National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 17, 1998
In reply refer to: A-98-40

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On June 17, 1997, just after takeoff from Las Vegas, Nevada, a Reno Air McDonnell Douglas MD-83 airplane, N875RA, operating as flight 516, experienced an uncontained failure of the No. 1 (left) engine, a Pratt & Whitney (P&W) JT8D-219, serial number (SN) 708177. The airplane returned to Las Vegas and landed without further incident. The airplane was operating on an instrument flight rules flight plan under the provisions of Title 14 Code of Federal Regulations Part 121 as a regularly scheduled passenger flight from Las Vegas to Colorado Springs, Colorado. The investigation of this incident is continuing; however, information gathered thus far raises safety concerns that the National Transportation Safety Board believes require Federal Aviation Administration (FAA) action.

During the aircraft's ascent after takeoff, high-pressure turbine (HPT) parts were liberated from the engine. Inspection of the airplane revealed two exit holes in the engine nacelle and one hole in the fuselage in a nonpressurized compartment of the airplane. Postincident examination of the engine revealed four exit holes in the combustion chamber fan ducts just forward of the HPT rotational plane, yet the HPT case (front turbine case) was not penetrated. Two sections of the HPT case rear flange were bent outward and forward, and were disengaged from the low-pressure turbine (LPT) case (rear turbine case) front flange, creating two large openings. The HPT shaft had sheared at the No. 4 ½-bearing scavenge oil holes; all the HPT blades fractured transversely across the blade airfoil; and all the 2nd-stage turbine vanes were missing.

The engine was equipped with an HPT containment shield (see figure 1) as required by Airworthiness Directive (AD) 93-23-10.[1] The AD was issued on January 18, 1994, and is

[1] The containment shield is intended to prevent engine HPT parts from being liberated and causing secondary damage to the airplane or injuring passengers. The shield is positioned radially outward from the rotational plane of the HPT blades. The width of the containment shield is approximately 4 inches, and its support attaches to the HPT case rear flange. The support, although it provides some containment capability, is primarily to buttress and properly position the containment shield.

applicable to all JT8D-209, -217, -217A, -217C, and -219 turbofan engines. The containment shield is a clam shell design consisting of two half-shields joined by clevis plates and supported by a cantilevered shield support attached to the HPT rear flange. Considerable impact damage (engine debris) was observed on the inner diameter (ID) of the containment shield; however, the shield remained intact. The impact of turbine material on the lower shield shifted it outward and aft from its normal installed position, buckling its support. First-stage turbine blades and 2nd-stage turbine vanes had exited the engine through the openings between the HPT and LPT case flanges and deflected off the containment shield ID while exiting the engine and before striking the airframe.

