

Investigation Report

EX007-0/98
April 2000

Factual Information

Classification:	Incident
Date:	August 8, 1998
Location:	Hannover Airport
Aircraft Type:	Brasilia EMB 145 EU
Injuries to Persons:	none
Damage to the A/C	none
Third Party Damage:	none

History of the Flight

A scheduled IFR flight from Hannover, Germany to Manchester, UK was planned with the a.m. aircraft. On board were 5 crewmembers and 33 passengers. When questioned about the exact sequence of events, the pilot in command stated the following:

After the previous landing in Hannover the APU (Auxiliary Power Unit) was started while completing the „After Landing Checklist“ to supply electrical power and bleed air for the r/h Air conditioning pack as the a/c was parked on an outside position. Shortly after that the PIC carried out the external check without discovering any abnormalities.

After boarding and closing the doors for the flight to Manchester a cabin crew member notified him about a smell like fuel fumes in the cabin. In turn he checked the status of the fuel pumps, APU and air-conditioning system and looked to the member of the handling agent who stood in front of the a/c for the start-up procedure and obviously didn't notice anything uncommon. After the wellcome call to the passengers the PIC mentioned to the F/O that the

ground engineer was not wearing a headset and thus there was no communication to him via the intercomm. Thereafter he began the start-up sequence for the r/h engine.

When reaching a rpm of 13% (N2) the PIC heard and felt a loud bang and first thought a vehicle had collided with the a/c when the ground engineer gave the handsignal to shutdown the engine. At this point the engine instruments showed normal readings and the EICAS screen did not display any warnings.

Shortly after that a cabin crew member entered the cockpit and when she opened the cockpitdoor he notified a strong smell of fuel from the cabin, ordered passenger evacuation and pulled both fire-wall-shutoff-valves (T-handles). After that he saw black smoke emitting from the rear of the a/c and triggered both fire extinguishers.

After completing of the emergency checklist „Enginefire“ and the procedures to shutdown the a/c the cockpit crew vacated the aircraft.

The ground engineer immediately started to extinguish the fire after it started using a handheld fire extinguisher and was supported by two members of the airport fire service who observed the event. They were able to stop the fire before the fire services arrived on scene.

The only damage was a contamination of the r/h engine with fire extinguishing agent.

Investigation

The incident was investigated by a BFU-member. On his arrival the aircraft was still parked on it's outside position. It was locked and all system were shut down. A small amount of jet fuel was dripping from the cowl of the r/h engine. A visual inspection

showed that the entire inner part of the engine was flooded with fuel which was overflowing into the cowling.

The a/c was towed into a hangar and the cowlings removed. The subsequent inspection of all fuel related systems and pipes did not reveal any evidence of a leak.

To check the fuel metering and pump unit (FMPU), the hose leading from the FMPU's outlet to the fuel nozzles was removed. After switching on the electrical boost pumps a massive fuel flow started through the hose which is significant as even with the fuel system pressurized there should be no fuel flow to the nozzles while the engine is not operating. According to this finding the flooding of the core-engine occurred through the fuel nozzles.

In turn the FMPU was removed and inspected at it's manufacturer's facilities which led to the following findings:

During the inspection on the testbench the previously observed leakage at the fuel outlet was confirmed with the FMPU being stationary pressurized. After starting the pump the fuel flow stopped when reaching a pressure of 75psi which corresponds to the normal closing of the air vent valve (AVV) at this pressure. This indicated a malfunction of the air vent solenoid valve (AVSV) which led to a fuel flow to the outlet despite the AVSV being closed. After exchange of this valve the FMPU performed regularly.

An investigation of the air vent solenoid at it's manufacturer confirmed that it didn't close while de-energized which caused the mentioned leakage. During strip examination a metallic strand was determined which appeared during the manufacturing process and was obviously not properly removed.

The strand got stuck between the housing and the spool body during assembly which caused a deep groove in the valve body and made it impossible to unscrew the spool body for disassembly by hand as usual. It can be assumed that also for the assembly during the manufacturing process a considerable force had to be applied to screw the body.

Following up these findings 10 valves which were manufactured in the same batch as the faulty one were checked without revealing any defective ones. To avoid a reoccurrence in the future the manufacturer improved the deburring process during manufacture and annotated the assembly and test instructions to ensure that the orifice carrier screws into the solenoid carrier using light finger pressure only.

Analysis

The incompletely closing air vent solenoid valve caused a flooding of the engine with fuel through the fuel nozzles. The necessary fuel pressure was delivered by the electrical boost pump which was operating as this was necessary for the operation of the APU which is being fed by the r/h engine's fuel system on this model.

The automatic start-up sequence incorporates powering up the ignition system at 13% N2. This caused a severe detonation and a fire. As all system indications showed normal readings at this point the crew was unable to detect the malfunction. The previously noticed fuel smell was not considered serious as this is not uncommon on an airport's tarmac.

Conclusions

The malfunction of the FMPU was caused by an internal damage of the air vent solenoid valve due to a mistake during the manufacturing process.

Investigator in charge Hasenfuss