



Aviation Investigation Factual Report

| | | | |
|--------------------------------|-----------------------------------|-------------------------|------------|
| Location: | Kansas City, Missouri | Incident Number: | CHI05IA116 |
| Date & Time: | May 19, 2005, 09:25 Local | Registration: | N814HK |
| Aircraft: | Embraer EMB-145LR | Aircraft Damage: | Minor |
| Defining Event: | | Injuries: | 54 None |
| Flight Conducted Under: | Part 121: Air carrier - Scheduled | | |

Factual Information

HISTORY OF FLIGHT

On May 19, 2005, about 0925 central daylight time, an Embraer EMB-145LR, N814HK, operated as Trans States Airlines, doing business as American Connection Flight 5699, piloted by an airline transport pilot, sustained minor damage as a result of an uncontained failure of the left engine as the airplane climbed through flight level 310 near Kansas City, Missouri. The airplane returned to the departure airport where an uneventful landing was made. The air carrier flight was operating under the provisions of 14 CFR Part 121 and was on an instrument flight rules flight plan. There were 51 passengers and 3 crewmembers on board. Two of the passengers were reported to be "lap-children". No injuries were reported. The flight originated from the St. Louis International Airport (STL), St. Louis, Missouri, and was bound for the Denver International Airport (DEN), Denver, Colorado.

DAMAGE TO AIRCRAFT

Examination of the airplane following the incident revealed that the left engine's fan spinner was completely missing and the forward fan blade retainer was missing a 90-degree section of the bolt flange. Several pieces of the fan spinner cap were recovered from within the cowl. The fan case had two holes. One of the holes was adjacent to a hole in the engine cowling. Several small holes and dents were found in the fuselage skin adjacent to the left engine's inlet. The engine was removed for further examination (See the "Tests and Research" section of this report).

AIRCRAFT INFORMATION

The airplane, serial number 145046, was an Embraer model EMB-145LR transport category airplane configured to seat 50 passengers in addition to the 3 crewmembers. Two Rolls Royce model AE3007A1 turbofan engines powered the airplane. Each engine was rated to produce 7,580 pounds of thrust for takeoff.

At the time of the incident, the left engine, serial number CAE311524, had accumulated 11,682.6 hours and 8,535 cycles since new. The engine was installed on N814HK on March 1, 2004, and had accumulated 3,775.3 hours and 2,240 cycles since that time. Review of the aircraft maintenance records did not indicate any discrepancies or maintenance activity with regard to the left engine except for routine oil servicing.

TESTS AND RESEARCH

Examination of the engine consisted of a partial disassembly of the engine and metallurgical examination of the forward fan blade retaining ring and the recovered portions of the fan spinner. The examination of the engine did not reveal any defects that could have contributed to the separation of the fan spinner. The pieces of the spinner and forward fan retaining ring were examined by the National Transportation Safety Board's (NTSB) materials laboratory, and

Rolls Royce.

The engine's spinner was fabricated from forged aluminum and was attached to the forward fan blade retaining ring with 12 bolts located around its perimeter. The aft side of the spinner had 12 bolt lugs around the perimeter that corresponded to the location of the bolt holes. The retaining ring had a flange for attaching the spinner and a raised lip inboard of the fan spinner bolt holes that interfaced with the inside diameter of the spinner's bolt lugs.

The NTSB examination of the fan blade forward retaining ring revealed features indicative of overstress failure which originated on the forward face adjacent to a linear impression. The length and location of the linear impression corresponded to the corner of one of the bolt lugs on the aft side of the spinner. The linear impression contained evidence of fretting damage. The inside radius between the retaining ring's raised lip and the flange was measured as 0.059 inches which was within the range specified by Rolls Royce (0.04 to 0.08 inches). The spinner's bolt lugs had a sharp outside corner where the spinner would interface with the radius on the retaining ring. The forging drawing for this part did not specify a radius; however, a Rolls Royce representative indicated that an engineering drawing for the spinner specified that exterior corners have an edge break with a radius between 0.005 and 0.020 inches. The combination of the radius on the retaining ring and the sharp edge on the aft side of the spinner resulted in an interference when the parts were assembled.

The Rolls Royce examination of the retained parts indicated the presence of high cycle fatigue on both the spinner and the fan blade retaining ring.

Rolls Royce performed three dimensional finite element analysis of the fan spinner and forward fan blade retaining ring. Two configurations were examined, one that represented the interference between the fan spinner and the radius on the retaining ring, and a second configuration for a spinner that has a chamfered edge as opposed to the sharp corner to eliminate the interference. The results showed that the non-chamfered spinner would result in higher cyclic stresses at the retaining ring's bolt circle flange, which would result in a reduced low cycle fatigue life.

