ACCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash Eight, G-JEDP
No & Type of Engines:	2 Pratt & Whitney PW150A turboprop engines
Category:	1.1
Year of Manufacture:	2003
Date & Time (UTC):	10 February 2005 at 1852 hrs
Location:	Glasgow Airport, Scotland
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 74
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	11,273 hours (of which 5,985 were on type) Last 90 days - 149 hours Last 28 days - 50 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

As the aircraft commenced its take-off run, the take-off warning horn sounded. The takeoff was rejected, but while taxiing for another attempt, the pilots noticed a burning smell on the flight deck. When advised by the cabin crew that there was also a smell of burning and some smoke in the cabin, the commander stopped the aircraft on the taxiway and initiated an expeditious disembarkation using the forward passenger door only. An engineering investigation carried out by the operator's maintenance personnel and the engine manufacturer found that a piece of the right hand engine compressor inner support had become detached, causing damage to a compressor oil seal and allowing oil to contaminate the engine bleed air. The engine manufacturer is aware of the issues and is addressing them through component re-design and engine modifications.

History of the flight

The aircraft was operating a scheduled passenger flight from Glasgow to Birmingham. As it commenced its take-off run from Runway 23, the take-off configuration warning horn sounded. The takeoff was rejected at a speed of approximately 10 kt and the aircraft vacated the runway. The pilots checked all settings and selections and found that these were correct for takeoff. The co-pilot then carried out the after landing and taxi checks and

the aircraft taxied back towards the holding point for Runway 23. The engine bleeds were selected ON during this procedure and, shortly afterwards, a burning smell was noticed on the flight deck. Both of the cabin attendants reported that they could smell burning and saw grey or charcoal coloured smoke emanating from the left hand cabin air vents. The commander stopped the aircraft on the taxiway and asked the co-pilot to switch off the engine bleeds, to determine if the observed smoke was in fact water vapour. However, because both cabin attendants confirmed the continued presence of smoke and the smell of burning, the commander shut down both engines.

In consultation with the cabin crew, the commander decided not to initiate a full evacuation, but to vacate the aircraft in a normal but expeditious manner. The aircraft was equipped with two doors for normal passenger use, one at the front and one at the rear of the cabin, both on the left hand side of the aircraft. The commander elected not to use the rear door because the stowable air stairs used at this door had been difficult to deploy on previous occasions, and a faulty door seal had rendered the door itself difficult to open. In the event, all of the passengers were able to vacate the aircraft safely using the front passenger door only. However, the left propeller, though feathered, was rotating at high speed in the strong prevailing wind and could not be stopped prior to disembarkation. The co-pilot led the passengers away from the propeller to a grass area clear of the aircraft, and the commander completed a total shut down of the aircraft. The fire crew, one of whom reportedly deployed a fire hose very close to the rotating propeller, entered the aircraft and used thermal imaging equipment to asses the condition of the cabin. They found no evidence of fire but discovered that the left hand lockers were considerably warmer than those on the right hand side. Maintenance personnel were unable to reproduce the condition during ground tests carried out immediately after the event.

Subsequent event

The following day, after landing at Glasgow, cabin crew aboard the same aircraft reported that there had been an unusual smell in the cabin during the descent. All of the cabin crew reported suffering from headaches and one cabin crewmember vomited. Both pilots had been aware of an unusual smell but were not adversely affected by it.

Engineering investigation

Propeller feathering

When the engines are shut down on the ground by placing the condition levers in the FUEL OFF position, the propellers move towards coarse pitch but do not feather fully. The small residual forward pitch may be sufficient to cause fast rotation in strong winds.

Take-off warning

The take-off configuration warning horn will sound during the take-off run if the following conditions are met:

1. Inboard and outboard spoilers extended
2. Elevator trim out of the take-off range
3. Parking brake lever set to PARK
4. One or both condition levers not at MAX/1020
5. Flaps extended more than 20º or less than 3.6º

Smoke and other air conditioning abnormalities have no direct effect on the take-off warning system. Consequently, either the above conditions were not met prior to the attempted takeoff, or there was a coincident fault with the take-off warning system which has not recurred since this incident.

