



National Transportation Safety Board Aviation Accident Final Report

Location:	Chesterfield, MO	Accident Number:	CHI05FA038
Date & Time:	11/30/2004, 1956 CST	Registration:	N604GA
Aircraft:	Hamburger Flugzeugbau (HFB) HFB 320 Hansa	Aircraft Damage:	Destroyed
Defining Event:		Injuries:	2 Fatal
Flight Conducted Under:	Part 91: General Aviation - Ferry		

Analysis

The Hansa 320, a corporate turbojet airplane departed runway 26L at night on a maintenance ferry flight at 1954 central standard time, and was destroyed when it impacted a river two miles west of the departure airport. Radar track data indicated that the airplane climbed to about 900 feet msl at about 180 knots before it began losing altitude and impacted the river. The current weather was: winds 270 degrees at 13 knots gusting to 19 knots, visibility 7 miles, light rain, 1,000 feet scattered ceiling, 1,800 feet broken, 2,400 feet overcast, temperature 2 degrees Celsius (C), dew point 2 degrees C, altimeter 29.90. The FAA had issued the pilot a Special Flight Permit for the flight. The limitations listed in the flight permit included the following limitations: Limitation number 6 stipulated, "IFR in VMC conditions approved, provided all equipment required for IFR flight is operational and certified iaw 14 CFR Part 91.413. If this equipment is NOT certified and operational, then VFR in VMC conditions ONLY." The ferry permit listed, "Additional Limitations: Engine power assurance runs, compass swing, and functional check of avionics equipment must be performed, and appropriate maintenance entries in the aircraft log prior to departure." The pilot was informed that none of the additional limitations had been performed prior to takeoff. The pilot had aborted a previous takeoff at about 1830 due to no airspeed indications. At the request of the pilot, maintenance personnel disconnected the lines to the pitot tubes and blew out the tubes, but no leak check, as required by FAR 91.411, was performed prior to the accident flight. The pilot performed a high-speed taxi to test the airspeed indicators prior to takeoff. The copilot did not have any ground school or flight time in a Hansa 320. The second-in-command requirements stated in FAR 61.55 9 (f) (1), required that the flight be conducted under day VFR or day IFR. The Toxicology report for the pilot indicated that 0.106 (ug/ml, ug/g) Diphenhydramine was detected in the blood. Diphenhydramine is an antihistamine commonly used in over-the-counter cold/allergy preparations. In therapeutic doses, the medication commonly results in drowsiness, and has measurable effects on performance of complex cognitive and motor tasks (e.g. flying an aircraft). The pilot's currency in the Hansa 320 expired on November 30, 2004, the day of the accident. He would be required to have an FAA checkride in a Hansa 320 to be a pilot-in-command (PIC) after November 30th. Engine teardown inspections revealed that both engines were developing power at the time of impact. The inspection of the elevator trim

system revealed that the elevator trim cables were improperly installed when they were replaced to comply with an Airworthiness Directive (AD) 224-01-11. The maintenance manager who inspected the installation of the elevator trim cables did not perform an operational check of the elevator trim tabs. The maintenance manager signed the aircraft log stating the "Aircraft is approved for one time ferry flight from SUS to TOL," although all stipulations of the ferry permit had not been met, and that a leak check of the pitot-static system had not been performed after the pitot tubes had been blown out.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The maintenance facility failed to properly install and inspect the elevator trim system resulting in the reversed elevator trim condition and the pilot's failure to maintain clearance with the terrain. Contributing factors included the dark night and low ceiling.

