SP-70
Log 1904

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 1, 1986

In reply refer to: A-86-61 through -64

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

On July 2, 1986, an Airbus Industrie A-310 airplane operated by Pan American World Airways, Inc. (PanAm) as flight 47 from Hamburg, West Germany, to John F. Kennedy Airport, New York, experienced an uncontained failure of the left engine shortly after takeoff from Hamburg. The airplane, which was powered by two Pratt & Whitney (PWA) JT9D-7R4D-1 engines, was returned to the Hamburg Airport and landed without further incident. The government of West Germany is currently investigating the engine failure with assistance from the National Transportation Safety Board and PWA.

Preliminary examination of the engine at the manufacturer's facility in East Hartford, Connecticut, indicated that the second stage, high pressure turbine (HPT) rotating airseal failed, causing massive damage to the HPT blades and nozzle vanes. The damage precipitated a chain reaction through the low pressure turbine assembly that resulted in an uncontained exhaust case rupture and engine seizure. Numerous pieces of engine components, which were ejected during the uncontained failure, caused damage to the left side of the airplane fuselage, wing, and horizontal stabilizer.

Currently, the Safety Board is aware of at least two other similar incidents which involved Airbus A-310-221 airplanes powered by Pratt & Whitney JT9D-7R4 series engines. On July 21, 1985, a Swissair A-310-221 airplane experienced an engine failure following takeoff from London, England, and on December 29, 1985, a Nigeria Airways A-310-221 Airbus experienced an engine failure during takeoff from Port Harcourt, Nigeria. In both incidents, the second stage, HPT rotating airseal failed as a result of high frequency fatigue which in turn caused sufficient damage to the HPT blades and vanes to require an in-flight shutdown of the engine. These two failures were contained within the engine, unlike the failure which occurred on July 2, 1986.

The investigation of all three of the above engine failures has revealed several common elements among the suspect airseals used on the HPT of the JT9D-7R4 series engines.

a. All three failed airseals were manufactured from material identified by heat code RLTM. 1/

1/ Heat code is a series of letters and/or numbers which identifies the specific batch of raw steel that the forging vendor used to form an engine component.

b. All of the failures occurred on first run engines (engines which had not been disassembled since new).

c. All of the failures occurred on Airbus A-310-221 airplanes.

d. The engine serial numbers were closely related, i.e., 707721, 707731, and 707735.

e. Engine operating hours/cycles were relatively low, i.e., 2,311/1,700, 2,691/3,238, and 3,426/2,362.

f. All three engines failed during the takeoff roll or climb.

Following the July 21, 1985, engine failure, PWA issued Service Bulletin (SB) JT9D-7R4-72-245, dated September 18, 1985, which recommends that operators inspect for cracks all HPT second stage airseals, P/N 5001413-01 (including spares), on JT9D-7R4 series engines. The SB, which is classified as a low priority bulletin by PWA, recommends that the inspection be accomplished when the engine is disassembled sufficiently to afford access to the affected subassembly; no recommended time for compliance is specified in the SB. The engines involved in the three incidents had not been inspected as recommended by the SB.

On July 22, 1986, PWA reported that, of the 271 engines in service, the affected airseals of 63 engines had been inspected; 2 airseals were found cracked and were removed. One airseal was made from material identified by heat code RLTM and the other one was from material identified by heat code RLTA. The RLTM heat coded seal had operated 1,053 cycles in an A-310 Airbus and was removed by Swissair in September 1985 before SB JT9D-7R4-72-245 was issued. The RLTA heat coded airseal was in a Boeing B-767 engine with 2,508 cycles and was removed by United Airlines in January 1986. Results of the inspections performed thus far, coupled with the evidence of the three in-flight airseal failures, show that of the five failed and cracked airseals, four were made from the material designated by heat code RLTM. There are currently 12 different heat codes among the 271 affected airseals and of these, approximately 20 percent (55 airseals) are designated by heat code RLTM. Accordingly, the relatively high ratio of airseal failures with the RLTM heat code tends to indicate that while all airseals, P/N 5001413-01, may be susceptible to high frequency fatigue fractures, the airseals identified with heat code RLTM material are more prone to failure. Therefore, the Safety Board believes that these airseals should be removed from service immediately to preclude the occurrence of high frequency fatigue fractures of the seals during a critical phase of flight.

Because the JT9D-7R4 series engine is installed on the A-310 and the Boeing B-767 airplanes, both of which are currently certified for extended range overwater operations, the Safety Board believes that action is needed to preclude the possibility of in-flight failures of the HPT rotating airseals made from material identified by the other 11 heat codes. SB JT9D-7R4-72-245 may be an initial step to correct the problem; however, the SB is not mandatory nor does it recommend a specific time to complete the airseal inspection. Since the airseal failures have occurred on engines of relatively low cycles (1,700 to 3,238 operating cycles), we believe that a directed safety investigation should be conducted to determine the requirements of an inspection program that will preclude failure of the airseals regardless of the heat code designation of the material from which the seals are made. Further, we believe that the cause of the high frequency fatigue failure of the airseals must be determined and the appropriate corrective action taken to eliminate the potential for premature failure of the rotating airseals.

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

Identify all JT9D-7R4 series engines that have high pressure turbine rotating airseals, P/N 5001413-01, made from material identified with heat code RLTM and require immediate removal of the airseals from further service. (Class I, Urgent Action) (A-86-61)

Conduct a directed safety investigation of the high pressure turbine rotating airseals, P/N 5001413-01, in Pratt & Whitney JT9D-7R4 series engines to determine the requirements for an inspection program that will preclude high frequency fatigue failure of the airseals regardless of the heat code designation of the material from which the airseals are made. (Class II, Priority Action) (A-86-62)

In conjunction with Pratt & Whitney Aircraft, establish a program to determine and correct the cause of the high frequency fatigue failures of the high pressure turbine rotating airseals, P/N 5001413-01, in Pratt & Whitney JT9D-7R4 series engines. (Class II, Priority Action) (A-86-63)

Notify appropriate foreign civil aviation authorities and foreign operators of airplanes equipped with Pratt & Whitney JT9D-7R4 series engines and inform them of the failures associated with the second stage high pressure turbine rotating airseal in these engines and of the actions taken to minimize or eliminate the failures. (Class I, Urgent Action) (A-86-64)

GOLDMAN, Acting Chairman, and BURNETT, LAUBER, and NALL, Members, concurred in these recommendations.

Patricia A. Goldman

By: Patricia A. Goldman
Acting Chairman