Aviation Investigation Final Report

Location:	Watkins, Colorado	**Accident Number:**	DEN01FA044
Date & Time:	January 24, 2001, 11:27 Local	**Registration:**	N602MC
Aircraft:	Aero Vodochody Aero. Works L-39CT	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot departed from runway 26 in the military jet trainer and made an immediate steep left hand turn at an estimated 100 to 300 feet above the ground. Approximately 30 seconds later, the back seat canopy transparency failed and separated from the aircraft. The back seat passenger's headset and hat accompanied the transparency fragments to the ground. The airplane began oscillating divergently, pitching up to near vertical, turned right, and impacted the ground longitudinally oriented approximately 60 degrees to the right of the energy track alignment. The airplane's most recent empty weight CG calculations indicate that the airplane was at 34.98% MAC; the factory recommends a 27.7% MAC empty weight CG. The airplane's flight CG (with two occupants and the main fuel tank full) was calculated to be 29.58% MAC. The manufacturer recommends an approximate flight CG of 23 to 25.5% MAC. As the CG moves aft of this envelope, aircraft control becomes progressively more sensitive. The manufacturer reported that their test pilot's have flown the airplane with CGs as high 34% to 35% MAC, and aircraft records indicate that the pilot had previous flight experience with CGs in the 29% to 30% MAC range. Aircraft records also indicate that the pilot had 38.6 hours of flight experience in the airplane in approximately 3 years, and 6.6 hours of experience during the last 18 months. The night before the accident, the pilot had returned from a trip around the world in his Boeing Business Jet, with multiple business stops along the way. Analysis of the rear canopy's transparency indicated that it was embrittled.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's failure to maintain aircraft control, and the subsequent inadvertent stall/mush. Factors were the pilot's diverted attention due to the failure of the rear canopy's acrylic transparency and the loss of communication with his back seat passenger, the pilot's lack of recent experience in make/model airplane, the airplane's improper aft weight distribution (center of gravity), and the pilot's fatigue (circadian rhythm).

Findings

Occurrence #1: ABRUPT MANEUVER
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. (F) AIRCRAFT WEIGHT AND BALANCE - IMPROPER - PILOT IN COMMAND
2. (F) AIRCRAFT HANDLING - ABRUPT - PILOT IN COMMAND

Occurrence #2: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
3. (F) WINDOW,CANOPY - FAILURE

Occurrence #3: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
4. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND
5. (F) DIVERTED ATTENTION - PILOT IN COMMAND
6. (C) STALL/MUSH - INADVERTENT - PILOT IN COMMAND
7. (F) LACK OF RECENT EXPERIENCE IN TYPE OF AIRCRAFT - PILOT IN COMMAND
8. (F) FATIGUE(CIRCADIAN RHYTHM) - PILOT IN COMMAND

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

Findings
9. TERRAIN CONDITION - OPEN FIELD

Factual Information

HISTORY OF FLIGHT

On January 24, 2001, at 1127 mountain standard time, an Aero Vodochody L-39CT, N602MC, was destroyed when it impacted terrain while on departure from Front Range Airport, Watkins, Colorado. The airline transport pilot and his passenger were fatally injured. MAC Flightlease, Inc., of Portland, Oregon, was operating the airplane under Title 14 CFR Part 91. Visual meteorological conditions prevailed for the local flight that was originating at the time of the accident. No flight plan had been filed.

According to airport personnel, on the morning of the accident, the airplane was topped off with 135 gallons of jet fuel. The tip tanks were not fueled, and an employee of the pilot said that the pilot always flew with them empty. Several witnesses observed the airplane taxi to runway 26 for departure (a tail wind departure). A pilot, in his airplane on the run up pad for runway 26, observed the accident airplane begin its takeoff roll while there was a Cessna 172 (possibly a 182) over the numbers on the departure end of the runway.

