

ASOS Research Request

Our flight department read with interest your safety brief on fuel contamination. Are there any hard statistics regarding the amount of bizjets accidents that are caused by contaminated fuel?

ASOS Research Brief

Unfortunately, the bizjet world lags behind the air carriers when it comes to statistical analysis. Virtually every flight hour or cycle that occurs during the life of a transport category aircraft is recorded. In corporate flight departments and 135 on-demand air charter operations, there is no federal requirement for reporting of hours or cycles. That means we cannot work out an event rate, like the airlines can.

What we can do is find examples that will demonstrate the significance of certain hazardous events.

We looked through our National Transportation Safety Board database for fuel contamination accidents specific to business aviation, and we found two significant crashes.



G-0B0B, when she was G-BAXL in better days.



N88HA, Crystal Aviation's Challenger after the dual engine flameout at Bassett, NE, 03/20/1994.

The first one occurred on January 30th, 1990 and involved a British Registered Hawker crashing near Columbia, Missouri. The NTSB report is brief. *"PROBABLE CAUSE: "Inadequate pre-flight by the pilot(s), water contamination of the fuel, low level of deice fluid (methanol) in the deice tank, and subsequent ice blockage of the fuel filters."* The pilot was killed and the co-pilot and passenger suffered injuries.

The second crash happened on March 20th, 1994. Here, the NTSB report speaks for itself.

These two events show that it CAN happen. Take the precautions necessary to assure it does not happen to your flight department.



NTSB Detail: CHI94FA116

212 W. 8th Street
Cincinnati, OH. 45202
Phone: 513.852.5110

General Information

Event Type:	ACC
NTSB Number:	CHI94FA116
Report Status:	F
Local Date/Time:	03/20/1994 36
City, State:	BASSETT NE
Airport:	RBE - ROCK COUNTY AIRPORT
Injury Severity:	SERS

Narrative

HISTORY OF THE FLIGHT

On March 20, 1994, at 0036 (all times are central standard time, cst), a Canadair CL601-3A, N88HA, operating as a positioning flight after a 14 CFR Part 135 passenger drop off, experienced a dual engine flameout during cruise flight between FL 370 and FL 410 in the vicinity of Bassett, Nebraska. The airplane sustained substantial damage during the subsequent forced landing in an alfalfa field. The two commercial pilots received serious injuries. Visual meteorological conditions prevailed for the flight, an IFR flight plan was in effect. The airplane departed Burlington, Vermont approximately 2128, with an intended destination of Long Beach, California.

The flight crew departed their home base of Long Beach, California (LGB) at 1028, and flew to San Diego, California (SAN). They picked up two passengers and a flight attendant and departed for Boston's Logan Airport (BOS), in Boston, Massachusetts. The flight arrived at BOS at 1728 and the passengers and flight attendant deplaned. The airplane departed BOS at 1807 with only flight crew on board. They flew to Lawrence Municipal Airport (LWM) in Lawrence, Massachusetts where they had prearranged a "quick turnaround" fuel stop for the trip back to LGB. A copy of the Aircraft Flight Log is appended.

Records indicate the airplane landed at LWM at 1814 with 3,000 pounds of Jet A fuel on board, and the flight crew planned to take on an additional 12,500 pounds of fuel. The contracted Fixed Base Operator (FBO) at LWM, Four Star Aviation, pumped about 221 US gallons into the airplane before the fuel truck stopped pumping. Attempts to revive the fuel truck were unsuccessful. Approximately two hours after they arrived at LWM, the flight crew decided to fly to Burlington, Vermont (BVT) to pick up the remainder of the required fuel load.

As the flight crew taxied the airplane to the active runway for departure, the FBO manager radioed them to report he found water in the bottom of the fuel truck, and wanted to check for contamination in the airplane. The pilots stated although they believed any water in the fuel would be dispersed due to movement on rough taxiways and motive flow fuel system, they parked the airplane to draw fuel samples. The FBO Manager drove to meet the airplane with a general aviation type (3 to 4 ounce) fuel strainer, and fuel samples were drawn from several drain points across the airplane. Small amounts of water were found at the belly drain points; the sampling continued until clear samples were obtained.

