NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, DC 20594

Group Chairman's Factual Report
February 14, 2005

----------SYSTEMS GROUP----------

DCA05MA004

A. ACCIDENT

Location: Kirksville, Missouri

Date: October 19, 2004

Time: 1945 central daylight time (CDT)

Aircraft: British Aerospace Jetstream 3201, N875JX
Corporate Airlines Flight 5966

B. SYSTEMS GROUP

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C. SUMMARY:

On October 19, 2004, about 7:45 p.m. central daylight time (CDT), a British Aerospace Jetstream 3201 twin-engine turboprop airplane, operating as American Connection flight 5966 (a feeder commuter for American Airlines), crashed during an instrument approach to the Kirksville Regional Airport in Kirksville, Missouri. The airplane carried 2 crewmembers and 13 passengers. The flight was being operated as a scheduled Part 121 airline flight. It departed from St. Louis, Missouri, about 6:45 p.m. and was destined for Kirksville.

The flight was being vectored by the Kansas City Air Route Traffic Control Center (ARTCC) for the Localizer Distance Measuring Equipment (LOC-DME) approach to runway 36 at Kirksville. The airplane was cleared to descend from 15,000 feet. The airplane crashed about 4 miles from the runway during the approach. Eleven of the 13 passengers and the 2 flight crewmembers were fatally injured. The two surviving passengers received serious injuries. The airplane was destroyed by impact and post-impact fire.

American Connection is owned and operated by Corporate Airlines, a commuter airline based in Smyrna, Tennessee.

D. DETAILS OF THE INVESTIGATION:

The Systems Group conducted examinations in Kirksville, MO on October 20-24, 2004. Work at the site consisted of wreckage documentation and recovery of significant items. Additional work was performed at Kollsman Instruments in Manchester, NH on November 9, 2004.

1.0 General Wreckage Description and Instrument Panels

Items found along the debris path (in order of passage) included a belly strobe light reflector piece, landing light lens pieces, strobe light piece, landing and/or taxi light reflector pieces, a piece of the propeller heater mat boot, and static wick, all of which were found near the beginning of the tree line, along with several vortex generators. Farther along the debris path the #2 comm antenna was found near the left wing piece. The instruments were all found in the main wreckage field.

1.1 Captain's Instruments

The majority of the forward instrument panel was complete and laying exposed (face up). The Captain's flight instrument panel had folded under the rest of the forward panels and had been almost completely consumed by fire. Only half of the facial frame from the vertical speed indicator was found and fire had consumed more than half of both the attitude and airspeed indicators.

The captain's RMI, P/N 622-2506-004, was found separated and loose in the debris field. The external casing was gone and only the front half of the instrument was recovered. The #1 needle was in the parked position, while the #2 needle appeared to be in agreement with the first officer's RMI, which was measured at 68 degrees (using the 12 o'clock position as a reference point.)

1.2 Engine Instruments

The engine instruments were observed to have the following readings/positions at the crash site:

ITEM:	LEFT	RIGHT
Torque	40%	10%
RPM (N1)	0	0
EGT	0	0 (loose needle)
Fuel PSI	0	0
Oil Temp	0	0
Fuel PSI	0	0
Fuel Flow	no needle	no needle
(Both needles were separated from panel)		
Fuel QTY (lbs)	470	490

1.3 Center Instrument Panel

The standby attitude indicator glass was smoked and the facial features were not visible. The indicator was partially extended from the panel. The face of the ADF tuner was burned away. The Bendix/King Altitude Alerter, P/N 065-0053-00, facial features were found with both impact and fire damage and when removed, about 2.5 inches of the concealed end of the box had been consumed by fire. The passenger briefing panel face had been consumed by fire. The facial features of the Collins IND270 radar indicator had been destroyed by impact and heat. The selector switch for the altitude encoder read-out to air traffic control was of the lift/latch toggle type and was found in the #2 position.

Four nearly identical radio faces were found together; all four had been extensively heat damaged, with the lower right partially consumed by fire. Beneath the four radio faces, the transponder control box was more than half-consumed by fire and crumbled when disturbed. The Traffic Collision Avoidance System (TCAS) switch panel was missing five of the seven switches.

1.4 First Officer's Instruments

The face of the airspeed indicator, P/N 39948B2236[1], was smoked and not visible. The radio magnetic indicator, P/N 622-2506-004, was found separated from the instrument panel; the #1 needle was free to move its position could not be determined, while the #2 needle was measured at 68 degrees[2] (using the 12 o'clock position as a reference point). The attitude indicator, P/N 7001182-906, glass was broken and smoked, and the display was not visible. The facial half of the horizontal situation indicator, P/N 7002493-902, had been consumed by fire. The compass control switch panel contained three switches: the left had been melted, the center (unguarded) was found in the up position, and the right was found in the down position. The marker beacon lights were heavily damaged by the post-impact fire. The face of the first officer's clock had been burned away.

