Aviation Investigation Final Report

Location:	ALBUQUERQUE, New Mexico	**Accident Number:**	FTW97FA255
Date & Time:	July 6, 1997, 16:50 Local	**Registration:**	N2809W
Aircraft:	Boeing 727-247	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	3 Minor, 153 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

The Captain reported a normal flight and that the landing approach was stabilized. He stated that the wind was 'right down the runway for the landing.' As the airplane decelerated through 70 KIAS, the first officer reported hearing a 'loud bang,' and the airplane began 'listing heavily to the right and drifting to the right.' The pilots determined that the right main landing gear (MLG) had collapsed and an evacuation was ordered. The right MLG was last removed (18,188 cycles before the accident) for overhaul on April 8, 1988, and the right MLG forward trunnion bearing support fitting (FTBSF) was last ultrasonically inspected in May 1993 (7,634 cycles before the accident). A Service Bulletin, dated March 8, 1990, recommended that the MLG FTBSFs be ultrasonically inspected after 12,000 flight cycles every 6 months or 1,500 flight cycles, whichever occurred first. Operators were to continue this inspection cycle until the part was replaced or the preventative modification was done. The NTSB Materials Laboratory examined the broken right MLG FTBSF and determined that the failure was the result of stress corrosion cracking.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The inadequate inspection of the right main landing gear forward trunnion bearing support fitting. Factors were the failure of the right main landing gear forward trunnion bearing support fitting and the subsequent right main landing gear failure.

Findings

Occurrence #1: MAIN GEAR COLLAPSED
Phase of Operation: LANDING - ROLL

Findings
1. (F) LANDING GEAR,MAIN GEAR ATTACHMENT - FAILURE,TOTAL
2. (C) MAINTENANCE,INSPECTION - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
3. (F) LANDING GEAR - FAILURE,TOTAL

Factual Information

HISTORY OF FLIGHT

On July 6, 1997, at 1650 mountain daylight time, a Boeing 727-247 airplane, N2809W, was substantially damaged when the right main landing gear collapsed during landing roll on runway 21 at Albuquerque International Airport, Albuquerque, New Mexico. The 3 airline transport rated pilots, 3 flight attendants, and 147 passengers were not injured; however, 3 passengers sustained minor injuries during the emergency evacuation from the airplane. The airplane was being operated by Delta Airlines Inc. as flight 1470 under Title 14 CFR Part 121. Visual meteorological conditions prevailed for the scheduled domestic passenger flight which originated at Dallas/Fort Worth International Airport 1 hour and 17 minutes before the accident. An IFR flight plan had been filed for the flight.

According to the captain, this was the first leg of the rotation for the flight crew and he was the flying pilot. He characterized the flight as "normal", but did observe some distant thunderstorms as they approached Albuquerque (not in the vicinity of the destination airport). The captain reported that they were originally assigned runway 8 for landing, but air traffic control (ATC) changed that to runway 21 approximately 25 miles from their destination. The first officer stated that ATC cleared them for a visual approach and a "normal stabilized approach was flown." He further described the landing as "average for a 727, nothing remarkable." The captain reported that the wind was "right down the runway for the landing."

The captain stated that after touchdown, the spoilers were deployed and reverse thrust selected. He said "as the airplane slowed to approximately 70 KIAS, I moved the thrust levers out of reverse and applied light to moderate wheel brakes." The first officer reported hearing a "loud bang," which was his first indication of a problem. He said that the airplane began "listing heavily to the right and drifting to the right." As the airplane came to a stop on the runway, all three pilots noticed that the right unsafe gear light was illuminated and they concluded that the right main landing gear had collapsed.

