
Uncontained engine failure, McDonnell Douglas DC-10-30, April 25, 2000

Micro-summary: Uncontained failure of the #1 engine results in damage to the #2 and #3 engines, the fuselage, and left landing gear.


Event Date: 2000-04-25 at 1942 EDT

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

Investigative Body's Web Site: <http://www.nts.gov/>

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		NTSB ID: NYC00FA122		Aircraft Registration Number: N39081	
		Occurrence Date: 04/25/2000		Most Critical Injury: None	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place NEWARK		State NJ	Zip Code 07114	Local Time 1942	Time Zone EDT
Airport Proximity: On Airport		Distance From Landing Facility:		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer McDonnell Douglas		Model/Series DC-10-30		Type of Aircraft Airplane	
Sightseeing Flight: No			Air Medical Transport Flight: No		
Narrative					
Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:					
<p>HISTORY OF FLIGHT</p> <p>On April 25, 2000, at 1942 Eastern Daylight Time, a McDonnell-Douglas DC-10-30, N39081, operating as Continental Airlines flight 60, was substantially damaged when an uncontained engine event occurred during takeoff from Newark International Airport (EWR), Newark, New Jersey. The 3-man cockpit crew, 11-person cabin crew, and 220 passengers were not injured. Visual meteorological conditions prevailed at the time of the accident. An instrument flight rules flight plan had been filed for the flight, between Newark and Brussels Airport (BRU), Brussels, Belgium. The scheduled passenger flight was conducted under 14 CFR Part 121.</p> <p>The captain stated that he conducted a crew briefing prior to boarding the airplane. Startup and taxi were normal, and during the taxi, the captain again briefed the cockpit crew, and included engine failures, as well as "non-reject" situations. The airplane lined up on Runway 04L, and the captain applied takeoff power slowly and smoothly. At takeoff decision speed (V1), there was a loud explosion. A white "engine fail" light illuminated in front of the captain, and the number 1 engine N1 decreased by 30 percent. Number 2 and number 3 engines appeared normal.</p> <p>The captain continued the takeoff, and the landing gear was raised. A red, left main landing gear warning light illuminated on the front panel. The airplane turned to a heading of 010, and slowly climbed to 3,000 feet. During the climb, an airframe vibration developed.</p> <p>After level-off, the crew began to troubleshoot the emergency, and found that when the number 3 engine N1 was reduced, the vibration disappeared. Both the number 1 and the number 3 engines remained at reduced power, in relation to number 2, for the rest of the flight.</p> <p>Air traffic control personnel provided vectors for a return to Newark. During the return, the crew dumped about 90,000 pounds of fuel. The crew also ran both 1-engine, and 2-engine inoperative checklists, and prepared data cards for both scenarios.</p> <p>The captain flew the ILS glideslope down to a full-stop landing, on Runway 04R. The ACARS recorded the landing at 2016. After stopping on the runway, the brakes would not release, so the crew shut down the engines, and the passengers and crew disembarked through the normal deplaning doors. The airplane was later towed to a ramp.</p> <p>According to the captain, the use of crew resource management (CRM) by both the cockpit and cabin crews was a major factor in the successful handling of the emergency.</p> <p>The accident occurred approximately 5 minutes before sunset, about 40 degrees, 41.5 minutes north latitude, 74 degrees, 10.2 minutes west longitude.</p>					
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FACTUAL REPORT

AVIATION

NTSB ID: NYC00FA122

Occurrence Date: 04/25/2000

Occurrence Type: Accident

Narrative (Continued)

PERSONNEL INFORMATION

The captain held an airline transport pilot certificate with a DC-10 type rating. His latest first class medical certificate was dated November 12, 1999. His last formal cockpit resource management training was completed on August 14, 1997.

The first officer also held an airline transport pilot certificate. His latest first class medical certificate was dated June 15, 1999.

The second officer also held an airline transport pilot certificate.

DAMAGE TO AIRCRAFT

Examination of the airplane revealed that all three General Electric Aircraft Engine (GEAE) CF6-50C2 engines were damaged. The number 1 (left) engine low pressure turbine (LPT) case was breached in the vicinity of the 2nd-stage nozzles, between approximately the 3 o'clock and 9 o'clock positions. The breach was about the width of the 2nd-stage nozzle segments, all of which were missing from the engine.

Nine of the 16 nozzle segments were recovered intact, and additional portions of 5 segments were found, for a total recovery of about 85 percent of the nozzle material. The majority of nozzle material was found on the departure runway; however, one nozzle segment was found in the left main landing gear wheel well.