The flight crew departed for BVT about 2019. They operated under visual flight rules (VFR) at an altitude of 16,500 feet Mean Sea Level (MSL), and arrived at BVT approximately 2053. They stated the flight to BVT was uneventful except for observed auxiliary tank fuel quantity gauge and fuel totalizer fluctuations. The flight crew reported as a precautionary measure they elected to top the airplane off at BVT. The fuel tanks were drained again after fueling at BVT, with no evidence of water contamination.

The flight crew departed BVT approximately 2128. The pilots reported during the flight the IMPENDING FILTER BYPASS warning light for the left engine illuminated. They monitored other engine indications in accordance with the flight manual, and continued en route to LGB with the warning light illuminated. The pilots stated the airplane was established in cruise flight at 41,000 feet, approximately 2 1/2 hours into the flight, when the warning light went out. Shortly thereafter, the fuel LOW PRESS and fuel boost pump "ON" lights for the left engine began to flash on and off.



NTSB Detail: CHI94FA116

212 W. 8th Street
Cincinnati, OH. 45202
Phone: 513.852.5110

At 0014 (March 20, 1994), the pilots initiated a descent as the left engine began to spool down. They selected CONTINUOUS IGNITION and left engine power was restored temporarily. Approximately 0016 the left engine lost power again. The flight crew contacted Air Traffic Control (ATC) to request a lower altitude in order to attempt engine restart within the restart envelope. The pilots stated a few minutes later, as the airplane descended through approximately 37,000 feet, the right engine lost power with no observed warning lights or indications.

The pilots stated they lost all electrical power (except center panel emergency instruments) with the loss of power on both engines. They manually deployed the Air-Driven Generator (ADG) and recovered power for pilot's side instruments, radios and 3B hydraulic pressure. The right seat pilot declared "MAYDAY", reported the loss of both engines and requested ATC vectors to the nearest airport. ATC advised the flight crew of several airports in the area, and the crew chose the closest, the Rock County Airport (RBE), in Bassett, Nebraska, for their emergency approach and landing.

The pilots reported throughout the emergency the left seat pilot flew the airplane and looked for the airport, while the right seat pilot worked the radios and attempted restarts on both engines and the APU. The flying pilot stated he set up a glide speed of 230 knots which resulted in a descent rate of about 1,500 foot per minute (fpm). He reported he selected the 230 knot airspeed as a compromise to provide the ram air necessary to keep the ADG running, but still maintain a moderate descent rate to allow time to locate the airport/runway and set up for the power off approach.

The right seat pilot stated he made 2 to 3 unsuccessful restart attempts on each engine during the emergency descent. He reported he also tried to start the APU about 7 times without success. The right seat pilot also attempted to activate the pilot controlled runway lighting system at RBE on the 122.9 Mhz frequency issued by ATC. After several unsuccessful attempts and some discussion, ATC revised the frequency to 122.8 Mhz. The right seat pilot continued to try to activate the runway lights without success.

The flying pilot reported when the airplane broke out of the overcast, he was able to locate the airport's rotating beacon, but didn't see the runway. He set the airplane up in a descending spiral above the airport and kept looking for the runway. The flying pilot stated when he finally saw the runway, he felt the airplane was too low to make a successful approach and landing. The pilots stated it was so dark they couldn't see anything, so they decided to keep the wings level and land straight ahead. The airplane impacted terrain in an alfalfa field about one mile northwest of the airport.

INJURIES TO PERSONS

The left seat pilot was wearing both lap belt and shoulder harness at the time of impact. He was hospitalized overnight and received treatment for what he described as "whiplash" type injuries to his neck and shoulders. The pilot was released and returned to California, where further examination revealed a fracture of the C2 vertebra.

