



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Baltimore, MD	<b>Accident Number:</b>	DCA09FA048
<b>Date &amp; Time:</b>	05/06/2009, 1302 EDT	<b>Registration:</b>	N139WA
<b>Aircraft:</b>	BOEING DC-10	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>	Abnormal runway contact	<b>Injuries:</b>	1 Serious, 11 Minor, 168 None
<b>Flight Conducted Under:</b>	Part 121: Air Carrier - Non-scheduled		

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## Analysis

The flight was conducting a straight-in approach during visual meteorological conditions. The approach was backed up by an ILS and was stable at 500 feet above touchdown. The initial touchdown was firm and main landing gear rebounded, possibly bouncing slightly off the runway. Control column input and possibly momentum from the touchdown resulted in a rapid pitch down and hard nose gear impact with the runway. Wing spoilers likely did not deploy due to the main gear bounce and/or throttle position. Following the nose gear impact, the airplane pitched up as expected and the column was held in a slightly forward position. Airspeed rapidly decayed, and engine power began to increase as the airplane pitch reversed to a downward motion for a second time. One of the crew, likely the FO, called "flare flare" and the column recorded a rapid nose up input, followed by a rapid nose down input, and the nose gear again struck the runway very hard, likely causing the majority of the damage at that point. Following the second nose gear impact, column inputs stabilized at a slightly nose up command, power was set on all three engines, and the go-around was successfully executed.

A slight lag in the power increase on engine number 3 may have contributed to the nose down motion leading to the second nose gear impact, although the large forward (airplane nose down) column movement appears to be a much more significant contributor. It is unclear why the engine was slower to increase. Throttle lever angle was not recorded, but the engine operated as expected for all other phases of the flight, including after the impact, therefore it is possible the pilot did not advance the number 3 throttle concurrently with the others.

The captain's flight and duty schedule complied with Federal Aviation regulations, but he experienced a demanding 10-day trip schedule prior to the incident involving multiple time zone crossings and several long duty periods, and reported difficulties sleeping prior to the accident leg. The captain was likely further affected by a digestive system upset during the accident flight. It is likely that the captain's performance was degraded by fatigue and some degree of physical discomfort brought on by a short-term illness.

The captain had recently completed upgrade training to DC-10, having previously been flying as an MD-11 first officer. The training program was fragmented over approximately ten

months, and while in accordance with FAA regulations, may have adversely affected his consolidation of skills and experience.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the captain's inappropriate control inputs following a firm landing, resulting in two hard nose-gear impacts before executing a go-around.

Contributing to the inappropriate control inputs was the captain's fatigue and physical discomfort; and a possible lack of practical consolidation of skills and experience due to a protracted and fragmented training period.

### Findings

<b>Personnel issues</b>	Incorrect action sequence - Pilot (Cause) Alertness/Fatigue - Pilot (Factor) Illness/injury - Pilot (Factor)
<b>Organizational issues</b>	Upgrade training - Operator (Factor)

## Factual Information

### HISTORY OF FLIGHT:

On May 6, 2009, at about 1302 Eastern Daylight Time (EDT), a Boeing DC-10-30, registration N139WA, operated by World Airways as flight 8535, experienced a hard landing on runway 10 at Baltimore/Washington-Thurgood Marshall International Airport, Baltimore, MD (BWI). The flight crew executed a go-around and landed on runway 33L. The flight was a non-scheduled international passenger flight, operated under 14 CFR Part 121, and had departed Leipzig, Germany at 0700 central European time. The flight was operated under a contract with the U.S. Department of Defense Air Mobility Command carrying troops returning from Iraq. The first officer experienced a serious neck injury. The captain, flight engineer and 9 flight attendants reported minor injuries. There were no additional injuries reported among the 168 passengers. The aircraft sustained substantial damage.

The flight to BWI was reported as routine, with VFR weather and light traffic prevailing in the terminal area. The airplane was established on the ILS runway 10 approach course descending through 1,500 feet, at 150 knots. The Captain was the pilot flying (PF) and reported the approach was stable. As the airplane descended through approximately 500 feet, the airplane was configured with the landing gear down and the flaps set to 35 degrees. The crew noted a departing airplane on a crossing runway, and the autopilot was disengaged. The power briefly increased at about 100 feet, then decreased until touchdown.