The glass face of the first officer's altimeter, P/N B45152-10-004, was heavily sooted both internally and externally. The case was intact, but had experienced severe thermal damage. The altimeter was taken to Kollsman Instrument in Manchester, NH for a detailed examination. Once the glass face was removed, the barometric setting was observed to be 29.95 – 29.96 inches. (The last barrel was found in between the "5" and "6" positions.) The barrels were free to rotate; soot conditions were consistent with the setting as documented above. The altimeter counter reading was approximately 1050 feet. The paint on the dial face had melted off, but the pointer position was compared to that on a known good altimeter and was found to be in agreement with the counter reading. The pointer was still securely attached and was jammed. Pressure was applied to the altimeter, but the pointer would not move. The flag was observed to be in the down/visible position. Kollsman representatives indicated that the flag would drop when electrical power was removed, but the altimeter continues to function without electrical power. Loss of power results in the data not being provided to ATC.

The glass face of the vertical speed indicator, P/N A32069-10-106, was heavily sooted both internally and externally. The case was intact, but had experienced severe thermal damage. The VSI was also taken to Kollsman Instruments for a detailed examination. The bezel was removed, and some loose/melted debris fell out. The face dial was found to be bent, and the pointer was observed to be in the 5500 feet/minute descent position.

The first officer's distance measuring equipment (DME) unit, P/N 622-6524-003, S/N 3316, was found beyond (down travel path) the remains of the fuselage

[1] All part numbers were provided by the Corporate Airlines representative, based on aircraft records.
[2] The measurements were made with a protractor.

and in a creek. The case had a repair station sticker that was dated 10-9-04. According to the sticker, the repair was done by Instrument Tech Corporation of Addison, TX. Maintenance records indicate that the unit had been submitted for repair because the display was unreadable. Instrument Tech removed and replaced the display, and performed an acceptance test on the unit. It was then returned to Corporate Airlines, where it was installed on the accident aircraft on October 16, 2004.

1.5 Other Instrumentation and Switches

The overhead panel stayed with the windshield and all panel facial features were consumed by fire. The outside air temperature gauge face glass was smoked and the gauge indication was not visible. A loose turn and bank coordinator was found. The needle did not move from a half-width to the left of center; the ball moved freely in the cracked glass tube. The landing gear selector was found loose and the facial features had been consumed by fire; the internal mechanism was in the DOWN position. The Central Annunciator Panel (CAP) was largely molten and the lights were only loosely held. Many of the light bulbs were partially melted. The portion of the pedestal that had contained the throttles had been consumed by fire. The pressurization panel and valves were partially consumed by fire.

2.0 Electrical:

2.1 Description:

Two 28VDC[3], 300A[4] engine-driven starter/generators provide the main power supply for the aircraft electrical systems. Control switches and indication for the DC electrical systems are located on the overhead panel, with warning indications located on the annunciator panel. The generators feed 28VDC main and essential bus-bars via line contactors, with each output controlled by an associated control unit which compensates for changes in engine speed and/or load. The control units also ensure the generators share the system loads. DC power is also provided by two nickel/cadmium batteries which normally feed the essential bus-bar via battery contactors. The batteries are also used in series for engine starting. Should a dual generator failure occur, the essential bus-bar will be powered by the batteries. If the battery contactors are opened, the No. 1 battery supplies the battery bus-bar for emergency services only. A left or right amber BAT warning on the annunciator panel illuminates when a battery contactor is opened.

Two 350 VA, 400 Hz, single-phase static inverters, energized from the aircraft 28 VDC bus bars, provide the 115 VAC[5] and 26 VAC supplies for avionics and navigational instruments. Controls for both inverters are located on the pilot's roof panel. Indications of essential AC, main AC, and inverter failure are provided by an illuminated red INV warning caption and illuminated amber AC ESS and AC MAIN captions on the

[3] Volts DC
[4] Ampere
[5] Volts AC

annunciator panel. An illuminated amber INV warning caption is provided to indicate that one inverter is running both main and essential ac bus-bars.

