



# National Transportation Safety Board Aviation Incident Final Report

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<b>Location:</b>	ST. LOUIS, MO	<b>Incident Number:</b>	CHI93IA352
<b>Date &amp; Time:</b>	09/02/1993, 1203 CDT	<b>Registration:</b>	N918TW
<b>Aircraft:</b>	MCDONNELL DOUGLAS DC-9-82	<b>Aircraft Damage:</b>	None
<b>Defining Event:</b>		<b>Injuries:</b>	108 None

**Flight Conducted Under:** Part 121: Air Carrier - Scheduled

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## Analysis

AS THE CAPTAIN WAS TURNING THE AIRPLANE OFF THE RUNWAY FOLLOWING ITS LANDING ROLL HE SAID IT WAS '...EXTREMELY DIFFICULT TO TURN.' THE CAPTAIN SAID THE AIRPLANE TURNED TO A 45 DEGREE ANGLE TO THE RUNWAY AND WOULD GO NO FURTHER. THE STEERING SYSTEM FAILED AND THE CAPTAIN ATTEMPTED TO STOP THE AIRPLANE ON THE TAXIWAY USING BRAKES AND REVERSE THRUST. THE AIRPLANE WOULD NOT STOP AND ROLLED OFF ONTO THE GRASS AREA ADJACENT TO THE TAXIWAY. EXAMINATION OF THE BRAKE SYSTEM FOUND THE HYDRAULIC SYSTEM POWER TRANSFER UNIT'S (PTU) HOUSING WAS CRACKED AROUND ITS ENTIRE CIRCUMFERENCE. THE PTU ON THE INCIDENT AIRPLANE WAS AN EARLY STYLE UNIT ACCORDING TO THE MANUFACTURER'S SERVICE BULLETIN. THE SERVICE BULLETIN ADVISED OWNERS OF THE AIRPLANE TO REPLACE THE ORIGINAL ALUMINUM HOUSING WITH A CAST IRON TYPE. EXAMINATION OF THE PTU'S HOUSING FRACTURE SURFACES REVEALED SHRINKAGE CAVITIES, AND LARGE SILICON INCLUSIONS.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: a fatigue failure of the power transfer unit caused by a material defect which resulted in a total hydraulic system failure.

## Findings

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Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION  
Phase of Operation: TAXI - FROM LANDING

### Findings

1. (C) HYDRAULIC SYSTEM - FAILURE,TOTAL
2. (C) HYDRAULIC SYSTEM - FATIGUE
3. REMEDIAL ACTION - ATTEMPTED - PILOT IN COMMAND
4. (C) MATERIAL DEFECT - MANUFACTURER
5. LANDING GEAR,NORMAL BRAKE SYSTEM - FAILURE,TOTAL
6. LANDING GEAR,STEERING SYSTEM - FAILURE,TOTAL

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Occurrence #2: MISCELLANEOUS/OTHER  
Phase of Operation: TAXI - FROM LANDING

## Factual Information

On September 2, 1993, at 1203 central daylight time, a McDonnell-Douglas DC-9-82, N918TW, operated by Trans World Airlines, Incorporated, as Flight 359, experienced a total hydraulic failure while taxiing to the parking gate after landing. The 14 CFR Part 121 flight had been operating on an IFR flight plan. Visual meteorological conditions prevailed at the time of the incident. The pilot, three flight attendants, and 103 passengers were not injured. The flight originated from New York, New York, at 1026 eastern daylight time.

The captain on Flight 359 stated: "At approximately 700 AFE I completed the landing check list and noted that there were no warning lights illuminated on the annunciator panel. Touchdown and initial roll-out were normal and F/O Harski initiated proper reverse and braking techniques slowing the aircraft to approximately 65 knots." The captain said he took control of the aircraft at this time and continued braking the aircraft.

When the airplane was slowed to four to five knots, the captain said he attempted to turn the airplane's nose wheel to exit the runway. "...I attempted to turn the nose wheel steering wheel to exit the runway but found that it was extremely difficult to turn." He stated he was able to turn the aircraft to a 45 degree angle to the runway heading. The captain said he "...found out that not only could I not turn the aircraft any further to the left but also I could not straighten out the nosewheel." The pilot stated he applied brakes and found them not available. He said, "I applied full left rudder in hope this would further turn the airplane so that I could position the airplane..." on the taxiway.

The airplane turned back onto the taxiway and the pilot attempted to use reverse thrust to stop it. Reverse thrust did not stop the airplane and it rolled off the edge, coming to a stop in the grass area adjacent to the taxiway.