Findings

Occurrence #1: MISCELLANEOUS/OTHER
Phase of Operation: STANDING - PRE-FLIGHT

Findings

1. (C) ELEVATOR TRIM - REVERSED - OTHER MAINTENANCE PERSONNEL
2. (C) MAINTENANCE, INSPECTION - INADEQUATE - OTHER MAINTENANCE PERSONNEL

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings

3. (C) ALTITUDE/CLEARANCE - NOT MAINTAINED - PILOT IN COMMAND
4. USE OF INAPPROPRIATE MEDICATION/DRUG - PILOT IN COMMAND
5. INADEQUATE TRAINING - COPILOT/SECOND PILOT
6. (F) LIGHT CONDITION - DARK NIGHT
7. (F) WEATHER CONDITION - LOW CEILING
8. TERRAIN CONDITION - WATER

Factual Information

HISTORY OF FLIGHT

On November 30, 2004, at 1956 central standard time, a Hamburger Flugzeugbau, HFB Hansa 320, N604GA, operated by Grand Aire Express, was destroyed when it impacted the Missouri River near Chesterfield, Missouri, soon after departure from runway 26L (7,485 feet by 150 feet, concrete) at the Spirit of St. Louis Airport (SUS), Chesterfield, Missouri. The pilot and copilot sustained fatal injuries. The 14 CFR Part 91 ferry flight departed SUS en route to the Toledo Express Airport (TOL), Toledo, Ohio. Night visual meteorological conditions prevailed at the time of the accident. The flight was on an instrument flight rules (IFR) flight plan.

The pilot contacted the St. Louis Automated Flight Service Station (AFSS) by telephone at 1504 to file a flight plan from SUS to TOL with a departure time of 1550. At 1615, the pilot contacted the St. Louis AFSS to amend the departure time to 1800. At 1733 and 1736, the pilot called the St. Louis AFSS to obtain information about a runway closure at TOL.

The pilot contacted the St. Louis AFSS at 1934 to re-file the flight plan from SUS to TOL with a new departure time of 2000. The pilot filed for an airspeed of 400 knots with an en route altitude of 33,000 feet. The proposed time en route was 45 minutes, and the pilot indicated that there were 3 hours of fuel on board. When the St. Louis AFSS briefer asked the pilot why the aircraft had not departed an hour earlier, the pilot responded, "We had to abort because the airspeed indicator didn't work, but ... it's fixed now."

At 1943, N604GA contacted the SUS Air Traffic Control Tower (ATCT) and received its IFR clearance to TOL. N604GA reported to ATCT that the airplane was positioned at the Millionaire ramp and requested permission to do a high-speed back taxi on runway 26L. At 1950, ATCT authorized N604GA to perform a high-speed back taxi on the runway, and to position and hold on the runway once the back taxi was complete.

At 1954, ATCT cleared N604GA for takeoff. At 1955, ATCT instructed N604GA to contact departure control, but there was no response from N604GA.

The St. Louis Approach control radar recorded six "hits" of radar track data as N604GA departed to the west. The radar track data indicated that at 1955:33, N604GA initially climbed to about 900 feet mean sea level (msl) with a ground speed of about 180 kts. The radar track data indicated that the airplane continued on a westerly heading. The last recorded radar contact with N604GA at 1955:51 indicated the airplane's altitude was about 600 feet msl with a ground speed of about 190 kts.

Witnesses who observed the airplane's departure reported that the engines sounded like they were at "full throttle" during the takeoff roll and climb. They reported seeing the airplane drift to the right during climbout and then the airplane started to lose altitude. The witnesses reported the engines continued to sound like they were at high power, and then there was silence followed by the sound of terrain impact.

A search for N604GA was initiated immediately, but due to poor weather conditions and the dark night, the airplane was not located until about 0230 on December 1, 2004. The airplane wreckage was located about 2 nautical miles west of SUS along the riverbank of Howell Island, a heavily wooded wildlife sanctuary.

PERSONNEL INFORMATION

The pilot was the chief executive officer and president of Grand Aire Express, Inc. and TriCoastal Air, based in Toledo, Ohio. According to company records, he held an airline transport pilot certificate with an airplane multiengine rating, and a commercial certificate with a single-engine land rating. He was also a certified flight instructor with multiengine land and airplane instrument ratings and held a first-class medical certificate. He had about 11,500 hours of total flight time, including 10,500 hours in multiengine aircraft. He had about 2,500 hours in a Hansa 320, and had flown the Hansa 320 about 1.3 hours in the last 12 months and about 44.5 hours in the last 24 months.

