AVIATION OCCURRENCE REPORT

A98W0192

ENGINE FAILURE

MARTINAIR HOLLAND N.V.
BOEING 767-300 PH-MCI
CALGARY INTERNATIONAL AIRPORT, ALBERTA
14 SEPTEMBER 1998

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Summary

The Martinair Holland N.V. Boeing 767, operating as Flight No. 815 (MPH815), took off from runway 16 at the Calgary International Airport, Alberta, destined for Amsterdam, The Netherlands, with 10 crew and 272 passengers on board. Shortly after passing through 400 feet above ground level (agl), the crew heard a loud bang similar to the noise heard when compressor stalls are practised in a flight simulator. The first cockpit indication was the loss of engine pressure ratio (EPR) on the right engine EPR gauge. While carrying out the memory items of the emergency checklist, it was noted that the right engine oil pressure was below the minimum limit and the engine was intentionally shut down. The aircraft returned to Calgary and landed on runway 34. During the landing, the aircraft brakes became overheated. The aircraft stopped on the taxiway and, after the brakes cooled, the passengers were deplaned and bused to the terminal.

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Other Factual Information

During the initial portion of the flight, the first officer was the pilot-flying. The captain made an urgency PAN call to Calgary air traffic control (ATC) and requested to climb straight ahead to 6 000 feet above sea level (asl). The aircraft was levelled at 6 000 feet and the captain reviewed his options. He determined that an overweight landing, at an aircraft weight of approximately 172 000 kg, at Calgary was preferable to prolonging the flight to dump fuel. ATC vectored the flight for a landing to runway 16.

The captain advised the passengers that they had experienced a technical problem with the right engine and were returning to Calgary. At this time, the captain and first officer switched roles and the captain became the pilot-flying.

The captain requested and received vectors for landing on runway 34 because it had an instrument landing system (ILS) approach, and the surface winds were reported as 090 degrees at only two knots. Runway 16 is equipped with an ILS and a non-directional beacon (NDB) approach; however, the ILS was not serviceable. During the approach, flap 20 was selected with a V_{REF} (landing reference speed) of 170 knots. On final at 6 000 feet asl, the wind read out was 230 degrees at 24 knots; at 4 500 feet asl (1 000 feet agl), it was 230 degrees at 20 knots, with the wind reducing at lower altitudes, resulting in a slight tail wind component and a high ground speed. At 50 feet agl, the left-hand thrust lever was set to idle. At touchdown, the spoilers deployed and the left engine was selected to full reverse with autobraking set at three, which is approximately half the system's deceleration capacity at MAX selection. The aircraft slowed to taxi speed with about 2 000 feet of runway remaining; runway 34 is 12 675 feet long.

After taxiing clear of the runway, the captain brought the aircraft to a stop. An airport emergency response team (AER) met the aircraft and placed chocks around the main wheels, then used fans to cool the wheels. Shortly after the aircraft came to a stop, three tire fuse plugs melted and the three tires deflated. After the wheels cooled sufficiently, an air-stair was put in place; the passengers and cabin crew deplaned and were transported to the terminal by buses.

After the aircraft came to a stop on the taxiway, communications with the AER Commander were conducted initially on Calgary ground control frequency and later via intercom. The captain was also communicating with the tower ground controller and with the Martinair Holland N.V. office in Amsterdam via ACARS (aircraft communications and reporting system). Once MPH815 cleared the runway, ATC resumed normal operations at the airport. The cockpit crew reported some frequency congestion which limited their ability to communicate with both the emergency response team and the ATC ground controller. A secondary ground frequency is available; however, it is not the practice of the controllers to use this frequency routinely when an emergency is in progress and airport aircraft traffic flow is being maintained.

Examination of flight data recorder (FDR) data shows that, before the engine failure, EPR and N_2 (high-pressure compressor speed) of both engines were matched, with values at approximately 1.61 and 99 per cent rpm, respectively. Both throttle resolver angles (TRAs) were matched at approximately 82 degrees. When the right engine failed, the right engine EPR rapidly decreased to 0.95 and the right N_2 gradually spooled down to 0 per cent rpm. When the engine failure occurred, the right exhaust gas temperature (EGT) rapidly increased from 600 to 680 degrees Celsius. The right engine oil pressure dropped from 237 pounds per square inch (psi) to 0 psi.

A review of previous flight data indicated matched engine parameters with no significant deviations in EPR, N_2 or EGT noted. The recorded engine vibration data indicated slightly higher vibration levels on the right engine during the occurrence take-off, although levels were well below the maximum range. A comparison of four previous take-offs revealed similar characteristics.

The right engine (model PW 4060, serial number 717648) was returned to The Netherlands and then to a Swissair engine overhaul facility in Zurich, Switzerland. Since the last refurbishment, the engine had accumulated 8 649 hours and 1 648 cycles. On disassembly, it was found that one 6th stage high-pressure compressor (HPC) blade had fractured and separated at the root attachment. One other 6th stage blade was found with a root attachment crack. The blades and 5th and 6th stage synchronizing rings and variable vanes were sent to the Pratt & Whitney facility at East Hartford, Connecticut, for analysis. It was determined that the cracks were due to high-cycle fatigue. The high stresses which precipitated the cracking were probably the result of excitation caused by the variable guide vanes. The source could not be identified. Examination of the blades did not reveal any material or manufacturing processing anomalies.

Analysis

The engine failed when one blade in the 6th stage HPC failed at the blade root due to high-cycle fatigue fractures. The cause of the fatigue cracking could not be determined.

The FDR was used for event analysis. An evaluation of the FDR at the TSB Engineering Branch indicates that the failure would not have been predictable based on an analysis of the engine parameters being recorded on the FDR.

Communications on the Calgary ground frequency were complicated due to the unresolved nature of the occurrence, the aircraft crew's need to maintain communications with the AER team and the ATC ground controller, and the need for continuing operation of aircraft using the ground frequency while taxiing to and from the terminal. The frequency congestion experienced by the flight crew did not compromise the safety of the passengers, crew or aircraft during this occurrence. However, the volume of transmissions did cause the flight crew concern that they might miss vital communications that could have jeopardized the safety of the passengers, AER ground crew, and flight crew. A separate frequency would have permitted the crew to communicate directly with the AER team.

The following Engineering Branch report was completed:

LP 112/98 - FDR Analysis

Findings

1. The right engine failed shortly after take-off.

2. The engine failure was precipitated by one blade in the 6^{th} stage high-pressure compressor failing due to high-cycle fatigue cracking. The cause of the fatigue cracking could not be determined.

3. Based on runway length and aircraft performance calculations, the captain determined that he did not need to dump fuel prior to landing.

4. Communications between the pilots and the air traffic control authority and the airport emergency response team were complicated after landing because of the use of the ground control frequency for the continued operation of aircraft.

Causes and Contributing Factors

The right engine failed when one blade in the 6^{th} stage high-pressure compressor failed due to high-cycle fatigue cracking. The cause of the cracking could not be determined.

Safety Action Taken

To enhance the efficiency of ground communications during an emergency, Transport Canada is working, through membership on an International Civil Aviation Organization (ICAO) working group, toward the establishment of a discrete frequency for direct communication between aircraft flight deck and senior fire officer responding to an aircraft emergency.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 29 September 1999.