

Air Transat Flight 236



Photo of removed fuel line showing crack

The accident investigators determined that the fuel leak leading to the fuel exhaustion and dual engine flameout on Air Transat TSC236 was caused by a crack in the right engine fuel line. The crack was approximately three inches long (80 mm) and was created by the fuel line rubbing against an adjacent hydraulic line.

The rubbing was a result of an interference created by the use of mismatched fuel and hydraulic lines during replacement of the right engine on the accident airplane.

The interference was caused by the incomplete incorporation of a Rolls-Royce service bulletin that detailed instructions for replacement of fuel and hydraulic tubes necessary for the installation of improved model hydraulic pumps.

The engine maintenance shop tasked with the installation of the fuel and hydraulic tubes on the loaned engine did not complete the installation because of a parts shortage and Air Transat did not complete the service bulletin work prior to installing the new hydraulic pump on the engine as part of its installation on the accident airplane.

Hydraulic Pump Replacement

In reaction to several cases of hydraulic fluid leakage at the hydraulic pump or attached hydraulic lines, Airbus published an optional service bulletin offering a modified hydraulic pump. The service bulletin offered three physically similar and interchangeable models for new production airplanes, while two other models were available for modification and/or replacement by operators.

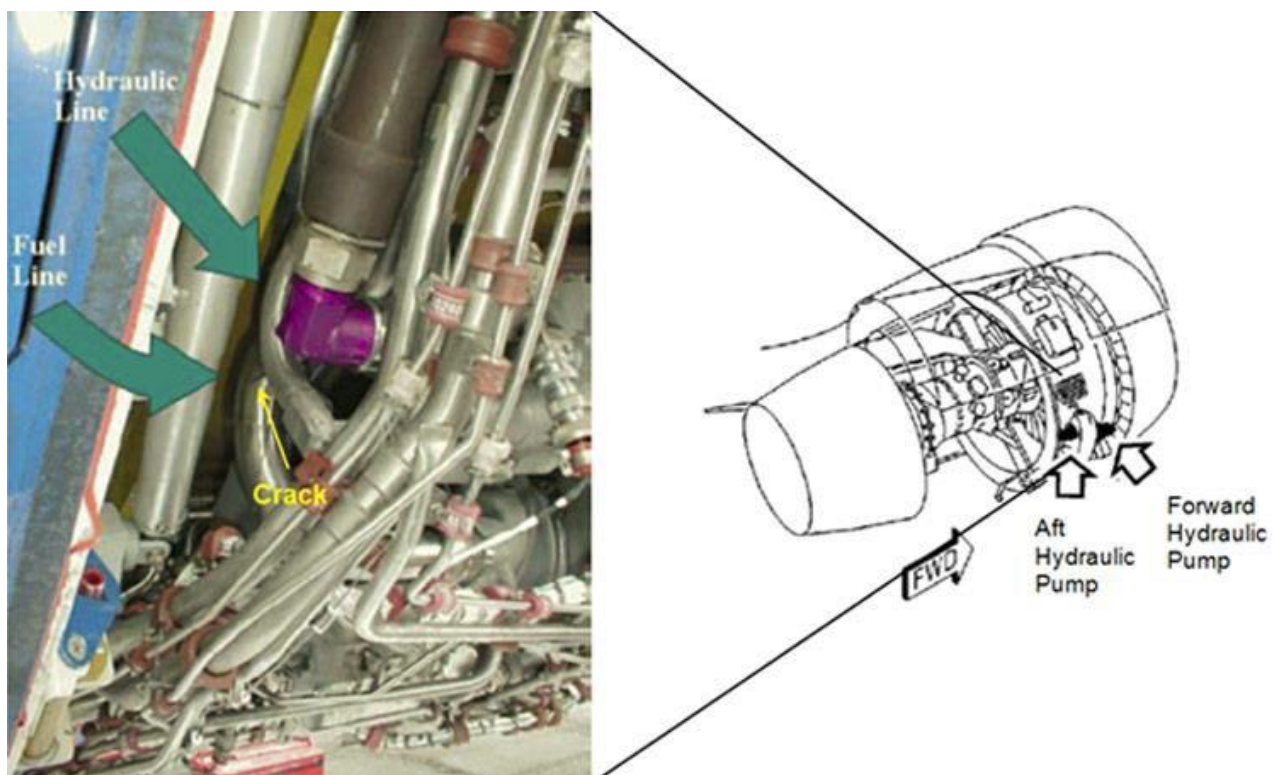
Because the pump was mounted on the engine, Rolls-Royce, the A330 engine manufacturer, issued two service bulletins, one for the installation of the modified hydraulic pump and the other detailing modifications to the engine build-up in order to accommodate the widened pump housing of the modified pump.

The larger hydraulic pump housing created an interference between the hydraulic line and the adjacent engine fuel line. The engine build-up service bulletin replaced three fuel tubes and two hydraulic tubes for the front and rear hydraulic pumps in order to eliminate the interference.

The Rolls-Royce hydraulic pump replacement service bulletin clearly required the engine build-up service bulletin to be accomplished prior to, or concurrently with, the hydraulic pump replacement. The engine build-up service bulletin stated that it was essential that the fuel and hydraulic tubes be fitted as a set.

