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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2007-035
Final

Engine in-flight shutdown – 926 km NW of Sydney, NSW - 15 August 2007

Abstract

At approximately 1405 Eastern Standard Time on 15 August 2007, an Airbus Industrie A330-300 aircraft, registered PK-GPF, was about 926 km north-west of Sydney, NSW enroute to Denpasar, Indonesia when the right (No-2) engine low oil pressure warning activated. The flight crew shut down the engine and commenced a descent to flight level 240 while they advised air traffic control (ATC) of the event and requested a clearance to return to Sydney. Air traffic control cleared the crew to descend and to track directly to Sydney.

After landing, the operator's contracted maintenance staff inspected the No-2 engine, a Rolls-Royce RB211-Trent 700 series. They found that oil was leaking from the braided section of the flexible oil pressure tube that supplied oil to the oil pressure transmitter for that engine.

The Australian Transport Safety Bureau (ATSB) inspected the oil pressure tube in conjunction with the UK Air Accidents Investigation Branch and the engine manufacturer. That inspection revealed that the tube had fractured, probably due to high cycle fatigue in a stress concentration area.

The aircraft operator has since commenced a modification program on all of its Airbus A330 aircraft to fit an additional retainer bracket and associated hardware to the flexible oil pressure transmitter tube in an effort to prevent similar occurrences.

FACTUAL INFORMATION

Sequence of events

On the 15 August 2007, an Airbus Industrie A330-300 aircraft, registered PK-GPF, was being operated on a scheduled passenger service from Sydney, NSW to Denpasar, Indonesia.

At approximately 1405 Eastern Standard Time[1], the aircraft was about 926 km north-west of Sydney (145 km west of Cunnamulla, Qld) when the right (No-2) engine low oil pressure warning activated. The flight crew shut down the engine and commenced a descent to fight level 240. The crew advised air traffic control (ATC) of the event and requested a clearance to descend and return to Sydney. After clearance from ATC, the crew descended the aircraft and tracked directly to Sydney.

After landing, the operator's contracted maintenance staff inspected the No-2 engine, a Rolls-Royce RB211-Trent 700 series, serial number 41053. That inspection found that the flexible oil pressure tube that supplied oil from the oil pump to the oil pressure transmitter was leaking at the braided section (Figure 1).

A new tube was fitted and approximately 27 litres of engine oil was placed in the engine. An engine run and performance check was carried out before the aircraft was returned to service.

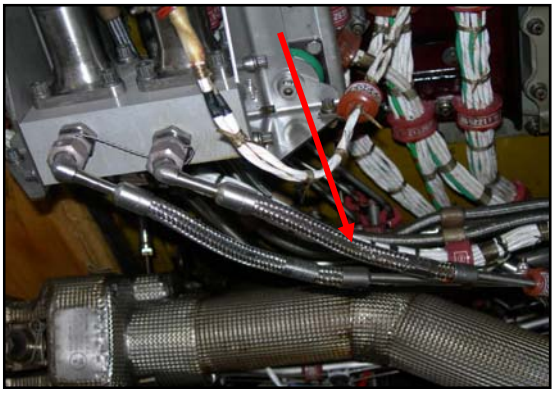
Tube Information

The convoluted-type flexible oil pressure transmitter tube, part number AE711312-2, was located at the lower section of the engine and was manufactured from stainless steel and fitted with a protective stainless steel outer braided sheaf. Convoluted metal tube assemblies are utilised in this engine application as they are flexible and

1 The 24 hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Co-ordinated Universal Time (UTC) + 10 hours.

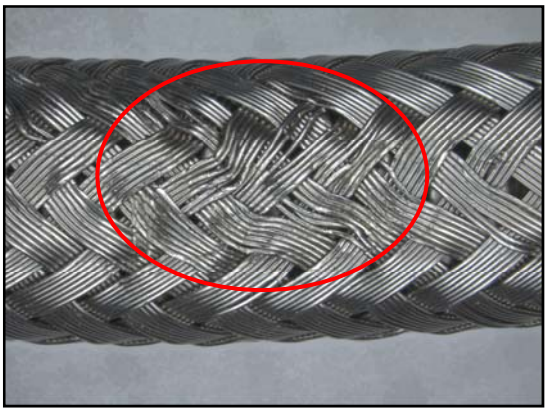
can sustain higher temperatures than Teflon or thermoplastic materials.

Figure 1: Flexible oil pressure tube



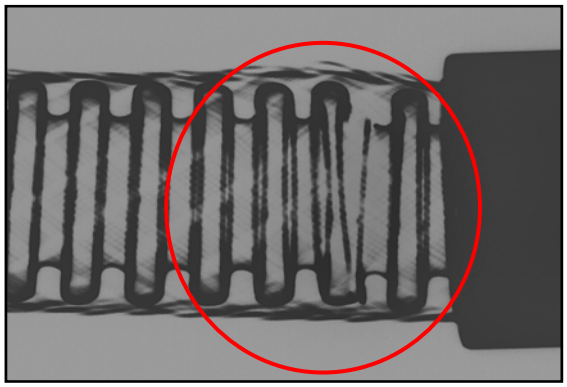
The stainless steel outer braiding was found bowed outwards in the area of the fracture. Further examination of the outer braiding found multiple vertical and horizontal score marks in an area that was locally crushed and distorted (Figure 2), with individual strands having been separated. However, the fracture of the convoluted stainless steel tube did not appear to be associated with the damage to the outer braiding.