Smoke in the cabin

Having failed to find any fault with the air conditioning system following the first incident, the operator's maintenance personnel inspected the engines after

the subsequent event and found cracking of the inter-compressor case struts. The right hand engine was then removed and inspected further with the assistance of Pratt and Whitney Canada (PWC), the engine manufacturer.

The inspection carried out by PWC revealed that a piece of the compressor inner support (CIS), approximately 38 mm long, had become detached. Investigation of this and other similar occurrences on Dash-8-400 aircraft worldwide enabled PWC to identify a probable failure sequence. The fit of the CIS to the low pressure (LP) compressor stator was such that an aerodynamic excitation had been set up, leading to fretting and eventually cracking of the inner support, to the extent that a piece of the CIS broke away. In most cases, it was found that such a piece would follow the normal gas path, exit the compressor and have no further consequences. In this and some other cases, however, the piece had fallen into the LP axial compressor drum. The resulting vibration during engine operation damaged the bearing and air/oil seal, allowing oil to enter the compressor air flow.

Bleed air for cockpit and cabin air conditioning is extracted from the high pressure centrifugal compressor, downstream of the LP compressor. Consequently, oil that has entered the gas path in the area of the LP compressor will contaminate the cockpit and cabin air. Shutting off bleed air from the affected engine should, therefore, be sufficient to prevent more oil from entering the air conditioning system; although it is likely that residual oil within the air conditioning system would continue to produce smoke for some time after this action was taken. It was the operator's normal practice to carry out all takeoffs with engine bleeds selected OFF. When, in this instance, the engine bleeds were selected ON again following the rejected takeoff, oil was able to enter the air conditioning system. Had the aircraft taken off at the first attempt, smoke would have entered the cockpit and cabin in flight.

The engine was replaced and there have been no further reports of smoke in the cabin or cockpit of G-JEDP.

Follow up action

As a result of its investigations into this and other similar occurrences worldwide, PWC issued Service Bulletin (SB) number 35158, effective from 22 July 2005. This SB was revised to number 35158R1 on 29 July 2005. The SB involves borescope inspection of the CIS (termed the Inner Compressor Support (ICS) in the SB). If cracking is found, the engine must be re-inspected within 65 hours. If a piece is missing, the engine must be changed. The operator has stated that it has been carrying out these inspections, even though the procedure is not mandatory.

The CIS itself has been redesigned, using a different material and relocation of the fit between the CIS and the LP compressor stator in an attempt to reduce the fretting and vibration which may have lead to cracking of the original component. All engines that are returned to the PWC service centre, for whatever reason, are being fitted with the new type CIS, regardless of whether or not cracking has been found during previous inspections.

Rear passenger door

The aircraft manufacturer stated that the left hand rear cabin door is primarily an emergency exit. It may also be used as an additional passenger loading door and an optional sliding air stair is installed on all aircraft of this type used by the operator. On previous flights this door had been difficult to open due to a torn seal and an entry to that effect was made in the aircraft technical log, noting that the seal was to be replaced upon the aircraft's next return to its Birmingham base. The steps associated with this door, on the other hand, were not the subject of any proposed remedial action, but

were considered by some operating crew to be of poor design and liable to jam in their stowed position on all Dash 8-400 aircraft operated by this company.

The aircraft manufacturer advises that, in the event of an emergency evacuation, the left rear exit may be used but the air stair should not be deployed. This is stated clearly on a placard beside the rear door of all Dash 8-400 aircraft operated by this company.

Conclusion

No cause could be found for activation of the take-off configuration warning.

Smoke in the cockpit and cabin was caused by oil contamination of the air conditioning system. A piece of the right hand engine compressor inner support had become detached, causing damage to a compressor oil seal and allowing oil to contaminate the engine bleed air.