Tailstrike during go-around, McDonnell Douglas MD-11, E-ICDK, June 21, 1997

Micro-summary: **This MD-11 experienced a tailstrike during a go-around.**

Event Date: **1997-06-21 at 1222 HDT**

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

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

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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: DCA97MA053	Aircraft Registration Number: EICDK
Occurrence Date: 06/21/1997	Most Critical Injury: None
Occurrence Type: Accident	Investigated By: NTSB

Location/Time

Nearest City/Place	State	Zip Code	Local Time	Time Zone	
HONOLULU	HI	96819	1222	HDT	

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

Aircraft Information Summary

Aircraft Manufacturer	Model/Series	Type of Aircraft
McDonnell Douglas	MD-11	Airplane

Sightseeing Flight: No

Air Medical Transport Flight: No

Narrative

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

On June 21, 1997, at 1222 Hawaiian daylight time (HDT), a McDonnell Douglas MD-11 airplane, EI-CDK, operated by Garuda Indonesia as flight 800, was substantially damaged due to a tail strike during a go-around from an attempted autopilot autoland landing on Runway 8L at Honolulu International Airport (HNL), Hawaii. The flight crew completed a touch down and a go-around followed by an uneventful landing at 1235. Visual meteorological conditions prevailed and an instrument flight plan was filed. There were no injuries to the 289 passengers, 4 flight crew and 15 cabin attendants. The flight, a scheduled CFR Part 129 operation, originated at 2355 (June 20, HDT) from Jakarta, Indonesia.

The captain provided a statement of circumstances on the day following the accident in which he stated that the first approach was flown as an autoland with flaps set 50 degrees. The approach and touchdown were normal. However, he indicated at touchdown that the airplane tended to pitch up and the nose tended to swing to the left. He disconnected the autopilot and the airplane was still "floating." He decided to initiate a go-around. The captain stated that upon initiating the go-around, he still observed the airplane drifting left. On the second landing, the captain stated that during the rollout, he needed to "force down the control" and required "additional downtrim to keep the nose wheel maintained on the ground."

Federal Aviation Administration (FAA) Air traffic control transcripts indicate the flight crew was given winds of 050 at 10 knots and landing clearance which they acknowledged at 1219:29. At 1222:26, the flight crew announced, "Indonesia eight hundred we go go-around," followed by a local controller acknowledgement. At 1222:31, the flightcrew stated, "Indonesia eight hundred we have a windshear on final." The local controller replied, "roger sir, no previous reports." The flight crew made no further mention of the event to air traffic controllers.

Runway inspection following the event indicated landing gear tire tracks and scrape marks of aluminum and ferrous metal transferred to the runway surface beginning adjacent taxiway Lima (4800 feet from the approach end) that extended in a left curving path about 1200 feet along the runway surface. The tire tracks and scrapes were consistent with the measurements of an MD-11 airplane. There were visible skid marks from the right main landing gear tires. Marks consistent with the track of the left landing gear tires and tail of the accident airplane continued along the curving path to exit the left side of the runway surface. A damaged runway edge light, metal scraps and aircraft antenna debris were located off the left side of the runway at the end of the scrape/drag marks. The total ground track extended about 1310 feet. Examination of the airplane revealed substantial damage to the aft lower fuselage and tailcone between fuselage stations 1700 and 2169. The aft pressure bulkhead was abraded and deformed about 45 inches across the bottom edge, wrinkling extended upward a maximum of about 7 inches.

An Aloha Airlines first officer located in an airplane on taxiway "A" parallel to the landing runway and directly facing in the landing airplane witnessed the accident from about 3000 feet

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away. He reported that following the landing, the nose began to come down as per a normal landing but then rotated to an unusually high nose attitude and held that attitude for approximately 3 seconds. It appeared that the tail missed hitting the runway by less than a foot. Then the airplane's nose again started coming down but within two seconds it again rotated to a high attitude. This time the tail struck the runway, and the airplane continued in a nose high attitude. It swerved left in the direction of the witnesses airplane while dragging the tail along the runway. The witness stated the airplane's nose continued raising so that it appeared that its main landing gear were off the ground, its tail still dragging, when it became airborne over the grass to the left of the runway. He observed the wings rocking as it lifted off with a great deal debris and grass filling the air. The airplane's wings wobbled several times as it turned to parallel the runway and slowly climbed out.