The right seat pilot was in the main cabin when the accident sequence initiated. He reported when he returned to his seat in the cockpit he fastened both the lap belt and shoulder harness. He was treated for cuts and lacerations to his head and hands, broken ribs, and fractures in three vertebrae in the lower back.

The left seat pilot stated: "When the engines quit, I kind of hunkered in, really tightened the belt and shoulder harness. [The right seat pilot] came back to his seat, got lap belt on but I don't know if he got the shoulder harness. I had a peripheral view of him going forward towards the instrument panel, while I was stationary at impact."

OTHER DAMAGE

The airplane collided with a barbed wire fence, a cedar tree windbreak and the free end of a center pivot irrigation rig during the impact sequence. Photographs are appended. The airplane also struck two farm fields during the crash sequence. The airplane fuel tanks were compromised during impact and there was evidence of fuel spillage on the alfalfa crop along the wreckage path.

CREW INFORMATION

The right seat pilot was employed as the Chief Pilot for the operator and was acting as pilot in command (PIC). He held an ATP Certificate, with an airplane multiengine land rating and a type rating in the accident make and model airplane. He completed a Biennial Flight Review on March 7, 1994. The pilot held a First Class Medical Certificate with no restrictions or



NTSB Detail: CHI94FA116

limitations, issued January 19, 1994. The NTSB Form 6120.1/2 indicated the pilot had 7,100 hours total flight time, with 2,570 hours in the accident make and model airplane. He had flown 169 hours in the accident make and model airplane within the 90 days preceding the accident.

The left seat pilot (second pilot) was a contract pilot employed frequently by the operator. He held an Airline Transport Pilot (ATP) Certificate, with an airplane multiengine land rating and a type rating in the accident make and model airplane. The type rating was issued October 21, 1993. The pilot held a First Class Medical Certificate with no restrictions or limitations, issued September 30, 1993. The NTSB Form 6120.1/2 indicated the pilot had 6,300 hours total flight time, with 390 hours in the accident make and model. He had flown 108 hours in the accident make and model airplane within the 90 days preceding the accident.

AIRCRAFT INFORMATION

The Canadair CL601-3A "Challenger" was manufactured in 1990. It was powered by two General Electric (GE) CF34-3A turbofan engines (original equipment). Airframe and engines had accumulated approximately 1108.5 hours since new. The airplane was operated under a Continuous Airworthiness Maintenance Program. The most recent inspection was a Daily Inspection dated March 19, 1994. No anomalies were noted. A copy of the Inspection sheet is appended.

The Challenger is equipped with an ADG which provides AC power in the event of an in flight total power loss. The ADG consists of a ram-air turbine (RAT) and an AC electrical generator. The pilots indicated they had an airspeed trade off, rate of descent/ADG operation vs. windmill airstart parameters. The Airplane Flight Manual notes:

With the ADG deployed, the time period above 250 KIAS must be minimized. For windmill airstarts, airspeed may be increased up to 330 KIAS for not more than twelve (12) minutes.

Information on the ADG flight envelope and engine restart procedures is appended.

The Challenger is fitted with a motive flow fuel system which uses a series of ejector pumps to supply fuel to the collector tanks, which then supply fuel (through ejector pumps) to the engines. The APU fuel supply is drawn directly from the right main fuel tank by an electric fuel pump. Pertinent excerpts from the aircraft and engine manuals, and the manufacturer's system description are appended.

COMMUNICATIONS

The flight crew was in radio contact with ATC during the emergency descent. Excerpts from the ATC package and a copy of the CVR transcript are appended.

AIRPORT INFORMATION

The Rock County Airport in Bassett, Nebraska, is an uncontrolled, unattended airport, with a field elevation of 2,349 feet. The airport has two runways: Runway 13/31 (4,698' X 75', asphalt) and Runway 02/20 (2,250' X 120', turf). The airport has a standard green and white rotating beacon, which operates continuously during hours of darkness or instrument meteorological conditions (IMC). The airport also has a runway lighting system which operates automatically between 6 am and midnight. Between midnight and 6 am, the runway lights can be activated by pilots "keying" the microphone switch three, five or seven times (for low, medium, or high intensity lights, respectively) on a frequency of 122.8 Mhz. Postaccident testing of the pilot controlled lighting system revealed it was capable of normal operation. The Common Traffic Advisory Frequency (CTAF) for RBE is 122.9 Mhz. An airport diagram is appended.

