## Failure of left man gear, Boeing 757-223, August 24, 2003

**Micro-summary:** **Failure of the left main gear bogie on this Boeing 757-223 taxi-out.**

**Event Date:** **2003-08-24 at 1110 EDT**

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

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

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National Transportation Safety Board

# FACTUAL REPORT AVIATION

| | |
|---|---|
| NTSB ID: MIA03IA168 | Aircraft Registration Number: N609AA |
| Occurrence Date: 08/24/2003 | Most Critical Injury: None |
| Occurrence Type: Incident | Investigated By: NTSB |

## Location/Time

| Nearest City/Place | State | Zip Code | Local Time | Time Zone | |
|---|---|---|---|---|---|
| Miami | FL | 33132 | 1110 | EDT | |

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

## Aircraft Information Summary

| Aircraft Manufacturer | Model/Series | Type of Aircraft |
|---|---|---|
| Boeing | 757-223 | Airplane |

Sightseeing Flight: No

Air Medical Transport Flight: No

## Narrative

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

On August 24, 2003, about 1110 eastern daylight time, a Boeing 757-223, N609AA, operated by American Airlines Inc. as flight 1163, a Title 14 CFR Part 121 scheduled domestic passenger flight, had a failure of the left main landing gear truck beam, while taxiing for takeoff at Miami International Airport, Miami, Florida. Visual meteorological conditions prevailed. An instrument flight rules flight plan was filed. The airplane received minor damage. The two airline transport-rated pilots, four flight attendants, and 163 passengers reported no injuries. The flight was originating at the time, and was en route to Chicago, Illinois.

The first officer stated that during preflight examination of the airplane he didn't see anything wrong with the aircraft and it was deemed suitable for flight. They closed the doors and blocked out at 1055. After receiving the taxi clearance, they proceeded on "Mike" taxiway to runway 9L. During taxi, the aircraft suddenly dipped left and skidded to a stop. They assessed a possible tire blowout and after contacting ground control the aircraft behind them confirmed it was the left outboard main tire and it was smoking. They immediately called for fire equipment, which responded to the aircraft. They shut down the aircraft and called ramp control, maintenance, and flight dispatch to coordinate. After the fire crews visually inspected the aircraft they reported the left main landing gear had failed and there was no fire or smoke to be seen. Maintenance confirmed that the bogie on the left main gear had failed. There was no threat to safety and they deplaned all of the passengers and crew uneventfully and were bussed to the terminal.

The failed landing gear components were initially examined by NTSB on the taxiway on the day of the incident and at the American Airlines maintenance facility at Miami International Airport on August 25, 2003. The left main landing gear truck beam had fractured in two pieces between the aft axle and the truck pivot pin. The fracture occurred about 14 inches forward of the aft axle centerline. The truck beam is P/N 161N1611-6 and S/N 16PE2 according to the aircraft records. According to American Airlines the landing gear was delivered new with the aircraft on July 29, 1996, and had accumulated 7,517 cycles since new. There was no truck beam shield present with the wreckage although the attach straps were present. The brake rods were recovered with the beam and show abrasion damage on the lower portion of the lug where they attach to the clevis of the inner cylinder.

The aft section of truck beam had shear lips and river patterns present on the fracture face from about the 7 o'clock position around to the 5 o'clock position. The inner diameter had cosmoline covering about 15 percent of the surface and grease covering about 25 percent of the surface area. A big ball of detached cosmoline was present at the lower end of the beam plugging up the drain hole. There was an apparent impact mark at the 6 o'clock position on the outer surface of the beam. There was no apparent degradation of the primer on the interior surface. On the forward section of the truck beam the fracture was located about 10.5 inches aft of the pivot centerline. There was some cosmoline evident on the inner surface but a majority of the surface was covered by grease. The lower third of the beam was filled with grease. There was no apparent internal primer

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degradation. Again at about the 6 o'clock position on the outer surface there was an apparent impact mark. The fracture surface matched that for the aft section.

Metallurgical examination of the failed left main landing gear truck beam was performed at the NTSB Materials Laboratory, Washington, D.C. The truck beam assembly was transported to the NTSB Materials Laboratory and initially examined on September 5 and 6, 2003, with representatives from the FAA and American Airlines present. Initial inspections found the truck beam circumferentially fractured between the aft axle and the central pivot point. The mating forward and aft portions of the beam were received along with the installed forward and aft axles and five attachment straps. The following markings were found stamped into the exterior of the forward section of the beam; 161N1611-7 ASSY, 161N1611-6, 16PE2 and 17576. The Illustrated Parts Catalog (IPC) indicated that one strap was intended to hold electrical wiring and the other four to attach a truck beam shield, p/n 161N1710-1 to the underside of the truck beam. The truck beam shield was not received in the laboratory and was reportedly not found on Miami International Airport. The interior surfaces of the beam were entirely covered by an intact layer of primer paint. Further, a corrosion preventative compound on top of the primer covered an estimated 15 percent of the interior surface and a grease like substance on top of the corrosion preventative compound covered between 25 percent and 35 percent of the interior surface. During initial on-scene examinations a large ball of corrosion preventative compound was reportedly found covering and blocking the beam drain hole at the aft bottom of the beam.