The captain stated that "he was sure the wing was on the ground, and there was approximately 16,000 pounds of fuel onboard." He ordered the first officer to radio for airport rescue and fire fighting (ARFF) personnel to assist them and the second Officer to read the evacuation checklist. The cockpit door was opened and the forward flight attendant was directed to begin evacuation of the passengers. The 1R, 2R, and 2L emergency slides were deployed and the evacuation began. The forward Flight Attendant reported that "the passengers were almost too calm; they appeared to have no sense of urgency." He reported that he yelled out instructions to the passengers at first and then the captain suggested using the megaphone. According to the flight attendant, using the megaphone "seemed to reduce the stress in my voice which in turn seemed to reduce the overall stress, and the megaphone seemed to work

better than the public address system."

The two flight attendants in the rear of the airplane were notified of the evacuation by interphone. They both reported having "some difficulty" opening their respective emergency doors and motivating the passengers to evacuate expeditiously. They both used voice commands to communicate with passengers.

INJURIES TO PERSONS

After the evacuation was completed, three women requested medical assistance. Two of the women received treatment by paramedics on scene; a third woman was taken to a local hospital for further examination and treatment.

DAMAGE TO AIRPLANE

Examination of the airplane revealed that right main landing gear forward trunnion bearing support fitting had failed at the 9 o'clock and 3 o'clock position of the bearing lug. The following right wing components were damaged: the main landing gear, the lower spar cap of the wing spar tip, the aft portion of the wing tip, all leading edge slats and their tracks, the aileron control cable had been broken, all the flaps, an 18"x8" hole in the upper wing skin, and the spoiler beam.

AIRCRAFT INFORMATION

Boeing Commercial Airplane Group manufactured 1,832 B-727s from February 1964 to September 1984. The accident airplane was built in 1972 and had accumulated 74,734 hours of flight time (50,711 cycles) when the right main landing gear (MLG) failed. The MLG were last removed for overhaul on April 8, 1988 and had accumulated 26,496 hours of flight time (18,188 cycles) since overhaul. The Boeing Commercial Airplane Group recommended that the MLG be overhauled every 12,000 cycles (this can be adjusted based on fleet experience in conjunction with regulatory approval). Delta Airline's maintenance was scheduling MLG overhaul for not more than 120 months or 30,000 flight hours, whichever came first (Delta averages 1.3 hours per cycle). The forward trunnion support fitting, a component of the MLG, has no manufacturer's specified life limit. That is, there is no requirement when the part must be taken out of service.

On May 24, 1989, a Delta Airlines Boeing 727-247, N296WA, had its left MLG collapse during push-back due to the failure of the MLG forward trunnion bearing support fitting. The airplane had 25,391 flight hours on its airframe and a total of 17,187 flight cycles at the time of the event. A third MLG forward trunnion bearing support fitting failure occurred on October 1, 1972 on a United Airlines, Inc. Boeing 727 during landing roll at San Francisco International Airport. After the May 24, 1989 failure, Delta Airlines ultrasonically inspected its entire fleet of Boeing 727s; 3 additional airplanes were found with cracks in their forward trunnion bearing support fitting. No cracks or corrosion were identified on the accident airplane.

On March 8, 1990, Boeing issued Service Bulletin number 727-57-0179 to inspect the forward trunnion bearing support fitting for stress corrosion cracking on all 727 airplanes using ultrasonic inspection (which could detect cracks and corrosion as small as .050 inches in depth). If no corrosion or cracks were found, the operator was to ultrasonically inspect their airplanes again at a maximum time between inspections of six months or 1,500 flight cycles, whichever occurred first. They were to continue this inspection cycle until the part was repaired or the preventative modification was done.

On January 13, 1991, a Service Bulletin revision was issued by Boeing to add an additional recommendation for corrosion protection and to expand the use of sealant to coat the trunnion fitting lug bore during its reassembly onto the MLG of the airplane. On April 30, 1992, Boeing issued revision 2, of Service Bulletin 727-57-0179 (see attached document). The Boeing Service Bulletin called for an ultrasonic inspection of the part after 12,000 flight cycles with a maximum time between inspections of 1500 cycles or 6 months. Inspections were to continue until the part was repaired or the fitting was replaced. Inspections could cease if the new (revised in April 1992) repair was accomplished or the fitting replaced.

