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

SUMMARY OF OPERATIONAL FACTORS

-- CEN17FA072 --

A. ACCIDENT

Location: Cleveland, Ohio
Date: December 29, 2016
Time: 2257 eastern standard time
Aircraft: Cessna 525C (Citation CJ4) airplane (s/n 525C0072), N614SB

B. PARTICIPANTS

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C. HISTORY OF FLIGHT

On December 29, 2016, at 2257 eastern standard time, a Cessna model 525C (Citation CJ4) airplane, N614SB, was destroyed during an in-flight collision with Lake Erie shortly after takeoff from runway 24R (6,604 feet by 150 feet, asphalt) at the Burke Lakefront Airport (BKL), Cleveland, Ohio. The pilot and five passengers were fatally injured. The airplane was registered to Maverick Air LLC and operated by the pilot under the provisions of Title 14 Code of Federal Regulations Part 91 as a personal flight. Night visual meteorological conditions prevailed for the flight, which was operated on an instrument flight rules (IFR) flight plan. The intended destination was the Ohio State University Airport (OSU), Columbus, Ohio.

The pilot and passengers initially departed OSU about 1730 and arrived at BKL about 1800. The pilot checked in at the fixed base operator (FBO) at 1812. The pilot and passengers reportedly attended a local sporting event before returning to the airport about 2230.

A review of the air traffic control (ATC) communications transcript, the cockpit voice recorder (CVR) transcript, automated dependent surveillance – broadcast (ADS-B) data, and full authority digital engine control (FADEC) unit data revealed the following: At 2247, the pilot contacted the BKL tower controller and requested an IFR clearance. At 2250, the pilot requested a taxi clearance. At 2255, the pilot informed the tower controller that he was holding short of runway 24R and ready for takeoff. The controller subsequently cleared the pilot for takeoff and instructed him to turn right to a heading of 330° and maintain 2,000 feet mean sea level (msl) after departure. The pilot acknowledged the clearance.

At 2256:33, the engine power increased for takeoff, and 15 seconds later the airplane became airborne. At 2257:09, an automated voice annunciated "altitude."[1] A second "altitude" annunciation followed 14 seconds later. At 2257:25, a sound similar to a decrease in engine power was recorded. Two seconds later, the enhanced ground proximity warning system (EGPWS) annunciated an excessive bank angle warning.[2] At 2257:29, about 2 seconds after the bank angle warning, the tower controller instructed the pilot to contact departure control. The CVR recorded "to departure six one four sierra bravo;" however, the tower controller did not receive that communication.[3]

At 2257:37, the controller again attempted to contact the pilot. However, two seconds after the controller's transmission, the EGPWS provided a "sink rate" warning to the pilot. The pilot again responded, "six one four sierra bravo," but this was not received by the tower controller. Beginning at 2257:43, the EGPWS provided 7 "pull up" warnings at 1.6-second intervals until the end of the CVR recording.[4] During that time, a sound similar to the overspeed warning began, which continued until the end of the recording.[5] The CVR recording ended at 2257:58.

The tower controller's continued attempts to contact the pilot were unsuccessful, and he subsequently initiated search and rescue procedures.

ADS-B position data depicted the airplane entering a right turn shortly after crossing the runway departure threshold. About 2257:28, the airplane became established on a magnetic course of 310 degrees. During that time, the airplane reached an altitude of approximately 2,925 feet msl. About 5 seconds later, the airplane entered a descending right turn that continued until the final data point. The final data point was recorded at 2257:52 and was located 1.83 miles northwest of BKL. The altitude was 775 feet msl; about 205 feet above the lake.

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[1] In normal operations, the altitude preselect mode will provide an annunciation passing ±1,000 feet from the preselected altitude. Once tracking the selected altitude, the system will provide an alert if the airplane deviates more than 200 feet.

[2] The EGPWS will provide a warning if the bank angle exceeds 50° when the airplane is operating above 210 feet above ground level.

[3] The CVR will record any audible sound that is picked up by the cockpit area microphone or a connected microphone such as on a pilot's headset. However, any sound picked up by a pilot's headset will not be transmitted unless the push-to-talk switch is simultaneously depressed. The presence of the pilot's response on the CVR recording in conjunction with the absence on the ATC recording is consistent with the pilot not having the push-to-talk switch depressed.

[4] The EGPWS will provide a sink rate warning within 2,450 feet of the terrain. At 2,450 feet, the triggering descent rate is 5,007 fpm. This varies linearly to a descent rate of 964 fpm at 10 feet.

[5] The maximum operating limit speed (V_{MO}) below 8,000 feet is 260 KIAS.

An NTSB aircraft performance study indicated that after takeoff the airplane pitch attitude was about 5° nose up for approximately 8 seconds. The airplane accelerated to about 215 knots. The pitch attitude increased to about 16° nose up and the rate of climb reached over 6,000 fpm during the initial climb. Beginning about 2257:25 and continuing over the next 12 seconds, the pitch attitude began to steadily decrease until reaching about 15° nose down. The airplane accelerated to about 300 knots and the rate of descent reached about 6,000 fpm once it became established in the descent.