2.2 Findings:

Both battery isolation switches were in the up (ON) position. The left battery temperature circuit breaker was extended, while the right was latched and had been partially melted. The #1 battery was found clear of the aircraft wreckage to the right side, approximately 25 yards away; it was intact with no fire damage. The #2 battery was in the fire field in approximately its correct location. It had severely burned except for the cover, which was found aft and outside of the burned area.

3.0 Oxygen System

3.1 Description

The aircraft was equipped with an emergency oxygen system to provide gaseous oxygen to the flight crew and passengers. The aircraft main emergency oxygen system is activated from a storage bottle pressurized with gaseous oxygen via a charging point, and a master (charge/outlet) control valve. The system pressure is indicated on a gauge adjacent to the charging point, and an additional gauge in the cockpit. A temperature gauge, also located adjacent to the charging point, is used in conjunction with a graph to determine the safe maximum charging pressure. The stored oxygen supply is piped to a self-sealing plug-in outlet at each pilot's position via the master control valve, a pressure regulator/transmitter assembly, and an ON/OFF control valve. Each pilot's oxygen mask can be connected into the associated plug-in outlet. The oxygen supply is delivered to a cabin altimetric regulator which, at a pre-determined cabin pressure differential, supplies oxygen to the passenger automatic drop-out boxes and ejects passenger masks ready for use. Portable gaseous oxygen bottles are provided for the flight crew at both positions. These bottles are the crew's primary oxygen supply.

3.2 Findings

A gauge on the passenger oxygen system charging panel was fixed at about 20 psi, although the oxygen supply bottle gauge, which is located on the charging panel and is electrically powered, read zero. The portable gaseous bottle was still pressurized; the pressure was released, and the burned bottle was set aside.

4.0 Fire Protection System

4.1 Description

Two separate fire protection systems are provided, one for each engine. Each system consists of a detection system initiated by two firewire sensing elements, and an extinguishing system fed by two fire extinguisher bottles mounted in each main landing gear bay.

4.2 Findings

The two left engine fire bottles and one right engine fire bottle were found with intact diaphragms. All were thermally discharged. The remaining fire bottle was directly beneath the right engine and its condition could not be determined.

A hand-held fire extinguisher from above the TCAS computer remained in its bracket.

5.0 Avionics

The avionics from the nose of the airplane were impact damaged, but most did not have fire damage. The TCAS computer from beneath the aft-right passenger seat had been partially consumed by fire. The Corporate Airlines representative stated that the airplane had been equipped with Collins ProLine 2 avionics, a Honeywell SPZ500 flight director system, Bendix/King TCAS 1, and a Honeywell/Sundstrand Mark 6 Ground Proximity Warning System.

5.1 Honeywell/Sundstrand Mk VI Ground Proximity Warning System Description

5.1.1 General

The Ground Proximity Warning System (GPWS) provides pilots with alerts and warnings to prevent inadvertent flight into terrain. It also monitors aircraft configuration and provides warnings when the aircraft is in a non-standard landing configuration. Data is used from the following aircraft systems:

- Height above the terrain from the radio altimeter
- Barometric altitude rate (vertical speed) and indicated airspeed from the air data sensor
- Glideslope deviation from a VHF NAV receiver via the pilot's gyro horizon
- Landing gear configuration from the landing gear select switch
- Flap position from the flap select switch
- Stall warning from the left stall warning signal summing unit
- Below decision height warning from the radio altimeter indicator

5.1.2 Excessive Descent Rate Alert/Warning (Mode 1)

Mode 1 provides the pilots with alerts and warnings for high descent rates into terrain. Alerts are provided when the descent rate exceeds that of a normal stabilized approach. When descending between 1000 and 300 feet above ground

level (AGL), a descent rate of 1200 feet per minute is allowed. Alerts will only be provided if the descent rate exceeds 1200 FPM in this regime.

5.1.3 Excessive Closure Rate to Terrain (Modes 2A and 2B)

Mode 2 provides two types of alert/warnings to help protect the aircraft from impacting the ground, when the terrain is RISING excessively fast with respect to the aircraft.

5.1.4 Insufficient Terrain Clearance (Modes 4A, 4B, and 4C)

Mode 4 generates three types of alerts based on Radio Altitude, Airspeed, and flight mode. These are referred to as Modes 4A, 4B, and 4C. Mode 4A is active during cruise and approach with landing gear up. Mode 4B is active during cruise and approach with landing gear down and flaps NOT in the landing range, and the GPWS FLAP OVERIDE switch in the cockpit is not selected. Mode 4C is active during takeoff. Warnings from modes 4A, 4B, and 4C cannot occur simultaneously.