The pilot had a check ride in the Hansa 320 on October 24, 2002, in accordance with FAR 61.58. On November 13, 2004, the pilot had a check ride in a Learjet 35A simulator in accordance with FAR 135.293 and FAR 135.297. According to FAR 61.58, the pilot could not act as pilot-in-command of a Hansa 320 after November 30, 2004, without first passing a FAA check ride in a Hansa 320.

The copilot was hired by TriCoastal Air on September 8, 2003. According to company records, he held an airline transport pilot certificate with an airplane multiengine rating, and a commercial certificate with a single-engine land rating. He was also a certified flight instructor with a single-engine land rating and held a first-class medical certificate. He had about 10,300 hours of total flight time, including 1,919 hours in multiengine aircraft. The copilot had not received any ground instruction in the Hansa 320 and had no flight time in the Hansa 320.

FAR 61.55 states the requirements for second-in-command. FAR 61.55 (f) (1) states:

"For the purpose of meeting the requirements of paragraph (b) of this section, a person may serve as second-in-command in that specific type aircraft, provided:

- (1) The flight is conducted under day VFR or day IFR, and
- (2) No person or property is carried on board the aircraft, other than necessary for conduct of the flight."

AIRCRAFT INFORMATION

The twin-engine Hamburger Flugzeugbau, HFB Hansa 320, serial number 1037, was manufactured in 1969. The maximum take-off weight was 20,280 pounds. The engines were General Electric CJ-610-5 engines that produced 2,850 pounds of static thrust each. Originally, the airplane had cabin seating for 7 or 8 passengers, but in October 9, 2002, the bench seat was removed per Supplementary Type Certificate (STC) SA01709CH, which configured the airplane to a four passenger corporate jet. The airplane was operated as a personal aircraft of the pilot. The airplane was being operated under FAR Part 91 regulations and was not listed on the FAR Part 135 operating certificate of TriCoastal Air. It was not equipped with a Cockpit Voice Recorder (CVR) or a Flight Data Recorder (FDR).

A Federal Aviation Administration (FAA) airworthiness inspector reviewed the airplane's logbooks and records. The logbooks indicated that the aircraft was issued a Standard Airworthiness Certificate on January 30, 2000, during a recurrent certification. The aircraft had been operated in South America from 1987 to September 1999. The aircraft records did not indicate what inspection program the airplane was being inspected under as required by FAR 91.409 (e) (f). The logbooks indicated that the aircraft was inspected in accordance with the Hansa HFB-320 Inspection Method, and Grand Aire's Approved Aircraft Inspection Program (AAIP). The last 75/300 Hour inspection on the airframe was accomplished on July

10, 2003, with an airframe total time of 6,847.3 hours. The logbook entry signoff indicated that it was inspected in accordance with Grand Aire's AAIP program. The airplane had flown 28.7 hours since the inspection and had a total airframe time of 6,876 hours.

The left engine, serial number E249-109, and the right engine, serial number 240B-249A, were installed on the airplane on March 10, 2004, at a total airframe time of 6,874.7 hours. The aircraft logbooks indicated that the altimeters, pitot static system, and transponders were recertified on March 10, 2004. A 1.3-hour functional test flight of the airplane's engines was conducted on March 23, 2004, when the airplane was flown from TOL to SUS. The airplane was not flown again until the accident flight on November 30, 2004.

According to witnesses at SUS, the airplane was initially parked on the Thunder Aviation's satellite ramp. The airplane developed a fuel leak so the airplane was moved to another location on the airport with a concrete parking ramp. The airplane stopped leaking so it was not de-fueled. Witnesses reported that the airplane was equipped with engine inlet covers and a windshield cover, but no covers for the pitot tubes. The windshield cover was eventually removed since it kept getting blown off by the wind.

In July 2004, the Director of Maintenance at TriCoastal Air requested that Midcoast Aviation, located at SUS, perform the maintenance required by the FAA Airworthiness Directive (AD) 2004-01-11, "Replace Elevator Trim Cables." The shop manager at Midcoast Aviation reported that the shop could perform the maintenance, but delayed that work until the shop had more time to complete the maintenance, and received the required maintenance manuals from TriCoastal Aviation.

