Uncontained engine failure, Douglas DC-9-32, May 5, 1994

Micro-summary: **This Douglas DC-9-32 had an uncontained engine failure of the #1 engine.**

Event Date: **1994-05-05 at 0855 CDT**

Investigative Body: **National Transportation Safety Board (NTSB), USA**

Investigative Body's Web Site: **http://www.ntsb.gov/**

Cautions:

1. Accident reports can be and sometimes are revised. Be sure to consult the investigative agency for the latest version before basing anything significant on content (e.g., thesis, research, etc).

2. Readers are advised that each report is a glimpse of events at specific points in time. While broad themes permeate the causal events leading up to crashes, and we can learn from those, the specific regulatory and technological environments can and do change. ***Your company's flight operations manual is the final authority as to the safe operation of your aircraft!***

3. Reports may or may not represent reality. Many many non-scientific factors go into an investigation, including the magnitude of the event, the experience of the investigator, the political climate, relationship with the regulatory authority, technological and recovery capabilities, etc. It is recommended that the reader review all reports analytically. Even a "bad" report can be a very useful launching point for learning.

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National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: ATL94IA097	Aircraft Registration Number: N986US
Occurrence Date: 05/05/1994	Most Critical Injury: None
Occurrence Type: Incident	Investigated By: NTSB

Location/Time

Nearest City/Place	State	Zip Code	Local Time	Time Zone	
MEMPHIS	TN	38116	0855	CDT	

Airport Proximity: On Airport	Distance From Landing Facility:	Direction From Airport:

Aircraft Information Summary

Aircraft Manufacturer	Model/Series	Type of Aircraft
DOUGLAS	DC-9-32	Airplane

Sightseeing Flight: No

Air Medical Transport Flight: No

Narrative

Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:

On May 5, 1994, about 0855 central daylight time, a Douglas DC-9-32, N986US, had an uncontained engine failure during the takeoff roll at Memphis, Tennessee. Flight 661 was operated by Northwest Airlines under Title 14 Code of Federal Regulations (CFR) Part 121 as a scheduled, domestic, passenger flight. Visual meteorological conditions prevailed. An instrument flight rules flight plan was filed for the flight to Phoenix, Arizona. There were no injuries to the airline transport pilots, the three flight attendants, nor the 64 passengers; and minor damage to the airplane. The flight was originating at the time of the accident.

During the takeoff roll, approximately 125 knots, the flight crew heard a loud explosion and noted that all of the left engine instruments were reducing to zero indication. The takeoff was rejected, and the engine shut down. The engine fire extinguisher was discharged. As the airplane was taxied onto a taxiway, tower personnel informed the flight crew that smoke was coming from the engine. The flight crew obtained information from fire/rescue personnel and determined that an evacuation was not required.

A post incident examination of the engine, which was installed in left position of N986US, showed that an uncontained failure of the combustion case had occurred. The engine cowling was partially opened up and distorted. There was minor shrapnel damage to an unpressurized portion of the fuselage, adjacent to the engine. The engine, a Pratt and Whitney JT8D-15, serial number 657510, was removed to the Northwest Airlines engine overhaul facility in Atlanta, Georgia, for additional visual examination. The combustion chamber outer case (CCOC) had fractured through a bolt hole of the rear flange, at the engine's three o'clock position. All of the combustion cans were in place and there was no evidence of an external fire. The outer case opened along an axial plane with the upper and lower halves displacing up and down, respectively, as if opening a briefcase. The fracture surface on the lower portion of the case was discolored black from the rear flange bolt hole forward about four inches. Its coloration then changed to red for about 3.75 to 4.00 inches. The fracture surface then abruptly changed to a lighter color (bronze then steel) for about five inches. Subsequently, the engine was forwarded to Pratt and Whitney facilities for in-depth examination. A metallurgical examination was conducted by Pratt and Whitney which revealed that the fracture resulted from low cycle fatigue in the separated bolt hole, of the rear flange. Low cycle fatigue cracks were observed in numerous additional bolt holes. The case material conformed to composition and hardness requirements.

Rear flange fractures of the CCOC are the subject of Federal Aviation Administration Airworthiness Directive 87-10-01 R1, effective November 13, 1989, and Pratt and Whitney Alert Service Bulletin 5676 dated July 15, 1986. The incident engine had been inspected in accordance with both documents on November 28, 1990. The combustion case had 5,940 cycles since the inspection, and had 2,060 cycles remaining until the required inspection was again due at 8,000 cycles.

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Occurrence Date: 05/05/1994

Occurrence Type: Incident

Narrative (Continued)

Two previous CCOC fractures have occurred, similar to the fracture in this incident. The first occurred during takeoff and the second occurred during routine reassembly following engine maintenance. An All Operator's Wire was issued by Pratt and Whitney, following the second fracture occurrence. The wire discussed a "low toughness condition" of older cases that, under certain conditions, could result in an intergranular crack.

Following the additional examinations of the engine, Pratt and Whitney, in conjunction with the Federal Aviation Administration, are pursuing the issuance of inspections to preclude similar, undetected CCOC cracks.

