Main landing gear collapse during taxi, Douglas DC-9-32, September 22, 2002

Micro-summary: **The right main landing gear of this Douglas DC-9-32 collapsed during taxi.**

Event Date: **2002-09-22 at 1852 CDT**

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

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

Cautions:

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.

4. Contact us before reproducing or redistributing a report from this anthology. Individual countries have very differing views on copyright! We can advise you on the steps to follow.

National Transportation Safety Board **FACTUAL REPORT** **AVIATION**	NTSB ID: CHI02FA289	Aircraft Registration Number: N941N
	Occurrence Date: 09/22/2002	Most Critical Injury: None
	Occurrence Type: Accident	Investigated By: NTSB

Location/Time

Nearest City/Place	State	Zip Code	Local Time	Time Zone	
Minneapolis	MN	55450	1852	CDT	

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

Aircraft Information Summary

Aircraft Manufacturer	Model/Series	Type of Aircraft
McDonnell Douglas	DC-9-32	Airplane

Sightseeing Flight: No Air Medical Transport Flight: No

Narrative

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

On September 22, 2002, at 1852 central daylight time, a McDonnell Douglas DC-9-32, N941N, owned and operated by Northwest Airlines as flight 1842, was substantially damaged when the right main landing gear collapsed during taxi at the Minneapolis-St. Paul International/Wold-Chamberlain Airport, Minneapolis, Minnesota. The 14 CFR Part 121 passenger flight was taxiing for takeoff and was bound for the Charlotte/Douglas International Airport, Charlotte, North Carolina. There were no injuries to the 81 passengers or 4 crewmembers.

The airplane departed from gate D3 and was taxiing on taxiway A to runway 30L when the right main landing gear collapsed. The airplane came to rest on taxiway A abeam gate F10. The right main landing gear outer-cylinder was found fractured into three pieces about 19 inches from the upper end of the cylinder. The fracture surface was visually examined and a dark spot was observed on the forward side the fracture surface of the cylinder. The cylinder was then removed from the aircraft and shipped to the National Transportation Safety Board's Materials Laboratory in Washington, D.C., for further examination.

The airplane, serial number 47450, was manufactured in 1969 and had accumulated 85,323 hours time in service, which included 74,121 landing cycles. The right main landing gear had accumulated a total of 105,099 landing cycles. The operator reported that the right main landing gear was last overhauled on April 22, 1995, and had accumulated 11,275 landing cycles in 18,446 hours time in service.

Laboratory examination of the fracture surface revealed that the fracture originated from the dark spot that was previously observed. This dark spot was examined using various methods and was found to have several areas with differing fracture features. The first region, centered on the fracture origin, showed intergranular fracture features. The first region was surrounded by a thin band, region 2, that exhibited transgranular fracture features that resembled fatigue progression in steel materials. Region 2 was also surrounded by a third region that again exhibited intergranular fracture features. Another band, region 4, surrounded region 3 and exhibited fatigue progression features. Outside of these regions, the fracture faces exhibited features consistent with overstress fracture.

A metallographic section of the upper surface of the fracture was made. The section was cut and polished perpendicular to the fracture face so that the polished surface intersected region 1. Multiple sulfide inclusions were found in the sectioned sample. Similarly, a section was made of the lower surface of the fracture, and a 0,012-inch long line of inclusions was found. This line of inclusions was oriented perpendicular to the fracture region and parallel to the outer surface of the cylinder. The inclusions were determined to be composed mainly of oxides of aluminum and calcium with others containing sulfides of iron and manganese.

Scanning electron microscope examination of the metallographic samples determined that the material

National Transportation Safety Board

FACTUAL REPORT

AVIATION

NTSB ID:	CHI02FA289
Occurrence Date:	09/22/2002
Occurrence Type:	Accident

Narrative (Continued)

was consistent with the material specified on engineering drawings for the part. Additionally, hardness testing indicated that the strength levels were also consistent with the engineering specification.

Additional testing was performed under the direction of the NTSB on samples from the landing gear of N941N and N8986E. N8986E is a McDonnell Douglas DC-9-31 that was damaged when its landing gear collapsed during landing at MSP (NTSB accident number CHI02FA148). The tests performed included dissolved hydrogen content, residual stress, tensile properties, notched tensile strength and sustained load tests. The results of the testing are summarized below.

Hydrogen content ranged from 1 to 5 ppm for both cylinders. Each cylinder was tested at three locations near the fracture.

Both cylinders had compressive stress layers at the outer surfaces consistent with shot peened surfaces. The residual stress profiles showed maximum compressive stresses of about 200 to 250 ksi transitioning to residual tensile stresses between 0.01 and 0.02 inch below the surface. Both cylinders were tested at two locations, one near the dark spot at the origin of the fracture and another remote from the dark spot. No significant differences were noted between locations.