FLIGHT RECORDERS

There was no Flight Data Recorder required or installed in the accident airplane. The accident airplane was equipped with a Fairchild Cockpit Voice Recorder (CVR), Model A100A. The CVR showed no evidence of impact damage. It was removed from the airplane and transported to the NTSB Office of Research and Engineering in Washington, DC. A copy of the CVR transcript is appended.

WRECKAGE/IMPACT INFORMATION



NTSB Detail: CHI94FA116

The airplane impacted terrain near the top of a slight rise in an open field, on a 240 degree heading. The wreckage path was approximately 1,000 feet from initial observed ground scars to main fuselage resting point. About 360 feet from the initial ground scars, the airplane broke through a barbed wire fence and the right wing impacted a cedar tree windbreak. The outboard 4 feet of right wing were located within the stand of cedar trees. Shortly after the right wing struck the cedar trees, the left wing struck the free end of a center pivot irrigation rig, and the outboard 4 feet of the left wing separated. As the airplane continued along the wreckage path, it shed pieces of the right wing, left wing, horizontal stabilizer, landing gear, and other components. Photographs and a wreckage diagram are appended.

Examination of the airplane wreckage revealed the lower portions of the fuselage and wings exhibited tears, scrapes, buckles and punctures. The fuselage fuel tank and right wing fuel tanks were compromised during the impact sequence and there was a strong smell of fuel at the accident site.

Engine cowl doors were opened and both engines were examined. Examination of the left engine revealed tree twigs located at the left engine fan inlet duct, but no sign of physical damage to the fan blades. There were several small pieces of metal debris and metal dust located in the left engine exhaust pipe. Visual inspection of the turbine blades revealed small nicks and dents. The left engine fuel filter bypass button was "popped" (in the bypass position). The left engine fuel control unit (FCU) throttle linkage was in the OFF position and agreed with the cockpit throttle lever setting.

The right engine fan section was jammed and contained several large pieces of cedar tree. There were no other signs of metal or vegetative debris in the right engine. The right engine fuel filter bypass button was still depressed (not in the bypass position). The right engine FCU throttle linkage was in the IDLE position and agreed with the cockpit throttle lever setting.

TESTS AND RESEARCH

Samples of contaminated fuel were obtained from the right and left collector tanks, fuel filters, and APU during the on scene portion of the investigation. Fuel samples collected in the field indicated the right engine fuel system contained more water. This water had a yellowish tint and contained some particulate matter. The left engine fuel system samples yielded smaller portions of clearer water contamination. Fuel analysis was performed at the GE laboratories in Lynn, Massachusetts. Chemical analysis of the samples revealed the distinct layers of liquid were water and Jet A fuel, and the solid contaminants appeared to be nondistinct vegetative matter.

Both engines were removed from the airframe and shipped to the GE Aircraft Engines maintenance facility at Strother Field, Arkansas City, Kansas for teardown and examination. Fuel samples taken from the engines and components appeared consistent with fuel samples taken from the fuel tanks during the on scene investigation. The fuel from both sides exhibited water contamination, with some evidence of solid contaminants in the right side components.

Major damage to the left engine was limited to thermal damage to the turbine section. The right engine came into contact with the Cedar tree hedgerow during the impact sequence. Major damage to the right engine was to be limited to the fan section, where a large Cedar branch was jammed, and smaller bits of Cedar debris were located. An engine teardown report is appended.

Fuel filters, fuel control units, and fuel heaters were removed from both engines and shipped to the vendors for further testing and examination. There was no evidence of preimpact anomaly in these units. Component examination reports are also appended.

