

LOG 2558



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 6, 1995

In reply refer to: A-95-71 through -73

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On June 8, 1995, the No. 2 engine of ValuJet flight 597, a McDonnell-Douglas DC-9-32, equipped with Pratt & Whitney JT8D-9A engines, experienced an uncontained failure during takeoff at the William B. Hartsfield International Airport, Atlanta, Georgia. Flight 597 was a regularly scheduled passenger flight from Atlanta, Georgia, to Miami, Florida, operating under the provisions of 14 Code of Federal Regulations (CFR) Part 121. On board the airplane were the 2 pilots, 3 flight attendants, and 57 passengers.

After the engine failure, the takeoff was aborted, and the airplane was stopped on the departure runway. Engine fragments penetrated the cabin, struck a fuel line, and initiated a fire that destroyed the airplane. The passengers and crew were evacuated, resulting in one serious and several minor injuries. The aft flight attendant suffered shrapnel injuries and second and third degree burns. There were no fatalities. The rapid progression of the fire leads the Safety Board to conclude that if the airplane had been airborne or if more passengers had been on board, there would most likely have been numerous fatalities because of the fire and the buildup of toxic fumes in the cabin.

The on-going investigation has determined that during the initial takeoff roll, the 7th stage high pressure compressor (HPC) disc on the No. 2 engine failed. Examination of the failed 7th stage disc, part number (P/N) 774407, serial number (S/N) G78851, revealed that the failure originated at one of the shielding holes in the disc. The shielding holes are aligned with the disc tie bolt holes and are designed to redistribute and reduce stress concentrations in the disc. The holes are

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below the base of the compressor blades and cannot be inspected without disassembling the engine.

The metallurgical examination showed that the failure was caused by a fatigue crack that originated at a corrosion pit in a shielding hole. There was evidence that the corrosion pit had been plated over during an overhaul of the disc in 1991. Additionally, it appears that the size of the corrosion pit exceeded the allowable limits at the time of the overhaul. Examination of the fatigue crack revealed a minimum of 7,000 to 8,000 fatigue striations. Assuming that each striation represents one "flight cycle," based on the 4,433 flight cycles accumulated since the last inspection, the crack would probably have been detectable by non-destructive testing or by visual inspection at the time that the engine was last overhauled.

Metallurgical examination of the disc also revealed numerous cracks, out-of-limit pitting, and plated-over corrosion in the other shielding holes, in addition to the hole from which the failure originated. Teardown of the engine showed that with the exception of the failed 7th stage disc, the engine appeared to be well maintained and in good condition. Visual inspection of the other discs from the failed engine found no evidence of cracks or abnormal corrosion.

Valujet records showed that the engine was one of a total of 23 acquired from Turk Hava Yollari (THY). THY is a Turkish domestic and international airline and operates an airframe and engine overhaul facility, including JT8D engines, in Istanbul. Valujet purchased 9 DC-9 series airplanes and 5 spare engines for a total of 23 engines. Of these 23 engines, one was involved in the accident, 3 have been overhauled since being acquired, 2 are currently under repair, 2 are awaiting disassembly for overhaul, and 15 have not been overhauled and are in service. To date, no evidence of cracks, out-of-limit pitting, or improper assembly and maintenance have been found in the discs that have been available to the Safety Board for examination.

Follow-on testing for plated-over corrosion and plating thickness is pending. The Safety Board has been informed that at least one other U.S. airline has purchased two engines that were last overhauled by THY.

In 1976, THY was authorized by the Federal Aviation Administration (FAA) to overhaul JT8D series engines. This authorization was reapproved on a bi-annual basis until 1986. At that time, THY decided not to reapply for the FAA authorization because the company had few customers that required their engines

to be overhauled by an FAA-approved facility. In 1994, THY again requested and received FAA certification under 14 CFR Part 145 as a JT8D overhaul facility. Between 1986 and 1994, THY continued to overhaul JT8D engines presumably in accordance with Pratt & Whitney manuals and procedures; however, they received no FAA oversight of their JT8D overhaul capability. THY reports that since 1985, the company has conducted 500 engine overhauls.

Valujet received all of the normal maintenance records upon purchase of the airplanes and engines. The examination of the maintenance records for the accident engine and a review of the importation process found nothing unusual. The records indicate that at the time of the accident, the engine had accumulated 36,601 hours and 32,200 cycles since new and 5,621 hours and 4,433 cycles since overhaul by THY in 1991. The 7th stage disc had originally been installed in another engine and has accumulated 24,101 hours and 16,340 cycles since new. Seventh stage discs installed in JT8D-9A engines have a life limit of 30,000 hours or 20,000 cycles, whichever comes first. The accident disc had a slightly reduced life limit of 30,000 hours and 18,932 cycles because it had originally been installed in a higher rated engine.

The maintenance records indicate that the disc was in storage for an extended period of time in 1991. Whether the disc was stored as spare parts or was installed on a stored spare engine is not known. However, while the records indicate that the part was visually inspected before being placed into service, the corrosion was not detected.

While the maintenance logs show when the engine was overhauled, the process logs or "fly sheets," which provide specific details on each component, were not provided to Valujet with the maintenance records. The process logs would include the dates when the disc was stripped, inspected and replated. The investigation has been unable to obtain copies of this information. However, the records do indicate that when the disc was visually inspected by THY on June 15, 1993, it had accumulated 21,583 hours and 14,360 cycles. The maintenance records do contain notations in the margin of the 7th stage HPC disc component card that indicate a "C" check was accomplished by THY on May 14, 1991. THY has stated that a "C" check involves overhaul and includes stripping, inspecting, and replating of the disc. At that time, it had accumulated 18,477 hours and 11,907 cycles.