The majority of the circumferential fracture was located at approximately 14 inches forward of the aft axle centerline and about 10.5 inches aft of the central pivot centerline. Examinations found that the fractures on the forward and aft piece matched and that no pieces of the beam were missing from the fracture area. Optical examinations of the fracture surfaces, after light cleaning, uncovered shear lips and river patterns indicating that the fracture initiated at the bottom of the beam between the 5 and 7 o'clock positions. Close examinations found features consistent with overstress fractures stemming from both sides of a 2.6 inch-long (circumferential) granular area at the bottom of the beam. From the granular area, the overstress portions of the fracture propagated circumferentially around the sides of the beam and forward near the top, meeting at the top of the beam just aft of the center pivot boss. The overall geometry of the fracture was consistent with beam bending loads producing tension stress on the bottom. The lower surface of the truck beam had several areas of disturbed paint and damaged finishes (top coat paint, primer and plating) due to apparent contact with other objects.

The granular portion of the fracture was located within the largest disturbed area measuring about 3 inches circumferentially and 4 inches longitudinally. The disturbed area was mostly on the forward piece of the beam but also extended onto the aft piece. At different points within this area, the paint, primer and cadmium plating were variously missing. Bare base metal was exposed adjacent to and forward of the fracture but no significant base metal appeared to have been removed. Most of the damage to the finishes was in the longitudinal direction on both sides of the fracture. Scratches, scuff marks and other signatures on the aft side clearly indicated a rearward displacement of the coating materials. Heavy randomly oriented scratches and gouges on the forward side of the fracture overlaid and obscured the longitudinal marks. In addition to the surface damage at the fracture, a portion of the edge of the forward fracture face was dented and deformed upward with the mating area on the aft fracture not damaged. A longitudinal crack was also visible in the damage area on the forward side of the fracture. This crack will be described in more detail later.

In a second area of finish damage the paint was missing and the underlying plating was damaged and displaced at several circumferentially elongated spots in a band between about 4 and 6 inches aft of the central pivot. The damaged spots were generally less than 0.3 inch wide but the largest area measured 1.2 inches long by 0.3 inch wide. Close examinations found the paint missing and the plating displaced mostly in the circumferential directions with flaking paint noted around the edges of the damage areas. A third area of finish damage was noted on the bottom of the beam just

Narrative (Continued)

forward of the jacking knob (approximately 5 inches forward of the aft axle centerline). In this area the coatings were damaged/missing over a large area with indicated movement of the contacting object in the forward direction To allow more in-depth examinations, sections were saw cut from both pieces of the beam. The sections included the forward and aft granular fracture areas, and the surrounding disturbed finish areas. The removed sections were cleaned of grease and corrosion preventative compound, inspected optically with a stereo microscope, and electronically with a scanning electron microscope (SEM).

Backscattered electron imaging of the outer surface of the beam adjacent to the granular fracture location on the forward side of the fracture uncovered a mottled surface with distinct elemental regions. Elemental maps acquired by energy dispersive x-ray spectroscopy (EDS) established the regions to be predominately cadmium, iron or aluminum. The aluminum regions were found either on top of iron or cadmium. Neither the beam material (AISI 4340M) nor the finishes contained significant amounts of aluminum. However, the base plate of the truck beam shield normally mounted under the truck beam was specified as an aluminum alloy (AA 2024).