The airplane flight log signed off by the captain contained two entries regarding the accident : (a)Auto Land/APP, not satisfactory, disconnect AT/tends pitch up and swing to the left upon touchdown and (b) Tail strike, suspect tail strike.

The flight recorders were removed from the accident airplane with the assistance of personnel from the FAA Honolulu Flight Standards District Office and sent to the Safety Board's laboratory in Washington D.C. for readout. The recorded conversation from the CVR was found to be from a period of time following the event and not pertinent to the accident.

Garuda personnel also removed the QAR data tape from the airplane and carried it directly to Teledyne Controls facility in Los Angeles, California. Teledyne engineers reported to the Safety Board that they were unable to locate a synchronization pattern on the tape due to an airplane system malfunction and they were therefore unable to derive any useful information from the recording.

From the airplane load sheet, the reported landing weight at the time of the accident was 386,100 lbs. The balance was reported to be 27.5 MAC, and within the airplane performance envelope. The calculated Vref speed for a flaps 50 landing is 141 KIAS. The Douglas recommended approach speed is Vref +5 or Vref+wind. The autopilot/flight director speed command is not recorded on the DFDR.

The data from the DFDR indicated the following:

* The accident landing was a Dual Auto Land approach, speed on final approach was recorded between 147-154 KIAS. * Touchdown speed was recorded at 145 KIAS. * Airplane pitch attitude (3-5 degrees) and heading (081) were normal and constant in the moments before touchdown. * The initial touchdown peak "g" was 1.23. * The Autopilot (A/P) discrete indicates it was disengaged just prior to main landing gear wheel spin-up (as indicated by ground spoiler deployment). * Following A/P disengagement, the rudder deflection went to neutral removing the right rudder input of 4 to 8 degrees that the A/P had applied on the final approach. * Following A/P disengagement, the rudder deflection remained neutral and the airplane began approximately a 2 degrees per second yaw to the left. * During the 4 seconds between touchdown and wheel spin-up (as indicated by ground spoiler deployment) the pitch attitude decreased from 5 degrees airplane nose up (ANU) to 1 degree ANU. * The thrust reverse discrete for all engines indicate a transition to "transit" 4 seconds after touchdown. * The thrust reverse "transit" discrete for engine 3 indicated it went back to "stow" within 1 second. * The thrust reverse deploy discrete for engine 1 indicated deployment for about 4 seconds, engine 2 thrust reverse discrete indicated deployment for approximately 8 seconds. * Wheel spin-up took place approximately 4 seconds after the initial touchdown. * When the ground spoilers were deployed at wheel spin-up, a characteristic a nose-up pitching moment developed. * Following ground spoiler deployment, the airplane nose down (AND) elevator inputs were insufficient to counter the ANU pitching moment. The airplane attitude increased over a 5 second period from 1 degree toward 13 degrees ANU. (a TAIL STRIKE occurs when the pitch attitude exceeds 11 degrees with the main gear on the ground) * Approximately 4 seconds after wheel spin-up the recorded

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Narrative (Continued)

throttle angles indicate selection of full thrust on all three engines. * Engine 3 N1 immediately began to increase but the N1 for engines 1 and 2 remained at idle until the thrust reverser discrete indications went from deploy to stow, 10 and 14 seconds later, respectively. * Following the increase in N1 on engine 3, the airplane began a left yaw that reached 14 degrees left of the runway heading. * At the lowest recorded airspeed of 112 KIAS, full right rudder (23-24 degrees) was applied. * Following the command for full thrust, the airplane pitch attitude remained from 11 to 13 degrees until it became airborne.). * The airplane became airborne at about 132 KIAS with engine 1 and 3 at full thrust (N1 110 percent), engine 2 was still accelerating for about 2 seconds more. However, at lift off the right rudder deflection was more than one half and the airplane rolled to the right reaching 26 degrees right wing down at a radar altimeter indication of 36 feet. Calculations indicate that the right wing tip was about 3 feet above the runway surface at this point.

