
Tail strike during go-around, McDonnell Douglas MD-11F, September 19, 2004

Micro-summary: This McDonnell Douglas MD-11F experienced a tail strike during a go-around maneuver.

Event Date: 2004-09-19 at 1243 CDT


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

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

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		NTSB ID: DCA04MA082		Aircraft Registration Number: N601FE	
		Occurrence Date: 09/19/2004		Most Critical Injury: None	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place Memphis		State TN	Zip Code	Local Time 1243	Time Zone CDT
Airport Proximity: On Airport		Distance From Landing Facility: 0		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer Boeing		Model/Series MD-11		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:					
HISTORY OF FLIGHT					
<p>On September 19, 2004, at 1243 central daylight time, a Boeing McDonnell Douglas MD-11F, N601FE, operating as FedEx (FDX) flight 859, experienced a tail strike during a go-around maneuver from runway 09 at Memphis International Airport (MEM). The crew was executing a Category III autoland procedure for proficiency. Neither of the 2 crewmembers was injured. The airplane sustained substantial damage to the underside of the rear fuselage and the aft pressure bulkhead. Flight 859 was operating on an instrument flight rules flight plan under the provisions of 14 Code of Federal Regulations (CFR) Part 121 as a regularly scheduled cargo flight from Oakland, California (OAK) to MEM. Visual meteorological conditions prevailed at the time of the accident. Flight 859 departed OAK at about 0721 Pacific daylight time. According to the flight crew, the flight was uneventful until the landing on runway 9 at MEM.</p>					
<p>Memphis air traffic control (ATC) provided radar vectors to a 14 to 15 mile final approach to runway 9. The pilots reported that the approach was stable and nominal. The calculated landing weight for the airplane was 370,000 pounds, with a calculated approach speed of 142 knots indicated. The captain took over flying responsibility for the airplane at about 300 feet above the runway, and he reported that the autoland system was working normally. Flight Data Recorder information showed the airplane was at an airspeed of 142 knots, there was less than dot deflection on the glideslope indicator, the flaps were set at 50 degrees, and the airplane was at a pitch attitude of about 3 degrees airplane nose up.</p>					
<p>The captain said everything appeared normal when the airplane entered the flare maneuver. Prior to touchdown, the airplane drifted slightly right of the centerline, touching down about 20 feet to the right of centerline. The captain said that the airplane touched down firmly, but not what he would consider a hard landing. After touchdown, he perceived that the airplane pitched further up, instead of pitching down as he expected. He applied forward pressure to the control column to bring the nose down, the sink rate rapidly increased and there was "a second touchdown." He was concerned that the airplane would begin to porpoise and felt it would be safer to go around.</p>					
<p>FDR data indicated that the airplane remained centered on the ILS localizer and glideslope beams during the approach, with the nose pointed to the left of the runway heading in order to compensate for a 10 knot left crosswind. As the airplane yawed to the right to align the nose with the runway heading just prior to touchdown, performance calculations indicate it drifted to the right and touched down about 30 feet to the right of centerline. With the autopilot still engaged, the airplane bounced slightly, eventually reaching a radio altitude of 3 feet; about 3 seconds after the first touchdown. As the airplane ascended through a radio altitude of about 1 foot during the bounce, the autopilot disconnect warning was recorded on the CVR.</p>					
<p>According to the FDR, following the autopilot disconnect the control column moved aft to 7 degrees,</p>					
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while the pitch angle decreased from 7 to 4 degrees before starting to increase. At this time the thrust reversers were "unlocked," indicating flight crew selection of reversers. The airplane touched down for the second time about 4.2 seconds after the first touchdown. The spoilers briefly deployed, in conjunction with aileron movement, then retracted concurrently with the go-around maneuver.

