
Uncommanded roll, McDonnell Douglas MD-11F, June 2, 2002

Micro-summary: This McDonnell Douglas MD-11F experienced a hard left roll on approach.


Event Date: 2002-06-02 at 1600 UTC

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

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

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		NTSB ID: DCA02MA042		Aircraft Registration Number: N601FE	
		Occurrence Date: 06/02/2002		Most Critical Injury: None	
		Occurrence Type: Accident		Investigated By: NTSB	
Location/Time					
Nearest City/Place Subic Bay		State	Zip Code	Local Time 1600	Time Zone UTC
Airport Proximity: Off Airport/Airstrip		Distance From Landing Facility: 1		Direction From Airport:	
Aircraft Information Summary					
Aircraft Manufacturer McDonnell Douglas			Model/Series MD-11F		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 June 16, 2002, about 1500 hours Universal Coordinated Time (UTC), a McDonnell Douglas MD-11F (N601FE), operating as Federal Express cargo flight 5080, experienced a flight control malfunction during final approach to runway 7 at the Subic Bay International Airport, Subic Bay, Philippines. The flight crew performed a missed approach, declared an emergency, and diverted to the Aquino International Airport at Manila, Philippines. During landing at Manila, the airplane experienced a tail strike. The captain and first officer, who were the sole occupants, were not injured. The airplane suffered substantial damage to the left wing, inboard flap and nearby flight controls. Night, visual meteorological conditions prevailed at the time of the accident. The flight had departed Bangkok, Thailand, and was destined for Subic Bay. Under the provisions of Annex 13 to the Convention on International Civil Aviation, the investigation was delegated to the U.S. National Transportation Safety Board by the Air Transportation Office (ATO), Department of Transportation and Communications, Republic of the Philippines.</p>					
<p>According to flight crew statements and digital flight data recorder (DFDR) information, the takeoff, climb, cruise, and descent of the accident flight were uneventful. As the airplane was on final approach to landing, the flight crew selected flaps 50 (full extension) and continued to approach the runway. About one minute later, as the airplane was flying about 1,500 feet above mean sea level, the flight crew heard a loud bang and felt the airplane shudder. The airplane then began to roll to the left, and nearly full right control wheel input was required to counter the left roll.</p>					
<p>The DFDR data indicates that the left inboard flap remained at 50 degrees while the left outboard flap and right inboard and outboard flaps were at approximately 28 degrees. The data also show that the L5 spoiler deployed to 60 degrees while the L3 spoiler remained retracted. The DFDR data indicates that the R5 and R3 spoilers varied between about 10 and 45 degrees immediately after the event. Less than one minute later, the data indicates the R3 spoiler retracted while the R5 spoiler continued to vary between about 10 and 45 degrees. The DFDR data also indicates that the number 3 hydraulic system quantity went to zero after the flap incident.</p>					
<p>The flight crew initiated a missed approach, declared an emergency, and diverted to Manila because of its longer runways and flat terrain. During the diversion, airplane controllability was "marginal" in the roll axis, and the flight crew took turns holding nearly full right control wheel. The flight crew noted cockpit indications of asymmetric flaps, deployed spoilers on the left wing, and a failure of the no. 3 hydraulic system. During landing at Manila, the airplane experienced a tail strike. The airplane rolled out from the landing uneventfully and taxied to the ramp.</p>					
<p>The 2-hour cockpit voice recorder continued to operate for at least 90 minutes until the captain</p>					
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returned to the airplane and directed maintenance personnel to pull the circuit breaker. The flight control malfunction and subsequent landing were overwritten.

PERSONNEL INFORMATION

The first pilot was the captain of the accident flight. The first pilot, age 50, held type ratings in the MD-11, B727, and DC-8. The first pilot reported he had 8,311 hours of total flight time, including 5,531 hours in type. The captain's first class medical certificate was issued on December 17, 2001.

The second pilot was the first officer of the accident flight. The second pilot, age 40, held a type rating in the MD-11. The second pilot reported he had 2,898 hours of total flight time, including 1,516 hours in type. The first officer's first class medical certificate was issued on February 11, 2002.

WRECKAGE AND IMPACT INFORMATION

Post-flight inspection of the airplane by representatives of Federal Express and Philippine officials revealed that the left wing inboard flap outboard hinge had pulled away from its attachment to the wing trailing edge and had dropped downward. Cable pulleys and linkages associated with the spoiler system and flap system were attached to the hinge and also pulled away from their normal positions. The drooped flap damaged hydraulic tubing for the outboard flap actuator (powered by Hydraulic System 3), which remained attached to the flap and the wing trailing edge. The flap was found damaged and jammed toward the downward outboard direction. When the hinge pulled away from the spar, the hydraulic system 3 lines were apparently damaged resulting in loss of system fluid. The hydraulic system 3 lines are installed along the wing rear spar and pass through a hole in the structure close to the hinge attachment. The left, outboard flight spoiler (L5) was found deployed in the fully extended position, and the left-hand inboard wing trailing edge beam assembly was deformed upward. The lower, aft fuselage sustained moderate scraping damage with some small localized areas where the skin was scraped away to the underlying frames and stringers. One of the lower fuselage antennas also exhibited scraping damage.