A pilot in a Cessna 182, who was on 3/4 to 1 mile final when the accident airplane took the active runway, said she was surprised to see the jet on the runway in front of her. She didn't hear any radio calls from him to indicate that he was taking the active runway for departure. She said that she had to slow down and do a couple of "S" turns to allow for spacing. Another witness said that the accident airplane lifted off after a ground roll about 3,800 to 4,000 feet, but appeared to be flying really slow. Several witnesses observed the airplane make a sharp left turn, at approximately 100 to 300 feet above the ground, just past the end of the runway. Another pilot observed the accident airplane taking off and thought it was "very low" and then observed it make a sharp left turn (estimated to be 70 to 90 degrees of bank). He said he could see the whole top of the airplane in the turn. Another pilot said that the Cessna in front of the jet was flying its crosswind leg when the accident airplane began its turn over the departure end of runway 26. One pilot said that she heard no radio transmissions from the accident airplane through his entire departure sequence from Front Range Airport.

Federal Aviation Administration (FAA) radar data indicates that at 1126:19, the airplane crossed the departure end of runway 26 at approximately 173 knots. At 1126:33, the airplane was turning southbound, and had lost an estimated 15 knots of airspeed. No altitude information could be retrieved from the radar data because the airplane's transponder was not emanating any signals. Approximately 2 nautical miles (nm) south of runway 26, the last raw radar return was recorded at 1126:56; the accident airplane's airspeed was estimated to be 200 knots.

A witness, driving south on Imboden Road, reported seeing a cloud of debris depart aft of the

airplane, and flutter in the sunlight to the ground. She said it looked like the airplane was discharging trash. She said the airplane suddenly nosed down and headed straight for the ground. A pilot driving north on Imboden Road said he saw the airplane fly nearly straight at him at approximately 300 feet. He said the airplane rolled left, and went straight down. A retired airline mechanic also driving north on Imboden Road said he estimated that the airplane was 400 feet above the ground and flying straight at him. He said that it was moving up and down "very quickly, in a real quick jerky manner [short frequent longitudinal oscillations]."

A pilot flying approximately 1.5 nm behind the accident airplane said that she observed the jet to enter a very slight left bank, and climb slightly. Suddenly, she saw the jet's nose "go straight vertical," as if entering an aerobatic maneuver. The pilot then observed the jet nose-over to the right (west) and impact the ground. A witness standing outside of his home said he saw the airplane's right wing suddenly drop, and the airplane nosed down approximately 45 degrees. He said that there was never any discernible change in its engine noise. The witness said the airplane appeared to be flattening its dive and may have rotated slightly clockwise before disappearing from sight.

The first police and fire/rescue personnel arrived on the scene at approximately 1140.

PERSONNEL INFORMATION

According to FAA records, the pilot received his airline transport pilot certificate on August 30, 1999; he was also a certificated flight instructor and ground instructor. On his last FAA flight medical application dated July 26, 2000, he reported that he had 5,100 hours of flight experience with 250 hours during the previous 6 months. The pilot reported on his last insurance application, dated August 27, 2000, that he had successfully completed a flight review and instrument competency check on August 15, 2000.

The pilot flew his first demonstration flight in the airplane on October 21, 1997, then purchased it and registered it with the FAA on December 16, 1997. During the months of March and April of 1998, he received 13 hours of ground school and 11 hours of flight training in the airplane . On April 17, 1998, a Letter of Authorization (LOA) was issued to the pilot by the FAA; it was good through April 30, 2000. The only flight limitation of his LOA was that he could not fly in formation with another airplane. The letter also required the pilot to make at least three takeoffs and landings in this model airplane within the preceding 6 calendar months, or the privileges of the LOA were rescinded. On July 15 and 16, 2000, the pilot received an estimated 2 hours of ground instruction and two flights in the airplane with an instructor for a total of 2.3 hours. The FAA issued the pilot a new LOA which was good through July 31, 2002.

A pilot flight logbook, documenting the pilot's L-39 flight time could not be found. The pilot reported on the airplane's insurance application, dated August 2000, that he had 150 hours in L-39s. His L-39 flight instructor estimated that the pilot had between 40 to 50 hours of L-39 flight experience. Maintenance logbooks, an aircraft flight log tracking sheet, and statements

from other L-39 pilots suggest that the pilot had a total 38.6 hours of L-39 flight experience and 6.6 hours during the last 18 months.