A mode 4A alert occurs whenever its envelope is penetrated (See Figure 1.) This causes a voice message to being repeating every three seconds, and the cockpit lamp(s) to illuminate. If the aircraft speed is less than 178 knots, the repetitive voice message will be "TOO LOW, GEAR". For speeds above 178 knots, the Mode 4A voice message is "TOO LOW, TERRAIN".[6]

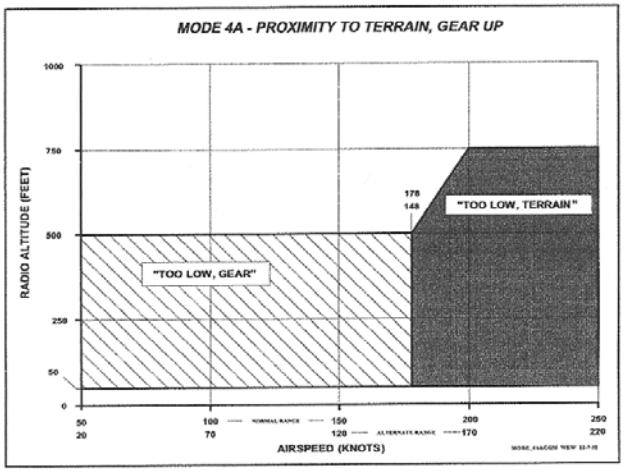

Figure 1 – GPWS Mode 4A Clearance Alert Envelope

The mode 4B envelope is utilized whenever the landing gear is down below 700 feet AGL, or the GPWS FLAP OVERRIDE switch in the cockpit is

[6] The airspeeds mentioned depend upon the type of aircraft. An alternate airspeed expansion range, activated by a program pin, begins at 148 knots and ends at 170 knots for slower aircraft.

selected. A mode 4B alert will occur whenever the mode 4B alert envelope (see Figure 2) is penetrated. The cockpit lamp(s) will illuminate, and one of three different voice alerts will occur every three seconds, depending on the situation:

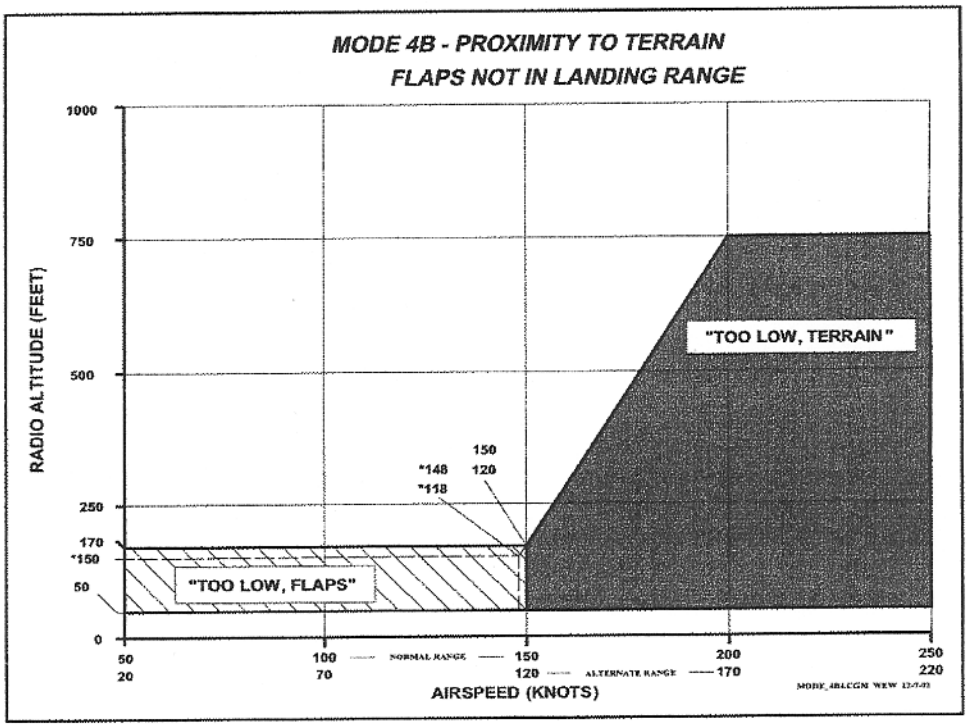

Figure 2 - GPWS Mode 4B Clearance Alert Envelope

- If flaps are NOT in the landing range and the gear is down, and the airspeed is less than that shown in Figure 2, and the GPWS FLAP OVERRIDE switch is not selected, then the "TOO LOW, FLAPS" message will repeat every three seconds.

