Aviation Investigation Final Report

Location:	Hernando, Mississippi	**Accident Number:**	MIA00FA221
Date & Time:	July 17, 2000, 12:03 Local	**Registration:**	N158MT
Aircraft:	Beech 58	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

Approximately 7 minutes after the flight departed while flying at 6,000 feet mean sea level (msl), the pilot radioed the controller advising, "star check four eighty four we're gonna shut the master switch off we've got a electrical fire." The controller asked the pilot to repeat the transmission to which he again reported he was going to shut off the master switch. The controller advised the pilot of the location of a nearby airport to which the pilot replied, "standby." Approximately 20 seconds after the pilot first advised the controller of an electrical fire, the pilot declared an emergency and advised the controller the flight was descending. The controller advised the pilot of a nearby grass airstrip to which the pilot questioned the location and, "...we need to land immediately." The controller again advised the pilot of the location of the grass strip; there were no further communications from the accident pilot. Witnesses located near the accident site reported seeing smoke or what was described as "vapor trail" or "dust" trailing the airplane before it impacted the water on Arkabutla Lake. Radar data indicates transponder beacon returns continue every 4.6 seconds when reviewed in 1-minute increments beginning at 1154:06, until 1201:54, when the last transponder beacon return indicated the airplane was at 5,400 feet msl. A primary uncorrelated radar return was observed in close proximity to the last correlated transponder return, and continue approximately every 4-5 seconds until 1203:31. Review of the primary radar returns revealed between 1201:59, and 1203:21, the target was noted to bank to the left from a southerly heading to a northeasterly heading; the final two uncorrelated radar returns indicates the airplane banked to the right where the last return was noted over a section of Arkabutla Lake. Before recovery of the airplane, a section of the horizontal stabilizer was noted above the surface of the water. The right wing and cockpit from the forward carry-thru spar forward were fragmented. The left wing was separated but comprised of mainly 1 piece. Examination of the cockpit revealed heat damage was localized on the pilot's side of the airplane behind the instrument panel. The battery switch was found in the off position while both alternator switches were found in the on position. A 10-gauge electrical wire which acts as a jumper between the W15 and W11 bus bars on the left hand subpanel was fractured and exhibited

evidence of arching on the supply side wire. The surface of a pilot air control located in the area of the arched 10-gauge wire exhibited arching damage on the surface which was comprised in part of tin. Tin was not detected on the undamaged area of the pilot air control. The damaged 10-gauge wire was noted to be comprised in part of tin. A rigid aluminum line for the left fuel flow and pressure indicator gauge was noted to be cracked, sooted, and bulged in the area on the pilot's side of the instrument panel near the combination oil pressure/oil temperature/cylinder temperature gauge. The line exhibited features associated with overstress fracture at an elevated temperature. A rigid aluminum line for left oil pressure was noted to have a section missing; the line exhibited features associated with overstress fracture at an elevated temperature. Post accident testing to duplicate the as-found condition of the 10-gauge wire revealed the large ball on the end of the accident wire could be duplicated when a compressive load was applied to the 10-gauge wire shorting it to ground, and current from the batteries supplying current to the 10-gauge wire. Additional post accident testing of current limiters with various loads applied revealed the current limiters opened at decreasing times with an increase in current applied. Review of the emergency checklist for the airplane pertaining to electrical smoke or fire revealed a pilot is directed to shut off the battery and both alternator switches.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The arcing of an electrical wire behind the instrument panel and the associated cracking of fuel and oil lines. Also causal was the pilot's inappropriate remedial action not in accordance with the emergency checklist.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: CRUISE

Findings
1. (F) ELECTRICAL SYSTEM,ELECTRIC WIRING - SHORTED
2. (C) CHECKLIST - NOT FOLLOWED - PILOT IN COMMAND
3. ELECTRICAL SYSTEM,ELECTRIC WIRING - UNDETERMINED

Occurrence #2: FIRE
Phase of Operation: CRUISE

Findings
4. (F) FUEL SYSTEM,LINE - OVERTEMPERATURE
5. (F) FUEL SYSTEM,LINE - CRACKED
6. (F) LUBRICATING SYSTEM,OIL LINE - OVERTEMPERATURE

7. (F) LUBRICATING SYSTEM,OIL LINE - MISSING

Occurrence #3: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
8. TERRAIN CONDITION - WATER

Factual Information

HISTORY OF FLIGHT

On July 17, 2000, about 1203 central daylight time, a Beech 58, N158MT, registered to and operated by AirNet Systems, Inc., as Star Check Flight 484, experienced a pilot reported electrical fire in-flight and crashed into Arkabutla Lake, Hernando, Mississippi. Visual meteorological conditions prevailed at the time and an instrument flight rules (IFR) flight plan was filed for the 14 CFR Part 135 non-scheduled, domestic, cargo flight, from Memphis, Tennessee, to Houston, Texas. The airplane was destroyed and the commercial-rated pilot, the sole occupant, was fatally injured. The flight originated about 1154, from the Memphis International Airport, Memphis, Tennessee.