Detailed examination of the left wing inboard flap outboard hinge revealed that all four of its attach bolt assemblies had failed. The two lower fasteners consisted of 7/8-inch diameter steel bolt assemblies. The lower inboard bolt fractured near the head of the bolt, and the lower outboard nut fractured leaving the lower outboard bolt intact. The two upper 5/8-inch diameter bolt assemblies, which were made of inconel, had fractured through the shanks of the bolts. Examination of the lower bolt assemblies revealed areas of discoloration normally associated with corrosion.

The MD-11F has five spoilers on each wing, numbered 1 to 5 from inboard to outboard. Spoilers 1, 4 and 5 are mechanically connected to each other, and spoilers 2 and 3 are mechanically connected to each other on each wing. Hydraulic system 1 powers spoilers 2 and 4, hydraulic system 2 powers spoilers 1 and 5, and hydraulic system 3 powers spoiler 3 on both wings.

TESTS AND RESEARCH

The Boeing Company, under the supervision of the Safety Board, examined the nuts and bolts of the inboard flap outboard hinge. The lower inboard bolt exhibited a complete, transverse fracture at the head-to-shank fillet radius. The head and shank region were heavily corroded 0.18 inch from the top end of the head to a length of approximately 3.02 inches. The fracture had multiple origins occurring around approximately 50 percent of the circumference. Reddish-brown corrosion products and mechanical damage obscured most of the fracture origins. Scanning electron microscope (SEM) analysis of the undamaged origins revealed a predominantly fatigue mode of rupture. The fatigue striations were rubbed, highly oxidized, and fine-spaced. Fatigue rupture accounted for 15 percent of the fracture surface with the remainder of the fracture exhibiting a dimple mode of rupture,

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consistent with overload failure. Material analysis identified the bolt as 4340 alloy steel.

The lower outboard bolt was intact and exhibited evidence of corrosion. The lower outboard nut exhibited two complete longitudinal fractures (fractures 1 and 2) and a third partial fracture that extended through the wall of the nut for a total crack length of 0.84 inch. The failure origin of fracture 1 was severely corroded. After cleaning the surface, the failure origin and initial region of fracture 1 appeared flat, heavily oxidized and had a grainy texture indicative of brittle failure to a crack length of approximately 0.74 inch. The remainder of fracture 1 exhibited signs of overload failure. The SEM analysis of the undamaged regions of the failure origin revealed a predominantly intergranular mode of rupture indicative of a brittle/slow-growth mechanism of failure, consistent with stress corrosion cracking (SCC). The majority of fracture 2 exhibited signs of overload failure with no obvious failure origin. The fracture surface along the first four threads was obscured by corrosion. Fracture 3 had a flat, elliptically shaped crack to a depth of approximately 0.16 inch. The crack features were completely masked by corrosion products. The remainder of the fracture exhibited signs of overload failure. Material analysis identified the nut as 8740 alloy steel.


The upper inboard bolt exhibited a complete transverse fracture through the shank approximately 2.03 inches from the threaded end. The fracture surface had a single origin point on the shank surface. The whole fracture surface had a dull, coarse-grained texture surrounded by a shear lip, consistent with overload failure. There was no evidence of corrosion in the area of the failure or of a brittle/slow-growth mechanism of failure. Material analysis identified the bolt as Inconel 718.


The upper outboard bolt exhibited a complete, transverse fracture at the second full thread root. The fracture surface had a single origin at the second full thread root. Like the upper inboard bolt, the whole fracture surface had a dull, coarse-grained texture surrounded by a shear lip, consistent with overload failure. There was no evidence of corrosion in the area of the failure or of a brittle/slow-growth mechanism of failure. Material analysis identified the bolt as Inconel 718.

ADDITIONAL INFORMATION

The accident aircraft (fuselage 447) had accumulated 37,439 flight hours and 9,241 landings. It was the first production MD-11 built, and had been initially used by McDonnell Douglas as a test flight airplane. The failed flap hinge bolts were most likely the original bolts and were subjected to the flight-testing. The test aircraft was subjected to flutter testing, stall testing, performance landings, and engine testing.