The airplane began a pitch up flare maneuver at about 45 feet above the runway threshold. The main landing gear (MLG) touched down first, with the airplane in about a 5.5 degree nose up attitude. Peak vertical acceleration at this touchdown was recorded as 1.6G, and the crew reported it to be a "firm" touchdown. The airplane bounced slightly, extending the main struts and possibly becoming airborne by a small amount. The captain perceived the airplane bounce and the nose pitched up, and he attempted to re-establish a normal landing attitude. Recorded data shows the control column position then shifted from the "pull" used during the flare to a "push" for two seconds. The pitch attitude decreased rapidly. As the nose-down pitch rate built up, the column position switched back to a "pull" and the nose landing gear (NLG) hit the runway at a recorded pitch attitude below zero and an FDR recorded vertical acceleration spike of 2.8G. The captain reported that he felt he had no elevator authority to arrest the derotation.

The cockpit voice recorder recorded a sound consistent with spoiler handle activation, but shortly afterward the flight engineer called "no spoilers." Spoiler and handle position was not a recorded parameter on this airplane, however Boeing performance analysts note that it is possible that the spoilers were knocked down due to throttle advance.

The pitch attitude then rebounded, reaching a pitch of 10 degrees nose up less than two seconds later. Both pilots reported the pitch rose very quickly. The control column then switched back to a "push" and engines 1 and 2 began spooling up. The pitch then began to drop rapidly and the NLG impacted the runway a second time, with a peak recorded vertical acceleration over 3.2G. Some dropouts of FDR data were observed at this point. Engines 1 and 2 were accelerating through approximately 85% N1 at the time of the second NLG impact and engine 3 was spooling up through about 50%. The pitch attitude rebounded again and a go-around was initiated, with all 3 engines at climb power.

Smoke appeared in the cockpit during the climbout, which the crew diagnosed as an

overheating AC pack. Some attitude instrumentation was lost, the inertial reference units were damaged and dislodged, and the #1 hydraulic system failed. The Captain declared an emergency with ATC. The controller advised the crew that they appeared to have damaged the nose gear and left debris on the runway.

The controller-in-charge activated the crash phone and called an "Alert II" notifying the airport rescue and fire fighting equipment and also notified the airport authority. The flight was vectored to a visual approach to runway 33L, remaining in visual conditions and using standby instruments due to the instrumentation failures. The flight deck crew then proceeded to prepare for a landing with blown nose tires and communicated twice with the cabin crew to prepare for an emergency landing. The landing and rollout on runway 33L were successful with no further incident, ARFF vehicles were standing by at the runway and responded immediately as the airplane stopped on runway 33L.

#### INJURIES TO PERSONS:

The first officer experienced a serious neck injury. The captain, flight engineer and 9 flight attendants reported minor injuries. There were no additional injuries reported among the 168 passengers.

#### DAMAGE TO AIRCRAFT:

The aircraft NLG right tire and wheel were damaged. There was extensive skin damage, buckling and cracking in the forward fuselage area. The right hand portion of the forward pressure bulkhead was severely buckled and fractured. The damage sustained met the NTSB "substantial damage" criteria. Additionally, numerous components in the electronics equipment bay were dislodged and damaged, and the number 1 hydraulic system failed.

The left nosewheel tire burst and shredded the carcass, requiring the right tire to be discarded due to overstress.

#### PERSONNEL INFORMATION:

The captain, age 40, had worked for World Airways since June, 2001. He held an Airline Transport Pilot certificate, multi-engine land, with type ratings in DC10, MD11 and SF34. He held an FAA first class medical certificate with no limitations or waivers. Company records indicate that he had 6,500 hours total time with 193 hours on the DC10. He had no previous accidents, incidents, or violations. The captain's trip sequence began on April 27, with his first flight as DC10 Captain from BWI, to Gray AFB, Texas, and Bangor, Maine. He continued on a series of flights as a passenger from Bangor to Hong Kong and Manila, Phillipines with some rest periods interspersed, and then flew as pilot from Clark AFB, Phillipines to Guam and Honolulu, Hawaii on May 3 and 4. On the flight from Guam to Honolulu, the captain reported that he felt ill, probably due to some bad food. He then continued on commercial flights as a passenger from Honolulu via San Francisco to Frankfurt and Leipzig, Germany to pick up the accident flight. The captain reported his illness returned on the accident flight from Leipzig to BWI. He indicated that he experienced digestive system discomfort that required frequent lavatory breaks.