An employee of the pilot said the pilot flew to Washington D.C. in his Boeing Business Jet (BBJ) for the Presidential inauguration and associated events on January 20, 2001. On January 21 and 22, he flew (with three other crew members) to Europe and on to Shang hai, China, with stops at several locations for business meetings. On January 23, he was in Seattle, Washington, for a 5 hour meeting, and then flew home to Denver that evening. The next morning he flew the accident flight with the L-39.

AIRCRAFT INFORMATION

The airplane was a Czech Republic military single engine, turbofan (jet) trainer, two seat tandem airplane (39.8 feet in length; 31 feet total wing span), which was manufactured by the Aero Vodochody Company in 1991 (approximately 3,000 were built). It was never delivered to the original buyer, and was refurbished and recertified in 1996. It was powered by an AI-25TL turbofan engine which had two shafts, by-pass flow, 12-stages of compressor, annular combustion chamber, three stages of gas turbine, which had a maximum sea level static thrust of 3,790 pounds. One pilot, who flew the airplane, said that at 25,000 feet, the airplane easily cruised at a true airspeed of 320 knots; the airplane's flight manual states that the airplane's maximum airspeed, without wing tanks or external stores, was 490 knots.

The airplane was certified for a maximum takeoff weight of 10,600 pounds, and a maximum landing weight of 10,582 pounds. The fuselage fuel tank held 289 gallons (1,936 pounds), and two 58 gallon wing tanks held an additional 104 gallons of usable fuel (704 pounds). The engine had an estimated 180 to 200 gallon per hour fuel burn rate. The maintenance records indicated that the last annual inspection was performed in Oklahoma City, Oklahoma, between August 14, 2000, and October 28, 2000. The previous annual was performed in Gadson, Alabama, between September 27, 1999, and October 19, 1999.

The airplane's empty weight when it left the factory in the Czech Republic, was 7,362 pounds; its center of gravity (CG) was 27.8 percent of mean aerodynamic cord (MAC). The manufacturer's manuals state that the airplane's CG, in its empty weight condition, must be 27.7 percent, plus or minus 0.5 percent of MAC. The manuals further state that a standard aircraft load (with two occupants and main fuel tank full) should have an approximate flight CG of 23 percent, not to exceed 25.5 percent, for the airplane's self-dampening characteristics to be effective. That is, if a sharp, spontaneous elevator movement is made by the pilot, the plane is designed to self-dampen long period longitudinal and short period longitudinal oscillations, if the CG is in the 23 percent to 25.5 percent envelope. As the CG moves aft of this envelope, aircraft control becomes progressively more sensitive, and the flight regime of negative static stability (divergent stability) increases.

The accident airplane was last weighed in Oklahoma on November 17, 2000; its empty weight was 7,349 pounds and maintenance personnel calculated its CG to be 34.42 percent of MAC.

A representative from the airplane's manufacturer, using the November 17, 2000 weight figures, computed the airplane's CG to be 34.98 percent of MAC. He further stated that with two pilots and main fuel tank full the CG would be 29.58 percent of MAC. The CG flight envelope, according to manufacturer's specification, is 21 to 26 percent MAC. Calculations by an L-39 maintenance consultant indicate that the loss of the rear seat's canopy transparency would move the CG aft an additional .25 percent of MAC. The airplane's manufacturer's representative said that an L-39 had been flown by a very experienced, factory test pilot with the whole canopy and the ejection seat missing, and had an estimated 34 percent to 35 percent of MAC.

Witness statements and maintenance records indicate that the pilot had nearly all of his L-39 flight experience with his airplane's empty weight CG between 34 percent and 35 percent MAC. In October, 1999, during its annual inspection in Gadson, Alabama, approximately 200 pounds of weight was placed in the airplane to produce an empty weight CG of 27.6 percent MAC. Maintenance records and a flight tracking sheet suggest that the pilot had 6.1 hours of flight experience with the airplane at this CG. On October 17, 2000, during its next annual, the 200 pounds of weight was removed from the airplane to create a CG of 34.42 percent [recalculated to be 34.98 percent] MAC. Witness statements and maintenance records indicate that the accident flight takeoff was the pilot's first takeoff since the CG had been adjusted back to the 34 percent to 35 percent MAC range.