As a result of this accident, and subsequent inspections of other MD-11s, the Boeing Company issued alert Service Bulletin (SB) MD11-57A067, on July 10, 2002, that recommends inspection and/or replacement of MD-11 inboard flap, outboard hinge, alloy steel attach bolt assemblies. The FAA issued Airworthiness Directive (AD) 2002-14-03, also on July 10, 2002, mandating the Boeing SB effective August 2, 2002. Prior to the AD, there were no mandated inspections of the flap hinge bolts of the MD-11. Subsequently, on January 7, 2003, Boeing issued SB MD11-57A68 and SB DC10-57A149 for MD-11 and DC-10 aircraft respectively, recommending the replacement of all inboard flap, outboard hinge, alloy steel attach bolt assemblies. The alloy steel bolts and nuts are to be replaced with bolts and nuts made from inconel. The FAA subsequently issued AD 2004-02-06 on January 20, 2004, mandating the two Boeing service bulletins, effective March 5, 2004.

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Landing Facility/Approach Information						
Airport Name Subic Bay International		Airport ID: SFS	Airport Elevation Ft. MSL	Runway Used NA	Runway Length	Runway Width
Runway Surface Type: Asphalt						
Runway Surface Condition: Dry						
Type Instrument Approach: NONE						
VFR Approach/Landing: Full Stop; Traffic Pattern						
Aircraft Information						
Aircraft Manufacturer McDonnell Douglas		Model/Series MD-11F		Serial Number 48401		
Airworthiness Certificate(s): Transport						
Landing Gear Type: Retractable - Tricycle						
Homebuilt Aircraft? No		Number of Seats: 5	Certified Max Gross Wt. 632000 LBS		Number of Engines: 3	
Engine Type: Turbo Fan		Engine Manufacturer: General Electric		Model/Series: CF6	Rated Power: 62000 LBS	
- Aircraft Inspection Information						
Type of Last Inspection Continuous Airworthiness		Date of Last Inspection 06/2002	Time Since Last Inspection 88 Hours		Airframe Total Time 37443 Hours	
- Emergency Locator Transmitter (ELT) Information						
ELT Installed?		ELT Operated?		ELT Aided in Locating Accident Site?		
Owner/Operator Information						
Registered Aircraft Owner Wilmington Trust Company		Street Address Rodney Square North				
		City Wilmington		State DE	Zip Code	
Operator of Aircraft FEDERAL EXPRESS CORP		Street Address				
		City Memphis		State TN	Zip Code 38118	
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: Non-scheduled; International; Cargo						
FACTUAL REPORT - AVIATION						

 <p>National Transportation Safety Board FACTUAL REPORT AVIATION</p>	NTSB ID: DCA02MA042
	Occurrence Date: 06/02/2002
	Occurrence Type: Accident

First Pilot Information

Name On File	City On File	State On File	Date of Birth On File	Age 50
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Sex: M	Seat Occupied: Left	Principal Profession: Civilian Pilot	Certificate Number: On File
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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? 01/2002
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Medical Cert.: Class 1	Medical Cert. Status: Valid Medical--no waivers/lim.	Date of Last Medical Exam: 12/2001
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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	8311	5531								
Pilot In Command(PIC)										
Instructor										
Last 90 Days		173								
Last 30 Days		28								
Last 24 Hours		5								

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

Type of Flight Plan Filed: IFR

Departure Point Bangkok	State	Airport Identifier BKK	Departure Time 1930	Time Zone UTC
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Destination Subic Bay	State	Airport Identifier SFS	
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Type of Clearance: IFR

Type of Airspace: Unknown

Weather Information

Source of Briefing: Company


Method of Briefing: Aircraft Radio; In Person; Telephone; Teletype

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Weather Information					
WOF ID	Observation Time	Time Zone	WOF Elevation Ft. MSL	WOF Distance From Accident Site NM	Direction From Accident Site Deg. Mag.
Sky/Lowest Cloud Condition: Clear			Ft. AGL	Condition of Light: Night	
Lowest Ceiling: None		Ft. AGL	Visibility: SM	Altimeter: "Hg	
Temperature: °C	Dew Point: °C	Wind Direction:		Density Altitude: Ft.	
Wind Speed:	Gusts:	Weather Conditions at Accident Site: Visual Conditions			
Visibility (RVR): Ft.	Visibility (RVV) SM	Intensity of Precipitation:			
Restrictions to Visibility: None					
Type of Precipitation: None					

Accident Information		
Aircraft Damage: Substantial	Aircraft Fire: None	Aircraft Explosion: None

Classification: U.S. Registered/Foreign 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					
Other Crew					
Passengers					
- TOTAL ABOARD -				2	2
Other Ground					
- GRAND TOTAL -				2	2

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Administrative Information

Investigator-In-Charge (IIC)
Jeffrey B. Guzzetti

Additional Persons Participating in This Accident/Incident Investigation:

William Steelhammer
Boeing Commercial Airplane Company
Long Beach, CA

Grant Brophy
Federal Express, Inc.
Memphis, TN

Michael Bender
Air Line Pilots Association
Memphis, TN