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.ntsb.gov/

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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	Ν	NTSB ID: DCA02MA042 Aircraft Registration Number: N601FE								
FACTUAL REPORT		Occurrenc	e Date: 06/02	2/2002	Most Cri	Most Critical Injury: None				
AVIATION	C	Occurrenc	e Type: Accid	lent	Investiga	ated By	: NTS	В		
Location/Time					-					
Nearest City/Place	State	Zip	Code	Local Time	Time Zo	one				
Subic Bay				1600	UTC					
Airport Proximity: Off Airport/Airstrip	Distance	ance From Landing Facility: 1 Direction From Airport:								
Aircraft Information Summary										
Aircraft Manufacturer			Model/Serie	5				Type of Aircraft		
McDonnell Douglas			MD-11F					Airplane		
Sightseeing Flight: No		A	ir Medical Tı	ansport Fligh	t: No					
Narrative										
Brief narrative statement of facts, conditions and circumstand HISTORY OF FLIGHT	ces pertiner	nt to the acc	ident/incident:							
tail strike. The captain and airplane suffered substantial Night, visual meteorological departed Bangkok, Thailand, and Convention on International of Transportation Safety Board I and Communications, Republic of According to flight crew sta takeoff, climb, cruise, and de final approach to landing, approach the runway. About one sea level, the flight crew heat to roll to the left, and ne roll. The DFDR data indicates that	misse la, Ph: damag condid d was of Civil by the the Pl atement the fi minute rd a lo early :	A, Philippines. During landing at Manila, the airplane experienced first officer, who were the sole occupants, were not injured. To damage to the left wing, inboard flap and nearby flight control conditions prevailed at the time of the accident. The flight H was destined for Subic Bay. Under the provisions of Annex 13 to the ivil Aviation, the investigation was delegated to the U.S. Nation of the Air Transportation Office (ATO), Department of Transportation						ed to the Aquino ane experienced a not injured. The flight controls. The flight had Annex 13 to the the U.S. National of Transportation information, the e airplane was on and continued to feet above mean counter the left the left outboard		
the L5 spoiler deployed to indicates that the R5 and R3 a event. Less than one minute lat continued to vary between abo hydraulic system quantity went The flight crew initiated a magnetic	ap and right inboard and outboard flaps were at approximately 28 degrees. The data also show that a L5 spoiler deployed to 60 degrees while the L3 spoiler remained retracted. The DFDR data dicates that the R5 and R3 spoilers varied between about 10 and 45 degrees immediately after the ent. Less than one minute later, the data indicates the R3 spoiler retracted while the R5 spoiler ntinued to vary between about 10 and 45 degrees. The DFDR data also indicates that the number 3 draulic system quantity went to zero after the flap incident. e flight crew initiated a missed approach, declared an emergency, and diverted to Manila because its longer runways and flat terrain. During the diversion, airplane controllability was							ed. The DFDR data diately after the Le the R5 spoiler that the number 3 to Manila because		
"marginal" in the roll axis wheel. The flight crew noted co wing, and a failure of the experienced a tail strike. The ramp.	, and ockpit no. e airpi	the indica 3 hyd lane ro	flight cr ations of draulic s olled out	ew took tun asymmetric ystem. Dun from the la	rns holding flaps, dep ring landi anding unev	g near oloyed ing at ventfu	rly fu d spoi t Mani ully a	all right control lers on the left la, the airplane and taxied to the		
The 2-hour cockpit voice recorder continued to operate for at least 90 minutes until the captain							intil the captain			

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AVIATION ETYBOR	Occurrence Type: Accident	

Narrative (Continued)

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 some small localized areas where the skin was scraped away to the underlying frames and with 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 exhibiting a dimple mode of rupture,

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Narrative (Continued)		