According to the captain, he and the first officer confirmed "...that the hydraulic gauges indicated that both left and right reservoirs had sufficient fluid in them to provide hydraulic pressure. We also confirmed that all four hydraulic pumps were on."

The on-scene investigation revealed the power transfer unit (PTU) made the hydraulic system pressure go to zero when it was opened while operating on the left or right hydraulic system. Closing the PTU returned the hydraulic system to normal. Examination of the PTU housing revealed it was cracked around its entire circumference. Hydraulic fluid had not leaked from the crack in the unit.

A November 9, 1992, Allied-Signal Aerospace Company service bulletin that applied to N918TW recommended the PTU's cast aluminum housings be replaced with a wrought iron housing due to previous unit housing cracking history. N918TW's PTU was the cast aluminum type.

A McDonnell-Douglas service bulletin addressed procedures to handle low hydraulic pressure with the system annunciator lights illuminated. According to the flight crew, the system annunciator lights were not illuminated. The company's maintenance personnel performed an operational check of the annunciator panel. The check showed the system annunciator lights were functional.

The NTSB's Materials Laboratory Division examined the PTU housing. The report states: "Visual examination of the housing fracture surface indicated that the fracture was brittle and

had no evidence of plastic deformation." The housing's fatigue fracture covered approximately 270 degrees of the circumference. The remaining portion of the fracture was typical of overstress separation. Examination revealed that in some areas the fatigue features stemmed from large shrinkage cavities. The metallurgists report states: "However, the vast majority of the fatigue crack origins were associated with large inclusions, which were identified as silicon inclusions... ."

The Allied Signal and McDonnell-Douglas service bulletins are appended to this report. The NTSB's Materials Laboratory Division metallurgist's report is appended to this report.

## Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	, Male
<b>Airplane Rating(s):</b>	Multi-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	
<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 Unknown	<b>Last FAA Medical Exam:</b>	03/31/1993
<b>Occupational Pilot:</b>		<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	11992 hours (Total, all aircraft), 3878 hours (Total, this make and model), 137 hours (Last 90 days, all aircraft), 37 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	MCDONNELL DOUGLAS	<b>Registration:</b>	N918TW
<b>Model/Series:</b>	DC-9-82 DC-9-82	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	No
<b>Airworthiness Certificate:</b>	Transport	<b>Serial Number:</b>	49367
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	132
<b>Date/Type of Last Inspection:</b>	AAIP	<b>Certified Max Gross Wt.:</b>	140000 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	2 Turbo Jet
<b>Airframe Total Time:</b>		<b>Engine Manufacturer:</b>	GE
<b>ELT:</b>	Not installed	<b>Engine Model/Series:</b>	JT8D-209
<b>Registered Owner:</b>	TWA, INC.	<b>Rated Power:</b>	18500 lbs
<b>Operator:</b>	TWA, INC.	<b>Operating Certificate(s) Held:</b>	Flag carrier (121)
<b>Operator Does Business As:</b>		<b>Operator Designator Code:</b>	TWAA

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Not Reported
Observation Facility, Elevation:	STL, 605 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	1251 CDT	Direction from Accident Site:	0°
Lowest Cloud Condition:	Scattered / 3300 ft agl	Visibility	8 Miles
Lowest Ceiling:	Broken / 4000 ft agl	Visibility (RVR):	0 ft
Wind Speed/Gusts:	6 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	210°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29 inches Hg	Temperature/Dew Point:	29° C / 22° C
Precipitation and Obscuration:			
Departure Point:	NEW YORK, NY (LGA)	Type of Flight Plan Filed:	IFR
Destination:	, MO (STL)	Type of Clearance:	IFR
Departure Time:	1029 EDT	Type of Airspace:	Class B; Class D; Class E

## Airport Information

Airport:	LAMBERT-ST. LOUIS INT'L (STL)	Runway Surface Type:	Concrete
Airport Elevation:	605 ft	Runway Surface Condition:	Dry
Runway Used:	30R	IFR Approach:	
Runway Length/Width:	11019 ft / 200 ft	VFR Approach/Landing:	Full Stop

## Wreckage and Impact Information

Crew Injuries:	5 None	Aircraft Damage:	None
Passenger Injuries:	103 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	108 None	Latitude, Longitude:	

## Administrative Information

Investigator In Charge (IIC):	FRANK S GATTOLIN	Report Date:	09/13/1994
Additional Participating Persons:	ROBERT E MULVANEY; KANSAS CITY, MO		
Publish Date:			
Investigation Docket:	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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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).