

Learjet 45, Failed Hydraulic Pressure Switch, ATA 2915

A mechanic describes the sequence of defect events that might have had an alternate ending. The story begins with the aircraft in final cruise condition. "Approximately 40 minutes into the flight at flight level 410...a white CAS (*caution annunciator*) advisory message appeared, indicating 'MAIN HYDRAULIC QUANTITY LOW.'

The flight crew opened the appropriate crew checklist and flight manual, referencing the checklist (*heading*) 'Main Hydraulic Quantity Low.' Apparently, no action was required (*as none was provided for this entry.*)

The pilot directed the copilot to refer to any abnormal procedures, or any emergency checklist procedures as a precaution for the loss of hydraulic quantity or pressure. The crew reviewed these procedures and continued in cruise. Approximately 15 minutes later (during descent), a white 'LEFT HYDRAULIC PUMP LO' message began to appear intermittently and hydraulic pressure fluctuations were noted on the pressure indication. Approximately 10 minutes later a drop in main hydraulic pressure to 70 psi (and concurrent) illumination of the 'MAIN HYDRAULIC PRESSURE' and 'SPOILER FAIL' messages appeared.

The crew diverted to the designated alternate airport, completed abnormal checklist procedures, declared an emergency, and executed a safe landing. Inspection of the aircraft revealed the left main hydraulic pressure switch S9 (*P/N 7629001004-001*) had failed, allowing the hydraulic fluid to escape under pump pressure until sufficient quantity was lost and resulted in cavitation in both left and right hydraulic pumps. This cavitation apparently caused pressure spikes of sufficient force to rupture both pump pressure output flexible hoses. This caused the failure of both pumps and the mechanics suspected it caused the landing gear control valve to fail. This (*control*) valve was inoperative during post-repair functional checks. The landing gear failed to retract when selected (*to the*) 'UP' position while the aircraft was on jacks and under pressure from a hydraulic power unit.

Based on the damage found on the S9 pressure switch, the submitter believed the probable cause of the switch failure stems from pressure spikes within the hydraulic system or an inadequate design of the switch assembly.

The mechanics notified the Bombardier technical services of the issue; they indicated an awareness of other switch failures. The mechanics team recommended that a review of the hydraulic system be conducted to determine if pressure spikes are evident, especially during high flow/high pressure situations.

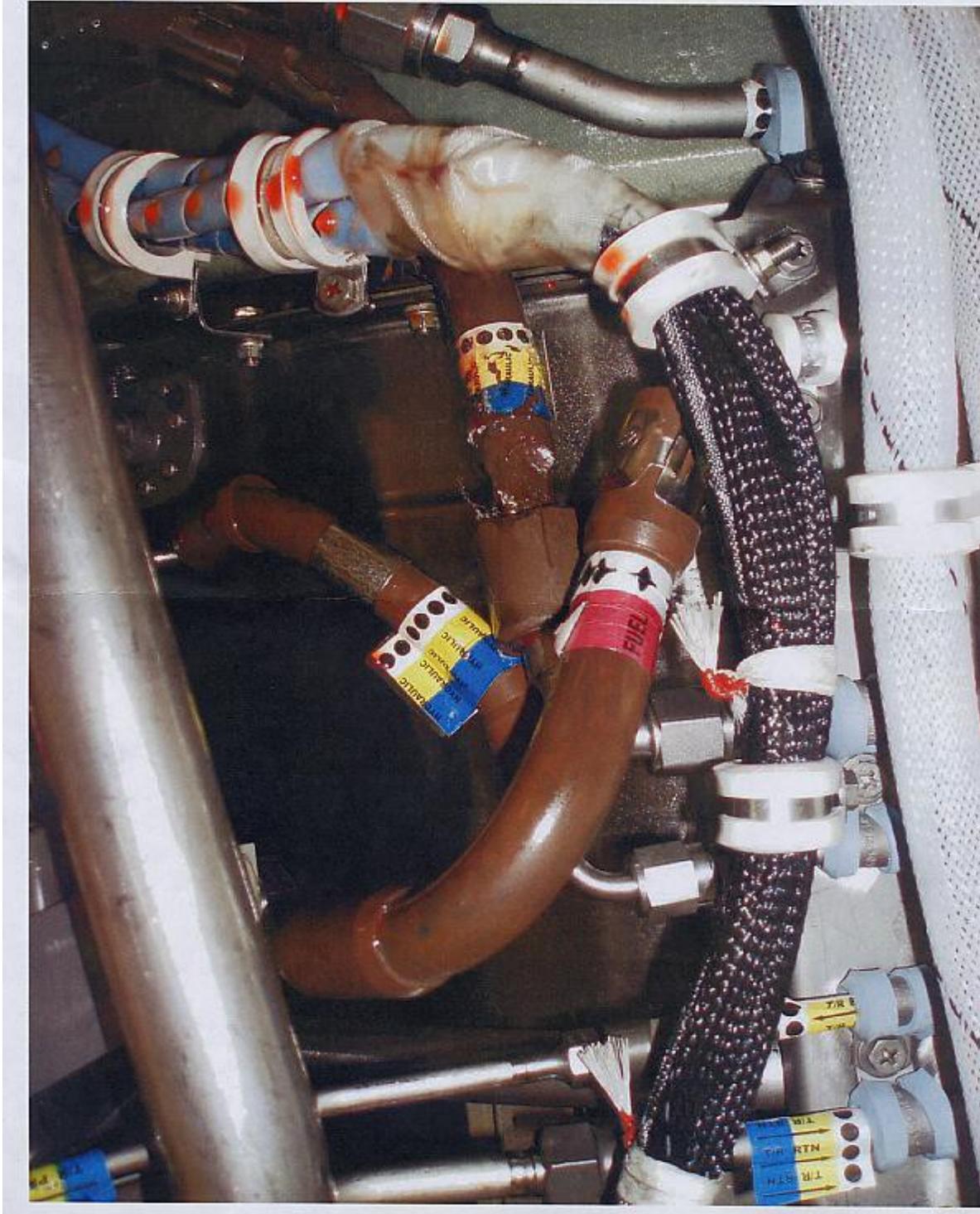
The repair team strongly urged Bombardier to install hydraulic fuses in the supply lines to the two (2) pressure switches (S8 and S9). The Team believed if a fuse had been installed, this switch failure would have resulted with a very small loss of hydraulic fluid and the crew would have managed the indicated CAS message as a possible switch failure (given pressure indications from a separate transducer would have indicated normal pump output).

This failure resulted in a repair exceeding \$36,000.00 and 5 days out of service. If a hydraulic fuse had been installed and functioned correctly... the repair costs would have been approximately \$2,000.00 with 1 or 2 days out of service. The Team attached photos of the S9 pressure switch and ruptured hydraulic hoses.

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Part Total Time: (unknown).

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