



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	DENVER, CO	<b>Accident Number:</b>	DEN93FA049
<b>Date &amp; Time:</b>	04/27/1993, 1728 MDT	<b>Registration:</b>	N72822
<b>Aircraft:</b>	MCDONNELL DOUGLAS DC-9-82	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>		<b>Injuries:</b>	2 Minor, 119 None
<b>Flight Conducted Under:</b>	Part 121: Air Carrier - Scheduled		

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## Analysis

FOLLOWING TOUCHDOWN A LANDING GEAR VIBRATION OCCURRED WHICH LED TO A COLLAPSE OF THE RIGHT MAIN LANDING GEAR AT 117 KNOTS. THE RIGHT WING CONTACTED THE RUNWAY AND THE AIRPLANE SKIDDED TO A STOP ON THE RUNWAY AS IT ENTERED THE OVERRUN. DURING THE ENSUING EMERGENCY EVACUATION TWO PASSENGERS SUSTAINED MINOR INJURIES. EXAMINATION OF APPLICABLE COMPONENTS DID NOT PROVIDE A SPECIFIC CAUSE FOR THE VIBRATION THAT LED TO THE COLLAPSE. THREADS ON THE RIGHT GEAR APEX BOLT FAILED RESULTING IN THE GEAR'S 90 DEGREE ROTATION AND THE SUBSEQUENT OVERLOAD COLLAPSE. THE GROUND SPOILERS DID NOT ACTIVATE AND THE CREW STATED THAT THEY HAD ARMED AUTO SPOILERS. THE MANUFACTURER REPORTED THAT THERE HAVE BEEN A TOTAL OF THREE SIMILAR NON-FLIGHT TEST OCCURRENCES. IN ALL THREE EVENTS THE GROUND SPOILERS DID NOT EXTEND.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A VIBRATION IN THE RIGHT MAIN LANDING GEAR, FOR UNDETERMINED REASONS, WHICH RESULTED IN COLLAPSE OF THE RIGHT MAIN GEAR. A FACTOR WAS FAILURE OF THE PILOT IN COMMAND TO ENSURE DEPLOYMENT OF THE GROUND SPOILERS.

## Findings

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Occurrence #1: MAIN GEAR COLLAPSED

Phase of Operation: LANDING - ROLL

### Findings

1. (F) SPOILER EXTENSION - NOT PERFORMED - PILOT IN COMMAND
2. (C) LANDING GEAR,MAIN GEAR - VIBRATION
3. (C) REASON FOR OCCURRENCE UNDETERMINED
4. LANDING GEAR,MAIN GEAR - FAILURE,TOTAL
5. LANDING GEAR,MAIN GEAR - OVERLOAD

## Factual Information

### HISTORY OF FLIGHT

on April 27, 1993, at 1728 mountain daylight time, a McDonnell Douglas DC-9-82, N72822, operating as Continental Airlines Flight 588, had the right main landing gear collapse during landing roll at Stapleton International Airport, Denver, Colorado. There were two minor injuries reported from the emergency evacuation, and the aircraft sustained substantial damage. The aircraft was being operated under 14 CFR Part 121 when the accident occurred. Visual meteorological conditions prevailed and an IFR flight plan was filed for this scheduled flight from San Francisco, California, which originated at 1515 mountain daylight time.

According to the flight deck crew, the takeoff, en route, and approach were normal. Upon touch down on runway 26R, a severe vibration occurred and the right main gear collapsed at what the copilot recalled to be 60 knots. The aircraft remained on the runway and skidded to a stop.

### PERSONNEL INFORMATION

Flight experience and flight deck crew qualifications are depicted in this document. The pilots' had a reported, combined, flight experience in this type of aircraft of 11,600 hours. Both were properly qualified and current to conduct the flight.

### FLIGHT RECORDERS

The flight data and voice recorder were analyzed at the National Transportation Safety Board Laboratory. The voice recorder contained no information pertinent to the accident. The flight recorder information is attached and provides information that the approach was within normal parameters and that touchdown occurred at 134 knots indicated airspeed. According to the recorded data, the right main gear collapsed at approximately 117 knots at which time the heading changed approximately 5 degrees to the left. There is no indication via the recorded information that the ground spoilers deployed following landing.

### WRECKAGE AND IMPACT INFORMATION

Runway witness marks provided no information that an abnormal touchdown occurred, and the actual point of touchdown could not be determined. Witness marks on the runway are computed from the approach end and indicate that at 3,500 feet, the left main landing gear tires left marks associated with a shimmy. At 3,600 feet, the right inboard tire left heavy marks, and at 3,750 feet, metal deposits from the right wing structure began. Also at 3,750 feet, the right main tire marks indicate that the right wheel assembly turned 90 degrees to the direction of travel and remained fixed in that position throughout the remainder of the aircraft travel. The aircraft came to a stop 8,600 feet from the

approach end of the runway at the beginning of the overrun approximately 30 feet right of centerline. A detailed wreckage diagram and photographs are attached.