An experienced L-39 pilot reported that L-39s require approximately 4,000 feet of runway to get airborne. He said that he departed a runway in Colorado once, and he used approximately 2.5 nm to accelerate to a recommended maneuvering speed of 220 knots. He also said that L-39s stall in clean configuration at approximately 98 knots. When they do stall, he said, they give an "aero rumble," nose down 3 to 5 degrees, and fall at about 2,000 feet per minute. The airplane's ground training guide states that during a stall "all control devices remain effective."

An employee of the pilot, who performed the airplane's preflight inspection with the pilot, said that the airplane's flight hour meter read 118.1 hours. He further stated that the ejection seats on the accident airplane were not armed.

METEOROLOGICAL INFORMATION

At 1053, the weather conditions at the Denver International Airport (elevation 5,431 feet), 315 degrees 7 nm from the accident site, were as follows: wind 050 degrees at 5 knots; visibility 10 statute miles; cloud condition 3,500 feet agl few, 22,000 feet agl broken; temperature 34 degrees Fahrenheit; dew point 24 degrees Fahrenheit; altimeter setting 30.35 inches. The density altitude was calculated to be 4,792 feet.

The sun was approximately 30 degrees above the horizon on an approximate 166 degree heading from the accident site.

AERODROME INFORMATION

The Front Range Airport (FTG; elevation 5,512 feet), Watkins, Colorado, is not serviced by a control tower. Two runways are available, 26-08, and 35-17. The airport lies under Denver International Airport's Class B airspace, which has a floor of 7,000 feet over Front Range Airport. The eastern edge (to the ground) of DIA's class B airspace is located 5,200 feet west of the departure end of runway 26. When aircraft use runway 26, a southbound turn is required so as not to enter Denver's class B airspace; the boundary is designated by Imboden Road (north-south).

WRECKAGE AND IMPACT INFORMATION

The airplane was found on a rolling grass covered field (elevation 5,546 feet, N39 degrees 45.75', W104 degrees 34.75') approximately 2 nm southwest of the Front Range Airport. The main debris path was oriented 168 degrees; the impact point ground scar suggested that the longitudinal axis of the airplane, at impact, was heading 225 to 230 degrees. The impact ground scar (including appropriately identified red and green navigation light lenses) and identifiable wreckage, suggested that the airplane impacted the ground relatively wings level and in a flat orientation.

All of the airplane's major components were accounted for at the accident site. Flight control continuity could not be established due to impact damage and postimpact fire. The instrument panel and flight controls were destroyed and/or separated from the fuselage. The fuselage was found approximately 250 feet from the impact point and the pilot was found associated with it. The passenger was located approximately 315 feet from the impact point.

Postaccident examination of the engine revealed no evidence of an in-flight fire, uncontainment, or case rupture. The turbine blades and vanes did not have any metallization on them. The fan blades were bent opposite the direction of rotation and the vanes were bent towards the direction of rotation.

The rear ejection seat was firmly attached to the ejection seat rails. An acrylic transparency (Plexi glass) fragment field (approximately 300 feet long by 150 feet wide), containing the back seat passenger's hat and head set, was found approximately 1,000 feet north of the main impact site (150 feet east of Imboden Road).

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the pilot by the Adams County Coroners Office, Brighton, Colorado, on January 25, 2001.

The FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City, Oklahoma, performed toxicology tests on the pilot. According to CAMI's report (#200100020001), the pilot's muscle tissue sample was tested for drugs with negative results; carbon monoxide and cyanide tests were not performed. The following volatiles were found in lung and muscle samples: ethanol

and acetaldehyde. CAMI personnel reported that the ethanol and acetaldehyde (an ethanol intermediate product; either production of or metabolite of) found in this case may potentially be from postmortem formation.