The airplane was repaired by a Douglas Aircraft Company Recovery and Repair Group. It was returned to service on 18 August 1997. During return to service checks, the engine 1 reverser indicated a high running torque. The discrepancy was cleared with the replacement of a flex shaft on the right upper assembly, PN 121282-10. No other maintenance was required on the autopilot or flight control systems.

The FAA National Airways Systems Low-Level Windshear Alert (LLWAS) data at HNL samples wind information from of 6 sensors around the airfield. FAA specialists reviewed the data recorded from the sensors from 1200 to 1259 and reported that there were no windshears indicated during this time period.

The captain stated that he disconnected the autopilot during autoland upon touchdown because the airplane "tends pitch up and swing to the left". The captain did not give any indication that the thrust reverse system was partially activated during the accident landing and prior to his selection of go-around thrust. The Aircraft Accident Investigation Commission of Indonesia provided a review comment that an abnormal situation occurred at the moment that the autopilot was executing an autoland sequence, "where there was an indication of failure to control or correct the pitch up attitude and to maintain a proper runway heading." However, the FDR data indicates that the heading swing and nose up pitch changes took place after the auto pilot and autothrottle were manually disconnected during the autoland sequence and the airplane was being flown manually.

The MD-11 Flight Crew Operating Manual, Volume II, Landing Roll Procedure, contains the following note: Ground spoiler deployment causes nose up pitching moment. This effect is most noticeable at aft centers of gravity. It is important to check the nose up pitching tendency with forward pressure on the control column and smoothly lower the nose wheel to the runway.

The Boeing Douglas Products Division was asked to evaluate the FDR data from the accident airplane and to estimate the elevator column movement required to lower the nose during ground spoiler deployment at wheel spin up. A total of 25 degrees of AND elevator was available to the pilot. Douglas engineers determined that a brief increase to 15 degrees AND elevator for about 1/2 second would have been sufficient to avoid the tail strike. More elevator input or a faster pilot response would have resulted in a more improved attitude control. The FDR indicated AND elevator of about 4 to 8 degrees during spoiler deployment.

Douglas Aircraft Company conducted a Tail Strike Seminar for all operators on August 22, 1996. Garuda International representatives did not attend the seminar due to a cost reduction program within the company that precluded seminar attendence.

As a follow-up action to the August 1996 seminar, Douglas Aircraft Company sent a Flight Operations All Operator Letter, FO-AOL-11-129, dated September 13, 1996, to all operators on the subject, "MD-11 Tailstrikes." Garuda International personnel verified that this AOL was received. However, at the time of the accident, the crew had not been advised of the content of the AOL.

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In June 1997, Douglas Aircraft Company sent a Tailstrike Avoidance Training Video to all MD-11 Operators. Garuda International had not received this training video at the time of the accident. On November 20, 1997, Douglas Aircraft Company sent a questionnaire to all MD-11 operators regarding the effectiveness of the tailstrike avoidance training material previously issued. Garuda International flight operations personnel responded on January 13, 1998, that they had received the video, incorporated it in their training programs, and that about 10 percent of their pilots had received the training to date.

Boeing Douglas Products Division Flight Operations Customer Service produced a Flight Operations Bulletin dated August 13, 1998, applicable to all DC-8, DC-9, C-9, MD-80, MD-90, DC-10, KC-10, and MD-11 airplanes. The bulletin (MD-11-97-06) stated that, "once thrust reversers have been deployed on landing, the landing must be completed because a successful go-around may not be possible."

Boeing Douglas Products Division Flight Operations published Temporary Revision 2-785, dated August 29, 1997, for the MD 11 Flight Crew Operating Manual, Volume II, Normal Procedures, LANDING ROLL PROCEDURE as follows:

WARNING AFTER REVERSE THRUST IS INITIATED, A FULL STOP LANDING MUST BE MADE.

This warning was also incorporated into the DC-10, MD-80 and MD-90 FCOMs in September 1997. Also, a review of all other Boeing transport aircraft operating manuals indicated that similar warnings existed in their manuals.