Midcoast Aviation started the maintenance necessary to comply with AD 2004-01-11 about September 7, 2004. After receiving new elevator trim cables and other serviceable parts associated with the elevator trim system, the mechanics at Midcoast Aviation performed the maintenance specified in the AD. The Midcoast maintenance Discrepancy Sheet, page 3 of 14, dated September 24, 2004, stated the following maintenance write-up:

"Removed vertical panels to gain access troughs [Initials JD] 9-7-04 Disconnected elevator trim cables at turnbarrels. Removed cable guard pins at all double pulleys, (8 pins total of 4 pulley pairs). Pulled cables off pulley and to drums. Removed lower drum per HFB 320 M.M. 27-31-0. Removed upper drum assy per HFB 320 M.M. 27-31-0. [Initials] 9-7-04. Unspooled cable drums + inspected drums 9-8-04. Sent old cables out to Beechurst Industries to manufacture new cables @ proper length. Received proper cables on 9/23/04, [Initials] Wrapped new cables on respective cable drums & installed in aircraft. Ran cables thru four sets of pulleys & installed cable guards (8 ea). Connected lower cables to upper cables w/ turnbarrels & set proper tension & saftied. Painted each turnbarrel & terminal ends green & red respectively. Performed operational test as required. Ops test good. Reinstalled panels previously removed. 9/24/04, [Initials] AD 2004-01-11 complied with. 9/24/04 [Initials]"

The 9/24/04 Discrepancy Sheet entry was signed by a Midcoast Aviation's technician and the lead inspector. Because the maintenance involved a flight control system, a Midcoast Required Inspection (MRI) was also performed by a Midcoast MRI inspector. After Midcoast performed AD 224-01-11, the aircraft was towed back to the satellite ramp.

The airplane sat on the satellite ramp until November 30, 2004. The Midcoast Aviation maintenance manager at SUS reported that the Director of Maintenance of TriCoastal Air contacted him on November 17, 2004, and requested that Midcoast Aviation perform a standby

compass swing, an avionics check, and to deep cycle the aircraft's batteries. The manager informed him that Midcoast did not have the time available to conduct a compass swing or an avionics check, but the batteries were removed and sent to a battery shop to have them deep cycled. The batteries failed the deep cycle test.

The Midcoast maintenance manager reported that the Director of Maintenance of TriCoastal Air contacted him on November 29, 2004, and requested again that Midcoast Aviation perform a standby compass swing, an avionics check, and attempt to start the engines. He also informed the Midcoast manager that pilots would be arriving the next day to fly the airplane back to TOL, and that a set of batteries were being shipped to Midcoast that would arrive the next day, November 30, 2004.

The Midcoast maintenance manager reported that on November 30, 2004, he and another technician from Midcoast started the engines with a set of "loaner" batteries and ran the engines for about 25 minutes before taxiing the airplane to Midcoast Aviation's ramp. He reported that they taxied to the ramp about 1245, and the pilots had arrived and were waiting at the hangar. The batteries being shipped from TriCoastal Air did not arrive until 1630. He reported that the copilot performed a walk around while waiting for the batteries to arrive. Once the batteries arrived, they were installed in the aircraft.

The Midcoast maintenance manager reported that the pilot informed him that the flight back to TOL was a ferry flight, and that a Special Ferry Permit needed to be signed. It was the first time that the maintenance manager was informed that the flight was a ferry flight that would require a signature from an Airframe and Powerplant (A&P) mechanic or a Repair Station certifying in the aircraft records that the aircraft was safe for the intended flight.

The Special Flight Permit issued by the FAA on November 29, 2004, stated the following Operating Limitations:

"This authorization expires upon arrival at destination or 12/8/2004.