Almost immediately after the second touchdown, the captain called for maximum power and initiated the go-around maneuver. The FDR indicated that the airplane pitched up steadily until reaching a pitch attitude of about 12 degrees, and the speed decayed to 107 knots. The captain said that he applied aft control column pressure to raise the nose; the airplane did not pitch up to this attitude on its own. About seven seconds after the go-around call, the power on all three engines began increasing, and the flaps began retracting from the 50 degree position. The airplane accelerated in the approximately 12 degree nose up attitude until about 15 seconds after the go-around call, when it reached an airspeed of 115 knots and achieved a positive rate of climb. About 3,650 feet of available runway remained. Witnesses reported that the rear fuselage of the airplane scraped the runway for about 3,000 to 4,000 feet and produced a great deal of sparks. The crew then maneuvered the airplane to a landing on runway 36R without further incident.

Boeing documentation states that the airplane's aft body would strike the runway surface at a pitch attitude of about 10 degrees with main gear struts compressed, or about 13 degrees with the main gear struts extended.

INJURIES TO PERSONS

The 2 crewmembers were uninjured.

DAMAGE TO AIRPLANE

During the tailstrike, three skin sections were abraded over an area of at least 12 feet by 3 feet.

A significant portion of the skin was abraded completely away. Five longerons exhibited abrasion damage as well as numerous shear clips and eight aft fuselage frames. The aft drain mast was fractured and the left aft tail cone hinge was damaged. The damaged area extended from the unpressurized portion of the fuselage across the aft pressure bulkhead to a point about 2 feet forward of the bulk cargo door. The T-cap on the pressure bulkhead exhibited some abrasion damage and there was a inch buckle in the bulkhead web above the point of contact. The listed damage was considered substantial under 49 CFR, Part 830.

OTHER DAMAGE

None.

PERSONNEL INFORMATION

The captain, age 46, was hired by FedEx on July 18, 1988. He held a Federal Aviation Administration (FAA) airline transport pilot (ATP) certificate with a multiengine land rating and a flight engineer certificate for turbojet-powered airplanes. The captain's ATP certificate indicated type ratings in the MD-11 and DC-10 (issued December 20, 2003). According to company records, at the time of the accident he had 6,390 hours total time; with 235 hours in the MD-11, all as Captain. The captain's most recent FAA first-class airman medical certificate was issued on July 23, 2004, with a restriction that the holder must wear corrective lenses. The captain had no history of failures or re-tests for FAA pilot and flight engineer certificates and ratings. He completed an MD-11 proficiency check on June 8, 2004, and completed MD-11 tailstrike awareness training on December 9, 2003.

The First Officer, age 43, was hired by FedEx on May 16, 1994. He held an FAA ATP certificate with

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a multiengine land rating and a flight engineer certificate for turbojet-powered airplanes. The First Officer's ATP certificate indicated a type rating in the MD-11 (issued April 18, 2004). According to company records he had 3,723 hours total time, with 133 in the MD-11. The First Officer's most recent FAA first-class airman medical certificate was issued on August 18, 2004, with no restrictions. He completed an MD-11 proficiency check on April 18, 2004, and completed MD-11 tailstrike awareness training on March 26, 2004. A review of FAA records indicated that on May 6, 1994, the first officer was issued a notice of disapproval of application for a Military Competency written test. He subsequently passed the test on July 5, 1994, and was issued a Temporary Airman Certificate for a Commercial Pilot Certificate, Airplane Multiengine Land and Instrument Airplane.

AIRPLANE INFORMATION

N601FE, an MD-11F, serial number 48401, was the first production MD-11. It was delivered new to Federal Express on June 27, 1991. The airplane had previously been involved in an incident involving a flight control malfunction on approach to Subic Bay, Philippines, on June 16, 2002 (NTSB # DCA02MA042).

METEOROLOGICAL INFORMATION

The Memphis aviation surface weather observation taken at 12:53 local time reported winds from 080 degrees magnetic at 10 knots, with 10 miles visibility under clear skies. The temperature was 28 degrees Celsius, and the dewpoint was 6 degrees Celsius. Sea level barometric pressure was 30.17 inches of mercury. The Memphis Automatic Surface Observation Station (ASOS) also recorded a five-minute average wind at 12:40 of 080 degrees at 12 knots, and at 12:45 a wind of 050 at 11 knots. Additionally, the ASOS recorded an instantaneous wind reading at 12:43 of 070 degrees at 9 knots with a gust of 060 degrees at 14 knots.