According to a transcription of communications with Memphis Air Traffic Control Tower (Memphis ATCT), at 1150:04 the pilot received IFR clearance to William P Hobby Airport, Houston, Texas, and at 1150:48, received clearance to taxi to runway 18L. At 1152:58, the pilot contacted local control and advised the controller that the flight was ready to depart. The controller advised the pilot to position the airplane and hold on runway 18L, which the pilot acknowledged. At 1153:49, the flight was cleared to takeoff and at 1154:39, the local controller advised the pilot to contact departure control. At 1154:50, the pilot established contact with the Memphis ATCT Departure Control West controller and advised that the flight was at 1,000 feet, climbing to 3,000 feet on an assigned heading of 220 degrees. Radar contact with the airplane was established at 1155:08, and at 1155:37, the controller cleared the flight to climb and maintain 6,000 feet. The pilot acknowledged the climb clearance and at 1157:12, the controller cleared the flight to fly heading 200 degrees, which the pilot also acknowledged.

The flight continued and the Memphis ATCT transcription of communications further indicates that at 1201:16, the pilot radioed, "star check four eighty four we're gonna shut the master switch off we've got a electrical fire." The controller asked the pilot to repeat his last transmission and at 1201:22, he advised the controller, "sir we gonna shut the master switch off we've got a electrical fire sir." The controller responded, "...ah tunica airport's the closet [sic] one to you it's about twelve miles off to your southwest", to which the pilot responded, "standby." At 1201:36, the pilot radioed, "okay sir we need to declare emergency we are descending", to which the controller advised the pilot of a grass airstrip located 4 miles northeast of the aircraft's position. At 1202:39, the pilot radioed, "star check four eighty four are you ah where's that airport sir we need to land immediately." The controller advised the pilot, "roger heading ah zero two zero it's northeast your position four miles hernando mississippi." The pilot did not respond to the controller. The controller again broadcast on the frequency for the pilot that the nearest airport was located 4 miles and 020 degrees from the airplane's present position; the pilot did not reply to that transmission. The controller vectored

another airplane to the last known radar position of the airplane; the flightcrew of the vectored airplane radioed the accident pilot but two-way communications were not established. The flight crew advised the controller of seeing a column of black smoke and boats proceeding to the direction of the smoke (see transcript of communications).

Review of recorded radar data provided by Memphis ATCT revealed 103 transponder beacon returns were recorded from the accident airplane beginning at 1154:06 (altitude of 200 feet), and continue approximately every 4.6 seconds when reviewed in 1-minute increments, until 1201:54 (altitude of 5,400 feet). Further review of the radar data revealed the airplane climbed to a maximum altitude of 6,000 feet, reaching that altitude at 1200:59, and remained at that altitude for an additional five radar returns. The radar data indicates the airplane then began descending. Review of recorded radar data provided by Memphis Air Route Traffic Control Center (Memphis ARTCC) revealed transponder beacon returns from the accident airplane were recorded beginning at 1154:32, and continue approximately every 10 seconds until the last radar return at 1201:55. The last radar return was located at 34 degrees 46 minutes 02 seconds North latitude and 090 degrees 08 minutes 24 seconds West longitude; the recorded altitude was 5,500 feet mean sea level. The accident site was located 3.14 nautical miles and 108 degrees from the last radar return recorded at the Memphis ARTCC.

Review of radar plots and data provided by the airplane manufacturer revealed transponder beacon code radar returns were noted from 1154:31, until 1201:54. Uncorrelated primary radar returns were observed between 1201:59, and 1203:31. Further review of the radar data revealed at 1201:59, an uncorrelated primary radar target was observed 170 degrees and .25 nautical mile from the last transponder beacon code return. Additionally, between 1201:59, and 1203:21, radar targets indicate the airplane made a left turn flying from a southerly to a northeasterly heading. The final two uncorrelated radar returns at 1203:26, and 1203:31, indicate the airplane began a right turn where radar contact was lost over a section of Arkabutla Lake.