1. Pilot must hold at least a private pilot certificate and be rated in the type equipment.
2. No person may be carried except necessary crew.
3. No baggage other than necessary personal baggage for the crew may be carried.
4. Maximum weight and center of gravity must conform to the operating limitations.
5. Aerobatic maneuvers are prohibited.
6. IFR in VMC conditions approved, provided all equipment required for IFR flight is operational and certified iaw 14 CFR 91.411 and 14 CFR 91.413. If this equipment is NOT certified and operational, then VFR in VMC conditions ONLY.
7. Flight must be conducted to avoid cities, towns or any congested area where it may create hazardous exposure to persons or property on the ground.
8. Aircraft is not to be moved without permission of owner.
9. Aircraft shall not be operated if an airworthiness directive (AD) applies except in accordance with requirements of that AD.
10. Aircraft shall not be operated until a certified A&P mechanic or appropriately rated Repair

Station certifies in the aircraft records that the aircraft is safe for the intended flight.

11. The pilot in command of this aircraft shall notify air traffic control of the non-standard nature of this aircraft when operating into or out of airports with an operational control tower.

12. This aircraft must be operated in accordance with all current (applicable) NOTAMS for intended route of flight.

Additional Limitations: Engine power assurance runs, compass swing, and functional check of avionics equipment must be performed, and appropriate maintenance entries in the aircraft log prior to departure."

The Midcoast maintenance Discrepancy Sheet, page 10 of 14, dated November 30, 2004, stated the following maintenance write-up:

"Perform compass swing"

The discrepancy was closed out with the following write-up:

"Hold per customer, Ferry flt"

The Midcoast maintenance Discrepancy Sheet, page 11 of 12, dated November 30, 2004, stated the following maintenance write-up:

"Perform annual radio inspection per customer supplied checklist"

The discrepancy was closed out with the following write-up:

"Hold per customer, Ferry flt."

The Midcoast maintenance Discrepancy Sheet, page 12 of 14, dated November 30, 2004, stated the following maintenance write-up:

"Prepare A/C for Ferry flight"

The discrepancy was closed out with the following write-up:

"A/C OK for one time flight from SUS to TOL"

A Midcoast maintenance record form dated November 30, 2004, that was retained in the aircraft logbook stated the following: "Aircraft is approved for one time ferry flight from SUS to TOL. For more information on work performed, reference Work Order No. VO535 on file at this facility." The logbook entry was signed by the Midcoast Aviation SUS maintenance manager.

Witnesses reported that the pilots taxied the airplane to Jet Corp for fuel at about 1830. Around 1900 to 1915, the airplane attempted to depart, but the takeoff was aborted. The pilots taxied the airplane back to the ramp where maintenance could be performed.

The Midcoast maintenance manager and a technician met the airplane when it returned. The pilot reported that there was no airspeed indication on either the pilot's or copilot's airspeed indicator. The maintenance manager reported that the pilot asked them to blow out the pitot tubes. The technician gained access to the rear of the pitot tubes, disconnected them from their plumbing, and blew them out with nitrogen. Particles were seen coming out of the pitot tubes, so the pitot tubes were reconnected. A leak check was not performed, as required by FAR 91.411, since the necessary equipment was not available. The technician reported that pilot stated that they would do a high-speed taxi to see if the airspeed indicators were working,

and if it did not work, that they would come back.

No logbook entry was made concerning the maintenance performed on the pitot tubes. The Midcoast maintenance Discrepancy Sheet, page 14 of 14, dated November 30, 2004, stated the following maintenance write-up:

"No airspeed indication on initial takeoff on either airspeed indicators."

The discrepancy was closed out with the following write-up:

"Gain access to both pitot probes under cockpit headliners, disconnected line from pitot probes + blow air through pitot probes only, reconnected lines to probes + reinstalled headliners"

METEOROLOGICAL INFORMATION

The 1928 reported weather at SUS was: winds 270 degrees at 13 knots gusting to 19 knots, visibility 7 miles, light rain, 1,000 feet scattered ceiling, 1,800 feet broken, 2,400 feet overcast, temperature 2 degrees Celsius (C), dew point 2 degrees C, altimeter 29.90 inches of mercury.

The 2002 reported weather at SUS was: winds 280 degrees at 14 knots gusting to 21 knots, visibility 9 miles, light snow, ceiling 1,600 feet broken, 2,200 feet broken, 2,800 feet overcast, temperature 2 degrees Celsius (C), dew point 2 degrees C, altimeter 29.91 inches of mercury.