Visual examinations of the damaged area adjacent to the fracture also uncovered a "y" shaped longitudinal crack in the bare metal area forward of the fracture. The crack was about 0.7 inches long and both arms of the "y" intersected the fracture near the center of the granular area. The granular area extended completely through the wall thickness of the beam and did not exhibit shear lips at either the inner or outer diameter surfaces. The granular area was made up of fracture regions on two offset planes connected in part by a shear ridge. The outboard region of the granular area was longer and 0.3 to 0.4 inch forward of the smaller inboard region. Micro fracture features within each portion of the granular region indicated crack initiation at heavily oxidized zones adjacent to the outer diameter surface of the beam. Closer inspections established that the oxidized zones were extensions of the arms of the "y" crack. Laboratory bending opened the majority of the "y" crack for examination. Visually, the opened crack surfaces were heavily corroded. Features indicated that the crack initiated at the outer surface of the beam and propagated directly inward. Most of the crack extended about 0.12 inches into the beam wall but a few areas penetrated as much as 0.2 inches. The beam wall thickness at this location was about 0.32 inch. The outboard arm of the "y" crack was not opened but intersected the opened portion at about 90. SEM viewing of the opened crack surfaces found a heavy covering of corrosion products obscuring some of the fracture details. Corrosion-damaged intergranular fracture facets consistent with stress corrosion cracking (SCC) were found throughout the crack. The laboratory-fractured area adjacent to the crack exhibited a ductile dimple fracture topography. SEM viewing of the granular areas of the circumferential fracture also revealed intergranular facets consistent with SCC. Beyond the granular regions, the fracture surface was composed of ductile dimples. A transverse metallographic section was cut through the forward end of the longitudinal "y" crack after it was opened. Initial viewing in the unetched state revealed cadmium plating on both the interior and exterior surfaces. The plating was discontinuous on both surfaces. Plating thickness averaged about 0.0006 to 0.0008 inch. EDS spectra of the plating established that it was mostly cadmium with a significant amount of titanium consistent with the specified cadmium titanium plating (Boeing finish detail F-15.01), 0.0005 inch minimum thickness. The primer on the beam interior was continuous and measured between 0.0014 and 0.0016 inch thick. Etching the specimen with 4 percent Nital1 reagent reveal a fine tempered martensite microstructure throughout the specimen consistent with quench and tempered heat treatment. No evidence of decarburization was noted at either surface. However, small areas of distorted microstructure were uncovered within 0.0006 inch of the beam exterior surface. Energy dispersive x-ray spectra of the beam base metal showed mostly iron with small amounts of chromium, manganese, nickel and molybdenum consistent with a 4300 series alloy steel. Hardness measurements made on the interior surface of the beam ranged from 49 to 52 HRC and indicated a tensile strength slightly less than the specified 275-300 ksi ultimate tensile strength.

As received, five attachment straps were present with the truck beam. Two straps were found around the forward section of the beam, one strap was around the aft section, one strap was loose in the container with the aft section of beam and the fifth was attached to electrical wires. Installation

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drawings show that the truck beam shield is attached to the beam with four straps, two forward and two aft of the truck beam pivot. Each strap contained two clips and bolts to connect to the guard. Chaffing protection tape was applied to the beam at the location of each strap. observations of each strap are presented below. An intact clip is also displayed along with a typical damaged clip and strap. The most forward strap was found about 8 inches behind the forward axle centerline with the T bolt installed on the inboard side with the nut on the upper side. The protective tape was found aft of the strap. The inboard clip was bent aft about 15 and the adjacent area of the strap was deformed rearward. The aft leg in the outboard clip was fractured and the adjacent strap was also bent aft. The second strap from the front was found at 15.5 inches from the forward axle centerline. Witness marks indicated that the strap had moved aft about 0.5 inch along with the protective tape. The bolt attachment legs of both of the clips showed wide separations and rearward deformation in the adjacent part of the strap. The strap was installed with the T bolt on the inboard side with the nut end up. The third strap attached to the beam was located about 4 inches forward of the aft axle centerline. It appeared to be in its installed location with the tape intact and the T bolt on the top of the beam with the nut end facing outboard. The bolt attachment legs of both clips exhibited wide separations of the legs. The strap displayed slight rearward deformation at the inboard clip and significant aft deformation at the outboard clip. The forth strap was loose and appeared to have been mechanically separated at the T bolt with the nut removed. One clip showed about inch separation of the legs and slight deformation of the adjacent strap. The other clip had a slight separation of the legs with visible twisting. The adjacent strap was slightly deformed. The fifth strap was loose from the beam but attached to the assembly by wires for the wheel transducer. No deformation was apparent on the clips and strap. Shadow lines were apparent in the paint indicating that straps had been installed on either side of the fracture. One was located 10 inches forward of the aft axle and the other was 7 inches aft of the pivot centerline. Remnants of protective tape were found at both locations.

The Boeing model 757 configuration deviation list (CDL), which was current at the time of the incident, lists items that can be missing for flight. The main landing gear truck beam shields may be missing for flight. There was no requirement to inspect the landing gear for damage prior to dispatch with a truck beam shield missing. American Airlines maintenance personnel had not identified the missing truck beam shield on the left main landing gear of N609AA and the item was not on the current list of items missing from the airplane under the CDL.