Several witnesses located near the crash site reported seeing smoke or what was described as "vapor trail" or "dust" trailing the airplane in flight. A witness reported a fire on the water after impact lasted an estimated 4-5 minutes.

PERSONNEL INFORMATION

According to FAA records, the pilot held a commercial pilot certificate with airplane single and multi-engine land, instrument airplane ratings. He also held an airframe and powerplant mechanic certificate, and a flight instructor certificate with airplane single engine and instrument airplane ratings. He was issued a first class medical certificate on April 18, 2000, with no limitations.

The pilot was hired by Airnet Systems, Inc., on July 8, 1999, and was authorized to fly Cessna 310's and the Beech 58 aircraft only. His last Part 135 checkride occurred in a Beech 58, on July 8, 1999. The employment application completed by him indicates that he had

accumulated a total time of 1,528 hours, of which 16 hours were in multi-engine airplanes, and 1,512 hours were in single-engine airplanes. Of the 16 hours in multi-engine airplanes, 6 hours were logged as pilot-in-command. A review of the pilot's logbook revealed at the time of the accident, he logged a total time of approximately 2,629 hours, of which 1,611 hours were in single-engine airplanes and 1,018 hours were in multi-engine airplanes. He logged a total of approximately 2,368 hours as pilot-in-command. He also logged a total time of 290 hours in the last 90 days, and 90 hours in the last 30 days, all in the accident make and model airplane. The company reported the pilot had accumulated 900 hours in the accident make and model airplane, all as pilot-in-command.

AIRCRAFT INFORMATION

The airplane was a Beech 58, serial number TH-1186, manufactured in 1980, and equipped with two Continental IO-520-CB engines rated at 285 horsepower, and two Hartzell PHC-J3YF-2UF propellers. Electrical wiring consisting of MIL-W-5086/1 of the single wire type was installed in the cockpit and cabin areas of airplane. It was also equipped with a cabin fire bottle. The airplane was certificated in the normal category in accordance with Civil Air Regulations Part 3 (CAM 3), titled, "Airplane Airworthiness Normal, Utility, and Acrobatic Category", as amended May 15, 1956, and 14 CFR Part 23.1385(c), 23.1387(a), and 23.1387(e) of Federal Aviation Regulations.

Review of the maintenance records revealed the airplane was last inspected in accordance with a Raytheon Aircraft 100-Hour inspection on June 14, 2000. The airplane had accumulated approximately 80 hours since the inspection, and approximately 4,870 hours since manufacture at the time of the accident. Review of the discrepancy sheets associated with the 100-Hour inspection revealed no discrepancies associated with electrical wiring or fuel lines in the cockpit. A mechanic and inspector initialed for inspecting electrical wiring and equipment in the cabin and baggage compartment for condition, security, and signs of chafing during the last 100-Hour inspection. A mechanic and an inspector also initialed for inspecting plumbing in the cabin and baggage compartment for security, leakage, and general condition during the last 100-Hour inspection. The maintenance records also reflect that the pilots attitude gyro was removed and replaced on June 7, 2000; the airplane had accumulated approximately 101 hours since the installation at the time of the accident. The inflatable door seal motor and power supply were removed on February 19, 1999; the components had been installed in accordance with a supplemental type certificate. On October 27, 1997, the airplane was modified for flight into known icing conditions. The modification included in part, installation of a segment of bus bar to the pitot heat circuit breaker located on the left hand and right hand pitot heat bus bar, which is installed on the left side panel. Additionally, a circuit breaker (heavy-duty stall warning vane) was installed on the added segment of bus bar.

Review of "Maintenance Log" sheets recovered from the wreckage that go back to at least June 19, 2000, revealed no logged discrepancies related to electrical wiring, or to flight or engine instruments.

Prior to the accident flight, the airplane was last flown on July 14th, for a total flight time of 4.5 hours on 8 flight legs. The pilot who last flew the airplane reported nothing abnormal with the airplane or systems. That same pilot also flew the airplane a total of 11.7 hours between July 10th and the 13th; again he reported no discrepancies on any of the days or flight legs.

