



Interagency Aviation Lessons Learned



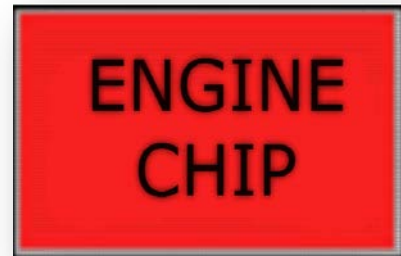
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Subject: Engine Magnetic Chip Caution Lights
Area of Concern: Helicopter Operations
Distribution: All Aviation Users

Discussion: On November 11, 2013, a contractor owned Bell 407 helicopter operating under an Exclusive Use Contract, departed an oil platform enroute to the home airport with a pilot and a bureau employee on board ([SAFECOM 14-0030](#)).



Approximately 5 minutes after takeoff, the engine chip Light illuminated and the pilot diverted to a nearby airport and performed a precautionary landing. The pilot called his company mechanic who coordinated for the services of a local Airframe and Powerplant (A&P) mechanic. The chip detector was removed and metallic fuzz and two metal slivers were discovered. The detector was cleaned, replaced, and the pilot performed a 15-minute ground run as instructed by the company mechanic.

During the first ground run, the engine chip light illuminated for a second time. The chip detector was inspected again revealing more metallic fuzz and small metallic debris. The chip detector was cleaned and replaced followed by second 15-minute ground run. During the second ground run, the engine chip light illuminated again for the third time. The mechanic and pilot repeated the same sequence of cleaning the chip detector and conducted a third 15-minute ground run. The mechanics assumed the detector had not been adequately cleaned from the previous events and even suggested using electrical contact cleaner.

The third ground run was completed without the chip detector light illuminating and the pilot and bureau employee departed for their return flight to home base.

Approximately 5 minutes into the flight, the engine chip light illuminated for the fourth time and the pilot immediately returned to the same airport. During the approach, the engine began losing engine oil pressure approximately ½ mile from the intended landing area. The pilot maintained a higher than normal approach airspeed in order to expedite the landing and to ensure adequate airspeed for an autorotation (if necessary). The pilot landed safely, but the engine was significantly damaged (seized).

What is a chip light?

Turbine engines have a system designed to notify the pilot of metallic particles or “chips” in the engine oil system possibly indicating an impending engine bearing or gear failure. Magnetic chip detectors on the engine gearbox attract the metallic particles within the oil system. The system will illuminate the engine chip annunciator light when metallic particles bridge the gap of the chip detectors.

Follow the emergency procedure. The Bell 407 Rotorcraft Flight Manual lists the emergency procedure for an engine chip light as “Land as soon as possible,” which is defined as “land without delay at nearest suitable area (i.e. open field) at which a safe approach and the landing is seasonably assured.”

These words imply that it's a time critical task to get the aircraft safely on the ground as soon as possible. A pilot can never know for certain as to the type of failure that causes the engine chip light indication to illuminate. The light indicates that there is a potentially unsafe condition that requires a landing sooner rather than later.

Chip lights are one of the most commonly reported events in the SAFECOM system. Most are benign which can contribute to the perception that they're "nuisance" lights. Most impending bearing/engine failures are preceded by metal wear that is discovered through routine maintenance or by the magnetic chip detector system prior to an engine failure. Although rapid failures may be uncommon, the pilot must assume that it will thus requiring an appropriate reaction to any chip light.

Follow the maintenance manual. Operations and maintenance procedures were not followed. After the first chip light event, the manufacturer's instructions for this helicopter (engine) requires that the chip detector be cleaned and replaced followed by a **30-minute (not 15-minute)** ground run. If the chip annunciator light illuminates again during the initial 30-minute ground run, it then requires the mechanic to **drain the oil (not done), clean or replace the filters (not done)**, and perform a second **30-minute** ground run. **If the chip light illuminates during the second 30-minute run, the maintenance manual then requires the engine to be removed from service.**

Many pilots and mechanics possess experience on a variety of aircraft that contain unique maintenance procedures. This type of "corporate knowledge" can create confusion especially when procedures are derived from memory rather than the official/approved maintenance manual. Some operators train their pilots on these procedures so that they can address these malfunctions in remote areas without maintenance personnel, but the requirements are the same for both pilots and mechanics: **They must be trained and follow the maintenance procedures established within the approved manufacturer's maintenance manual.**

The bias created by the maintenance personnel resulted from an (incorrect) interpretation was that it was an indication problem which led them to believe that they weren't adequately cleaning the detector. Unfortunately, the indication system was performing exactly how it was designed to perform. This bias overcame their ability to properly diagnose the situation based on the data the indication system provided, despite the unusual number of occurrences within the period of time.

This type of bias is also known as "Plan Continuation Error" (or sometimes "Get-home-it is") and can be defined as those decisions in which a person continues with an initial plan of action, despite evidence suggesting that an alternative form of action would now be preferable. Ultimately, this "bias/error" led them all to believe that the aircraft was airworthy when it was not.

This aviation service provider has re-trained its maintenance personnel on the proper procedures for clearing engine chip detector lights and has reminded field personnel that an aircraft must be cleared by maintenance management in order to be considered airworthy following a precautionary landing (or in this case a chip light).

Chip detectors are a proven and effective means of providing crews with an early warning of an impending system or engine failure, but they are only valuable if properly interpreted and appropriate actions taken.

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