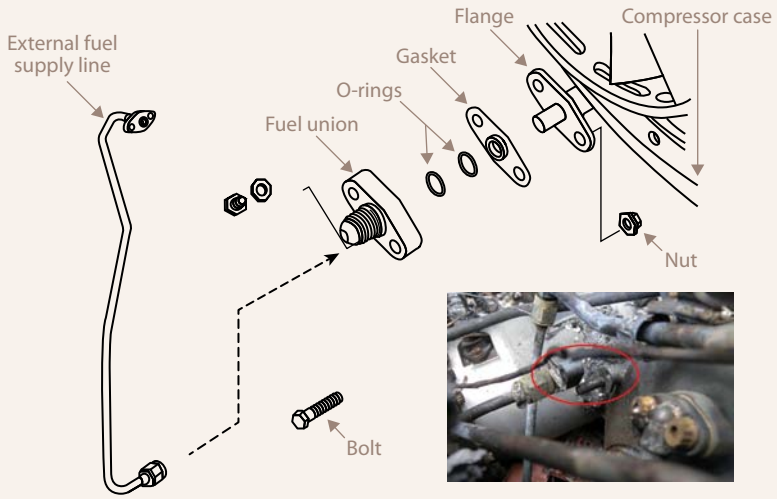
After the engine was reassembled, Air Methods maintenance personnel installed it in the helicopter. The HSN technician inspected his own work, as he was authorized to do, and Air Methods personnel inspected the engine after it was installed in the helicopter but did not inspect the HSN technician's work.

"In interviews with the Air Methods mechanics and HSN technician, they all reported feeling a sense of pressure to complete the maintenance and return [the accident helicopter and a second Air Methods helicopter with a similar coking problem that required attention at the same time] to service," the report said.

During an initial ground test, a leak from the engine hydromechanical unit was identified, and then repaired. After that, a duty pilot performed a 7.5-minute post-maintenance check flight, which included several flight checks — but not the four post-maintenance checks specified in the AS350 B3 *Flight Manual*. There were no records from the check flight.

The report noted that the American Eurocopter chief pilot said that the four checks specified by the flight manual typically are completed in 30 to 45 minutes.

Fuel Supply Routing



Source: U.S. National Transportation Safety Board

Figure 2

The duty pilot who conducted the check flight said that he had never received training on how to conduct a post-maintenance check flight and that any company pilot who was qualified in the model was permitted to perform check flights.

Missing Nuts and Bolts

An examination of the engine at the accident site revealed that the fuel inlet union, on the lower right side of the engine, had separated from the boss on the compressor case but was still attached to the fuel supply line and the hydromechanical unit. During a search of the area, there was no sign of two five-point bolts and self-locking nuts used to mount the union to the compressor case flange, the report said.

The accident investigation found no indication of pre-existing airframe failure.

Engine Test Runs

As part of the investigation, a series of engine test runs were performed on another Arriel 2B1 engine at Turbomeca facilities in Bordes, France, under the supervision of the Bureau d'Enquêtes et d'Analyses, to "assess the engine's operating abilities with the fuel inlet union incorrectly affixed to the engine case flange."

During these test runs, the fuel inlet union was partially attached to the compressor case flange in several configurations, with the attachment nuts and bolts either hand-tightened or, in some cases, omitted; the engine was operated at power levels to simulate engine startup and flight.

"The data revealed that, with the [fuel inlet] union installed without its associated mounting nuts and bolts, it was possible to start and run the engine with no observable fuel leak," the report said. "During the test with the union nuts and bolts tightened by hand, the engine ran for three minutes and 32 seconds before the nuts began to unscrew from the bolts.

"The tests further revealed that, with both nuts and bolts removed, the union would ultimately eject … , resulting in an expulsion of about 0.5 L [0.1 gal] of fuel, followed by a subsequent engine shutdown."

The report said it was "likely that the technician did not tighten the bolts and nuts securing the union with a torque wrench and only finger-tightened them."

Missed Opportunities

Any of several procedural requirements might have identified the problem before the accident flight, the NTSB said.

Neither the operator nor the repair station had implemented procedures for an independent inspection of the maintenance technician's work, and no such procedures were required by the FAA.

The report noted that requirements are stricter for Federal Aviation Regulations (FARs) Part 135 ("Commuter and On-Demand Operations") operators with aircraft equipped with at least 10 passenger seats. Regulations say that, for those aircraft, "No person may perform a required inspection if that person performed the item of work required to be inspected."

If an independent inspection had been conducted, the NTSB said, it "may have detected the improperly installed fuel inlet union."

The report also noted that the FAA's principal maintenance inspector (PMI) for HSN had revoked the company's authorization to perform work outside its primary location in 2008.

"However, the *Repair Station Manual* was not updated to reflect this change, and the PMI did not follow up on the change, nor did he log the change in the FAA's tracking system," the report said. "The PMI was unaware that, in the year before the accident, the repair station had performed work for the operator at locations other than the repair station's primary fixed location at least 19 times.

"The FAA's inadequate oversight of the repair station allowed the repair station to routinely perform maintenance at locations other than its primary fixed location even though this practice was not authorized."

In addition, if — instead of the abbreviated 7.5-minute check flight — a standard full-length post-maintenance check flight had been conducted as specified by the manufacturer's flight manual, the fuel inlet union probably would have separated then, the report said.

"Because the helicopter would not have been operating near its maximum gross weight and the check flight would have been conducted over an open area, the pilot would have had greater opportunities for a successful autorotative landing," the report added.

This article is based on NTSB accident report WPR10FA371 and accompanying documents.

Notes

1. The report described the fuel inlet union as a "body mounting flange and seal [that] provide the interface" between the tip of the internal fuel line and external fuel supply lines.
2. According to information in the NTSB accident docket, Level 3 maintenance, also known as "deep maintenance," is defined as requiring "disassembly of a module and/or maintenance intervention." Level 2 maintenance requires removal of an engine and/or the separation of engine modules. Level 1 maintenance is performed without removing an engine.
3. An injection manifold is sometimes called a fuel manifold.