The airplane was equipped with two 100-ampere, 24 volt, engine-driven alternators, and two 12-volt lead acid batteries connected in series. Electrically, in part, both alternators and/or the batteries provide electrical power to a bus identified as "W30", labeled, "current limiter bus" which is located in the nose section of the airplane. A 4-gauge electrical cable labeled "P6A4" provides an electrical path from the W30 bus to a bus identified as "W15", labeled, "circuit breaker bus bar", which is located on the lower portion of the instrument panel on the pilot's side of the airplane and has ten switch/circuit breakers. A 10-gauge electrical wire labeled "P5A10" provides an electrical path from the W15 bus to a bus identified as "W11", labeled, "left hand and right hand pitot heat bus bar", located next to the W15 bus. During manufacturing, the length of the P5A10 wire was fabricated to fit by the installing technician. Two circuit breakers (pitot heat and stall warning vane heater) are installed at the W11 bus. An 80-amp current limiter identified as p/n FLLB, is installed at the current limiter bus and protects the circuit consisting of the 4-gauge wire from the current limiter bus to the W15 bus, the W15 bus, the 10-gauge wire from the W15 to the W11 bus, and the W11 bus.

A dual (left and right) direct reading fuel flow and pressure indicator gauge calibrated to indicate fuel flow was installed in the instrument panel above the throttle quadrant to the left of the audio panel. Direct reading combination oil pressure/oil temperature/cylinder temperature gauges were installed for each engine. The gauges were installed side by side in the lower left portion of the instrument panel on the pilot's side of the airplane, above the switch/circuit breakers installed on the W15 and W11 bus bars. Rigid 1/4 inch outside diameter aluminum tubing connects at a union located at the left wing root area for left fuel flow and oil pressure, and continue into the cockpit under the instrument panel where the tubing connects either to a union near the upper middle portion of the instrument panel then to the gauge (left fuel flow and pressure indicator), or directly to the gauge (left oil pressure).

METEOROLOGICAL INFORMATION

A METAR weather observation taken at the Memphis International Airport, Memphis, Tennessee, on the day of the accident at 1216, which was approximately 13 minutes after the accident, indicates the wind was from 160 degrees at 5 knots, the visibility was 10 statute miles, the sky condition was clear and the temperature and dew point were approximately 91 and 68 degrees Fahrenheit, respectively. The altimeter was 30.03 inHg. The accident site was located approximately 192 degrees and 18.4 nautical miles from the Memphis International Airport.

COMMUNICATIONS

The pilot was last in contact with the Memphis Air Traffic Control Tower.

WRECKAGE AND IMPACT INFORMATION

The airplane crashed into Arkabutla Lake, near Hernando, Mississippi. The main wreckage was located at 34 degrees 44.867 minutes North latitude and 090 degrees 04.868 minutes West longitude. That location when plotted was 192 degrees and 18.4 nautical miles from the Memphis International Airport. The tip of the right horizontal stabilizer was noted above the water level (see photograph 1); heat damage to the tip was noted. The airplane was recovered and identifiable wreckage pieces were placed in proper location for further examination (see photograph 2).

Examination of the airplane revealed the fuselage was fragmented from the main spar forward; the forward spar carry-thru was complete. Both wings were structurally separated from the airplane; the left wing was nearly complete while the right wing was fragmented. The spar carry-thru cover map case had plastic from the pilot's cooler melted onto it in two places on the co-pilot's side. The lower fuselage was structurally separated at fuselage station (FS) 100, and the instrument panel/firewall assembly were structurally separated but were recovered as a unit (see photograph 3). Both horizontal stabilizers and vertical stabilizer remained attached to the airframe. The left propeller remained attached to the engine; the engine and propeller were structurally separated from the airframe. The right propeller separated from the engine; the engine remained secured to a portion of the airframe structure. The landing gears, which were structurally separated, were extended at the time of impact; the flaps were extended 30 degrees. Heat damage along a defined line was noted on the right main and nose landing gear tires. Examination of the flight controls for roll, pitch, and yaw revealed no evidence of preimpact failure or malfunction.

Heat damage to the lower empennage skin along a defined line was noted beginning at FS 190, and continued aft (see photograph 4). The lower skin surfaces of both horizontal stabilizers exhibited heat damage. No fire or heat damage was noted on the fuselage interior from FS 94 to approximately FS 207. No fire or heat damage was noted to the wiring bundle on the left side of the fuselage from FS 94 to FS 247. Examination of the pilot's seat revealed heat damage, a witness later reported it was floating and on-fire after the accident. The pilot's seatbelt was located unfastened; damage to the release cover was noted. Examination of the cabin door of the airplane revealed soot on the outer skin below and aft of the storm window; scratches in the sooted area of the outer skin of the door were noted (see photographs 5 and 6). The storm window hinge was missing; no soot was noted in the area where the hinge would normally be installed on the window (see photograph 7). The cabin door window was fractured, only several small sections remained. Soot was also noted on the manufactured surface of the storm window; no soot was noted on the fracture surfaces of the window. Blistering and discoloration of paint was observed on skin near the middle section of the instrument panel immediately forward of the windshield (see photograph 8).