All eight of the 2nd-stage LPT nozzle locks were missing from the engine. A single nozzle lock stud and nut remained attached to the LPT case lower half, but the lock itself was missing. Two of the eight anti-rotation nozzle locks were recovered from a debris field along the runway.

The 1st-stage LPT blades had minor trailing edge airfoil damage, and the 2nd-stage LPT blades exhibited circumferential rub marks on the inner platform leading edge, and on the airfoils near the blade root.

The number 2 (center) engine exhibited leading edge damage to two fan blades.

The number 3 (right) engine had leading edge damage to all of the fan blades, consisting of tears, rips and material loss. Pieces of fan blade, and material similar to that of the 2nd-stage nozzles from the number 1 engine, were found embedded in the engine inlet acoustic panels.

The front inboard tire of the left main landing gear was ruptured, and the front outboard tire exhibited tread separation, but remained inflated. Impact marks, including punctures and scrapes, were noted on the outboard side of the left engine pylon, the left wing outboard flap, the underside of the fuselage, the left main landing gear access door, the left side of the fuselage aft of the left wing, and a right wing panel outboard of the flap actuator housing.

TESTS AND RESEARCH

According to the Powerplants Group Chairman's Factual Report:

The GEAE CF6-50C2 engine was a dual-rotor, high-bypass, axial flow turbofan, which produced approximately 50,000 pounds of thrust. It featured a 14-stage high pressure compressor, driven by a 2-stage high pressure turbine; an annular combustor; and an integrated front fan and low pressure compressor, driven by a 4-stage LPT.

The LPT included eight 2nd-stage nozzle locks, one for every two nozzle segments, and ten 3rd- and 4th-stage nozzle locks, one for every six segments. All of the nozzle locks were of the same

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configuration and material.

On May 4, 1993, GEAE issued CF6-50 service bulletin (SB) 72-1065, to replace existing nozzle locks with ones that had thicker posts and arms, to prevent cracking and breaking. The increased diameter of the stud shank required modification of the LPT case nozzle lock holes. Before SB 72-1065 could be incorporated into the accident engine, a new service bulletin was issued.

On March 30, 1994, GEAE issued CF6-50 SB 72-1082, which discontinued SB 72-1065, and introduced a newly designed nozzle lock. SB 72-1082 returned to the use of original-diameter stud shanks, but the material was changed. The new nozzle lock did not require modification of the LPT case.

In March 1997, Greenwich Caledonian Limited, Prestwick, Scotland, incorporated SB 72-1082 into the accident engine. The engine was subsequently installed on another DC-10, in position number 3, where it remained until July 6, 1999. At that time, it was removed due to high pressure turbine damage, and shipped to GE Caledonian Limited (name change for the same company) for repair. The LPT nozzle segments were not removed from the case, but were visually inspected, on July 26, 1999. On December 16, 1999, the operator installed the engine in position number 1 on the accident airplane.

At the time of the accident, the nozzle locks had attained 9,226 hours of operation since new, and 1,302 cycles since new. They had not been inspected after the last shop visit, since maintenance inspection frequency required that the fan, thrust reverser, and core cowls be opened and visually inspected every 1,650 hours, or 400 cycles. Since the last shop visit, the engine had attained 1,339 hours, and 191 cycles of operation.

There were two previously reported failures of SB 72-1082 LPT nozzle locks. Those two were discovered during routine under-cowl inspections. The first failure resulted in all the 2nd-stage nozzle locks being broken. The nozzle segments had rotated 120 degrees within the LPT case, but the case itself was not breached. In the second event, two 4th-stage nozzle locks had failed, but there was no collateral damage. According to GEAE metallurgical reports, the failures were intergranular, "suggesting either stress rupture or sustained peak low cycle fatigue."

The two recovered 2nd-stage nozzle locks, and a section of the LPT case with part of the 2nd-stage nozzle lock stud attached, were sent to the Safety Board Materials Laboratory for evaluation. According to the metallurgist's factual report,

"Examination of the fractures from the submitted locks and studs revealed intergranular fracture features. Some of these fractures also contained degradation at the surface of the fracture features and grain boundaries typical of oxidation damage. No evidence of a fatigue crack was noted on the fracture surfaces. The area around the studs appeared to contain no elongation deformation."

The report further stated:

"The intergranular fractures and oxidation damage found at the grain boundaries (both at the surface of the fracture and those adjacent to the fracture surface) are consistent with stress rupture."

During the Powerplants Group visit to GE Caledonian, the inspection of a comparison engine revealed that a 2nd-stage nozzle lock was also cracked. "The crack progressed around the stud recess - between the stud and the base plate interface - and into the plate." The stud was forwarded to the Safety Board Materials Laboratory for examination, with the results being the same as those from the accident engine, with oxidation and intergranular fracture features, consistent with stress rupture.