### TESTS AND RESEARCH

Applicable components from the right main landing gear assembly, brakes, anti-skid, and spoilers were shipped to the facilities of

McDonnell Douglas and/or Continental Airlines for further examination. The results of the examinations are attached and provide no definitive data as to the initiation of the vibration

which lead to the gear collapse. The tests did reveal that the threads on the right gear apex bolt failed causing the nut to depart and allowed the right main gear to rotate 90 degrees, bending the lower torque link and damaging the flange bushings and spacers on the left torque link. Ultimately, the gear collapsed as a result of overload on the side brace of the right main landing gear. Research and tests are continuing; however, as a result of the work done to date, McDonnell Douglas issued an ALL OPERATORS LETTER (AOL), with recommended alterations to operating procedures. A copy of that AOL is attached. It also addresses the fact that there have been three other similar in- service events. In all three cases the spoiler non extension was a common denominator.

As a result of the flight data recorder information, it was determined that the aircraft ground spoilers did not activate and the crew stated that they armed the spoilers. Tests on those components revealed no discrepancies which would have prevented deployment.

#### ADDITIONAL DATA/INFORMATION

The aircraft was verbally released to Continental Airlines on April 28, 1993, following examination and identification of components to be retained. The retained components are being returned to Continental upon completion of additional testing.

#### Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	49, Male
<b>Airplane Rating(s):</b>	Multi-engine Land; Single-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>	No
<b>Medical Certification:</b>	Class 1 Valid Medical--w/ waivers/lim.	<b>Last Medical Exam:</b>	03/18/1993
<b>Occupational Pilot:</b>	<b>Last Flight Review or Equivalent:</b>		
<b>Flight Time:</b>	25000 hours (Total, all aircraft), 5600 hours (Total, this make and model), 7000 hours (Pilot In Command, all aircraft), 210 hours (Last 90 days, all aircraft), 70 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

Aircraft Manufacturer:	MCDONNELL DOUGLAS	Registration:	N72822
Model/Series:	DC-9-82 DC-9-82	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	49482
Landing Gear Type:	Retractable - Tricycle	Seats:	150
Date/Type of Last Inspection:	04/01/1993, Continuous Airworthiness	Certified Max Gross Wt.:	142000 lbs
Time Since Last Inspection:	252 Hours	Engines:	2 Turbo Jet
Airframe Total Time:	21572 Hours	Engine Manufacturer:	P&W
ELT:	Not installed	Engine Model/Series:	JT8D-217
Registered Owner:	CONTINENTAL AIRLINES	Rated Power:	20750 lbs
Operator:	CONTINENTAL AIRLINES	Air Carrier Operating Certificate:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	CALA

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	DEN, 5333 ft msl	Observation Time:	1731 MDT
Distance from Accident Site:	1 Nautical Miles	Direction from Accident Site:	30°
Lowest Cloud Condition:	Unknown / 6500 ft agl	Temperature/Dew Point:	17° C / 2° C
Lowest Ceiling:	Broken / 6500 ft agl	Visibility	50 Miles
Wind Speed/Gusts, Direction:	16 knots, 120°	Visibility (RVR):	0 ft
Altimeter Setting:	30 inches Hg	Visibility (RVV):	0 Miles
Precipitation and Obscuration:			
Departure Point:	SAN FRANCISCO, CA (SFO)	Type of Flight Plan Filed:	IFR
Destination:		Type of Clearance:	IFR
Departure Time:	1515 MDT	Type of Airspace:	Class E

## Airport Information

Airport:	STAPLETON INTERNATIONAL (DEN)	Runway Surface Type:	Concrete
Airport Elevation:	5333 ft	Runway Surface Condition:	Dry
Runway Used:	26R	IFR Approach:	ILS; Visual
Runway Length/Width:	8599 ft / 150 ft	VFR Approach/Landing:	

## Wreckage and Impact Information

<b>Crew Injuries:</b>	6 None	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	2 Minor, 113 None	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	2 Minor, 119 None	<b>Latitude, Longitude:</b>	

## Administrative Information

<b>Investigator In Charge (IIC):</b>	NORMAN F WIEMEYER	<b>Adopted Date:</b>	06/30/1994
<b>Additional Participating Persons:</b>	DONALD J WILLIAMS; DENVER, CO		
<b>Publish Date:</b>			
<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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