- If the gear is now up, having been down previously below 700 feet AGL to activate this sub-mode initially, and airspeed is less than that shown in Figure 2; OR if the gear is still up and the GPWS FLAP OVERRIDE is selected, then any airspeed will trigger a "TOO LOW, GEAR" message, which will repeat every three seconds.

- If airspeed is greater than that shown in Figure 2 and the GPWS FLAP OVERRIDE switch is not selected, then the "TOO LOW, TERRAIN" message will repeat every three seconds.

6.0 Landing Gear:

The landing gear selector switch from the cockpit was observed in the down position. The nose landing gear strut nitrogen charging valve had been in the fire and was found loose. The left main gear radius rod was in the extended (gear down) position.

7.0 Flight Controls

7.1 Description

The primary control surfaces (ailerons, rudder, and elevators) are operated using the control wheel and rudder pedals at each pilot's station. These controls activate the control surfaces by means of two-way cable systems, pulleys, adjustable connecting rods, and levers. Combined trim/balance tabs are fitted to the ailerons and elevators, while the rudder incorporates a combined spring/trim tab. All trim tabs are operated by screwjacks driven by cables from trim operating controls.

The double slotted flaps mounted in each wing are interconnected by a torque shaft and operated by a double-acting jack powered by the aircraft hydraulic system. The flap positions RETD (retracted), 10^{o}, 20^{o}, and 35^{o}, are controlled by a four-position selector and electro-hydraulic selector valves. On landing, with 35^{o} flaps selected, the weight of the aircraft is sensed by a micro-switch on the nose landing gear. The flaps automatically extend beyond the 35^{o} position to a DUMP setting (70^{o}) to act as an airbrake to shorten the landing rollout.

To assist recovery from certain flight attitudes, the rudder and aileron cable control system are interconnected. A spring fitted in the rudder operating system provides the pilots with artificial feel. To ensure stick-free stability in pitch modes, the elevators are biased downwards by a spring incorporating a fail-safe nylon cord. A stall protection system gives physical and audible warning of impending stall conditions.

The stall protection system provides stall warning and stall correction facilities. These consist of left and right electro-mechanical control/indicating sub-systems, each providing tactile (stick shaker) and audible (intermittent tone) warning of impending stall conditions on the wing concerned. Upon identification of a stall condition by the system, if corrective action is not taken immediately by the flight crew, a hydraulically-powered pusher unit responds to sub-system signals to move the elevators down approximately 8^{o} to assist in restoring airspeed.

7.2 On-Scene Findings

The elevator torque shaft in the vertical stabilizer was the central shaft between the two elevators and was found near the elevator trailing edge down position. The mechanical portions of the elevator controls in the cockpit were destroyed by impact and fire. The elevator cables were followed from the cockpit to the aft bellcrank in the tail and the elevator DOWN cable was found broken at about the station of the main cabin door. The aft bellcrank had a downforce spring that was attached to the bellcrank at one end and to structure at the other end. The aft bellcrank had a control rod attached and that rod was routed upward through the vertical stabilizer. From the top of the rod,

an idler bellcrank and an upper (second) pushrod were broken and missing. From the upper end of the second control rod, the end of the elevator torque shaft was missing the lug that the input rod had been connected to.

Both the DOWN elevator and RIGHT rudder cables had separated at the turnbuckles from overload. The rudder control cables were followed from the tail to the attachment points in the cockpit. The right rudder cable had broken at about the station of the main cabin door. The cockpit rudder pedal bearings were found free to rotate on the support tube.

The aileron mechanical controls in the cockpit had been consumed by fire. Only a quarter of the forward pressure bulkhead remained, which was from the first officer's side. The bulkhead had the roll cable drum and most of a pulley attached. The aileron cable terminal pulley on the left wing rear spar was found with both the upper and lower cables intact to the first turnbuckle. There was no evidence of pre-impact damage noted on any of the cables, pulleys, rods or stops.

The flap jack was identified by the Corporate representative as P/N AIR86840-2. The center section of the torque shaft, including the two universal joints adjacent to the input lever on the torque shaft was intact. The input lever on the torque shaft and the flap jack were connected. The anchor point for the flap jack had pulled free of its fuselage attach point. At least two hydraulic lines associated with the lift-dump portion of the flap jack were separated. The flap jack exhibited extension of both the normal and lift-dump pistons. However, the hydraulic system was compromised during the impact, and the position of the flap jack could not be determined.

The stick pusher in the stall protection system is located in the aft equipment bay and was not fire damaged. However, the hydraulic system was compromised during the impact, and the position of the pusher unit could not be determined.

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