SAFETY ALERT 086

NTSB National Transportation Safety Board

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AVIATION
HIGHWAY
MARINE
RAILROAD
PIPELINE

Mechanics: Ensure B-nuts Are Properly Secured!

B-nuts are a small piece of hardware that can cause a big problem if they are not properly secured.

The problem

- A B-nut is a common term for a nut that provides the clamping force to create a reliable seal in lines (such as fuel, oil, or air lines on a reciprocating or turbine engine) installed on an aircraft. If a B-nut is improperly secured (either torqued too much or not enough), a loss of engine power or an engine fire could result.
- Under- and over-torqued B-nuts could cause fuel, oil, or air leaks depending on where the B-nuts are installed; over torqued B-nuts could also result in deformation and damage to a line. Fuel or oil leaked onto a hot engine could result in a fire.
- B-nuts are exposed to vibration and thermal expansion and contraction during aircraft operations; therefore, it is critical that maintenance personnel ensure that the B-nuts are properly secured.
- The figure at the right shows a loose B-nut that was examined as part of National Transportation Safety Board (NTSB) investigation ERA21LA023 (which is discussed in this safety alert). The threads from the line are visible in the figure.

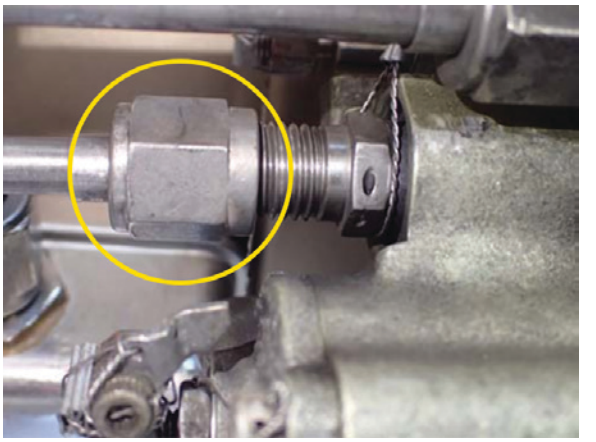

Figure. Loose B-nut at the fuel control unit of the accident engine (SOURCE: ROLLS-ROYCE ENGINES).

Related accidents

The NTSB has investigated several accidents involving a failure to properly secure B-nuts, including the following:

- A Hughes (MD Helicopters) 369D helicopter lost partial engine power during external load (longline) operations. The pilot attempted an autorotation, but the helicopter impacted muddy terrain and rolled onto its right side, resulting in substantial damage. On the day before the accident, the fuel control unit on the overhauled turboshaft

engine was replaced with a unit that had previously been installed on the helicopter. A leak check and a ground run were then performed, which were successful. On the day of the accident, the pilot aborted the first engine start due to a high turbine outlet temperature. A mechanic adjusted the acceleration settings, and the second start was within turbine outlet temperature limitations. Postaccident examination of the helicopter revealed that the air line that connected the governor to the fuel control unit was not attached and that the fuel control B-nut had "backed out" to the elbow of the air line. These findings indicated that the mechanic had not properly secured the fuel control unit B-nut and that the loose B-nut led to the partial loss of engine power. **Even though the pilot avoided serious injuries during the autorotation, the mechanic's failure to secure the fuel control B-nut could have had catastrophic consequences.** (CEN22LA146) After the accident, MD Helicopters issued an operational safety notice about maintaining external lines on the accident model engine (a Rolls-Royce M250 engine).