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FACTUAL REPORT AVIATION

NTSB ID: ATL94IA097

Occurrence Date: 05/05/1994

Occurrence Type: Incident

Landing Facility/Approach Information

Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
MEMPHIS INTERNATIONAL	MEM	352 Ft. MSL	36L	9319	150

Runway Surface Type: Concrete

Runway Surface Condition: Dry

Type Instrument Approach: NONE

VFR Approach/Landing: None

Aircraft Information

Aircraft Manufacturer	Model/Series	Serial Number
DOUGLAS	DC-9-32	47480

Airworthiness Certificate(s): Transport

Landing Gear Type: Retractable - Tricycle

Homebuilt Aircraft?	Number of Seats:	Certified Max Gross Wt.	Number of Engines:
No	104	108000 LBS	3

Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:
Turbo Fan	P&W	JT8D-15	15000 LBS

- Aircraft Inspection Information

Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time
Continuous Airworthiness	04/1994	37 Hours	54685 Hours

- Emergency Locator Transmitter (ELT) Information

ELT Installed?	ELT Operated?	ELT Aided in Locating Accident Site?
No		

Owner/Operator Information

Registered Aircraft Owner: FIRST SECURITY BANKS OF UTAH

Street Address:

City: SALT LAKE CITY | State: UT | Zip Code:

Operator of Aircraft: NORTHWEST AIRLINES, INC

Street Address: 5101 NORTHWEST DRIVE

City: ST. PAUL | State: MN | Zip Code: 55111

Operator Does Business As:

Operator Designator Code: NWAA

- Type of U.S. Certificate(s) Held:

Air Carrier Operating Certificate(s): Flag Carrier/Domestic

Operating Certificate:

Operator Certificate:

Regulation Flight Conducted Under: Part 121: Air Carrier

Type of Flight Operation Conducted: Scheduled; Domestic; Passenger Only

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: ATL94IA097

Occurrence Date: 05/05/1994

Occurrence Type: Incident

First Pilot Information

Name	City	State	Date of Birth	Age
On File	On File	On File	On File	49

Sex: M | Seat Occupied: Left | Principal Profession: Civilian Pilot | Certificate Number: On File

Certificate(s): Airline Transport

Airplane Rating(s): Multi-engine Land

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): Airplane Single-engine; None

Type Rating/Endorsement for Accident/Incident Aircraft? Yes | Current Biennial Flight Review?

Medical Cert.: Class 1 | Medical Cert. Status: Valid Medical--no waivers/lim. | Date of Last Medical Exam: 02/1994

- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Mult-Engine	Night	Instrument Actual	Instrument Simulated	Rotorcraft	Glider	Lighter Than Air
Total Time	19657	4266								
Pilot In Command(PIC)										
Instructor										
Last 90 Days	198	198		198						
Last 30 Days	83	83		83						
Last 24 Hours	7	7		7						

Seatbelt Used? Yes | Shoulder Harness Used? Yes | Toxicology Performed? No | Second Pilot? Yes

Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point	State	Airport Identifier	Departure Time	Time Zone
Same as Accident/Incident Location			0840	CDT

Destination	State	Airport Identifier
PHOENIX	AZ	PHX

Type of Clearance: IFR

Type of Airspace: Class D; Class E

Weather Information

Source of Briefing: Commercial Weather Service; Flight Service Station; PATWAS

Method of Briefing:

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: ATL94IA097

Occurrence Date: 05/05/1994

Occurrence Type: Incident

Weather Information

WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
MEM	0855	CDT	352 Ft. MSL	1 NM	180 Deg. Mag.

Sky/Lowest Cloud Condition: Clear 0 Ft. AGL

Condition of Light: Day

Lowest Ceiling: None 0 Ft. AGL

Visibility: 10 SM

Altimeter: 30.00 "Hg

Temperature: 16 °C

Dew Point: °C

Wind Direction:

Density Altitude: Ft.

Wind Speed: Calm

Gusts:

Weather Condtions at Accident Site: Visual Conditions

Visibility (RVR): 0 Ft.

Visibility (RVV) 0 SM

Intensity of Precipitation: Unknown

Restrictions to Visibility: None

Type of Precipitation: None

Accident Information

Aircraft Damage: Minor

Aircraft Fire: None

Aircraft Explosion None

Classification: U.S. Registered/U.S. Soil

- Injury Summary Matrix	Fatal	Serious	Minor	None	TOTAL
First Pilot				1	1
Second Pilot				1	1
Student Pilot					
Flight Instructor					
Check Pilot					
Flight Engineer					
Cabin Attendants				3	3
Other Crew					
Passengers				64	64
- TOTAL ABOARD -				69	69
Other Ground	0	0	0		0
- GRAND TOTAL -	0	0	0	69	69

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FACTUAL REPORT

AVIATION

NTSB ID: ATL94IA097

Occurrence Date: 05/05/1994

Occurrence Type: Incident

Administrative Information

Investigator-In-Charge (IIC)

PRESTON E. HICKS,

Additional Persons Participating in This Accident/Incident Investigation:

JEROME FRECHETTE
NTSB
WASHINGTON, DC

JOE EPPERSON
NTSB
WASHINGTON, DC

F. K PORTER
MEMPHIS, TN FSDO
MEMPHIS, TN