ADDITIONAL INFORMATION

The aircraft wreckage, except as noted on the NTSB Form 6120.15 Wreckage Release, was released to the owner's representative on March 23, 1994, upon completion of the on scene investigation. Retained components were released upon completion of required teardown/testing.

Probable Cause

the pilot in command's inadequate planning/decision making and inadequate preflight inspection after receiving a load of contaminated fuel. Related factors are the contaminated fuel, improper refueling by FBO personnel, and the dark night light



NTSB Detail: CHI94FA116

conditions.

Environmental Information

Basic Weather Conditions:	VMC
Visibility (sm):	10
Visibility RVR (ft):	0
Temperature:	8
Wind Direction (deg):	310
Wind Speed (knots):	17
Cloud Height:	0
Precipitation Type:	UNK
Light Condition:	NDRK

Aircraft Information: Aircraft #1

NTSB Number:	CHI94FA116
Phase of Flight:	570
Aircraft Damage:	SUBS
Operator Name:	CRYSTAL AIR AND AVIATION
Operator Code:	YRLA
Aircraft Type:	AIR
Aircraft Make/Model:	CANADAIR CL=601-3A
Aircraft Regist Nbr:	N88HA
Aircraft Serial Nbr:	5072
Number of Seats:	15
Landing Gear:	RETR
Cert. Max Gross Weight:	45100
Number Engines:	2

Engine Type (Eng1):	TF
Engine Make (Eng1):	
Engine Model (Eng1):	CF34-3A2

Type of Operation	UNK
Domestic/International:	
Passenger/Cargo:	
Departure Airport ID:	BVT
Departure City:	BURLINGTON
Departure State:	VT
Destination Airport ID:	LGB
Destination City:	LONG BEACH
Destination State:	CA
Flight Plan Filed:	IFR

Sequence of Events for Aircraft 1

Occurrence #1	
Phase of Flight	540
Altitude	0



NTSB Detail: CHI94FA116

Event Number 1
Subject Code: 20100
Cause Factor: F
Modifier Code: 2305
Person Code: 0

Event Number 2
Subject Code: 20200
Cause Factor:
Modifier Code: 2532
Person Code: 0

Event Number 3
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20100
Cause Factor: F
Modifier Code: 2305
Person Code: 0

Event Number 2
Subject Code: 20200
Cause Factor:
Modifier Code: 2532
Person Code: 0

Event Number 3
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Flight Crew Information for Aircraft #1

Crew Person 1

Crew Category: PLT
Seat Occupied PIC: RGT
Pilot Profession: PCIV
Medical Certif: CL1
Med Certif Valid: VNOW
Date Last Med: 01/19/1994
BFR: Y
Seatbelts Used: Y
Shlder Harness Used: Y

Flight Time Information for Crew Person 1

	MAKE	ALL	ACTUAL	SIMU	SENG	MENG	NIGHT
INST							



NTSB Detail: CHI94FA116

	MAKE	ALL	ACTUAL	SIMU	SENG	MENG	NIGHT
L24H	8	8				8	
L30D	41	41				41	
L90D	169	169				169	
PIC	2000	6060					
TOTL	2570	7110					1000

Injury Summary for Aircraft 1

Injury summary	Fatal	Serious	Minor	None	Total
First Pilot		1			1
Co-Pilot		1			1
Dual Student					
Flight Engineer					
Cabin Crew					
Other Crew					
Passengers					
Total Aboard		2			2



NTSB Detail: BFO90MA023

212 W. 8th Street
Cincinnati, OH. 45202
Phone: 513.852.5110

General Information

Event Type: ACC
NTSB Number: BFO90MA023
Report Status: F
Local Date/Time: 01/30/1990 2205
City, State: COLUMBIA MO
Airport: COU - COLUMBIA REGIONAL
Airport Involvement: Y
Injury Severity: FATL