Witnesses reported that it was raining when the airplane departed. Later the rain turned to snow. The airport manager reported he ordered a runway inspection shortly after 2000. He reported, "According to our pavement sensors, the air temperature was 36 degrees [F] and the pavement temperatures were near 40 degrees [F]. Although it was snowing quite hard by this time, I did not observe the precipitation sticking to any surfaces."

WRECKAGE AND IMPACT INFORMATION

The main airplane wreckage was located at coordinates 38 degrees 39.520 minutes north, 090 degrees 42.156 minutes west. The fuselage forward of the main wing spars was found along the riverbank of Howell Island. The cabin and cockpit were fragmented and crushed. The outboard section of the right wing was found along the riverbank about 145 feet east of the main wreckage. The forward 1/2 section of the right wingtip fuel tank was found about 120 feet south of the main wreckage. A line of trees about 50 feet tall on the opposite river bank at the river's edge exhibited broken branches at the top of the trees.

The majority of the rest of the airplane was found submerged in about 15 feet of water between Howell Island and the east bank of the Missouri River. The major sections of the right and left wings had separated from the fuselage and were recovered separately. The fuselage aft of the center wing section, the vertical stabilizer, and both engines remained attached and were recovered together. The horizontal stabilizer was intact, but had separated from the vertical stabilizer. The wreckage was recovered from the river on December 3, 2004. The aircraft wreckage was transported to a storage facility in St. Peters, Missouri, for inspection.

During the inspection of the airplane wreckage, the elevator trim wheel was found separated from the cockpit center pedestal. The trim wheel setting was found in the white band and indicated 19.7 increments of nose-up trim. The inspection of the horizontal stabilizer revealed that the left and right elevator trim tabs were in an up position with 20 mm of space between the trailing edge of the trim tabs and the trailing edge of the elevator.

The pilot's and copilot's airspeed indicators, attitude indicators, and horizon situation indicators

(HSI's) were recovered from the wreckage site. The instruments were inspected, but because of the impact damage, they could not be functionally tested.

The engines were removed from the airframe and shipped to AVMATS in O'Fallon, Missouri, for engine teardowns.

MEDICAL AND PATHOLOGICAL INFORMATION

Autopsies of the pilot and copilot were performed at the St. Charles County Medical Examiner's Office, St. Charles, Missouri, on December 1, 2004.

The FAA Civil Aeromedical Institute prepared Forensic Toxicology Fatal Accident Reports for the pilot and copilot. The report for the copilot indicated negative results for all drugs and substances tested. The report for the pilot indicated that 0.106 (ug/ml, ug/g) Diphenhydramine was detected in the blood, and Diphenhydramine was detected in the lung and kidney.

Diphenhydramine is an antihistamine, often known by the trade name Benadryl, and commonly used in over-the-counter cold/allergy preparations. In therapeutic doses, the medication commonly results in drowsiness, and has measurable effects on performance of complex cognitive and motor tasks (e.g. flying an aircraft). Reduced performance has been demonstrated even in individuals who feel normal after ingesting the drug. Over-the-counter antihistamines may also interfere with the normal function of the inner ear, potentially increasing susceptibility to spatial disorientation. Warnings in the small print on packaging of medications containing diphenhydramine indicate the possibility of drowsiness with its use.

TESTS AND RESEARCH

The two engines were disassembled by AVMATS technicians familiar with GE-CJ-610 engines on December 7 to 9, 2004. The National Transportation Safety Board (NTSB) Investigator-in-charge (IIC) provided oversight on the engine teardowns. GE Aircraft Engines prepared a "CJ610 Engine Disassembly Report."

The inspection of the left engine compressor section revealed that the stage 1 blades had impact damage to their tips, leading edges and trailing edges, with bending opposite to the direction of rotation. The next six rotor stages also had numerous blades with severe impact damage to their tips and leading edges, with only stage 8 blades with no apparent damage.

The stage 1 and stage 2 turbine wheels and blades, and the stage 1 and stage 2 nozzles exhibited no impact damage. No debris or fibrous material was found in the cooling passages behind the shrouds.

