National Transportation Safety Board
Aviation Accident Final Report

Location:	BUFFALO, NY	**Accident Number:**	NYC97LA068
Date & Time:	04/03/1997, 1955 EST	**Registration:**	N553AC
Aircraft:	Cessna 650	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	3 None
Flight Conducted Under:	Part 91: General Aviation - Executive/Corporate		

Analysis

While being vectored for the final approach in visual conditions, at night, the flight crew lost radio contact with the control tower and smelled smoke aboard the airplane. They continued the approach and landed, and after reaching their parking space, were notified by ground personnel of flames penetrating the top of the aft fuselage between the engines. The fire was extinguished by airport fire fighting personnel. Postaccident investigation found a hydraulic return line in the aft equipment bay had evidence of electrical arcing and a small hole through which fluid could escape. An 115-volt electrical line used to heat the horizontal stabilizer also had evidence of rubbing on its surface. In addition to the hydraulic fluid, a pressurized fuel line to the APU was damaged by the fire and leaking fuel. A test simulating an electrical line arcing with a leaking hydraulic line resulted in a fire during each of the three tests. The production standards that Cessna used did not specify a minimum space between electrical lines and flammable fluid lines. The FAA had certified the airplane without requiring Cessna to specify a minimum spacing between electrical lines and flammable fluid lines.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A combination hydraulic fluid and fuel-fed fire which originated from electrical arcing, due to the lack of an adequate production standard from Cessna for the separation of flammable fluid lines and electrical lines. A factor was the lack of oversight from the FAA, which allowed Cessna to space the flammable fluid lines and electrical lines at too close a position.

Findings

Occurrence #1: FIRE
Phase of Operation: APPROACH

Findings
1. (C) ELECTRICAL SYSTEM,ELECTRIC WIRING - ARCING
2. (C) INSUFFICIENT STANDARDS/REQUIREMENTS,AIRCRAFT - MANUFACTURER
3. (F) INADEQUATE CERTIFICATION/APPROVAL,MANUFACTURER - FAA(ORGANIZATION)

Factual Information

On April 3, 1997, about 1955 eastern standard time, a Cessna 650 (Citation III), N553AC, operated by Mercury Communications, was substantially damaged by a fire while on approach to Buffalo, New York. The two certificated airline transport rated pilots, and one passenger were not injured. Night visual meteorological conditions prevailed for the corporate flight which had departed from Wellsville, New York, about 1930. The flight was operated on an instrument flight plan under 14 CFR Part 91. The flight originated in Coudersport, Pennsylvania, with two passengers onboard. An intermediate stop was made at Wellsville, New York, and one passenger exited the airplane. The flight then continued on to Buffalo. In the NTSB Pilot/Operator Aircraft Accident Report, the pilots stated: Flying Pilot - "...(Air Traffic Control) ATC cleared us to 4000 MSL. Upon leveling at 4000 we were assigned a heading of 350 degrees. We were now i (visual meteorological conditions). We turned off the anti-ice systems. Next the FMS-1 (flight management system) went black and the circuit breaker (C/B) popped. We smelled electrical smoke. I noticed smoke in the cabin. All communication with ATC were lost. Multiple circuit breakers were popping with multiple appropriate enunciators. We turned to the BUF airport to land. We continued to try to establish communications with ATC, our transponder was inop. We were given the steady green light to land and taxi in to Prior Aviation. We had a pressurization spike on the ground. Once we opened the cabin door we were advised the airplane aft upper fuselage was on fire. We turned off all power and exited the airplane. Fire crews took over from that point." Non-flying pilot - "...Leveled at 4,000 VMC conditions, turned anti-ice off. We were on a heading of 350 for sequence to runway 23. 1st we lost #1 FMS. I asked flying pilot if he smelled anything. He said yes. Smells electric. Found C/B FMS1 popped. Didn't reset. Switched #2 FMS to pilot-in-command.. Attitude direction indicator then cockpit voice recorder C/B popped. We noticed smoke in cabin, decided to get aircraft on ground. Attempted to call approach to declare an emergency. No com. Went to emgr Batt, and emgr com, still no com. We now had multiple C/B's popping. Hyd [fluid] volume went low, set landing configuration, got green light from tower. Landed, got flashing green light to taxi, had a major pressurization spike while taxing. On the ramp, we secured the aircraft, opened the door, the aircraft was slightly overpressurized. Door opened rapidly. Line service told me we had flames on the aircraft. We evacuated aircraft. Notified (emergency authorities)." According to statements received from the Buffalo Airport Traffic Control Tower, the airplane was tracked on radar as it continued toward the airport after radio communications was lost. The flight was cleared to land using voice communications and a light signal. After the airplane cleared the runway, the tower personnel were advised by Prior Aviation that the airplane was on fire, and the CFR was directed to the Prior ramp. The airplane was initially examined by personnel from the Federal Aviation Administration (FAA) Flight Standards District Office, and Cessna Aircraft Company. The origin of the fire was not identified, and on April 10 and 11th, 1997, a National Transportation Safety Board (NTSB) Systems Engineer led a Systems Group for additional examination of the airplane. The systems group found metal splatter and black soot patterns in the area between the right engine pylon and the fuselage. A hole approximately 9 inches by 8 inches had burned through the fuselage skin near the right pylon. Another hole, approximately 24 inches by 30 inches was burned through the top of the aft fuselage just aft of the fuselage fuel tank. This hole had been expanded by airport fire and rescue personnel who used it to gain access to the fire. Fire damage was observed throughout the avionics bay and in the area above the baggage compartment. The avionics shelf had separated from its mounts