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Occurrence Date: 08/24/2003

Occurrence Type: Incident

## Landing Facility/Approach Information

| Airport Name | Airport ID: | Airport Elevation | Runway Used | Runway Length | Runway Width |
|---|---|---|---|---|---|
| Miami International | MIA | 8 Ft. MSL | NA | | |

Runway Surface Type: Unknown

Runway Surface Condition: Unknown

Type Instrument Approach: Unknown

VFR Approach/Landing: Unknown

## Aircraft Information

| Aircraft Manufacturer | Model/Series | Serial Number |
|---|---|---|
| Boeing | 757-223 | 27447 |

Airworthiness Certificate(s): Transport

Landing Gear Type: Retractable - Tricycle

| Homebuilt Aircraft? | Number of Seats: | Certified Max Gross Wt. | Number of Engines: |
|---|---|---|---|
| No | 187 | 251000 LBS | 2 |

| Engine Type: | Engine Manufacturer: | Model/Series: | Rated Power: |
|---|---|---|---|
| Turbo Fan | Rolls-Royce | RB211-535-E4B | 40100 LBS |

- Aircraft Inspection Information

| Type of Last Inspection | Date of Last Inspection | Time Since Last Inspection | Airframe Total Time |
|---|---|---|---|
| Continuous Airworthiness | 08/2003 | 1 Hours | 25608 Hours |

- Emergency Locator Transmitter (ELT) Information

| ELT Installed? | ELT Operated? | ELT Aided in Locating Accident Site? |
|---|---|---|
| No | No | No |

## Owner/Operator Information

| Registered Aircraft Owner | Street Address | | |
|---|---|---|---|
| AMERICAN AIRLINES INC | PO Box 619616 MD 5662 | | |
| | City: DFW Airport | State: TX | Zip Code: 75261 |

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

Operator Does Business As:

Operator Designator Code: AALA

- 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

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# FACTUAL REPORT AVIATION

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Occurrence Date: 08/24/2003

Occurrence Type: Incident

## First Pilot Information

| Name | City | State | Date of Birth | Age |
|---|---|---|---|---|
| On File | On File | On File | On File | 55 |

Sex: M | Seat Occupied: Left | Principal Profession: Civilian Pilot | Certificate Number: On File

Certificate(s): Airline Transport; Flight Instructor

Airplane Rating(s): Multi-engine Land; Single-engine Land

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): Airplane Multi-engine; Airplane Single-engine

Type Rating/Endorsement for Accident/Incident Aircraft? Yes | Current Biennial Flight Review? 02/2003

Medical Cert.: Class 1 | Medical Cert. Status: Valid Medical--w/ waivers/lim. | Date of Last Medical Exam: 03/2003

| - 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 | 19378 | 1924 | 125 | 19245 | 4350 | 2200 | | | | |
| Pilot In Command(PIC) | 15500 | 1924 | 95 | 15408 | | | | | | |
| Instructor | 3200 | | 30 | 3170 | | | | | | |
| Last 90 Days | 213 | 213 | | 213 | | | | | | |
| Last 30 Days | 66 | 66 | | 66 | | | | | | |
| Last 24 Hours | 4 | 4 | | 4 | | | | | | |

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 | | MIA | 1110 | EDT |

| Destination | State | Airport Identifier |
|---|---|---|
| CHICAGO | IL | ORD |

Type of Clearance: IFR

Type of Airspace: Class D

## Weather Information

Source of Briefing: Company

Method of Briefing: In Person

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Occurrence Type: Incident

## Weather Information

| WOF ID | Observation Time | Time Zone | WOF Elevation | WOF Distance From Accident Site | Direction From Accident Site |
|---|---|---|---|---|---|
| KMIA | 1153 | EST | 8 Ft. MSL | 1 NM | 270 Deg. Mag. |

Sky/Lowest Cloud Condition: Scattered 2500 Ft. AGL

Condition of Light: Day

Lowest Ceiling: None Ft. AGL

Visibility: 10 SM

Altimeter: 30.04 "Hg

Temperature: 32 °C

Dew Point: 22 °C

Wind Direction:

Density Altitude: 1200 Ft.

Wind Speed:

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: Minor

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 | | | | 4 | 4 |
| Other Crew | | | | | |
| Passengers | | | | 163 | 163 |
| - TOTAL ABOARD - | | | | 169 | 169 |
| Other Ground | | | | | |
| - GRAND TOTAL - | | | | 169 | 169 |

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## Administrative Information

Investigator-In-Charge (IIC)

Jeffrey L. Kennedy

Additional Persons Participating in This Accident/Incident Investigation:

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