The inspection of the right engine compressor section revealed that all stages of rotor blades (except stage 8) had blades that were bent opposite the direction of rotation and with tip curl, with the leading edge forward of the rotor plane of rotation at the tip. All stages of stator vanes (except stage 7) had trailing edge bending or curling in the direction of rotation due to rotating impact with the leading edges or the forward-bent rotor blades located directly behind them.

The right engine stage 1 and stage 2 turbine wheels and blades and the stage 1 and stage 2 nozzles exhibited no impact damage. All turbine components were splattered with small white flakes and small pieces of fibrous debris. Fibrous debris was found extruding out of the secondary cooling airflow passages behind the stage 1 shrouds.

A systems group was formed to investigate the condition of the elevator trim control system. The NTSB systems group chairman and IIC traveled to Toledo, Ohio, on December 20, 2004, to examine and document the elevator trim system of an exemplar HFB 320. The HFB 320 was stored in a hangar at the Grande Aire Express facility at the Toledo Express Airport.

The examination of the elevator trim system on the exemplar airplane at Grand Aire Express revealed the following:

NOTE: . The following description will primarily trace the mechanical control of the elevator trim tabs, paying particular attention to the relative direction of motion of the components during nose up and nose down trim commands. All references to rotation direction, in terms of clockwise (CW) and counter clockwise (CCW) will be as viewed from the left side of the airplane or looking forward, as applicable.

1. For the elevator trim wheel fully forward (CCW or full airplane nose down direction), the tab should move 4 degrees trailing edge up. For the elevator trim wheel fully aft (CW or full airplane nose up direction), the tab should move 19 degrees trailing edge down.
2. Putting the elevator trim wheel fully forward (CCW), caused the lower cable drum to turn CW. The right cable from the lower cable pulley traveled through the vertical stabilizer on the right side of a series of pulleys until it was connected to the upper cable drum. The right side cable was attached to the aft side of the upper cable drum. The left cable from the lower cable pulley traveled through the vertical stabilizer on the left side of a series of pulleys until it was connected to the upper cable drum. The left side cable was attached to the forward side of the upper cable drum. A CW rotation of the lower cable drum caused a CW rotation of the upper cable drum.
3. A CW rotation of the upper cable drum was observed to produce elevator trim tab motion in the trailing edge up direction.

On December 21, 2005 the systems group convened at the location where the accident airplane wreckage was in storage. The group identified and documented the condition of the elevator trim components from the lower cable drum to the tab. The cables were fractured, and in one place purposefully cut, but control continuity could be determined.

The examination of the elevator trim system on the accident airplane revealed the following:

1. The inspection found that the right cable from the lower cable pulley traveled through the vertical stabilizer on the right side of a series of pulleys until it was connected to the upper cable drum. It was determined that the right side cable had been attached to the forward side of the upper cable drum. It was determined that the left cable from the lower cable pulley traveled through the vertical stabilizer on the left side of a series of pulleys until it was connected to the upper cable drum. It was determined that the left side cable was attached to the aft side of the upper cable drum. A CW rotation of the lower cable drum caused a CCW rotation of the upper cable drum.
2. It was determined that a CCW rotation of the upper cable drum produced elevator trim tab motion in the trailing edge down direction, opposite the result on the exemplar airplane.

ADDITIONAL INFORMATION

Interviews were conducted with the Midcoast technicians and the maintenance manager about the maintenance performed on the airplane. The maintenance manager reported that when he

inspected the elevator trim cable installation, he "checked the installation of the drums, the cables, [and] to give an okay to close the panels." He reported that he viewed the upper cable drum and the cables as they were fed through the pulleys in the vertical stabilizer. He reported that the trim cables were not crossed. He reported, "The left cable went down the left pulley side. The right cable went to the right pulley." He reported that he did not perform an operational check of the cables. He reported that he did check to insure that the pilot's elevator trim button located on the pilot's yoke operated properly. He reported that the airplane's engines were started so that the hydraulically actuated trim system could be checked. He reported, "We just switched up and made sure the trim wheel went the right direction, full travel both directions, and that was it. We didn't actually get out and look at it. It had already been checked. We just made sure it worked." He reported that he did not check the deflection of the elevator trim tab when he checked the operation of the pilot's trim button.