Examination of the instrument panel and firewall of the airplane revealed extensive heat damage to the electrical wiring behind the instrument panel. The damage was localized on the

pilot's side of the airplane. The left side of the firewall was noted to have excessive heat damage with a section of structure missing (see photographs 9 and 10). Oil soaked insulation was noted on the left firewall side area; the case of the combination left oil pressure/oil temperature/cylinder temperature gauge was found substantially heat damaged and the inlet fitting was not in position (see photograph 11). The case of the right combination oil pressure/oil temperature/cylinder temperature gauge exhibited evidence of heat damage; the inlet fitting remained secured to the instrument. The instruments/gauges on the pilot's side were sooted, while the instruments/gauges on the co-pilots side were sooted to a lesser extent. The battery switch was found in the "off" position while both alternator switches were found in the "on" position (see photograph 12). The throwover control yoke was found positioned to the pilot's side. Heat damage was noted on the faceplate of the left hand subpanel and circuit breaker panel assemblies (see photographs 12 and 13). The rigid aluminum line for the left fuel flow gauge between the wing root and union installed at the upper middle portion of the instrument panel was cracked and sooted (see photograph 14). The cracked portion of the line was determined to be located near the combination oil pressure/oil temperature/cylinder temperature gauges. The rigid aluminum line for the left oil pressure between the wing root area and the instrument had a section missing, and was sooted (see photograph 15). The missing section was noted to be in an area behind the pilot's side of the instrument panel.

An examination of the electrical wires attached to the circuit breakers of the left hand subpanel was performed; the panel is located above the pilot's knee beneath the flight and engine instruments on the instrument panel. The examination revealed in part the supply and load wires of the propeller anti-ice circuit breaker (p/n 35-380132-7) were fractured. The circuit breaker was attached to the outboard end of the W15 bus bar. Beaded material was noted on both fractured ends of the electrical wires (see photograph 16). The supply wire of the pitot heat circuit breaker (p/n 35-380132-3) was fractured approximately 1.6 inches from the beginning of the crimped terminal fitting; a large bead of material was observed at the end of the fracture (see photograph 17). The circuit breaker was attached to the inboard end of the W11 bus bar. There was no evidence of arching on the screw terminals of either circuit breaker.

Two wires attached to the voltage regulator switch exhibited evidence of beaded material approximately 1 inch from each crimped terminal fitting; the voltage regulator is installed to the right of the right magneto switch. Examination of electrical cables identified as P6A4 and P6B4 revealed evidence of chafing; no evidence of arching was noted. The cables provide an electrical path to the left hand subpanel and circuit breaker panel assembly, respectively. A 10-gauge wire identified as (G1A10), was fractured approximately 95 inches from the "Front Carry-Through", evidence of arching was noted near the fracture end. The wire was to the landing gear motor.

Examination of a "control-push pull detent" identified as p/n 35-380051 (pilot air control), revealed damage on the surface approximately .2 inch in length (see photograph 18). The pilot air control is installed beneath and to the right of the propeller anti-ice circuit breaker. An 80-

amp current limiter (p/n FLLB), was in an "open" condition (see photograph 19). The "open" current limiter was located at the current limiter bus, which is installed in the nose section of the airplane. Continuity was confirmed on an 80-amp current limiter (also p/n FLLB), and a 50-amp current limiter (p/n FLLA); both of those current limiters were also located on the current limiter bus. The rigid aluminum tubes for the left engine fuel flow and oil pressure gauges, structural members of the firewall, the above identified circuit breakers, pilot air control, left engine load meter fuses, anti-collision light, landing gear motor circuit breaker, and panel containing the current limiter bus were retained for further examination (see TESTS AND RESEARCH SECTION of this report).

Examination of the left engine revealed crankshaft, camshaft, and valve train continuity. The magnetos were properly timed to the engine but could not be sparked when rotated by hand. Examination of the fuel pump drive coupling revealed it was not failed. Reduction fittings were installed in the fuel and oil lines in the engine compartment. Examination of the left propeller revealed all three blades were bent aft and were free to rotate inside the propeller hub.