Delta Airline's maintenance had planned for the removal of the accident airplane's MLG for inspection and overhaul approximately 274 cycles after the accident. The procedure would have been required by Delta maintenance 3,504 hours after the accident. The removal of the MLG is the only time that the MLG forward trunnion bearing support fitting can be visually inspected for corrosion or cracking.

Delta Air Lines maintenance records indicate that during May 1993, the right MLG forward trunnion bearing support fitting of the accident airplane was ultrasonically inspected. The airplane flew 11,723 hours (7,634 cycles) until the accident in Albuquerque on July 6, 1997. Delta Airline's maintenance states that its current trunnion bracket inspection program follows the requirements of Service Bulletin number 727-57-0179, Rev. 2.

TESTS AND RESEARCH

The NTSB Materials Laboratory examined the airplane's right main landing gear forward trunnion bearing support fitting. According to the Materials Laboratory Report, the failure of the fitting was the result of stress corrosion cracking. The stress corrosion cracking was precipitated by fatigue cracking that had radially propagated from three corrosion pitting locations on the bore surface of the fitting in the area adjacent to its forward face (see attached report).

X-ray energy dispersive spectroscopy (EDS) analysis of corrosion deposits at the fracture origin area revealed the presence of sulfur, chlorine, and oxygen. Various other low atomic number elements and the elements normally associated with 4330M steel specified for the fitting were also detected in these areas. EDS analysis in the area of the fracture containing no evidence of corrosion product generated spectra consistent with chemical composition of the

specified material.

ADDITIONAL DATA

The airplane was released to a Delta Airlines representative on July 10, 1997; the forward trunnion bearing support fitting and spherical bearing from the right main landing gear were released to Delta Airlines on February 10, 1998.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	54,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	June 6, 1997
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	15325 hours (Total, all aircraft), 4984 hours (Total, this make and model), 164 hours (Last 90 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N2809W
Model/Series:	727-247 727-247	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	20581
Landing Gear Type:	Retractable - Tricycle	**Seats:**	157
Date/Type of Last Inspection:	June 20, 1997 Continuous airworthiness	**Certified Max Gross Wt.:**	184200 lbs
Time Since Last Inspection:	119 Hrs	**Engines:**	3 Turbo fan
Airframe Total Time:	9198 Hrs	**Engine Manufacturer:**	P&W
ELT:	Not installed	**Engine Model/Series:**	JT8D-15A
Registered Owner:	DELTA AIR LINES, INC.	**Rated Power:**	15500 Lbs thrust
Operator:		**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:	DELTA AIR LINES, INC.	**Operator Designator Code:**	DALA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	ABQ ,5352 ft msl	**Distance from Accident Site:**	2 Nautical Miles
Observation Time:	17:09 Local	**Direction from Accident Site:**	40°
Lowest Cloud Condition:	Scattered / 8000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 12000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	30°C / 4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	DFW AIRPORT , TX (DFW)	**Type of Flight Plan Filed:**	IFR
Destination:	(ABQ)	**Type of Clearance:**	IFR
Departure Time:	15:47 Local	**Type of Airspace:**	Class C

Airport Information

Airport:	ALBUQUERQUE INTERNATIONAL ABQ	**Runway Surface Type:**	Asphalt
Airport Elevation:	5352 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	17	**IFR Approach:**	Visual
Runway Length/Width:	10000 ft / 150 ft	**VFR Approach/Landing:**	Full stop

Wreckage and Impact Information

Crew Injuries:	6 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 Minor, 147 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Minor, 153 None	**Latitude, Longitude:**	35.059009,-106.620758(est)

Administrative Information

Investigator In Charge (IIC):	Struhsaker, James
Additional Participating Persons:	GARY R GOMES; ALBUQUERQUE , NM JOHN HAMILTON; SEATTLE , WA RALPH E HICKS, JR.; ATLANTA , GA JIM D SHAW; HERDON , VA
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