The first officer, age 37, had worked for World Airways since April of 2008. He held an Airline Transport Pilot certificate, multi-engine land, with type ratings in the DC10, CE560, and Lear. He held an FAA first class medical certificate with no limitations or waivers. He reported a total of 6,300 flight hours, with 373 hours in the DC10. The FO had flown the accident

airplane from Bangor, Maine to Leipzig and then to BWI, arriving on April 26. He then followed the same sequence of flights as the Captain. The FO also reported feeling ill on the flight between Guam and Honolulu, but reported he did not have any difficulty during the accident leg.

The flight engineer had worked for World Airways since October of 2007, and reported 3,580 hours total time, with 621 as FE on the DC10. He was not type rated as a pilot in the DC10. The FE met the other two flight crew members at Leipzig after being called in to cover for another FE who could not make the trip.

#### AIRCRAFT INFORMATION:

N139WA, manufacturer serial number 46583, World Airways ship number AC139, was a Boeing McDonnell-Douglas DC-10-30 equipped with General Electric CF6-50C2 engines. The airplane had approximately 107,814 hours total time on the airframe. Recorded data and airline records indicated no relevant maintenance issues with the airplane. At the time of the accident the estimated landing weight was 360,000 pounds with a center of gravity at 20.6% mean aerodynamic chord.

#### METEOROLOGICAL INFORMATION:

The current observation at the time of the accident was effective at 12:54 EDT, and indicated wind calm, visibility 10 miles, few clouds at 2,100 feet above ground level, temperature 17 degrees C. There was no precipitation.

#### AIDS TO NAVIGATION:

The instrument landing system (ILS) runway 10 indicated no anomalies.

#### COMMUNICATIONS:

No communications problems were noted at any time during the accident sequence.

#### AERODROME INFORMATION:

The Baltimore/Washington-Thurgood Marshall International Airport is located approximately 9 miles south of the city of Baltimore, MD. The airport averages about 760 operations per day, mostly air carrier and air taxi activity. Runway 10 is 10,502 feet long and 200 feet wide, aligned to 105 degrees magnetic. Touchdown zone elevation is 139 feet above sea level. The runway is marked for precision instrument operations, has in-pavement centerline and touchdown zone lighting, and is equipped with a standard 2,400 foot high intensity approach lighting system with centerline sequenced flashers. There is no visual approach slope indicator. A full instrument landing system serves the runway. The runway has no significant obstacles and was dry at the time of the accident.

#### FLIGHT RECORDERS:

The Digital Flight Data Recorder was a Lockheed Aeronautical Systems Model 209 (LAS 209) mylar tape unit, that records 25 hours of flight data, consisting of 22 parameters. The accident aircraft was not in compliance with the federal FDR carriage requirements because the pressure altitude parameter was not recorded properly. Additionally all elevator position parameters (left inboard elevator and right outboard elevator) and the upper rudder position parameter could not be converted properly using the conversion information provided by the operator's FDR analysis service provider. The recorder was in good condition and the data

were extracted normally from the recorder.

The Cockpit Voice Recorder was a Honeywell 6022 SSCVR 120, a solid-state CVR that records 2 hours of digital cockpit audio. The CVR had not sustained any heat or structural damage and the audio information was extracted from the recorder normally, without difficulty. A CVR group was convened and produced a transcript including events from the aircraft's initial approach, hard landing, go around, and 2nd approach and landing, as well as post-landing activity.

#### MEDICAL AND PATHOLOGICAL INFORMATION:

Toxicological samples provided by the flight crew tested negative.

#### FIRE:

None. Smoke was determined to be from an overheated air conditioning pack.

#### TESTS AND RESEARCH:

An aircraft damage and performance study was conducted by Boeing with NTSB oversight. Data from the study is incorporated in the history of flight and damage to aircraft sections of this report.

#### ORGANIZATIONAL AND MANAGEMENT INFORMATION:

The flight was operated as a contract to the Department of Defense Air Mobility Command (AMC), although not introduced as party to the investigation, AMC was kept informed of investigative progress per an existing agreement between NTSB and DoD.