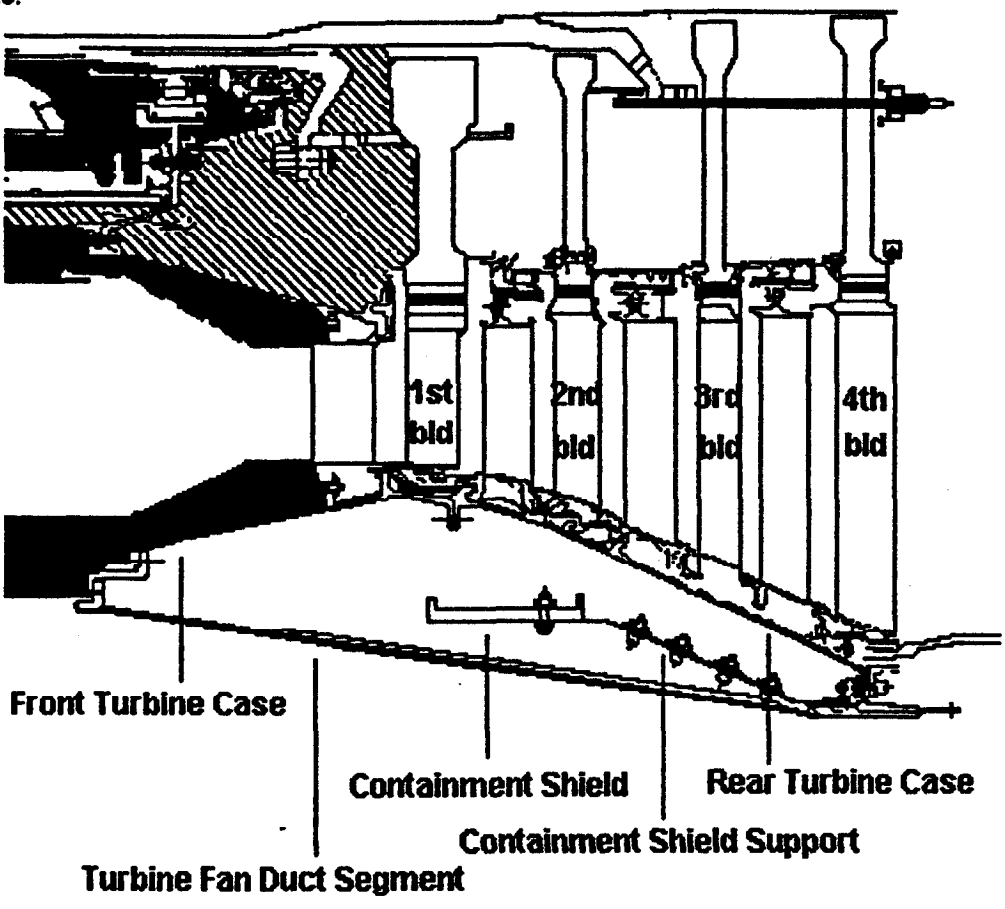

Figure 1 Containment Shield Configuration

Another incident involving a P&W JT8D-219 uncontained turbine failure that resulted from a sheared HPT shaft occurred on July 13, 1996, on a Centennial Airlines[2] McDonnell Douglas MD-80 airplane, en route from Dusseldorf, Germany, to the Canary Islands. Like the Reno Air incident, the failed engine was equipped with an HPT containment shield, which was not

[2] Centennial Airlines is a Spanish-registered supplemental air carrier based in Palma de Mallorca, Spain.

penetrated; however, exiting turbine parts impacted the shield ID, buckled its support, and shifted the shield from its normal position. The buckled support allowed the exiting turbine parts to deflect off the shield and penetrate the engine nacelle.

On November 7, 1991, after the JT8D-200 series engine had experienced six HPT shaft fractures, three resulting in the liberation of turbine parts, P&W issued Alert Service Bulletin (ASB) 6053 to incorporate a containment shield for JT8D-209, -217, 217A, -217C, and -219 engines.[3] Subsequently, P&W issued Service Bulletin (SB) 6122 on May 20, 1993, to address premature wear of the support slip joint caused by buffeting of the shield. The basic design stayed the same; however, new hardware with hardfacing[4] on the mating surfaces was incorporated. AD 93-23-10 required JT8D-200 series engines to be outfitted with a containment shield as instructed by P&W ASB 6053, Revision 7, dated May 24, 1993. The FAA's Engine Certification Manager, ANE-140, issued a letter on June 28, 1994, approving SB 6122 as an equivalent means of compliance to AD 93-23-10.

The Reno Air and Centennial Airlines incidents have shown that the JT8D-200 series engine HPT containment shield design is inadequate to prevent all turbine parts from being liberated because the support is insufficient to sustain the shield in the proper location when impacted by some exiting turbine material. In addition, the incidents have shown that the containment shield is not wide enough nor the sidewalls deep enough to ensure that exiting material will be contained under a variety of exit paths. The Safety Board is concerned that the current containment shield cannot prevent HPT part liberation and therefore believes that the FAA should evaluate the current P&W JT8D-200 series engine HPT containment shield required by AD 93-23-10 and, if shown by evaluation, require that it be replaced with an HPT containment shield that would provide a larger coverage area and more impact resistance and durability.

Therefore, as a result of the ongoing investigation of this incident, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Evaluate the current Pratt & Whitney JT8D-200 series engine high-pressure turbine (HPT) containment shield required by Airworthiness Directive 93-23-10 and, if shown by evaluation, require that it be replaced with an HPT containment shield that would provide a larger coverage area and more impact resistance and durability. (A-98-40)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Jim Hall
Chairman

[3] At the time ASB 6053 was issued there had been six documented HPT fractures resulting from No. 4 and 5 bearing compartment oil fires, three of which have resulted in uncontained events.

[4] Hardface is a seal facing of high hardness that is applied to a softer material, such as by flame spraying, plasma spraying, electroplating, nitriding, carburizing, or welding for better wear resistance.