Figure 2: Damaged outer stainless steel braided sheaf



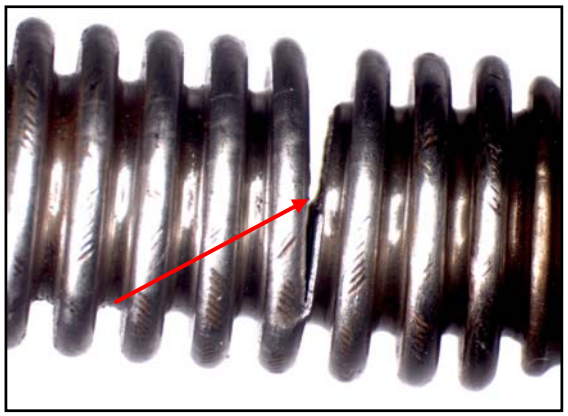
The engine manufacturer x-rayed the convoluted stainless steel tube (Figure 3) under the supervision of the UK Air Accidents Investigation Branch (AAIB). That examination showed a fracture located between the first and second visible (third and fourth actual) convolutes adjacent to the 90 degree end fitting, and a corresponding area of bulging on the outer stainless steel braiding.

Figure 3: X–rayed tube showing fractured convoluted tube



The stainless steel braiding was then removed to reveal the convoluted tube and fracture, which extended approximately 180 degrees around the tube's circumference (Figure 4). The fracture was located in the corner radius of the trough between the convolutes.

Figure 4: Convoluted tube showing the fracture



The engine manufacturer stated that a total of nine fractured oil pressure transmitter hoses had been investigated since 2003. Of those, only one had a support bracket fitted. However, that support bracket had only been fitted for part of the life of the hose.

Oil pressure indicating system modification

The Rolls-Royce RB211-Trent 700 series engine fitted to the aircraft was previously modified under the Rolls-Royce Service Bulletin RB211-79-D743. That service bulletin had a recommended 2B

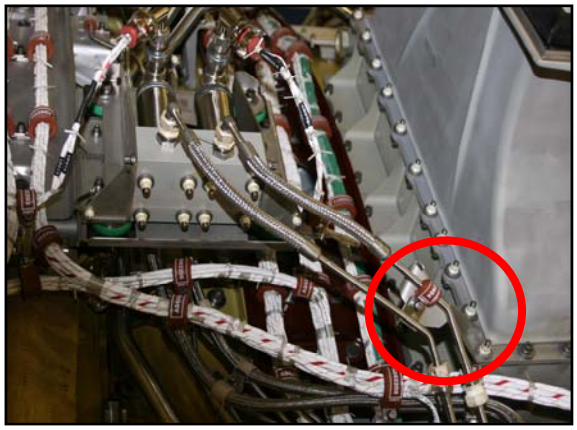
category[2], and was introduced by the engine manufacturer in September 2002. The purpose of the service bulletin was to alleviate false low oil pressure warnings and fluctuating oil pressure readings that were attributed to intermittent electrical signals that originated from contact pin wear of the oil pressure transmitter connecter. The engine manufacturer identified that the contact pin wear was due to high frequency vibrations transmitted from the engine oil pump and external gearbox.

The modification entailed the relocation of the oil pressure transmitter from the oil pump to a new position mounted on the low pressure compressor case, and necessitated the re-routing of the transducer wiring loom, replacement of the supply and return oil tubes and the modification of the transducer assembly.

In September 2005, the engine manufacturer issued Service Bulletin RB211-24-E914 as a result of reported oil pressure transmitter tubes leaking and fracturing. That service bulletin was also a 'recommended 2B category', and was designed to support and secure the flexible oil pressure transmitter tube P/N AE711312-2 and scavenge tube P/N AE711312-1 to prevent failure from fractures that can occur from high levels of vibration (Figure 5). Further investigation in conjunction with the National Transportation Safety Committee of Indonesia (NTSC) found that, at the time of the incident, Service Bulletin RB211-24-E914 had not been incorporated by the aircraft operator.

The engine manufacturer stated that all engines manufactured since engine serial number 41373 have had both of the above service bulletins incorporated during manufacture.

Figure 5: Example of the flexible oil pressure transmitter tube with modification RB211-24-E914 fitted



ANALYSIS

It was probable that the fracture to the flexible oil pressure transmitter tube was a result of the tube not being adequately supported while being subjected to high levels of vibration, causing a fatigue crack to propagate. As a result of the crack, engine oil leaked to atmosphere, activating the right (No-2) engine low oil pressure warning. The fracture was not associated with the damage to the stainless steel outer braiding sheath.

It was probable that, had the operator incorporated the requirements of Service Bulletin RB211-24-E914, the risk of the oil tube fracturing due to metal fatigue from high levels of vibration would have been reduced.

FINDINGS

Context

From the evidence available, the following findings are made with respect to the engine in-flight shut down involving Airbus Industrie A330-300 aircraft, registered PK-GBF, and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The flexible oil pressure transmitter tube fitted to the No-2 engine fractured in flight, probably due to high levels of vibration that induced metal fatigue.

2 Rolls-Royce described a 2B Service Bulletin as being accomplished when the engine or module is disassembled sufficiently to afford access to the affected part.

- Engine oil leaked to the atmosphere during flight, activating the low pressure oil warning system.
- Service Bulletin RB211-24-E914, to install a retaining bracket to the flexible oil pressure transmitter tube, had not been incorporated by the aircraft operator.

Other key findings

- The flight crew were alerted to the right (No-2) engine low oil pressure warning and conducted an in-flight engine shut down.

SAFETY ACTION

Operator

As a result of this incident the aircraft operator implemented a programme to modify all of its Airbus A330 Rolls-Royce RB211-700 series aircraft engines (14 in total) to incorporate the requirements of Service Bulletin RB211-24-E914.

SOURCES AND SUBMISSIONS

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to Civil Aviation Safety Authority, Australia, the operator's transit maintenance provider, the engine manufacturer, the operator's safety manager. Submissions were received from the engine manufacturer. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.