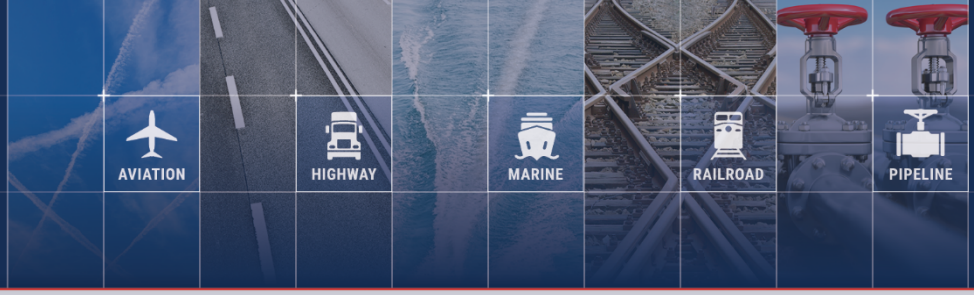

Aviation Investigation Factual Report

Location:	Detroit Lakes, Minnesota	**Accident Number:**	CEN13FA101
Date & Time:	December 7, 2012, 22:34 Local	**Registration:**	N212M
Aircraft:	Cessna 501	**Aircraft Damage:**	Substantial
Defining Event:	Inflight upset	**Injuries:**	6 None
Flight Conducted Under:	Part 91: General aviation - Personal		

On December 7, 2012, about 2234 central standard time, a Cessna model 501 airplane, N212M, was substantially damaged during recovery from an unusual attitude after departing from Detroit Lakes Airport (KDTL), Detroit Lakes, Minnesota. The two pilots and four passengers were not injured. The airplane was registered to Makaira Aircraft Sales LLC and operated under the provisions of 14 Code of Federal Regulations Part 91 while on an instrument flight plan. Night instrument meteorological conditions (IMC) prevailed at the flight level of the accident, which had an intended destination of Bessemer Airport (KEKY), Bessemer, Alabama.

After takeoff from Runway 31, the pilot stated that the airplane entered IMC about 1,000 feet above ground level (AGL) and the autopilot was engaged about 3,000 feet mean sea level (MSL); 2,400 AGL. After receiving an air traffic control (ATC) clearance for a left turn on course, he rotated the heading select 'bug' to command the autopilot to initiate a left turn. While climbing through approximately 7,000 MSL, with the autopilot still engaged, the pilot stated that the airplane rolled to the left and transitioned rapidly into a nose down descent. Both pilots stated that their attention had been focused away from the attitude indicators during the time immediately prior to the unusual attitude commencing.

The pilot disconnected the autopilot and attempted to recover the airplane, which he observed had entered into a nearly inverted, left turning spiral, with a steep nose down attitude. To recover from the unusual attitude, the pilot referenced the standby attitude indicator, turn needle, and heading indicator. Both wings were structurally damaged during recovery from the nose low attitude.

Radar track data indicated on departure from KDTL, the airplane made a climbing left turn, leveled at 6,000 feet MSL, and subsequently flew straight ahead at 6,000 feet MSL for about 30 seconds. Next, the airplane made a climbing, right turn to about 7,200 feet MSL and then transitioned into a descending spiral to the right, with a descent rate exceeding 10,000 feet per minute. The descending spiral continued until about 3,500 feet MSL. The airplane then transitioned to a right climbing turn through 4,800 feet MSL and subsequently began to climb with a wings level attitude. A radar study, which includes ground tracks and flight parameters, is located in the NTSB public docket.

Pilot Information

Certificate:	Airline transport	**Age:**	62
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	October 4, 2012
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	June 11, 2012
Flight Time:	10161 hours (Total, all aircraft), 810 hours (Total, this make and model), 9850 hours (Pilot In Command, all aircraft), 61 hours (Last 90 days, all aircraft), 29 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Commercial	**Age:**	50
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 25, 2011
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	April 20, 2012
Flight Time:	1498 hours (Total, all aircraft), 273 hours (Total, this make and model), 1225 hours (Pilot In Command, all aircraft), 65 hours (Last 90 days, all aircraft), 26 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

The pilot, age 62, held an airline transport pilot certificate, with single-engine and multiengine land airplane ratings. He reported 10,161 total flight hours, with 810 hours in the make and model of the accident airplane. The acting copilot, age 50, held a commercial pilot certificate, with single-engine and multiengine landing ratings. He reported 1,498 total flight hours, with 273 hours in the make and model of the accident airplane.