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ADDITIONAL INFORMATION

The airplane was released to the operator on April 27, 2000.

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		Occurrence Type: Accident			
Landing Facility/Approach Information					
Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
NEWARK INTERNATIONAL	EWR	18 Ft. MSL	4L	10000	150
Runway Surface Type: Asphalt					
Runway Surface Condition: Dry					
Type Instrument Approach: NONE					
VFR Approach/Landing: None					
Aircraft Information					
Aircraft Manufacturer		Model/Series		Serial Number	
McDonnell Douglas		DC-10-30		47861	
Airworthiness Certificate(s): Transport					
Landing Gear Type: Retractable - Tricycle					
Homebuilt Aircraft? No	Number of Seats: 256	Certified Max Gross Wt.	491521 LBS	Number of Engines: 3	
Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:		
Turbo Fan	GE	CF6-50C2	51800 LBS		
- Aircraft Inspection Information					
Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time		
Continuous Airworthiness	03/2000	217 Hours	13346 Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed? No	ELT Operated?	ELT Aided in Locating Accident Site?			
Owner/Operator Information					
Registered Aircraft Owner		Street Address			
		1211 AVENUE OF THE AMERICAS			
CIT LEASING CORP		City	State	Zip Code	
		NEW YORK	NY	10036	
Operator of Aircraft		Street Address			
		1600 SMITH STREET			
CONTINENTAL AIRLINES, INC.		City	State	Zip Code	
		HOUSTON	TX	77002	
Operator Does Business As:			Operator Designator Code: CALA		
- 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; International; Passenger Only					
FACTUAL REPORT - AVIATION					

 <p>National Transportation Safety Board FACTUAL REPORT AVIATION</p>	NTSB ID: NYC00FA122
	Occurrence Date: 04/25/2000
	Occurrence Type: Accident

First Pilot Information

Name On File	City On File	State On File	Date of Birth	Age 49
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Sex: M	Seat Occupied: Left	Principal Profession: Civilian Pilot	Certificate Number:
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Certificate(s): Airline Transport

Airplane Rating(s): Multi-engine Land; Single-engine Land

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): None

Type Rating/Endorsement for Accident/Incident Aircraft? Yes	Current Biennial Flight Review?
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Medical Cert.: Class 1	Medical Cert. Status: Valid Medical--w/ waivers/lim.	Date of Last Medical Exam: 11/1999
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- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Multi-Engine	Night	Instrument		Rotorcraft	Glider	Lighter Than Air
						Actual	Simulated			
Total Time	22000	1000	1900	20100						
Pilot In Command(PIC)	17000	1000								
Instructor										
Last 90 Days	165	165								
Last 30 Days	38	38								
Last 24 Hours										

Seatbelt Used? Yes	Shoulder Harness Used? Yes	Toxicology Performed? No	Second Pilot? Yes
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Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point Same as Accident/Incident Location	State	Airport Identifier EWR	Departure Time 1942	Time Zone EDT
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Destination BRUSSELS	State OF	Airport Identifier BRU	
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Type of Clearance: IFR

Type of Airspace: Class B

Weather Information

Source of Briefing:
Company

Method of Briefing:

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Weather Information

WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
EWR	1951	EDT	18 Ft. MSL	0 NM	0 Deg. Mag.
Sky/Lowest Cloud Condition: Unknown			0 Ft. AGL	Condition of Light: Dusk	
Lowest Ceiling: Broken		11000 Ft. AGL		Visibility: 10 SM	Altimeter: 29.00 "Hg
Temperature: 48 °C	Dew Point: 40 °C	Wind Direction: 130		Density Altitude: Ft.	
Wind Speed: 6	Gusts:	Weather Conditions 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: Substantial	Aircraft Fire: None	Aircraft Explosion: None
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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				1	1
Cabin Attendants				11	11
Other Crew					
Passengers				220	220
- TOTAL ABOARD -				234	234
Other Ground	0	0	0		0
- GRAND TOTAL -	0	0	0	234	234

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NTSB ID: NYC00FA122

Occurrence Date: 04/25/2000

Occurrence Type: Accident

Administrative Information

Investigator-In-Charge (IIC)

PAUL R. COX

Additional Persons Participating in This Accident/Incident Investigation:

SAM WALL
FAA/FSDO
TETERBORO, NJ

TOBY CARROLL
CONTINENTAL AIRLINES
HOUSTON, TX

KEN WOLSKI
GENERAL ELECTRIC AIRCRFT ENGS
CINCINNATI, OH