Performance calculations indicated a crosswind component of approximately 10 knots. According to the Limitations section of the FedEx Express MD-11/MD-10 Flight Manual, the maximum MD-11 crosswind speed component during an Autoland is 15 knots. The manual directs flight crews to adjust approach speed by increasing VREF by a wind additive. The wind additive is the greater of 5 knots, the steady wind in excess of 20 knots, or the reported gust factor. The maximum wind additive is 20 knots.

AIDS TO NAVIGATION

Memphis International Airport runway 9 was equipped with an instrument landing system capable of Category I guidance, i.e. to a landing minima of 200 feet above the runway with mile visibility minima an ILS approach. The FedEx MD-11/MD-10 Flight Manual (page 4-4-1-1) states that "an Auto-Land approach can be performed to any runway (CAT I, II, or III) providing it has a minimum TCH [Threshold Crossing Height] of 47 feet. Because of the inconsistencies in ILS beam qualities from one airport to another it becomes imperative that flight crews monitor the Auto-Land system performance on every approach. Approach charts should be reviewed for restrictions i.e., 'Glideslope Unusable Below 100 ft.' In these cases an Auto-Land approach must not be conducted." The Memphis ILS Runway 9 approach chart indicated that the TCH is 55 feet, and there were no pertinent restrictions noted.

COMMUNICATIONS

N/A

AIRPORT INFORMATION

Memphis International Airport is located about 3 miles south of the city of Memphis,

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Tennessee. Runway 9 is constructed of grooved asphalt and is 8,946 feet long, and 150 feet wide. The touchdown zone is at 253.2 feet above mean sea level (msl). It is not equipped with a visual approach slope indicator.

FLIGHT RECORDERS

The airplane was equipped with a Honeywell Model 980-4700 Flight Data Recorder. The recorder was in good condition and the data were extracted normally. For further information see the FDR Specialist's Factual Report.

The airplane was equipped with a Smith Industries Combined Voice and Flight Data Recorder, (CVR/FDR). The unit contained a two hour digital voice recorder. A CVR group was convened and prepared a transcript of 20 minutes and 2 seconds of the total 2 hour, 8 second recording. The transcript is attached to the CVR Group Factual Report.

WRECKAGE AND IMPACT INFORMATION

N/A

MEDICAL and PATHOLOGICAL INFORMATION

Flight crew toxicological testing was not accomplished.

FIRE DAMAGE

N/A

SURVIVAL ASPECTS

N/A

TESTS AND RESEARCH

An Aircraft Performance Study was conducted to determine and analyze the motion of the aircraft and the physical forces that produce that motion. This study describes the results of using the flight recorder and radar data in defining, as far as possible, the position of flight 859 relative to the MEM runway 09 threshold throughout the approach, landing, and go-around. The study introduces the aircraft motion data collected during the investigation, describes the methods used to extract additional aircraft motion information from recordings, and presents the results of these calculations. The aircraft performance information described in this Accident Brief is described in detail in the Performance Study.

After the accident, FedEx maintenance personnel removed the autoland system and conducted bench tests. No pertinent fault codes were found, and the equipment was found to be operating normally.

An NTSB systems investigator reviewed the MD-11 spoiler logic, and compared the accident go-around to the previous landing and the landing immediately after the go-around recorded on the FDR. The spoilers appeared to operate as designed.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

FedEx was incorporated in June 1971 and, in April 1973, began operating 14 corporate-type jet airplanes from the airline's hub at MEM. After the deregulation of the air cargo industry in 1977, FedEx began to expand, acquiring more and larger airplanes (including Boeing 727s and

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McDonnell Douglas DC-10s) and using multiple airports for its operations. In recent years, FedEx has added various models of Boeing, Airbus, Fokker, ATR, and Cessna airplanes to its fleet, including McDonnell Douglas MD-11s/-10s and Airbus A300s and A310s. At the time of the accident, FedEx operated a fleet of 624 airplanes with about 4,200 pilots.