#### ADDITIONAL INFORMATION:

An internal World Airways recommendation was sent to the Director of Training and Standards and the Chief Pilot to implement more balked and bounced landing training with the line check pilots and the line pilots.

The accident airplane was operating such that it was required to be equipped with an FDR that recorded 22 parameters, as cited in 14 CFR 121.344c. The NTSB recorder lab found that the pressure altitude parameter was not recorded properly and all elevator position parameters conversion information was invalid. World Airways stated that the airline's Quality Control verified that the test procedures were being followed at the required intervals and the required parameters were being captured. World Airways stated that they were in the process of phasing out their DC-10 fleet.

## History of Flight

Landing-flare/touchdown

Abnormal runway contact (Defining event)

## Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	40, Male
<b>Airplane Rating(s):</b>	Multi-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 1 Without Waivers/Limitations	<b>Last Medical Exam:</b>	11/03/2008
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	04/28/2009
<b>Flight Time:</b>	6500 hours (Total, all aircraft), 193 hours (Total, this make and model), 64 hours (Last 90 days, all aircraft), 45 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

## Co-Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	37, Male
<b>Airplane Rating(s):</b>	Multi-engine Land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 1 Without Waivers/Limitations	<b>Last Medical Exam:</b>	01/13/2009
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	04/10/2009
<b>Flight Time:</b>	6300 hours (Total, all aircraft), 373 hours (Total, this make and model), 112 hours (Last 90 days, all aircraft), 44 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

## Flight Engineer Information

<b>Certificate:</b>	Airline Transport; Flight Engineer	<b>Age:</b>	, Male
<b>Airplane Rating(s):</b>		<b>Seat Occupied:</b>	Center
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>		<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>		<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>		<b>Last Medical Exam:</b>	
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	3580 hours (Total, all aircraft)		

## Aircraft and Owner/Operator Information

Aircraft Manufacturer:	BOEING	Registration:	N139WA
Model/Series:	DC-10 30	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	46583
Landing Gear Type:	Retractable - Tricycle	Seats:	328
Date/Type of Last Inspection:	03/29/2009, Continuous Airworthiness	Certified Max Gross Wt.:	580000 lbs
Time Since Last Inspection:		Engines:	3 Turbo Fan
Airframe Total Time:	107814 Hours	Engine Manufacturer:	GE
ELT:	Installed, not activated	Engine Model/Series:	CF6
Registered Owner:	World Airways	Rated Power:	
Operator:	World Airways	Air Carrier Operating Certificate:	Supplemental
Operator Does Business As:		Operator Designator Code:	WRLA

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KBWI, 130 ft msl	Observation Time:	1254 EDT
Distance from Accident Site:	0 Nautical Miles	Direction from Accident Site:	0°
Lowest Cloud Condition:	Few / 2100 ft agl	Temperature/Dew Point:	17° C / 12° C
Lowest Ceiling:		Visibility	10 Miles
Wind Speed/Gusts, Direction:	Light and Variable, Variable	Visibility (RVR):	
Altimeter Setting:	30.06 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:			
Departure Point:	Leipzig	Type of Flight Plan Filed:	IFR
Destination:	Baltimore, MD (KBWI)	Type of Clearance:	IFR
Departure Time:	0700 UTC	Type of Airspace:	

## Airport Information

Airport:	Baltimore (KBWI)	Runway Surface Type:	Concrete
Airport Elevation:	130 ft	Runway Surface Condition:	Dry
Runway Used:	10	IFR Approach:	ILS
Runway Length/Width:		VFR Approach/Landing:	Go Around; Straight-in



## Wreckage and Impact Information

<b>Crew Injuries:</b>	1 Serious, 11 Minor	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	168 None	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	1 Serious, 11 Minor, 168 None	<b>Latitude, Longitude:</b>	

## Administrative Information

<b>Investigator In Charge (IIC):</b>	William R English	<b>Adopted Date:</b>	09/27/2010
<b>Additional Participating Persons:</b>			
<b>Publish Date:</b>	09/27/2010		
<b>Investigation Docket:</b>	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at <a href="mailto:pubinq@ntsb.gov">pubinq@ntsb.gov</a> , or at 800-877-6799. Dockets released after this date are available at <a href="http://dms.nts.gov/pubdms/">http://dms.nts.gov/pubdms/</a> .		

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