Log 2287

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 11, 1991
In reply refer to: A-91-42 through A-91-44

Honorable James S. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

At 0550 eastern daylight time on May 3, 1991, the crew of Ryan International Airlines flight 476, a Boeing 727-100QC, registration N425EX, rejected a takeoff on Runway 33 at Bradley International Airport (BDL), Hartford, Connecticut. The crew executed the rejected takeoff (RTO) procedures when, at approximately 80 knots during the takeoff roll, they heard a loud "bang," felt the airplane "shudder," observed a No. 3 engine fire warning light, and noted that the instrument indications for the No. 3 engine were erratic. The airplane was stopped on the runway using normal braking. The crew discharged two fire extinguisher bottles into the No. 3 engine compartment but were unsuccessful in extinguishing the fire. The fire, which initially involved the No. 3 engine, subsequently spread to the cabin and destroyed the airplane. After the airplane stopped, the crew successfully evacuated the airplane via the escape rope at the L-1 cabin door; the crew was not injured. There were no passengers aboard the all-cargo flight.

Flight 476 originated at Indianapolis, Indiana, and was scheduled to fly to Boston, Massachusetts, with an intermediate stop at BDL. At the time of the accident, flight 476 was carrying 12,640 pounds of U.S. mail. Much of the cargo was consumed by the postaccident fire, which required more than 5 hours to extinguish. N425EX was owned by Polaris Leasing Company and "wet leased" from Emery Worldwide Air Freight by Ryan International Airlines.

Inspection of the aft section of the airplane disclosed numerous holes in the midsection of the engine nacelle, adjacent to the leading edge of the engine nacelle pylon mount. There was also a large hole in the right side of the fuselage, 3 feet by 2 feet, located slightly above the pylon mount and

aft of the No. 2 engine air inlet. This hole was adjacent to a large hole between 7:30 and 9 o'clock (aft looking forward) on the left side of the engine nacelle. Inboard of the holes in the nacelle and airplane fuselage, there was matching damage to the engine cases, all located in the plane of rotation of the high-pressure compressor (HPC) 9th stage disk assembly.

Examination of the Pratt & Whitney JT8D-7B turbofan engine disclosed that the 9th stage HPC disk had ruptured, liberating the outer section of the disk rim. The liberated fragments severed the engine main fuel line and some oil and hydraulic lines before penetrating the airplane skin immediately forward of the fuselage aft pressure bulkhead.

The No. 3 engine was removed from the airplane for disassembly and further inspection. Most of the damage was considered to be secondary to the 9th stage disk rupture. The HPC consisted of the 7th through 13th stage compressor rotors, stators and associated hardware. Examination of the individual disks showed that the 9th through 12th stage HPC disks were severely corroded and pitted in the radius under the compressor blade dovetail area on one or both of the disk faces.

Further examination of the HPC 9th stage disk at the Safety Board's Materials Laboratory disclosed that the entire circumferential outer rim, including all of the compressor blade dovetail slots and the 9th stage compressor blades, had separated slightly below the rim fillet radius where the rim joined the outer web section of the disk. Detailed inspection of a separated segment of the outer rim revealed that the failure was due to metal fatigue that originated from a 0.010-inch-deep corrosion pit at the forward edge of the rim in the bottom of a compressor blade dovetail slot. From the origin, fatigue propagated radially inward to a point just below the rim fillet radius then circumferentially along the disk outer web to a point where separation resulted from overstress. The forward rim fillet radius of the disk exhibited heavy surface corrosion and numerous corrosion pits, some of which were measured to be as deep as 0.020 inch.

The No. 3 engine, serial number 653965, had been operated 41,210 hours and 32,306 cycles since new. This engine was installed on the accident airplane on October 19, 1985, following a shop visit at United Airlines, and had operated for 7,553 hours and 4,564 cycles since that installation. The failed 9th stage disk was part number 701509, serial number G62507, and had been operated 24,625 hours and 15,523 cycles since new; 4,553 hours and 4,564 cycles since being installed in the failed engine. The authorized life before retirement for a JT8D, 9th stage compressor disk is 30,000 hours and 20,000 cycles; therefore, this disk had 5,375 hours and 4,477 cycles of life remaining by current applicable standards.

Subsequent to the No. 3 engine examination, the high-pressure compressor of the No. 1 and No. 2 engines from N425EX were borescope-inspected to determine if the disks of these engines were similarly corroded. The examination disclosed that the No. 1 engine (a low-time engine with new disks installed at the last shop processing) showed no indications of corrosion on those HPC disks. However, the No. 2 engine, which had approximately the same operating time as the No. 3 engine, had heavy

corrosion on the HPC disks. Further engine disassembly will be required to determine the magnitude and location of the corrosion.

Because corrosion is a function of calendar time as well as engine operating time and cycles, the Safety Board believes that the conditions that caused the No. 3 engine 9th stage HPC disk to fail on Ryan flight 476 may exist on other JT8D engines that have been "on wing" for similar time periods and that were subjected to similar operational histories. Furthermore, many JT8D operators perform their engine maintenance under an "on condition" philosophy. There is no current requirement for inspections between the on condition removals of the compressor disks.

Because of the large population, and the historical reliability of the JT8D engine, this practice could lead to long periods between inspections and extended "on wing" periods for many JT8D engines, particularly on those airplanes with low utilization rates. For example, the failed No. 3 engine HPC had not been inspected for more than 5 1/2 years. With the time remaining on the disk before scheduled retirement, it is conceivable that this engine could have remained on wing without any required HPC inspection for several more years. The manufacturer has determined that corporate operators and certain dedicated services operators, such as cargo and package carriers, average substantially fewer operating hours per month than scheduled air carriers. It is not unusual for engine HPCs to remain on wing and uninspected for 5 years or more with these operators. The manufacturer has also determined that the amount of corrosion buildup on the HPC disks can be directly related to the type of service by the airplane and the operational environment. The Safety Board believes that to prevent additional failures of this nature, it is urgent that the FAA and the engine manufacturer implement a program to obtain the information necessary to determine the specific cause and magnitude of the compressor disk corrosion problem, considering the operational requirements of the operators involved. Corrective action should then be taken to ensure the continued safe operation of the JT8D engine.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Immediately conduct a directed safety investigation, in conjunction with Pratt & Whitney, to determine the magnitude and cause of the corrosion (pitting) on the high-pressure compressor rotating disks of JT8D model engines, to identify those engines that are being operated in a manner that makes them susceptible to corrosion, and to develop corrective action that will ensure the continued safe operation of the those engines. (Class I, Urgent Action) (A-91-42)

> Require the engine manufacturer to immediately inform all JT8D operators of the HPC corrosion pitting problem. (Class I, Urgent Action) (A-91-43)

Issue an airworthiness directive to require timely corrective actions that are developed as a result of the directed safety investigation. (Class I, Urgent Action) (A-91-44)

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members LAUBER, BURNETT and HART concurred in these recommendations.

By: James L. Kolstad
Chairman