Examination of the right engine revealed crankshaft, camshaft, and valve train continuity. The magnetos were properly timed to the engine but could not be sparked when rotated by hand. Examination of the fuel pump drive coupling revealed it was not failed. Reduction fittings were installed in the fuel and oil lines in the engine compartment. Examination of the separated right propeller revealed all three blades were bent aft and were free to rotate inside the propeller hub.

MEDICAL AND PATHOLOGICAL INFORMATION

Postmortem examination of the pilot was performed by Steven T. Hayne, M.D., F.C.A.P., designated Pathologist for the Mississippi State Medical Examiner's Office. The cause of death was listed as internal injuries. No evidence of soot was noted on the mucosal surface of the upper airway; examination of the cross section of the heart revealed no evidence of cherry red discoloration. Additionally, no thermal injury was reported.

The FAA Toxicology and Accident Research Laboratory (CAMI) performed toxicology analysis of specimens of the pilot. The results of analysis were negative for carbon monoxide, cyanide, volatiles, and tested drugs.

TESTS AND RESEARCH

Review of CAM 3 section 3.671, pertaining to instrument lines revealed, "Powerplant instrument lines shall comply with the provisions of section 3.550. In addition, instrument lines carrying inflammable fluids or gases under pressure shall be provided with restricted orifices or other safety devices at the source of the pressure to prevent escape of excessive fluid or gas in case of line failure." Examination of the engine compartments of both engines revealed the restrictive orifices for fuel and oil were installed.

The NTSB Materials Laboratory, located in Washington, DC, performed metallurgical examination of the aluminum tubing for the left fuel flow and oil pressure gauges, and structural members from the firewall. Examination of the aluminum tubing for the left fuel flow gauge associated from the union at the wing root area to a union under the instrument panel revealed the line was fractured into 3 pieces. The surface of the line exhibited dark discoloration consistent with fire from the union under the instrument panel outboard for approximately 27 inches. The line exhibited one longitudinal crack and one circumferential crack located approximately 21 inches outboard of the union under the instrument panel. Bulging of the line was also noted in the area of the cracks. The longitudinal crack penetrated the tubing wall thickness and exhibited an appearance typical of overstress fracture at high temperature. The circumferential crack did not penetrate the wall thickness; the fracture surface exhibited an appearance typical of overstress fracture at a lower temperature than that of the longitudinal crack. Examination of the aluminum tubing for the left oil pressure gauge associated from the union at the wing root area to the gauge revealed the tube was not a complete length; it was fractured in the area of the wing root. The surface of the tubing exhibited dark discoloration consistent with fire from the gauge fitting to a point approximately 17 inches along its length; a section of the tube wall was missing. The fracture surface of the area where the tube wall was missing had an appearance consistent with overstress fracture at high temperature. Examination of the structural members of the firewall revealed they had a dark appearance consistent with fire. The features were consistent with overstress fracture at high temperature for a textured material.

Metallurgical examination of the pitot heat and propeller anti-ice circuit breakers, pilot air control, left engine load meter fuses, anti-collision light, landing gear motor circuit breaker, and panel containing the current limiter bus were also performed by the NTSB Materials Laboratory, located in Washington, DC. Both ends of the wires of the propeller anti-ice circuit breaker exhibited some beaded material consistent with some arching. Energy dispersive x-ray spectroscopy (EDS) spectrum for the sire showed peaks of copper, tin, and silicon. One of the wires attached to the pitot heat circuit breaker exhibited a large bead at the fractured end of the wire; beaded material was also noted at the inner radius of a bend in the wire. The beaded material is consistent with electrical arcing. EDS of the wire with the large bead on the end showed peaks of copper, tin, and silicon.