ADDITIONAL INFORMATION


According to Boeing and FedEx tailstrike awareness training material:

If a high sink rate or low bounce occurs, the PF should establish a 7 pitch attitude and increase thrust until the sink rate has been arrested and/or a normal landing is accomplished. If a high bounce occurs, a low level go-around should be initiated. Low-level go-arounds are dramatically different than normal go-arounds. During low-level go-arounds, main wheel touchdown may be unavoidable. The PF must not exceed 10 of pitch or retract the landing gear until the aircraft is safely airborne with a positive rate of climb.

Additionally, the Fedex Crew Flight Manual states:

After reverse thrust is initiated, a full stop landing must be made. Do not attempt a go-around.

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Landing Facility/Approach Information					
Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
Memphis International	KMEM	Ft. MSL	9	8946	150
Runway Surface Type: Asphalt					
Runway Surface Condition: Dry					
Type Instrument Approach: ILS-complete					
VFR Approach/Landing: None					
Aircraft Information					
Aircraft Manufacturer		Model/Series		Serial Number	
Boeing		MD-11		48401	
Airworthiness Certificate(s): Transport					
Landing Gear Type: Retractable - Tricycle					
Homebuilt Aircraft? No	Number of Seats:	Certified Max Gross Wt.	632000 LBS	Number of Engines: 3	
Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:		
Turbo Fan	General Electric	CF-6	62000 LBS		
- Aircraft Inspection Information					
Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time		
Continuous Airworthiness		Hours	Hours		
- Emergency Locator Transmitter (ELT) Information					
ELT Installed? Yes	ELT Operated? No	ELT Aided in Locating Accident Site? No			
Owner/Operator Information					
Registered Aircraft Owner		Street Address			
FEDERAL EXPRESS CORP		3131 Democrat Ave			
		City	State	Zip Code	
		Memphis	TN	38118	
Operator of Aircraft		Street Address			
Same as Reg'd Aircraft Owner		City	State	Zip Code	
Operator Does Business As:			Operator Designator Code: FDEA		
- 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; Cargo					

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First Pilot Information				
Name On File	City	State	Date of Birth	Age 46

Sex: M	Seat Occupied: Left	Principal Profession: Occupational Pilot	Certificate Number:
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Certificate(s): **Airline Transport; Flight Engineer**

Airplane Rating(s): **Multi-engine Land**

Rotorcraft/Glider/LTA:

Instrument Rating(s): **Airplane**

Instructor Rating(s):

Type Rating/Endorsement for Accident/Incident Aircraft?	Current Biennial Flight Review? 06/2004
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Medical Cert.: Class 1	Medical Cert. Status: With Waivers/Limitations	Date of Last Medical Exam: 07/2004
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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	6390	235								
Pilot In Command(PIC)										
Instructor										
Last 90 Days	97									
Last 30 Days	45									
Last 24 Hours	4									

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	
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Departure Point Oakland	State CA	Airport Identifier KOAK	Departure Time	Time Zone PDT
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Destination Same as Accident/Incident Location	State	Airport Identifier KMEM	
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Type of Clearance: **IFR**

Type of Airspace:

Weather Information

Source of Briefing:
National Weather Service

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
KMEM	1253	CDT	253 Ft. MSL	0 NM	0 Deg. Mag.

Sky/Lowest Cloud Condition: Clear	Ft. AGL	Condition of Light: Day
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Lowest Ceiling: None	Ft. AGL	Visibility: 10	SM	Altimeter: 30.17	"Hg
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Temperature: 27 °C	Dew Point: 6 °C	Wind Direction: 80	Density Altitude: Ft.
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Wind Speed: 10	Gusts: 14	Weather Conditions at Accident Site: Visual Conditions
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Visibility (RVR): Ft.	Visibility (RVV) SM	Intensity of Precipitation:
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Restrictions to Visibility: No Obscuration; No Precipitation

Type of Precipitation:

Accident Information

Aircraft Damage: Substantial	Aircraft Fire: None	Aircraft Explosion: None
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Classification:

- 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					
Other Crew					
Passengers					
- TOTAL ABOARD -				2	2
Other Ground					
- GRAND TOTAL -				2	2

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Administrative Information

Investigator-In-Charge (IIC)

William English

Additional Persons Participating in This Accident/Incident Investigation:

Bob Drake

AAI-100