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Occurrence Type: Accident

Landing Facility/Approach Information

Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
HONOLULU INTERNATIONAL	KHNL	13 Ft. MSL	8L	12357	200

Runway Surface Type: Asphalt

Runway Surface Condition: Dry

Type Instrument Approach: ILS-complete

VFR Approach/Landing:

Aircraft Information

Aircraft Manufacturer	Model/Series	Serial Number
McDonnell Douglas	MD-11	48501

Airworthiness Certificate(s): Transport

Landing Gear Type: Retractable - Tricycle

Homebuilt Aircraft?	Number of Seats:	Certified Max Gross Wt.	Number of Engines:
No	295	602500 LBS	3

Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:
Turbo Fan	GE	CF6-80C2A3	60200 LBS

- Aircraft Inspection Information

Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time
Continuous Airworthiness		Hours	19103 Hours

- Emergency Locator Transmitter (ELT) Information

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

Owner/Operator Information

Registered Aircraft Owner	Street Address	City	State	Zip Code
AIRPLANES FUNDING LTD.	GPA HOUSE	SHANNON		

Operator of Aircraft	Street Address	City	State	Zip Code
GARUDA INDONESIAN AIRWAYS PT	SOEKAMMO-HATTA AIRPT BOX 1004	JAKARTA		

Operator Does Business As:

Operator Designator Code: WGFF

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

Air Carrier Operating Certificate(s): Foreign Operation

Operating Certificate:

Operator Certificate:

Regulation Flight Conducted Under: Part 129: Foreign

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

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Occurrence Date: 06/21/1997

Occurrence Type: Accident

First Pilot Information

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

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

Certificate(s): Airline Transport

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

Rotorcraft/Glider/LTA:

Instrument Rating(s): Airplane

Instructor Rating(s): 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:

- 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	14000	3000								
Pilot In Command(PIC)										
Instructor										
Last 90 Days										
Last 30 Days										
Last 24 Hours										

Seatbelt Used? Yes | Shoulder Harness Used? Yes | Toxicology Performed? | Second Pilot? Yes

Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point	State	Airport Identifier	Departure Time	Time Zone
JAKARTA		WRRR	2355	HDT

Destination	State	Airport Identifier
Same as Accident/Incident Location		KHNL

Type of Clearance: IFR

Type of Airspace: Class B

Weather Information

Source of Briefing: Company; National Weather Service

Method of Briefing:

National Transportation Safety Board

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Occurrence Type: Accident

Weather Information

WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
HNL	1250	HDT	50 Ft. MSL	0 NM	Deg. Mag.

Sky/Lowest Cloud Condition: Scattered 3500 Ft. AGL

Condition of Light: Day

Lowest Ceiling: None Ft. AGL

Visibility: 15 SM

Altimeter: 30.00 "Hg

Temperature: -2 °C

Dew Point: -7 °C

Wind Direction: 50

Density Altitude: Ft.

Wind Speed: 10

Gusts:

Weather Condtions at Accident Site: Visual Conditions

Visibility (RVR): Ft.

Visibility (RVV) SM

Intensity of Precipitation:

Restrictions to Visibility:

Type of Precipitation:

Accident Information

Aircraft Damage: Substantial

Aircraft Fire: None

Aircraft Explosion None

Classification: Foreign Registered/U.S. Soil

- Injury Summary Matrix	Fatal	Serious	Minor	None	TOTAL
First Pilot				1	1
Second Pilot				3	3
Student Pilot					
Flight Instructor					
Check Pilot					
Flight Engineer					
Cabin Attendants				15	15
Other Crew					
Passengers				289	289
- TOTAL ABOARD -				308	308
Other Ground	0	0	0		0
- GRAND TOTAL -	0	0	0	308	308

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Occurrence Type: Accident

Administrative Information

Investigator-In-Charge (IIC)

ROBERT M. MACINTOSH

Additional Persons Participating in This Accident/Incident Investigation:

DR OETARJO DIRAN
ACFT ACCIDENT INVEST COMMISION
JAKARTA, OF

CAPT ROY MEGANTORO
GARUDA DIRECTOR FLT OPERATION
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