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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FACTUAL REPORT	Осси	urrence Date	e: 06/02/2002		7				
AVIATION ETYBON	Оссі	urrence Type	e: Accident		1				
Landing Facility/Approach Information	 ו				I				
Airport Name	ļ	Airport ID:	Airport Elevat	tion Ru	unway Used	Runwa	y Length	Run	way Width
Subic Bay International		SFS	Ft.	MSL N	IA				
Runway Surface Type: Asphalt									
Runway Surface Condition: Dry	_	_	_	_					
Type Instrument Approach: NONE									
VFR Approach/Landing: Full Stop; Traffic Pa	attern								
Aircraft Information									
Aircraft Manufacturer McDonnell Douglas		Mode MD-	el/Series 11F				Serial Nu 48401	mber	
Airworthiness Certificate(s): Transport									
Landing Gear Type: Retractable - Tricycle									
Homebuilt Aircraft? No Number of	of Seats: 5		ed Max Gross W	t.	632000	LBS	Number o	f Engine	s: 3
Engine Type: Turbo Fan		U U	anufacturer: I Electric		Model/Ser CF6	ies:			ed Power: 000 LBS
- Aircraft Inspection Information		.							
Type of Last Inspection	l		st Inspection	Time \$	Since Last Inspe				otal Time
Continuous Airworthiness		06/2002				88 Ho	ours	3	7443 Hours
- Emergency Locator Transmitter (ELT) Inform	nation								
ELT Installed? ELT	T Operated?			ELT Aideo	d in Locating Acc	cident Si	ite?		
Owner/Operator Information									
Registered Aircraft Owner		Street	Address Rodney S	Square No	rth				
Wilmington Trust Company		City State Zip							Zip Code
		Street	Wilmingto Address	on			D	E	
Operator of Aircraft									
FEDERAL EXPRESS CORP			City Memphis						Zip Code 38118
Operator Does Business As:				(Operator Desigr	nator Co	de: FDEA	\	
- Type of U.S. Certificate(s) Held:									
Air Carrier Operating Certificate(s): Flag Carr	rier/Domestic								
Operating Certificate:			Operator C	ertificate:					
Regulation Flight Conducted Under: Part 121	1: Air Carrier								
Type of Flight Operation Conducted: Non-sch	heduled; Interr	national; C	argo						
	FACT	UAL REP	ORT - AVIATI	ON					Page 2

