Aviation Investigation Final Report

Location:	ATLANTA, Georgia	**Incident Number:**	ATL97IA035
Date & Time:	January 31, 1997, 16:10 Local	**Registration:**	N611DL
Aircraft:	Boeing 757-232	**Aircraft Damage:**	Minor
Defining Event:		**Injuries:**	168 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

After takeoff, the left engine experienced an uncontained failure of the Stage 1 High Pressure Turbine (HPT). The airplane returned safely and made a precautionary landing. After further examination of the engine, it was determined that the 'HPT disk blade retention lug had separated because of a low cycle fatigue fracture'. Both a Service Bulletin, PW2000 A72-592, and an Airworthiness Directive, TAD 97-11-51T, were issued to address this problem in this and other Pratt and Whitney engines.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: failure of the Stage 1 High Pressure Turbine due to a fatigue fracture in a disk blade retention lug.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: CLIMB

Findings
1. 1 ENGINE
2. (C) TURBINE ASSEMBLY - FATIGUE
3. MISC,ENGINE UNCONTAINED FAILURE - FAILURE,TOTAL

Factual Information

On January 31, 1997, about 1610 eastern standard time, a Boeing 757, N611DL, experienced an uncontained failure of the number one (left) engine during climb, near Atlanta, Georgia. The airplane, Flight 602, was operated by Delta Air Lines under instrument flight rules, and the provisions of Title 14 CFR Part 121, as a scheduled, domestic, passenger flight. An instrument flight plan was activated. Visual meteorological conditions prevailed. There were no injuries to the two flight crewmembers, the five flight attendants, and the 161 passengers, and the airplane incurred minor damage. Origination of the flight was Atlanta, Georgia, about 1600 on the same day. The flight was destined for Dallas, Texas.

According the captain, the airplane was climbing through about 15,000 feet when "the engine failed abruptly". The cockpit and aft cabin filled partially with smoke which cleared quickly. The captain requested an immediate return to Atlanta's William B. Hartsfield International Airport. The landing was uneventful. After being visually inspected for fire, the airplane was able to taxi back to the gate without further incident.

The left engine was a Pratt and Whitney PW2037 turbofan, serial number 716582. Delta's records indicate the engine had accumulated 19,243 hours total time and 9,823 cycles since new. The engine had operated 3,518 hours and 1,719 cycles since its last heavy maintenance visit on September 26, 1996.

An examination by Delta, Pratt and Whitney, and the Powerplants Group of the National Transportation Safety Board revealed the Stage 1 high pressure turbine (HPT) disk, Part Number 1B3621, had fractured and was missing the lug between two blade root slots. According to the report by the Powerplants Group, this rupture liberated one Stage 1 lug and two Stage 1 HPT blades. One blade was recovered from the cowling and determined to be "battered and fractured transversely across the airfoil adjacent to the blade root platform".

A visual examination showed the fracture surface was "smooth and had a purple discoloration from the front side that faded to a gold color towards the rear" of the disk. According to the Powerplants Group report, the "fir tree serrations on the adjacent lugs were intact." At the time of separation, according to Delta's records, the Stage 1 HPT disk had accumulated 9,825 cycles since new, and 1,719 cycles since the last heavy maintenance. Part Number 1B3621 Stage 1 HPT disks are life limited to 15,000 cycles.

The remaining rotating parts of the HPT were intact, with impact damage on the blades. The low pressure turbine (LPT) was intact. Its vanes and blades both had "nicks and dents". The remainder of the engine appeared normal and was not disassembled.

A metallurgical examination was completed by Pratt and Whitney's material laboratory

in February, 1997. The examination showed that the "HPT disk blade retention lug had separated because of a low cycle fatigue (LCF) fracture that had initiated from multiple origins along the front sideplate snap radius and propagated axially rearward. The origins of the fatigue fracture were parallel to circumferential machining marks that were just inboard of the snap radius".

After this and other similar HPT failures, Pratt and Whitney produced an Alert Service Bulletin (ASB). This bulletin, PW2000 A72-592, described a modification of the HPT disk assembly for all PW2037, PW2037(M), PW2040, PW2240, and PW2337 engines. This Service Bulletin attempted to prevent further blade attachment lug liberations by enlarging the front and rear sideplate snap radii. This modification was designed to reduce the stresses and eliminate the cracking in the radii which was allowing the blades to be liberated.

From Pratt and Whitney's Alert Service Bulletin, the FAA produced a Telegraphic Airworthiness Directive (TAD) 97-11-51T, which required serviceable disks to be operated in accordance with Pratt and Whitney's ASB No. PW2000 A72-592.

Pilot Information

Certificate:	Airline transport	**Age:**	58,Male
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	November 8, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	15000 hours (Total, all aircraft), 2751 hours (Total, this make and model), 225 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N611DL
Model/Series:	757-232 757-232	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	22818
Landing Gear Type:	Retractable - Tricycle	**Seats:**	190
Date/Type of Last Inspection:	January 20, 1997 Continuous airworthiness	**Certified Max Gross Wt.:**	223800 lbs
Time Since Last Inspection:	106 Hrs	**Engines:**	2 Turbo fan
Airframe Total Time:	37395 Hrs	**Engine Manufacturer:**	P&W
ELT:	Not installed	**Engine Model/Series:**	PW2037
Registered Owner:	DELTA AIR LINES	**Rated Power:**	37530 Lbs thrust
Operator:		**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:		**Operator Designator Code:**	DALA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	ATL ,1026 ft msl	**Distance from Accident Site:**	35 Nautical Miles
Observation Time:	15:56 Local	**Direction from Accident Site:**	270°
Lowest Cloud Condition:	Unknown	**Visibility**	10 miles
Lowest Ceiling:	Broken / 25000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots / 15 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	260°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	15°C / -1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	(ATL)	**Type of Flight Plan Filed:**	IFR
Destination:	DALLAS , TX (DFW)	**Type of Clearance:**	IFR
Departure Time:	16:00 Local	**Type of Airspace:**	Class B

Airport Information

Airport:	HARTSFIELD INTERNATIONAL ATL	**Runway Surface Type:**	Concrete
Airport Elevation:	1026 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	27L	**IFR Approach:**	None
Runway Length/Width:	11889 ft / 150 ft	**VFR Approach/Landing:**	Precautionary landing

Wreckage and Impact Information

Crew Injuries:	7 None	**Aircraft Damage:**	Minor
Passenger Injuries:	161 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	168 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	Hicks, Preston
Additional Participating Persons:	FRAN DEJOSEPH; REGAN H CAMPBELL;
Original Publish Date:	April 24, 1998
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=3787