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N212M
Model/Series:	501	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	501-0280
Landing Gear Type:	Retractable - Tricycle	**Seats:**	8
Date/Type of Last Inspection:	Continuous airworthiness	**Certified Max Gross Wt.:**	12500 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo fan
Airframe Total Time:	3612 Hrs at time of accident	**Engine Manufacturer:**	P&W CANADA
ELT:	Installed, not activated	**Engine Model/Series:**	JT15D-1
Registered Owner:	MAKAIRA AIRCRAFT SALES LLC	**Rated Power:**	2200 Lbs thrust
Operator:	MAKAIRA AIRCRAFT SALES LLC	**Operating Certificate(s) Held:**	None

The accident airplane, a Cessna 501 (serial number 501-0280) was manufactured in 1977. It was registered with the Federal Aviation Administration (FAA) on a standard airworthiness certificate and certificated for single pilot operation. The logbooks showed a total time of 3,612 hours as of December 5, 2012.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	KDTL,1397 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	22:13 Local	**Direction from Accident Site:**	262°
Lowest Cloud Condition:	1900 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 1900 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.03 inches Hg	**Temperature/Dew Point:**	-5°C / -9°C
Precipitation and Obscuration:	In the vicinity - None - Snow		
Departure Point:	Detroit Lakes, MN (DTL)	**Type of Flight Plan Filed:**	IFR
Destination:	Bessemer, AL (EKY)	**Type of Clearance:**	IFR
Departure Time:	22:32 Local	**Type of Airspace:**	Class E

The weather observing station at KDTL, located 5 miles east of the unusual attitude location, reported the following conditions at 2213: wind 140 at 3 knots, visibility 10 miles, broken

clouds at 1,900 feet AGL, temperature minus 5 degrees Celsius, dew point minus 9 degrees Celsius, altimeter setting 30.03. The pilots stated that light snow was occurring at the time of takeoff. Upper air soundings from Aberdeen, South Dakota and Chanhassen, Minnesota near the accident time indicate that moderate or greater rime icing would have been likely from 2,000 feet through 14,000 feet MSL.

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	4 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	6 None	**Latitude, Longitude:**	46.820835,-96.009719(est)

Tests and Research

Following the accident, Federal Aviation Administration (FAA) personnel examined the airplane and observed about a quarter cup of water pooled at the bottom of the forward avionics bay, as well as openings (not water tight) in the nose radome quick release latches.

The NTSB, FAA, and an avionics technician conducted avionics testing of the airplane about ten weeks after the accident. A moderate amount of snow was observed in the forward avionics bay, as the airplane had been parked on a ramp during several high-wind snowstorms. Previous to the accident, nose radome quick release latches were installed utilizing Sierra Industries supplemental type certificate (STC) SA8437SW.

The avionics system was tested in accordance with Sperry maintenance manual ground test procedures. With ground power connected, the #1 and #2 attitude systems, autopilot, and flight director system were tested, with no anomalies noted. The heading system tested normally, although the #2 heading system exceeded the manufacturers recommended time to retract its warning flag, requiring nine minutes vice the recommended five minutes. The #1 vertical gyro, #1 vertical gyro (Ledex) switching unit (relay), autopilot computer, and flight director computer were removed from the airplane for follow on testing.

The #1 vertical gyro and vertical gyro switching unit were examined and tested by an avionics overhaul facility, with oversight by FAA personnel. The vertical gyro became erect and operational within specified limits and gyro output signals were verified to be within manufacturer specifications. The

vertical gyro case was opened and proper bearing movement was confirmed, with no evidence of previous moisture. The vertical gyro base, which holds the electronic circuit boards, was dissembled and inspected for evidence of moisture, with two small areas of corrosion noted. The vertical gyro was reassembled and a Precession Test was conducted, which showed values within manufacturer specifications.

With FAA oversight, the flight director computer (Z-500, P/N 4018369-901) was examined and tested at a Honeywell facility. No corrosion or water damage was observed on the interior or exterior of the unit. No short or blown fuses were detected during manual functional testing and the flight director passed acceptance testing.

The autopilot computer (SPZ-200, P/N 4008519-911) was also examined and tested at the Honeywell facility. No moisture or water damage was observed on the interior of the unit. Black spots were observed on the left and right side of the chassis and boards where the connector pins extended downward. The substance/spots were not able to be rubbed off. The autopilot was subjected to acceptance testing, with two tests marginally out of tolerance. No short or blown fuses were detected during simple manual functional testing.

Additional testing of the autopilot computer, which included cold temperature conditions, was conducted by an avionics overhaul facility, with oversight by FAA personnel. An avionics technician at the overhaul facility was familiar with previous failures of the fault isolation transformer in the SPZ-200 autopilot computer which had produced an uncommanded roll of the autopilot. The avionics technician stated that the isolation transformer was often intermittent in operation, and it was often difficult to recreate a failure on the bench. No anomalies with the autopilot computer were discovered during the additional testing. Moisture conditions were not introduced during any of the tests.

Additional Information

The pilots estimated the time from engine start to departure at KDTL was about seven minutes. A minimum avionics warm up time is not required by the flight manual, other than to ensure that avionics warning flags are not in view.

Administrative Information

Investigator In Charge (IIC):	Folkerts, Michael
Additional Participating Persons:	Karmen C Johnson; Federal Aviation Administration; Fargo, ND
Report Date:	March 26, 2014
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=85807