Pratt & Whitney engine manuals provide overhaul facilities with inspection guidance, allowable limits for damage, and repair procedures. The Safety Board

believes that the inspection material is quite detailed but that it can be difficult to understand. For instance, it would appear that, per the engine manual, damage, such as a corrosion pit of less than 0.005 inch, can be blended out to a maximum of 0.005 inch and that the disc can be replated and returned to service. However, the Safety Board believes that the maintenance material could also be interpreted to mean that a 0.005-inch pit is allowable before blending. The instructions are also ambiguous in that they provide for inspection of the tie bolt holes and later provide that all holes are to be inspected; however, there is no specific reference to inspecting the shielding holes. Additionally, there can be some confusion as to whether it is necessary to remove the blades to inspect the disc. Such misunderstandings and interpretations can be magnified when translating the instructions from English into another language. The Safety Board believes that the language concerning inspection and damage limits provided in the maintenance manual should be changed to prevent any misunderstanding about the amounts of allowable and repairable damage, and the procedures required for inspecting and repairing the disc and returning it to service.

Thus far, the investigation has been unable to determine whether the accident disc was the only disc that was improperly processed and inspected, or whether a systemic process control problem exists at THY. Additionally, the Safety Board is aware that since this engine was overhauled, THY received an FAA Part 145 approval as an engine overhaul facility. Therefore, the current procedures and processes in effect at THY may not reflect the practices in effect when the engine was overhauled.

The accident involving Valujet flight 597 indicates that there is a potential for a major catastrophic accident because of a failure in the 7th stage HPC disc in certain JT8D engines. The Safety Board believes that safety-of-flight concerns are sufficiently great as to warrant examinations of 7th stage and other steel HPC discs overhauled by THY. Based upon the examination of the failed disc, the Safety Board believes that such an examination should be made before the engines have accumulated 3,000 cycles since the last THY overhaul.

The Safety Board is concerned over the process by which the THY engines were accepted for service in the United States. The investigation has determined that an FAA-designated airworthiness inspector (DAR) was responsible for determining the airworthiness of the airplanes purchased by Valujet. However, Valujet hired the services of a consultant to determine the serviceability of the spare engines, including the accident engine. The consultant examined the serviceability tags provided by THY, the engine records, compliance with

airworthiness directives, and had a borescope examination of the engines conducted after they came to the United States. As previously stated, it is not possible to examine the 7th stage disc in the area of the tie bolt and shielding holes even by the use of a borescope. Since all of the records for the engine were in the Turkish language, the previous 2 years of maintenance records were translated into English. However, since the engines were not overhauled by an FAA-approved facility, the consultant could not have been assured whether all practices and procedures used in the overhaul complied with FAA and Pratt & Whitney specifications. The THY serviceability tags for the accident engine are missing from the Valujet maintenance records and have not been examined by the Safety Board's maintenance records group.

Both the DAR and the consultant might have assumed that THY possessed a valid FAA certificate to overhaul JT8D engines at the time that the accident engine was last overhauled. This would be a relatively easy assumption because the engines were provided with serviceability tags from an FAA-approved facility that by all appearances had held an overhaul certificate since 1974. However, during the time that this engine was overhauled, THY did not have FAA authorization to overhaul JT8D series engines. Thus, there would have been no FAA surveillance of the company's JT8D overhaul procedures or practices for several years before THY's recertification in 1994.

Furthermore, a detailed examination of the engine's history may have been complicated because most of the records were in Turkish. The Safety Board believes that the DAR and the consultant would have had a better understanding of the condition of the engines and the history of their maintenance if more of the records had been in English. The Safety Board believes that additional guidance should be provided to DARs and consultants to ascertain whether facilities that have repaired or overhauled aircraft, aircraft engines and aircraft equipment submitted for acceptance in the United States held the proper FAA certificates at the time the work was accomplished. In either event, the guidance should include the actions to be taken to ensure compliance with the Federal Aviation Regulations.

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

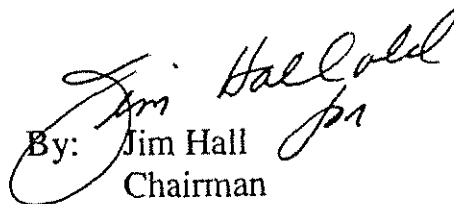
Issue an Airworthiness Directive to require the inspection of Pratt & Whitney JT8D engine high pressure compressor steel discs that were last overhauled and maintained by Turk Hava

Yollari of Turkey prior to reaching 3,000 cycles since that last overhaul and inspection. Special attention should be given to the potential for corrosion pitting or cracks in the shielding holes in 7th stage high pressure compressor discs. (Class I, Urgent Action) (A-95-71)

Modify the wording of the inspection and damage limits provided in the Pratt & Whitney manuals and service bulletins for JT8D high pressure compressor steel discs to prevent any misunderstanding of the amount of damage allowed and the procedures required for the repair and return to service of the discs. (Class II, Priority Action) (A-95-72)

Provide additional guidance to designated airworthiness representatives and aviation maintenance personnel to ascertain whether facilities that have repaired or overhauled aircraft, aircraft engines and aircraft equipment submitted for acceptance in the United States held the proper Federal Aviation Administration certificates at the time the work was accomplished. In either event, the guidance should include the actions to be taken to ensure compliance with the Federal Aviation Regulations. (Class II, Priority Action) (A-95-73)

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in these recommendations.


By: Jim Hall
Chairman