and fell onto the structure below. Black soot was observed as far aft as the tailcone. Inboard of the right pylon, a small hole was found in a section of the right engine hydraulic pump suction [return] line. The hole was in the area adjacent to the routing of the 115 volt AC electrical wiring that provided power to the horizontal stabilizer anti-ice elements. The hydraulic line and electrical wire bundle were removed and examined in the NTSB's materials lab. According to the Systems Group Chairman Report: "...Examination in the materials lab revealed that the hole in the hydraulic line was 0.09 inch by 0.12 inch, and was tapered through the thickness of the line. X-ray examination of the hole indicated the presence of copper (Note: The 115 VAC wiring has a copper conductor). Microscopic examination of the hydraulic line also revealed rub marks adjacent to the hole. Examination of the electrical wiring revealed a crater exhibiting localized melting and resolidification, and the individual wire strands were fused together...." The Cessna Aircraft Company performed a series of tests in the presence of representatives of the FAA Wichita Aircraft Certification Office, at the Cessna Aircraft Company facility in Wichita, Kansas, on May 2, 1997, to determine if the arcing of a 115VAC wire could cause leaking hydraulic fluid to ignite. A test apparatus was developed to simulate the installation of the pressurized hydraulic line, 115V AC wiring and electrical load simulating the airplane systems in operation at the time of the event. Before the test, a small hole was created in the hydraulic line by touching an exposed section of 115VAC wiring and allowing arcing to occur. Then the hydraulic line was pressurized and fluid began to escape through the hole. Technicians then caused the exposed wiring to touch the hydraulic line and arcing occurred. The test was performed three times and each test produced a sustained hydraulic fire. Certification Standards The Cessna model 650 was certificated to Title 14 CFR Part 25 standards. Examination of Title 14 CFR Part 25 failed to find any reference to the spacing between electrical lines and flammable fluid lines. Cessna Aircraft Company documentation for the installation of electrical wiring for commercial aircraft did not specify a minimum distance between electrical lines and flammable fluid lines. The documentation did state, "...wiring within 6 inches of [flammable fluid lines] must be firmly supported and where possible be routed above the line...." No mention was made of the use of back to back clamps to ensure rigidity in their separation. Guidelines for safe wire routing practices were found in two references; Advisory Circular 43.13-1A, Acceptable Methods, Techniques, and Practices, Aircraft Inspection and Repair; and Advisory Circular 65-15A. Airframe and Powerplant Mechanics Airframe Handbook. Both sources stated that no electrical wire should be located within 1/2 inch of any combustible fluid or oxygen line. If the separation was greater than 1/2 inch but less than 2 inches, back to back clamps or a polyethylene sleeve should be installed to ensure positive separation. According to AC 43.13-1A, the references were used for repair and not as an initial design guide. AC 43.13-1A does state, "...This advisory circular contains methods, techniques, and practices acceptable to the Administrator for inspection and repair to civil aircraft, only when there is not manufacturer repair or maintenance instructions...." ADDITIONAL INFORMATION Cessna 650 Hydraulic System The airplane was equipped with an open center hydraulic system. The maximum pressure on the return line, during system actuation would have been about 50 PSI. Hydraulic fluid was always present in the return line. The fluid used was Mil-H-83282, brand name BRAYCO. It had a flash point of 385 degrees Fahrenheit, and an auto-ignition temperature of 670 degrees Fahrenheit. Fire Spread The airplane was equipped with an auxiliary power unit in the tail cone. The fuel line to the APU was pressurized anytime the right engine was operating. The fuel line between the right engine and the APU was found to have been damaged by the fire, and leaked fuel. Cockpit Voice Recorder The cockpit voice recorder (CVR) was retained and a transcript was provided by the

