

SP-26
Page 1858

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: December 31, 1985

Forwarded to:

Honorable Donald D. Engen
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-85-141

On October 19, 1985, the left engine on a McDonnell Douglas DC-9-51, N412EA, operated by Eastern Air Lines, Inc., failed just after rotation during takeoff from Tampa International Airport, Tampa, Florida. A major part of the upper and lower engine wraparound cowling was blown free of its attachments, and the cowling created an area of sufficient drag that the pilot was forced to exceed the normal operating limits of the right engine to maintain flight. The flightcrew immediately implemented emergency procedures, and the flight returned and landed at Tampa without further incident. Except for a reported momentary fireball at the time of the engine failure, there was no in-flight or ground fire.

The investigation disclosed that the outer combustion case of the Pratt & Whitney JT8D-17 engine had ruptured at the 3 o'clock position, as viewed from the rear of the engine. The rupture originated with a fatigue crack at the No. 25 bolt hole of the rear flange of the outer case. The crack propagated forward axially approximately 4 inches along the outer case before the high internal pressure of the burner compartment caused the axial crack to tear forward to the front flange and the case to unpeel circumferentially along the front and rear flanges. The resultant approximately 19- by 33-inch opening in the case exposed the engine's combustion chambers. The sudden release of burner compartment pressure fragmented the fan duct and caused the engine cowling to distort into the airstream.

On August 22, 1985, the left engine of a Boeing 737-200, G-GBJL, operated by British Airtours, failed during takeoff from the Manchester International Airport, Manchester, England. The takeoff was aborted, but the entire aft portion of the aircraft was engulfed in fire shortly after the airplane came to a stop. Of the 137 persons on board the airplane, 54 were fatally injured before the fire was extinguished. The postaccident inspection revealed that the outer combustion case of the Pratt & Whitney JT8D-15 engine also had ruptured and that the rupture had been preceded by failure of one of the engine's nine combustion chambers. The combustion chamber failure allowed hot combustion air to impinge on and burn the wall of the outer case to the point where it was not capable of containing the internal pressure of the burner compartment air.

The two aforementioned engine failures are examples of a number of JT8D engine outer combustion case failures which have been attributed to either fatigue cracking or burn-through of the outer case wall. The high pressure of the burner compartment air is contained circumferentially within the engine by the combustion outer case. Whether the outer case ruptures as a result of fatigue cracking in the case itself (a primary rupture), or as a result of distress, such as combustion chamber cracking/rupture, within the burner compartment (a secondary rupture), the rupture causes the burner compartment air which is under high pressure to be released from the engine. The high pressure imparts sufficient force on the engine fan duct to cause it to fragment. After the fan duct fractures, the burner compartment air then enters the engine nacelle with sufficient force to blow engine cowling panels open or to separate cowlings from the airplane.

One major air carrier developed an inspection method for JT8D engines after experiencing a ruptured outer case caused by fatigue cracking that propagated from the rear flange of the case. The inspection method resulted in the detection of an approximately 2 1/2-inch-long crack in the outer case of another engine, which has been removed from service and has been sent to the engine manufacturer's facility for further investigation.

A number of reported engine failure incidents have involved outer combustion cases which were found to have cracked, burned-through, or ballooned but not ruptured. Other reported incidents have involved burn-through of sufficient magnitude to penetrate the fan duct and activate the engine fire/overtemperature alarm system, resulting in in-flight engine shutdown. These incidents have indicated that outer combustion case distortion caused by combustion chamber distress creates a disruption of the combustion process that can be detected by a properly administered Engine Condition Monitoring (ECM) program. Thus, ECM programs are very beneficial to the determination of engine maintenance requirements. However, it is improbable that a cracked outer combustion case, even with advanced cracking which originates from fatigue in the outer case rear flange could be detected by an ECM program since air leakage from the crack is not sufficient to cause a detectable variation in the engine's performance parameters until the complete rupture of the case. Thus, the Safety Board believes that ECM maintenance programs must be supplemented by a periodic "on-wing" burner compartment and outer case inspection program to enhance the probability of detecting impending outer combustion case failure.

The Safety Board is cognizant of the Federal Aviation Administrator's Notice of Proposed Rule Making (NPRM) that was published in the Federal Register on November 8, 1985, and that addresses comprehensively the current Pratt & Whitney JT8D combustion chamber problems. However, the proposed Airworthiness Directive would effectively detect only those potential outer combustion case failures attributable to the impingement of hot combustion chamber gases on the outer case. The Safety Board considers the other possibility of outer case failure due to fatigue in the rear flange of the case to be equally serious and of sufficient hazard to warrant further investigation and development of an inspection procedure or corrective action to prevent further failures of this type.

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

Require that the engine manufacturer and JT8D operators (1) develop and implement inspection procedures which ensure early detection of outer combustion case cracking and evidence of high temperature burner air impingement on the combustion case wall, and (2) specify the criteria and procedure for repair of detected fatigue or overheat damage. (Class II, Priority Action) (A-85-141)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER, Member, concurred in this recommendation.

By: *Gavin A. Goldman*
Jim Burnett
Chairman *for*