The maintenance manager reported that he reviewed the ferry permit item by item with the pilot. The maintenance manager reported, "He [the pilot] said that he was going to do the power assurance run, and he was okay with no compass swing and the avionics check out."

The Federal Aviation Administration, GE Aviation Engines, Midcoast Aviation, and TriCoastal Air were parties to the investigation.

The airplane wreckage was released to St. Peters Recovery and Storage, Wright City, Missouri.

Pilot Information

Certificate:	Airline Transport; Flight Instructor	Age:	50, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	Airplane Multi-engine; Instrument Airplane	Toxicology Performed:	Yes
Medical Certification:	Class 1 With Waivers/Limitations	Last Medical Exam:	11/01/2004
Occupational Pilot:		Last Flight Review or Equivalent:	11/01/2004
Flight Time:	11500 hours (Total, all aircraft), 2500 hours (Total, this make and model), 11275 hours (Pilot In Command, all aircraft), 103 hours (Last 90 days, all aircraft)		

Co-Pilot Information

Certificate:	Airline Transport; Flight Instructor	Age:	43, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	Airplane Single-engine	Toxicology Performed:	Yes
Medical Certification:	Class 1 With Waivers/Limitations	Last Medical Exam:	06/01/2004
Occupational Pilot:		Last Flight Review or Equivalent:	11/01/2004
Flight Time:	10377 hours (Total, all aircraft), 8035 hours (Pilot In Command, all aircraft), 189 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Hamburger Flugzeugbau (HFB)	Registration:	N604GA
Model/Series:	HFB 320 Hansa	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	1037
Landing Gear Type:	Retractable - Tricycle	Seats:	
Date/Type of Last Inspection:	07/01/2003, AAIP	Certified Max Gross Wt.:	20280 lbs
Time Since Last Inspection:	27.4 Hours	Engines:	2 Turbo Jet
Airframe Total Time:	6875 Hours	Engine Manufacturer:	General Electric
ELT:	Installed, not activated	Engine Model/Series:	CJ-610-5
Registered Owner:	Grand Aire Express	Rated Power:	2850 lbs
Operator:	Grand Aire Express	Air Carrier Operating Certificate:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument Conditions	Condition of Light:	Night/Dark
Observation Facility, Elevation:	SUS, 463 ft msl	Observation Time:	1928 CST
Distance from Accident Site:	2 Nautical Miles	Direction from Accident Site:	90°
Lowest Cloud Condition:	Scattered / 1000 ft agl	Temperature/Dew Point:	2°C / 2°C
Lowest Ceiling:	Overcast / 1800 ft agl	Visibility	7 Miles
Wind Speed/Gusts, Direction:	13 knots/ 19 knots, 270°	Visibility (RVR):	
Altimeter Setting:	29.9 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:	Light - Rain		
Departure Point:	Saint Louis, MO (SUS)	Type of Flight Plan Filed:	IFR
Destination:	Toledo, OH (TOL)	Type of Clearance:	IFR
Departure Time:	1954 CST	Type of Airspace:	

Airport Information

Airport:	Spirit of St. Louis (SUS)	Runway Surface Type:	Concrete
Airport Elevation:	463 ft	Runway Surface Condition:	Wet
Runway Used:	26L	IFR Approach:	None
Runway Length/Width:	7485 ft / 150 ft	VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	2 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Fatal	Latitude, Longitude:	38.664444, -90.702500

Administrative Information

Investigator In Charge (IIC): JAMES SILLIMAN **Adopted Date:** 05/30/2006

Additional Participating Persons: June Tonsing; FAA, St. Louis FSDO; St. Ann, MO
John Mecalo; Midcoast Aviation; St. Louis, MO
Dave Gridley; GE Aviation Engines; Lynn, MA
Akhtar Naqvi; Grand Aire; Toledo, OH

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 pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at <http://dms.nts.gov/pubdms/>.

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