NTSB Engineering and Computer Services Division. Both pilots in written statements had reported that they turned off the anti-ice and then smelled the smoke. According to the CVR transcript, the smoke was smelled about 50 seconds prior to the anti-ice being turned off. Power to the CVR was lost shortly thereafter. Examination of Other Cessna 650 Aircraft Cessna Aircraft sent service bulletin, SB650-24-57, to owners of Cessna 650s which asked for a check of the clearance between the hydraulic return line and the electrical line. According to data from Cessna, there were 144 airplanes affected by the service bulletin, and replies were received from 136 owners/operators. Of the 136 airplanes, 43 airplanes had clearances of 1/2 inch or less, and 8 additional airplanes (including the accident airplane) had evidence of contact between the electrical lines and the hydraulic line. Additional Persons not listed on page 5 of Factual Report James F. Wildey NTSB National Resource Specialist - Metallurgy Albert G. Reitan NTSB Transportation Safety Specialist (CVR)

Tim Marker FAA Tech Center (Fire Specialist) Jack Pearson FAA Certification Office - Wichita, KS Tom Williams FAA FSDO - Rochester, NY Harry White Cessna - Propulsion Mike Dame Cessna - Project 650 Don Klein Cessna - Pneumatics Lynn Young Cessna - Hydraulics Tim Zimmerman Cessna - Electrical Wreckage Release The airplane was released to the operator on May 5, 1997.

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:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim.	**Last Medical Exam:**	05/29/1996
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	8900 hours (Total, all aircraft), 1000 hours (Total, this make and model), 8800 hours (Pilot In Command, all aircraft), 100 hours (Last 90 days, all aircraft), 30 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Cessna	**Registration:**	N553AC
Model/Series:	650 650	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Transport	**Serial Number:**	198
Landing Gear Type:	Retractable - Tricycle	**Seats:**	10
Date/Type of Last Inspection:	02/13/1997, Continuous Airworthiness	**Certified Max Gross Wt.:**	22200 lbs
Time Since Last Inspection:	59 Hours	**Engines:**	2 Turbo Fan
Airframe Total Time:	2128 Hours	**Engine Manufacturer:**	Garrett
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	TFE-731
Registered Owner:	MERCURY COMMUNICATIONS INC.	**Rated Power:**	3650 lbs
Operator:	MERCURY COMMUNICATIONS INC.	**Air Carrier Operating Certificate:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Night/Dark
Observation Facility, Elevation:	BUF, 724 ft msl	**Observation Time:**	1954 EST
Distance from Accident Site:	0 Nautical Miles	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Scattered / 4700 ft agl	**Temperature/Dew Point:**	9°C / -1°C
Lowest Ceiling:	Overcast / 6000 ft agl	**Visibility**	10 Miles
Wind Speed/Gusts, Direction:	8 knots, 240°	**Visibility (RVR):**	0 ft
Altimeter Setting:	29 inches Hg	**Visibility (RVV):**	0 Miles
Precipitation and Obscuration:			
Departure Point:	WELLSVILLE, NY (ELZ)	**Type of Flight Plan Filed:**	IFR
Destination:	(BUF)	**Type of Clearance:**	IFR
Departure Time:	1930 EST	**Type of Airspace:**	Class E

Airport Information

Airport:	GREATER BUFFALO INTL (BUF)	**Runway Surface Type:**	Asphalt
Airport Elevation:	724 ft	**Runway Surface Condition:**	Dry
Runway Used:	23	**IFR Approach:**	None
Runway Length/Width:	8102 ft / 150 ft	**VFR Approach/Landing:**	Straight-in

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	In-Flight
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	ROBERT L HANCOCK	**Adopted Date:**	04/24/1998
Additional Participating Persons:	RICHARD LANSILL; ROCHESTER, NY JEFF RICH; WASHINGTON, DC JOHN DELISI; WASHINGTON, DC DAVID RYAN; WICHITA, KS		
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.ntsb.gov/pubdms/.		