Metallurgical examination of the pilot air control revealed the surface exhibited localized damage that had a crater-like appearance with areas of porous, previously molten metal, features consistent with damage caused by an electrical arc. EDS examination of the surface of the pilot air control sleeve away from the damaged area revealed peaks of zinc, copper, and silicon; no tin was detected. EDS examination of the damaged area of the pilot air control sleeve revealed peaks of copper, zinc, and tin. Both load meter fuses for the left engine were in an "open" condition. The filament of the rear bulb of the anti-collision light exhibited features consistent with a 'cold' break. The filament of the front bulb of the anti-collision light exhibited features associated with 'hot' and 'cold' breaks. Remnants of recovered filament of the front bulb exhibited evidence of 'cold' breaks. The landing gear motor circuit breaker was found in the 'off' position, and corroded. The plastic material of the push-pull button installed

in the neck mounting was noted to have resolidified material; the button mechanism was mechanically operable. Corrosion was noted internally to the electrical components of the landing gear motor circuit breaker. The open 80-ampere current limiter (p/n FLLB) located on the current limiter bus was examined revealing the fusible portion had separated. Crazing on the mica window directly above the fusible portion was noted. Disassembly of the open current limiter revealed both ends were bent in the same direction and were tapered to a sharp flat edge. One end of the fusible portion maintained its cross section while the other end was increased in thickness with the added material producing a rounded cross section.

Postaccident examination with FAA oversight was performed on the supply side wires connected to the propeller anti-ice and left pitot heat circuit breakers to determination wire gauge and whether the crimped terminals were consistent with terminals installed when the airplane was manufactured. The testing determined the wires were consistent with a 10-gauge wire, and the crimped terminals were consistent with factory-crimped terminals.

Testing with FAA oversight was performed in an attempt to duplicate the large bead of material found on the end of the 10-gauge supply side wire attached to the pitot heat circuit breaker installed on inboard portion of the W11 bus bar. The first test performed was with a length of 10-gauge wire connected to a 28-volt DC power supply with various current loads applied. The testing determined that when 90 amps were applied, some swelling of the insulation was noticed; a burning odor was noticed at 140 amps and signs of insulation melting was noted at 160 amps. The insulation melted off the wire at 180 amps, and the wire melted in two at 270 amps. Another test was performed when 300 amps of current were rapidly applied to a length of 10-gauge wire; the wire melted in two with the absence of a large ball on the end of the wires. The same test but with approximately ½ of the wire strands cut was performed which revealed the cut section fused together then melted in two; again, the absence of a large ball on the end of the wires was noted. Still another test involved shorting of a 6-gauge wire to a 10-gauge wire of an open circuit with approximately 200 amps of current, only mild arching was noted. Another test was performed similar to the above listed test but with the 300 amps short to ground applied in compression; some signs of beaded material was noted.

Additional testing with FAA oversight was performed to duplicate the large bead of material found on the end of the 10-gauge supply side wire attached to the pitot heat circuit breaker installed on inboard portion of the W11 bus bar. The aircraft's circuit was duplicated from the W30 bus (current limiter bus), to the W15 bus (circuit breaker bus bar), to include the 80-amp current limiter. The testing was performed using two 12-volt lead acid batteries connected in series, with the 10-gauge wire attached to an electrical load. A separate short to ground was applied to the 10-gauge wire; the 80-amp current limiter opened. Additional testing was performed with a 500-amp current limiter installed for test setup safety concerns, instead of the 80-amp current limiter. The testing determined that balling on the end of the 10-gauge wire could be duplicated when a compressive load was applied shorting the 10-gauge wire to ground, and the batteries supplying current to the 10-gauge wire.

The manufacturer of the "open" current limiter performed testing in an attempt to duplicate the as-found condition of the fusible portion of the accident "open" current limiter. The testing was performed with the correct gauge and length of wire from the current limiter to the W15 bus titled, "circuit breaker bus bar" located on the lower left portion of the instrument panel. The testing determined that with various current applied, the test current limiter opened at various times that decreased with increased current. A representative of the manufacturer of the current limiter reported that examination of the accident current limiter revealed evidence it experienced a low overload condition between an estimated 200 and 280 amperes. Additionally, the representative stated that comparison of the tested current limiters with the accident current limiter confirmed the estimated overcurrent range.

As discussed in the HISTORY OF FLIGHT section of this report, the pilot radioed the Memphis ATCT at 1201:16, reporting an electrical fire and that he was going to turn off the master switch. Radio communications with the pilot continue until the pilot's last radio contact at 1202:39. Additionally, transponder returns continue approximately every 4.6 seconds when examined in 1-minute increments beginning at 1154, and ending at 1201. As discussed in the WRECKAGE AND IMPACT INFORMATION section of this report, the battery switch was found in the "off" position while both alternator switches were found in the "on" position. Testing of an airplane of the same make and model and within 3 serial numbers of the accident airplane was performed duplicating the postaccident positions found of the battery (off), and both alternator switches (on). The testing determined that, "...aircraft had full power; radios, lights everything was powered up, only noticed a slight drop in amp draw when battery switch turned off."

The Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH/FAA AFM) contains a checklist titled, "Electrical Smoke Or Fire" in the emergency procedures section. That checklist states the following:

Action to be taken must consider existing conditions and equipment installed:

1. Battery and Alternator Switches - OFF

Warning

Electrically driven flight instruments will become inoperative.

2. Oxygen - AS REQUIRED
3. All Electrical Switches - OFF
4. Battery and Alternator Switches - ON
5. Essential Electrical Equipment - ON (Isolate defective equipment:

NOTE

Ensure fire is out and will not be aggravated by draft. Turn off CABIN HEAT switch and push in

the CABIN AIR control. Open pilot's storm window, if required.

An 8.5 inch by 11 inch laminated checklist and a Pilot's Operating Handbook and FAA Approved Airplane Flight Manual were recovered with the wreckage. Review of the recovered checklist revealed that it did not contain the emergency procedures pertaining to "Electrical Smoke or Fire", which are listed in the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual. A copy of an 8.5 by 11 inch laminated checklist that contained emergency procedures pertaining to "ELECTRICAL SMOKE OR FIRE", was provided to NTSB by the operator following the accident. The checklist listed an effective date of June 01, 2000. This checklist was not recovered with the wreckage. According to company personnel, they provided the commercially produced checklist to their pilots.

A direct reading dual (left and right) fuel flow and pressure indicator was installed during manufacture on Beech 58 and 58A model airplanes with serial numbers TH-773 thru TH-1193; the accident airplane was serial number TH-1186. During manufacture of the same make and model airplane from serial number TH-1194 and after, an electrically controlled dual (left and right) fuel flow indicator is installed.

ADDITIONAL INFORMATION

The airplane minus three sections of the fuel tubing (p/n 96-324128-39), one section of fuel tubing (p/n 96-324128-31), one segment of oil tubing (p/n 96-324038-99), eight segments of heat damaged metal from the firewall, retained wiring bundle with some cockpit instruments for the left side of the cockpit, control-push pull detent (p/n 35-380051-31), circuit breakers (p/n 35-380132-3 and 35-380132-7), left engine load meter fuses (2 each), anti-collision light, landing gear motor circuit breaker, and current limiter bus panel were released to W. Shaen Phillips, of U.S. Aviation Underwriters, Inc., on March 19, 2003. All retained components were released to W. Shaen Phillips, in care of Raymond Ladd, on April 7, 2003.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	26,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Unknown
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	April 18, 2000
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	February 9, 2000
Flight Time:	2629 hours (Total, all aircraft), 900 hours (Total, this make and model), 2368 hours (Pilot In Command, all aircraft), 290 hours (Last 90 days, all aircraft), 90 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N158MT
Model/Series:	58 58	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	TH-1186
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	June 14, 2000 100 hour	**Certified Max Gross Wt.:**	5400 lbs
Time Since Last Inspection:	79.65 Hrs	**Engines:**	2 Reciprocating
Airframe Total Time:	4869.85 Hrs at time of accident	**Engine Manufacturer:**	Continental
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-520-CB
Registered Owner:	Airnet Systems, Inc.	**Rated Power:**	285 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	BSYA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KMEM,341 ft msl	**Distance from Accident Site:**	18 Nautical Miles
Observation Time:	12:16 Local	**Direction from Accident Site:**	12°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	160°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	33°C / 20°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Memphis, TN (KMEM)	**Type of Flight Plan Filed:**	IFR
Destination:	HOUSTON, TX (KHOU)	**Type of Clearance:**	IFR
Departure Time:	11:54 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	In-flight
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	34.747776,-90.081108

Administrative Information

Investigator In Charge (IIC):	Monville, Timothy
Additional Participating Persons:	Ed Aycock; FAA Flight Standards District Office; Jackson, MS Todd Dixon; FAA, Aircraft Certification Office; Wichita, KS John V Bures; Teledyne Continental Motors; Mobile, AL Paul E Yoos; Raytheon Aircraft Company; Wichita, KS Stuart E Bothwell; Raytheon Aircraft Company; Wichita, KS Chuck Paul; Airnet Express; Columbus, OH Daniel B Giblin; Cooper Bussman; St. Louis, MO Karl J Koederitz; Cooper Bussman; St. Louis, MO
Original Publish Date:	July 23, 2003
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=49735