- After departure and climbout, a Piper PA28 lost total engine power. The pilot was unable to restart the reciprocating engine and performed a forced landing, resulting in substantial damage to the airplane. Postaccident examination of the engine revealed that the B-nut on the line from the electric fuel pump to the engine-driven fuel pump was loose. When the electric fuel pump was started, fuel leaked out of the line where the loose B-nut was located. A mechanic tightened the loose B-nut, and fuel flowed normally. The loose B-nut likely led to a loss of fuel pressure and fuel flow to the engine, which resulted in the total loss of engine power. **If the B-nut to the fuel line had been properly tightened during maintenance, the accident might have been avoided.** (ERA21LA104)
- During cruise flight, the pilot of a Bell 206B helicopter heard a "binding" sound and felt a reduction in power to the turboshaft engine. The low rotor rpm alarm sounded, and the pilot initiated an autorotation to swampy terrain, resulting in substantial damage to the helicopter. Postaccident examination of the helicopter found that the B-nut at the engine fuel control unit was loose with no thread engagement (which can be seen on page 1). During an engine test run, the B-nut was tightened and torqued to the proper specification, and the engine ran smoothly and continuously at all power settings. The pilot, who was also a mechanic, performed the helicopter's most recent annual inspection about 75 hours before the accident, and he had likely not torqued the B-nut on the fuel control according to procedures, which led to the total loss of engine power. **If the pilot had properly inspected his maintenance work and asked another mechanic to inspect the work, the improperly torqued B-nut might have been discovered, and the accident might have been avoided.** (ERA21LA023) After the accident, Bell Helicopters reissued an operation safety notice about maintaining external lines on the accident model engine (a Rolls-Royce M250 engine).
- A Beech A36 airplane climbed to an altitude of about 1,300 ft above ground level and began descending at a groundspeed of 70 to 75 knots with a steady vertical speed. The airplane subsequently impacted terrain, which resulted in a postcrash fire and a fatal injury to the pilot. The flight profile was consistent with a total loss of power to the reciprocating engine followed by a forced landing attempt. The engine was installed about 4 months before the accident and, since that time, had accumulated about 21 hours. Postaccident examination of the engine revealed that the flexible fuel hose B-nut that connected the firewall fuel outlet fitting to the inlet fitting on the engine-driven fuel pump was only finger tight and that the green "torque putty" was not aligned between the B-nut outlet fitting and the fuel pump inlet. Both findings were consistent with improper torquing of the B-nut. Because the B-nut was loose, air likely entered the fuel line and caused the loss of engine power. **If maintenance personnel had ensured that the B-nut was properly torqued during the engine installation, the total loss of engine power and subsequent forced landing might have been avoided.** (CEN20FA096)

What can mechanics do?

- **Ensure that the proper type of B-nut is used for the maintenance task and that the B-nut does not have any pre-existing damage, especially to the threads or the sealing surfaces. If a B-nut (or any hardware) appears questionable, remove it from service—when it doubt, throw it out!**
- **Follow procedures from the maintenance manual and the manufacturer's guidance (including service bulletins and letters) to ensure that all steps are taken to complete a task or an inspection. Remember that some B-nuts may be in hard-to-access locations; as a result, additional time and effort might be needed for the task.**
- **Ensure that the proper tools are used for tightening B-nuts and that torque wrenches are calibrated; check to confirm that the calibration is current.**
- **Develop a process to ensure that B-nuts that have been tightened during maintenance are also torqued as part of the task. Ensure that proper torquing practices are followed. Use appropriate checklists.**
- **During maintenance work and inspection intervals, inspect B-nuts for indications of slippage, cracking, misalignment, looseness, and leakage and ensure that the B-nuts are intact and safety wired (if required).**
- **Make every effort to avoid distractions while performing maintenance. Set a reminder about the remaining checklist items if you need to step away from a task before completing it.**
- **Perform the required leak checks after the task is completed.**
- **Properly apply torque stripe paint to the B-nuts, after they have been tightened and torqued, to provide a visual aid for identifying a B-nut that has become loose or is otherwise not properly secured. Remove any previous torque stripe paint before applying the new torque stripe paint.**
- **Upon completion of a maintenance task, inspect the work. If another mechanic is available, ask them to inspect the work as well.**
- **Seek out industry best practices for tightening and torquing B-nuts.**
- **For maintenance management personnel, incorporate procedures for properly securing B-nuts into maintenance training programs and safety management systems.**

Interested in more information?

- **The Federal Aviation Administration's (FAA) Safety Team Notice, "The 'B' Nut Can Be Deadly," describes potential scenarios and consequences of improperly secured B-nuts.**

- **The FAA's *Aviation Maintenance Technician Handbook*, chapter 7, "Aircraft Materials, Hardware, and Processes," provides information on the types of metal and hardware used on aircraft and describes good maintenance practices.**

- **The FAA's Advisory Circular 43.13-1B, Acceptable Methods, Techniques, and Practices — Aircraft Inspection and Repair, contains guidance concerning the inspection and repair of nonpressurized areas of civil aircraft.**

- **The FAA Safety Team's "Avoid the Dirty Dozen" document describes 12 common causes of human factors errors during maintenance and notes that those mistakes, if not detected, would lead to accidents.**

- **The NTSB's Safety Alert SA-056, "Take Time to Torque," describes several accidents that resulted from the application of improper torque and provides tips to ensure the proper application of torque.**

NTSB Safety Alerts can be accessed from the Safety Alerts page at www.ntsb.gov. For additional information on the NTSB investigation in this alert, access the public docket using the investigation numbers (NTSB Accident ID) cited above.Use the CAROL Query to search NTSB safety recommendations and investigations.

The NTSB's Aviation Information Resources web page, https://www.ntsb.gov/air, provides convenient access to NTSB aviation safety products.

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