Narrative

THE ACFT WAS EN ROUTE AT 31,000 FT, WHEN THE LOW PRESSURE FUEL FILTER WARNING LIGHT ILLUMINATED. THE PLT DIVERTED TOWARD COLUMBIA, MO, BUT BEFORE REACHING COLUMBIA, BOTH ENGINES LOST POWER. SUBSEQUENTLY, THE ACFT CRASHED ABOUT 2 MI EAST OF THE ARPT. AN INVESTIGATION REVEALED THE FUEL WAS CONTAMINATED WITH WATER. THE FUEL FILTER DEICING SYSTEM WAS OPERATIONAL, BUT A POST-ACDNT EXAM REVEALED THE DEICING TANK WAS EMPTY. THIS WAS THE 2ND FLT SINCE THE DEICE TANK HAD BEEN SERVICED. THE MANUFACTURER'S INFO INDICATED THE SUPPLY TANK SHOULD HAVE PROVIDED ABOUT 3 TO 4 HRS OF FILTER DEICING OPERATION.

Probable Cause

INADEQUATE PREFLIGHT BY THE PILOT(S), WATER CONTAMINATION OF THE FUEL, LOW LEVEL OF DEICE FLUID (METHANOL) IN THE DEICE TANK, AND SUBSEQUENT ICE BLOCKAGE OF THE FUEL FILTERS. DARKNESS WAS A RELATED FACTOR.

Environmental Information

Basic Weather Conditions: VMC
Visibility (sm): 15
Visibility RVR (ft): 0
Temperature: -1
Wind Direction (deg): 60
Wind Speed (knots): 8
Cloud Height: 0
Precipitation Type: UNK
Light Condition: NDRK

Aircraft Information: Aircraft #1

NTSB Number: BFO90MA023
Phase of Flight: 570
Aircraft Damage: DEST
Aircraft Type: AIR
Aircraft Make/Model: Hawker Siddeley HS.125-35
Aircraft Regist Nbr: G0B0B



NTSB Detail: BFO90MA023

Aircraft Serial Nbr:	25069
Number of Seats:	10
Landing Gear:	RETR
Cert. Max Gross Weight:	21700
Number Engines:	2
Engine Type (Eng1):	TJ
Engine Make (Eng1):	
Engine Model (Eng1):	522
Type of Operation	EXEC
Domestic/International:	UNK
Passenger/Cargo:	UNK
Departure Airport ID:	CSV
Departure City:	CROSSVILLE
Departure State:	TN
Destination Airport ID:	IXD
Destination City:	OLATHE
Destination State:	KS
Flight Plan Filed:	IFR

Sequence of Events for Aircraft 1

Occurrence #1	
Phase of Flight	540
Altitude	0
Sequence of Events	
Event Number 1	
Subject Code:	16906
Cause Factor:	
Modifier Code:	1220
Person Code:	0
Event Number 2	
Subject Code:	24002
Cause Factor:	C
Modifier Code:	3115
Person Code:	4000
Event Number 3	
Subject Code:	17001
Cause Factor:	C
Modifier Code:	1193
Person Code:	0
Event Number 4	
Subject Code:	17006
Cause Factor:	C
Modifier Code:	1161
Person Code:	0



NTSB Detail: BFO90MA023

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Event Number 1
Subject Code: 20200
Cause Factor:
Modifier Code: 2517
Person Code: 0

Flight Crew Information for Aircraft #1

Crew Person 1
Crew Category: PLT
Seat Occupied PIC: LEFT



NTSB Detail: BFO90MA023

Pilot Profession: PCIV
Medical Certif: CL1
Med Certif Valid: VNOW
Date Last Med:
BFR: Y
Seatbelts Used: Y
Shlder Harness Used: Y

Flight Time Information for Crew Person 1

	MAKE	ALL	ACTUAL	SIMU	SENG	MENG	NIGHT
INST							
L24H							
L30D							
L90D							
PIC							
TOTL	400	1525					

Injury Summary for Aircraft 1

Injury summary	Fatal	Serious	Minor	None	Total
First Pilot	1				1
Co-Pilot		1			1
Dual Student					
Flight Engineer					
Cabin Crew					
Other Crew					
Passengers			1		1
Total Aboard	1	1	1		3