Replacement Engine Installation

The engine change took place over a weekend and had fallen behind schedule due to the late arrival of a leased jacking pad. There was a commitment to complete the work by noon on Sunday for the next scheduled flight and to make space available for another use.



Accident aircraft hydraulic and fuel line installation

Interference between the hydraulic pump and the adjacent fuel tube was the first indication of a problem with the installation of the post-mod hydraulic pumps from the original engine on the pre-mod replacement engine.

The lead technician attempted to access the engine build-up modification service bulletin from the airline computer network from three different workstations, but was denied access due to a computer malfunction.

The Air Transat Maintenance Control Center (MCC) had stand-alone compact disks (CDs) of the Rolls-Royce service bulletins, but they were not used.

According to the accident report, the lead maintenance technician did not consider the use of the stand-alone CDs because he was not aware of this capability in the MCC.

The MCC technicians did not consider the use of the CDs because their role in providing technical assistance to maintenance crews was to locate resources, not to search for technical references.

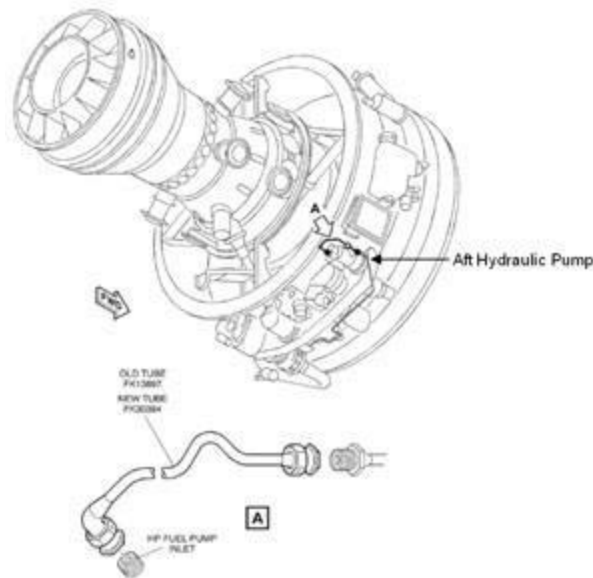


Figure from Rolls-Royce engine build-up service bulletin showing routing of revised fuel line in vicinity of aft hydraulic pump

Although initially concerned about the difficulty of retrieving the required service bulletin, discussions between the lead maintenance technician and the Air Transat Trent engine controller were primarily devoted to the time required to complete the work because they were behind schedule.

Without access to the applicable engine build-up service bulletin, the lead maintenance technician and the engine controller determined that the replacement engine fuel lines needed to be replaced, even though the service bulletin also specified replacement of the hydraulic lines. Effectively, the engine controller and the lead maintenance technician agreed to this course of action without further reference to the service bulletin.

Because the engine controller was knowledgeable about the service bulletin and the background of the hydraulic pump modification, the lead maintenance technician felt confident that the planned fuel line replacement was the only remaining requirement to complete the hydraulic pump installation. The Rolls-Royce service representative, who was familiar with the hydraulic pump modifications, made himself available to the airline for assistance during the engine change, but was not consulted.

Both segments of the post-mod fuel tube assembly were taken from the removed engine and installed on the replacement engine. The different shape and routing of the new fuel line eliminated the interference that previously created difficulties installing the post-mod hydraulic pump. However, the pre-mod hydraulic tube received with the loaned engine was retained.

The installing maintenance technician recalled the hydraulic line had the tendency to spring back when trying to achieve the required separation between it and the fuel line taken from the original engine. However, he stated that he could easily obtain the clearance by positioning and holding the hydraulic tube while tightening the B-nut to hold it in place. No other installation difficulties were reported. Considering the hydraulic system working pressure of 3,000 psi and the pump pulsation, the accident investigators considered it feasible that any clearance between the hydraulic and fuel lines at installation on the occurrence aircraft would have vanished once the flexible hydraulic line was pressurized. The installation of the post-mod hydraulic pump, the pre-mod hydraulic tube, and the post-mod fuel tube assembly resulted in a mismatch between the fuel and hydraulic tubes.

The company maintenance control manual required a quality control inspection of the documentation following an engine change. However, the manual did not specify the time when this is to be completed.

There was no quality control representative on site during the engine change because it was a weekend. The company plan was to do the document verification when preparing the removed engine for shipment to the repair shop. The accident flight occurred before this quality control verification was completed.

Configuration Control

The accident investigators were concerned about a lack of configuration control for optional non-mandatory service bulletins.

Air Transat had received the loaned engine in an unexpected pre-engine build-up service bulletin configuration to which the airline had not previously been exposed, because all of its airplanes had been delivered in a post-mod configuration.

The accident report states that documentation that came with the loaned engine had identified the incorrect hydraulic pump part numbers for this configuration, which may have masked the pre-mod configuration of the engine until near completion of the engine change. The accident investigators

noted that there is no airworthiness requirement to review all non-mandatory service bulletins for applicability to a component prior to its installation on an aircraft.