TESTS AND RESEARCH

The L-39CT's canopy acrylic transparencies were manufactured by Aerospace Composite Technologies located in Luton, England. The 3/8 inch thick acrylic transparencies were installed in their respective canopy frames at the airplane's factory in the Czech Republic in 1996. Pieces of the failed acrylic transparency were submitted to the Department of the Air Force, Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio, for analysis. Their representative stated that the back canopy transparency failed because of acrylic embrittlement (chemical contamination to the acrylic substrate). He said this could be a result of aggressive cleaning fluids getting into the canopy frame and staying there during thermal and structural loading. He said the canopy system design comes from the 1950's, and there are no channels in the canopy frame to allow fluids to dissipate. Surplus inappropriate cleaning chemicals can build up and soak into the acrylic substrate. Subsequent thermal and/or mechanical stresses can fracture the acrylic. The research scientist, who determined that the back seat acrylic transparency was altered, said that destructive testing was not accomplished. She said that the test that was performed only showed polymer deterioration, which could be attributed to ultraviolet exposure, thermal exposure, chemical damage, or manufacturing defect.

The Life Sciences Equipment Laboratory, Brooks Air Force Base, San Antonio, Texas, examined the airplane's back canopy frame. A representative of that facility said the following:

"The damage observed on the rear cockpit canopy structures indicate that the front and rear canopy locks were not properly secured to their respective latches at the time the damage occurred. It also indicates that the top of the canopy locks were in contact with canopy structures that were adjacent to both sides of the front and rear latches. It is considered improbable that the type of damage noted in this mishap was the result of a single motion such as aircraft impact with the terrain. Instead, it is considered much more likely that the damage observed was the result of multiple motions, such as flexing of the canopy frame while in-flight; resulting from rear canopy locks not being properly secured at some point during the flight prior to aircraft impact with the terrain."

The airplane manufacturer's maintenance manual indicates that the L-39CTs have rubber seals between the canopies and the aircraft's frame. When the canopies are lacked closed, these seals can be inflated pneumatically, which permits cabin pressurization, external noise reduction, and holds the canopies securely in place. The airplane's Pilot Ground Training Manual states that on the back seater's center console, there is a round blue knob (up and down actuation) which permits the back seater (normally the flight instructor) to deactivate the rear canopy seal only. This would permit the flight instructor to demonstrate a cabin depressurization while in flight.

An employee pilot of the accident pilot, who had LOAs in MIG fighter type aircraft, said that he flew with the pilot in the L-39CT on November 18, 2000. He said the pilot had asked him to fly the airplane, but the employee agreed to do so only if the pilot flew with him. The employee flew the airplane from the front seat, and the pilot rode in the back seat. The employee pilot said that while in flight, during high "G" maneuvers, he could hear and feel the rear canopy to chatter loudly. This abnormality, along with persistent intermittent canopy ajar light, persuaded him to terminate the flight early. He landed the airplane after approximately 30 to 35 minutes of flight. This was the last flight before the accident.

Another L-39 pilot said that on two occasions, he has had passengers inadvertently move the blue seal depressurization knob (deactivating the rear canopy seals), while getting into the back seat. He said that for lower altitude flights, the front seat pilot probably would not be aware of it.

ADDITIONAL DATA

The airplane, including all components and logbooks, was released to the owner's insurance representative on March 21, 2002.

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	46,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 None	**Last FAA Medical Exam:**	July 26, 2000
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	August 27, 2000
Flight Time:	5100 hours (Total, all aircraft), 150 hours (Total, this make and model), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Aero Vodochody Aero. Works	**Registration:**	N602MC
Model/Series:	L-39CT	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	135234
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	October 18, 2000 Annual	**Certified Max Gross Wt.:**	10166 lbs
Time Since Last Inspection:	2 Hrs	**Engines:**	1 Turbo fan
Airframe Total Time:	118 Hrs at time of accident	**Engine Manufacturer:**	Ivchenko
ELT:	Not installed	**Engine Model/Series:**	AI-25
Registered Owner:	MAC Flightlease, Inc.	**Rated Power:**	3790 Lbs thrust
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	DEN,5431 ft msl	**Distance from Accident Site:**	7 Nautical Miles
Observation Time:	10:53 Local	**Direction from Accident Site:**	315°
Lowest Cloud Condition:	Few / 3500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	50°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.35 inches Hg	**Temperature/Dew Point:**	1°C / -4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Watkins, CO (FTG)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	11:26 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	39.762222,-104.57917

Administrative Information

Investigator In Charge (IIC):	Struhsaker, James
Additional Participating Persons:	Randy Holder; Denver, CO
Original Publish Date:	July 15, 2002
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=51387