Tensile tests of material from both cylinders met engineering drawing and specification requirements for tensile strength, yield strength, elongation and reduction in area.

Notched tensile strength was about 325,000 psi for both specimens. This property is not controlled by drawing or specification but is used in the sustained load tests.

Specimens from both cylinders passed 200 hour sustained load tests without failure.

Samples of both cylinders were tested for cleanliness by magnetic particle inspection. No significant inclusions were detected and both exceeded the requirements for cleanliness.

Parties to the investigation were the Federal Aviation Administration, Northwest Airlines, The Boeing Company, Air Line Pilots Association, and the Aircraft Mechanics Fraternal Association.

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: CHI02FA289

Occurrence Date: 09/22/2002

Occurrence Type: Accident

Landing Facility/Approach Information

Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
MINNEAPOLIS-ST PAUL INTL/WOLD-	MSP	841 Ft. MSL	NA		

Runway Surface Type:

Runway Surface Condition:

Type Instrument Approach:

VFR Approach/Landing:

Aircraft Information

Aircraft Manufacturer	Model/Series	Serial Number
McDonnell Douglas	DC-9-32	47450

Airworthiness Certificate(s): Transport

Landing Gear Type: Retractable - Tricycle

Homebuilt Aircraft?	Number of Seats:	Certified Max Gross Wt.	Number of Engines:
No	85	109800 LBS	2

Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:
Turbo Jet	Pratt & Whitney	JT8D-15	15500 LBS

- Aircraft Inspection Information

Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time
AAIP	09/2002	105 Hours	62452 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
NORTHWEST AIRLINES INC	5101 Northwest Drive C7-8960	St. Paul	MN	55111

Operator of Aircraft	Street Address	City	State	Zip Code
Same as Reg'd Aircraft Owner	Same as Reg'd Aircraft Owner			

Operator Does Business As:

Operator Designator Code: NWAA

- 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: Scheduled; Domestic; Passenger Only

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: CHI02FA289

Occurrence Date: 09/22/2002

Occurrence Type: Accident

First Pilot Information

Name	City	State	Date of Birth	Age
On File	On File	On File	On File	43

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: None

Instrument Rating(s): None

Instructor Rating(s): None

Type Rating/Endorsement for Accident/Incident Aircraft? Yes | Current Biennial Flight Review? 09/2002

Medical Cert.: Class 1 | Medical Cert. Status: Valid Medical--no waivers/lim. | Date of Last Medical Exam: 06/2002

- 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	4221	2025								
Pilot In Command(PIC)		1815								
Instructor										
Last 90 Days										
Last 30 Days										
Last 24 Hours										

Seatbelt Used? Yes | Shoulder Harness Used? Yes | Toxicology Performed? No | Second Pilot? Yes

Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point	State	Airport Identifier	Departure Time	Time Zone
Same as Accident/Incident Location		MSP	1852	CDT

Destination	State	Airport Identifier
CHARLOTTE	NC	CLT

Type of Clearance: Unknown

Type of Airspace: Unknown

Weather Information

Source of Briefing: No record of briefing

Method of Briefing: Unknown

National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: CHI02FA289

Occurrence Date: 09/22/2002

Occurrence Type: Accident

Weather Information

WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
KMSP	1853	CDT	841 Ft. MSL	0 NM	0 Deg. Mag.

Sky/Lowest Cloud Condition: Few 6000 Ft. AGL

Condition of Light: Day

Lowest Ceiling: Broken 20000 Ft. AGL

Visibility: 10 SM

Altimeter: 30.10 "Hg

Temperature: 12 °C

Dew Point: 2 °C

Wind Direction: 300

Density Altitude: Ft.

Wind Speed: 5

Gusts:

Weather Condtions 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/U.S. 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				2	2
Other Crew					
Passengers				81	81
- TOTAL ABOARD -				85	85
Other Ground					
- GRAND TOTAL -				85	85

National Transportation Safety Board **FACTUAL REPORT** **AVIATION**	NTSB ID: CHI02FA289 Occurrence Date: 09/22/2002 Occurrence Type: Accident	

Administrative Information

Investigator-In-Charge (IIC)

John M. Brannen

Additional Persons Participating in This Accident/Incident Investigation:

James Freseman
FAA-Minneapolis, Minnesota - CMO
2901 Metro Drive, Suite 500
Bloomington, MN 55425

Patrick Schmitz
Air Safety Investigator
Northwest Airlines
Dept N7218, 5101 Northwest Drive
St Paul, MN 55111

James Wegener
Aircraft Mechanics Fraternal Association
7801 Metro Parkway
Bloomington, MN 55425

William B Etzold
Air Line Pilots Association
4570 Neal Ave N.
Stillwater, MN 55082

William Steelhammer
Sr. Flight Safety Investigator
Boeing Long Beach Division
3855 Lakewood Blvd.
Long Beach, CA 90846