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	AVIATI ETYBO	A		Occurren	ce Type: A	cident								
First Pilo	ot Information													
Name						City					State	Dat	te of Birth	Age
On File						On Fi	le				On File	0	n File	50
Sex: M	Seat Occupied	: Left	Pr	incipal Profes	sion: Civilia	an Pilot				Cer	tificate Nu	nber:	On File	•
Certificate	(s): Airlir	ne Transpor	ť							1				
Airplane R	Rating(s): Mult	i-engine La	nd: Sinale-	engine Land										
Rotorcraft	/Glider/LTA: None	-	-,- 3-	<u> </u>										
	t Rating(s): Airpl													
Instructor														
Type Ratir	ng/Endorsement fo	or Accident/Ir	ncident Aircr	aft? Ves				urrent F	Biennial Fl	iaht R	eview? 01	/200	2	
	ert.: Class 1		cident/Incident Aircraft? Yes Current Biennial Flight Review? 01/2002 Medical Cert. Status: Valid Medicalno waivers/lim. Date of Last Medical Exam: 12/2001											
- Flight Tir	me Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Mult-Engine	Nig	ght	Actual	Instrument	nulated	Rotorcra	ft	Glider	Lighter Than Air
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Pilot In Co	ommand(PIC)													
Instructor														
Last 90 Da			173											
Last 30 Da	-		28			_					_			
Last 24 Ho			5											
Seatbelt U	Ised? Yes	Shou	Ider Harnes	s Used?			Toxico	ology Pe	erformed?	No		Seco	nd Pilot? Ye	S
Flight Pla	an/Itinerary													
Type of Fli	ight Plan Filed: IF	R												
Departure	Point						State		Airport Ide	entifie	r Dep	arture	e Time	Time Zone
Bangkok									BKK		193	0		UTC
Destinatio	Destination State					Airport Identifier								
Subic Ba	ау								SFS					
Type of C	learance: IFR													
Type of Ai	rspace: Unkno	wn												
Weather	⁻ Information													
Source of	Briefing: Compa	any												
Method of	f Briefing: Aircraf	t Radio; In	Person; Te	lephone; Te	letype									
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Occurrence Type: AccidentWork InformationWOF IDObservation TimeTime ZoneWOF ElevationWOF Distance From Accident SiteDirection From Accident SiteSkylLowest Cloud Condition: ClearFt. MSLWOF Distance From Accident SiteNMDeg. Mag.SkylLowest Cloud Condition: ClearFt. MSLVisibility:SMAttimeter:"HgTemperature:°CDew Point:°CWind Speed:Oensity Altitude:FtVisibility (RVR):FtGusts:Visibility (VV)SMIntensity of Precipitation:Attimeter:"HgAccident InformationAccident InformationAccident InformationAccident InformationAccident InformationAccident InformationAccident Free: NoneTotalStatest PlatStatest PlatSetterMatrixFatelSetterNoneTotalStatest PlatSetterStatest PlatSetterAlteratt Ere: NoneTotalStatest PlatSetterStatest PlatSetterAlteratt Ere: NoneTotalAlteratt Ere: NoneTotalStatest PlatSetterStatest PlatSetterAlteratt Ere: NoneTotalAlteratt Ere: NoneTotalAlteratt Ere: NoneTotalAlteratt Ere: NoneTotalAlteratt RiseSett	F	ACTUAL REPOI	RT	Occurrent	Occurrence Date: 06/02/2002								
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- Injury Summary MatrixFatalSeriousMinorNoneTOTALFirst Pilot111Second Pilot111Student Pilot111Flight Instructor111Check Pilot111Flight Engineer111Other Crew111Passengers111- TOTAL ABOARD -122	Aircraft Da	mage: Substantial		Aircraft Fir	e: None	;			Aircraft Exp	olosio	n None		
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Second PilotImage: Constraint of the second depined depined of the second depined depined of the second dep	- Injury Su	mmary Matrix	Fatal Se	erious Mino	or	None	TOTAL						
Student PilotImage: Student PilotImage: Student PilotFlight InstructorImage: Student PilotImage: Student PilotCheck PilotImage: Student PilotImage: Student PilotFlight EngineerImage: Student PilotImage: Student PilotCabin AttendantsImage: Student PilotImage: Student PilotOther CrewImage: Student PilotImage: Student PilotPassengersImage: Student PilotImage: Student PilotImage: TOTAL ABOARD -Image: Student PilotImage: Student Pilot	First Pi	ilot				1	1						
Flight InstructorImage: Check PilotImage: Check PilotImage: Check PilotCheck PilotImage: Check PilotImage: Check PilotImage: Check PilotFlight EngineerImage: Check PilotImage: Check PilotImage: Check PilotCabin AttendantsImage: Check PilotImage: Check PilotImage: Check PilotOther CrewImage: Check PilotImage: Check PilotImage: Check PilotPassengersImage: Check PilotImage: Check PilotImage: Check Pilot- TOTAL ABOARD -Image: Check PilotImage: Check PilotImage: Check Pilot	Second	d Pilot				1	1						
Check PilotImage: Check PilotImage: Check PilotImage: Check PilotFlight EngineerImage: Check PilotImage: Check PilotImage: Check PilotCabin AttendantsImage: Check PilotImage: Check PilotImage: Check PilotOther CrewImage: Check PilotImage: Check PilotImage: Check PilotPassengersImage: Check PilotImage: Check PilotImage: Check Pilot- TOTAL ABOARD -Image: Check PilotImage: Check PilotImage: Check Pilot	Studen	nt Pilot											
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Cabin AttendantsImage: Cabin AttendantsImage: Cabin AttendantsOther CrewImage: Cabin CrewImage: Cabin CrewPassengersImage: Cabin CrewImage: Cabin Crew- TOTAL ABOARD -Image: Cabin CrewImage: Cabin Crew	Check	Pilot											
Other Crew Image: Crew Passengers Image: Crew - TOTAL ABOARD - Image: Crew	Flight E	Engineer											
Passengers Image: Constraint of the second	Cabin /	Attendants											
- TOTAL ABOARD - 222	Other 0	Crew											
	Passer	ngers											
Other Ground III III IIII	- TOTAL A	ABOARD -				2	2						
	Other 0	Ground											
- GRAND TOTAL - 2 2	- GRANE	D TOTAL -				2	2						
				FACTUAL	REPO	RT - AV	IATION					Page 4	

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