Rolls Royce also performed spin pit testing of several non-chamfered fan spinners. Two new fan spinners cracked at about 22,500 and 19,000 cycles respectively. One fan spinner that had accumulated about 10,000 cycles in service was also tested and developed cracks at about 18,500 cycles.

ADDITIONAL INFORMATION

As a result of this investigation, Rolls-Royce initiated a one-time, on-wing eddy current inspection of all of the one-piece fan spinners that was to be accomplished within 18 months or 2,000 hours. Rolls-Royce also initiated a re-design of the fan spinner and indicated that the one-piece fan spinners will be removed from service by the end of 2010.

Pilot Information

| | | | |
|----------------------------------|---------------------------------------|------------------------------------------|---------|
| Certificate: | Airline transport | Age: | 37,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 | Last FAA Medical Exam: | |
| Occupational Pilot: | Yes | Last Flight Review or Equivalent: | |
| Flight Time: | 7900 hours (Total, all aircraft) | | |

Co-pilot Information

| | | | |
|----------------------------------|---------------------------------------|------------------------------------------|-----------------|
| Certificate: | Commercial | Age: | 35,Male |
| Airplane Rating(s): | Single-engine land; Multi-engine land | Seat Occupied: | Right |
| 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 | Last FAA Medical Exam: | |
| Occupational Pilot: | Yes | Last Flight Review or Equivalent: | January 1, 2005 |
| Flight Time: | 3200 hours (Total, all aircraft) | | |

Aircraft and Owner/Operator Information

| | | | |
|--------------------------------------|----------------------------------------|---------------------------------------|--------------------|
| Aircraft Make: | Embraer | Registration: | N814HK |
| Model/Series: | EMB-145LR | Aircraft Category: | Airplane |
| Year of Manufacture: | | Amateur Built: | |
| Airworthiness Certificate: | Transport | Serial Number: | 145046 |
| Landing Gear Type: | Retractable - Tricycle | Seats: | 53 |
| Date/Type of Last Inspection: | April 1, 2005 Continuous airworthiness | Certified Max Gross Wt.: | 48721 lbs |
| Time Since Last Inspection: | | Engines: | 2 Turbo fan |
| Airframe Total Time: | 18852 Hrs at time of accident | Engine Manufacturer: | Rolls-Royce |
| ELT: | | Engine Model/Series: | AE3007A1 |
| Registered Owner: | American Eagle Airlines Inc. | Rated Power: | 7425 Lbs thrust |
| Operator: | TRANS STATES AIRLINES INC | Operating Certificate(s) Held: | Flag carrier (121) |
| Operator Does Business As: | American Connection | Operator Designator Code: | RAIA |

Meteorological Information and Flight Plan

| | | | |
|-----------------------------------------|----------------------------------|---------------------------------------------|-------------|
| Conditions at Accident Site: | Visual (VMC) | Condition of Light: | Day |
| Observation Facility, Elevation: | MCI | Distance from Accident Site: | |
| Observation Time: | 10:53 Local | Direction from Accident Site: | |
| Lowest Cloud Condition: | Clear | Visibility | 10 miles |
| Lowest Ceiling: | None | Visibility (RVR): | |
| Wind Speed/Gusts: | 8 knots / None | Turbulence Type Forecast/Actual: | / |
| Wind Direction: | 220° | Turbulence Severity Forecast/Actual: | / |
| Altimeter Setting: | 29.84 inches Hg | Temperature/Dew Point: | 26°C / 17°C |
| Precipitation and Obscuration: | No Obscuration; No Precipitation | | |
| Departure Point: | ST LOUIS, MO (STL) | Type of Flight Plan Filed: | IFR |
| Destination: | DENVER, CO (DEN) | Type of Clearance: | IFR |
| Departure Time: | 10:00 Local | Type of Airspace: | |

Wreckage and Impact Information

| | | | |
|----------------------------|---------|-----------------------------|---------------------------|
| Crew Injuries: | 3 None | Aircraft Damage: | Minor |
| Passenger Injuries: | 51 None | Aircraft Fire: | None |
| Ground Injuries: | N/A | Aircraft Explosion: | None |
| Total Injuries: | 54 None | Latitude, Longitude: | 39.269004,-94.730628(est) |

Administrative Information

| | |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Investigator In Charge (IIC): | Brannen, John |
| Additional Participating Persons: | Sam Cochran; FAA; St Louis, MO Jeff Holmstedt; Trans States Airlines; St. Louis, MO Michael Weber; Rolls Royce; Indianapolis, IN Bryan Riley; Standard Aero (Alliance); Maryville, TN |
| Report Date: | May 30, 2007 |
| Last Revision Date: | |
| Investigation Class: | Class |
| Note: | |
| Investigation Docket: | https://data.nts.gov/Docket?ProjectID=61520 |

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).