The performance study also indicated that the airplane entered a right turn after takeoff and the bank angle steadily increased until 2257:31 when it reached about 62° (right wing down). Over the next 14 seconds, the bank angle decreased to about 40° right wing down. The bank angle decreased further to about 25° right wing down shortly before the accident.

The ADS-B data included information related to the altitude preselect and heading bug settings. The altitude preselect setting was consistent with the 2,000-foot altitude assigned to the accident flight. The heading bug was set to 240° until 2257:11. Over the following 12 seconds, the heading bug was reset to 329° where it remained for the duration of the flight.

D. PERSONNEL INFORMATION

The pilot's Cessna 525 single-pilot type rating was added December 8, 2016, after he successfully completed the prescribed Federal Aviation Administration (FAA) practical test (checkride). His initial Cessna 525 training was completed in the accident airplane. The pilot subsequently completed a simulator-based recurrent training course at FlightSafety International on December 17, 2016.

The pilot had accumulated a total of 56.5 hours in CE-525 airplanes. Of that time, 8.7 hours were as pilot-in-command which included the practical test. His most recent logged flight was on December 17 from Orlando International (MCO) to OSU. The pilot owned a Cessna 510 (Mustang) for about 2 years before purchasing the accident airplane. He had logged 372.9 hours total time in Cessna 510 airplanes.

According to the pilot's colleague, the pilot normally went to bed about 2200 and woke up about 0600. He was in good health with no significant medical issues.

The pilot's colleague reported that on December 26, three days before the accident, the pilot was off work. On December 27, two days before the accident, and on December 28, the day before the accident, the pilot was in the office from 0800 until 1700. The last recorded cellphone activity for those days was an outgoing call that ended at 2035 and 2229, respectively.

On December 29, the day of the accident, the pilot was in the office about 0800. He visited a new building that was under construction that morning and returned to the office after lunch. He left for the day about 1600. That afternoon, he flew to BKL to attend a basketball game. The accident occurred during the return flight to OSU.

Night	Sleep	Wake[6]	Sleep Opportunity
1 night prior	2229[7] December 28, 2016	0600 December 29, 2016	7 hrs 31 min
2 nights prior	2035[8] December 27, 2016	0600 December 28, 2016	9 hrs 25 min
3 nights prior	2200[9] December 26, 2016	0600 December 27, 2016	8 hrs 00 min

E. METEOROLOGICAL INFORMATION

At 2253, the observed conditions at BKL were: wind 260° at 25 knots, with gusts to 31 knots; 8 miles visibility in light snow; scattered clouds at 1,200 feet above ground level (agl), broken clouds at 2,200 feet agl, overcast clouds at 3,200 feet agl; temperature 1° Celsius, dew point -2° Celsius; and altimeter 29.74 inches of mercury.

At 2300, the observed conditions at BKL were: wind from 260° at 22 knots, with gusts to 31 knots; 9 miles visibility; scattered clouds at 1,500 feet agl, broken ceiling at 2,300 feet agl, overcast skies at 3,900 feet agl; temperature of 1° C, dew point temperature of -2° C; and altimeter of 29.74 inches of mercury.

The observations from BKL and Cleveland Hopkins International (CLE) indicated that marginal visual conditions[10] prevailed at the time of the accident. Precipitation was reported in the one-minute observations at BKL until 2251, with no precipitation reported at the surface until 2342. While the surface temperature remained above freezing after the airplane landed at BKL and about the accident time, the dew point temperature remained below freezing the entire time with precipitation occurring on and off in the snow shower activity.

There were no Significant Meteorological Information advisories valid for the accident site at the accident time. No Center Weather Service Unit (CWSU) Center Weather Advisories were valid for the accident site at the accident time. Airmen's Meteorological Information (AIRMET) advisories Zulu, Tango, and Sierra were issued at 2145 and valid at the accident time for the accident site. The AIRMETs forecasted IFR conditions due to precipitation and mist, moderate icing conditions below 10,000 feet msl, and moderate turbulence below 10,000 feet msl.

The possibility of a trace to light icing was present at low altitudes at the time of the accident flight.

F. AIRPORT INFORMATION

Burke Lakefront Airport (BKL) is located along the south shoreline of Lake Erie within the metropolitan area of the city. The airport elevation is about 584 ft, which is approximately 14 ft above the level of the lake. Visual cues are available from the city

[6] Conversations with the pilot's colleague suggested that he awoke about 6am every day.
[7] Outgoing text message at 2229
[8] Outgoing phone call at 2029:04 duration 5 min 56 sec
[9] The only phone activity recorded for December 26th was an incoming call at 1227. Conversations with the pilot's colleague suggested that he routinely went to bed about 2200 each day.
[10] Marginal visual conditions are defined as cloud ceilings from 1,000 feet to 3,000 feet agl, and visibility between 3 and 5 miles.

lights south of the airport. However, there is a lack of visual cues north of the airport due to the lake.

Two pilots provided statements to the NTSB regarding the lack of visual cues when departing BKL at night. One described the conditions as a "black hole" during a dark night, VFR departure. The second noted that turning toward Lake Erie and away from the lights of the city may result in "absolute darkness" for a pilot.

G. MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy and toxicology testing were not performed due to the limited remains recovered.

H. ADDITIONAL INFORMATION

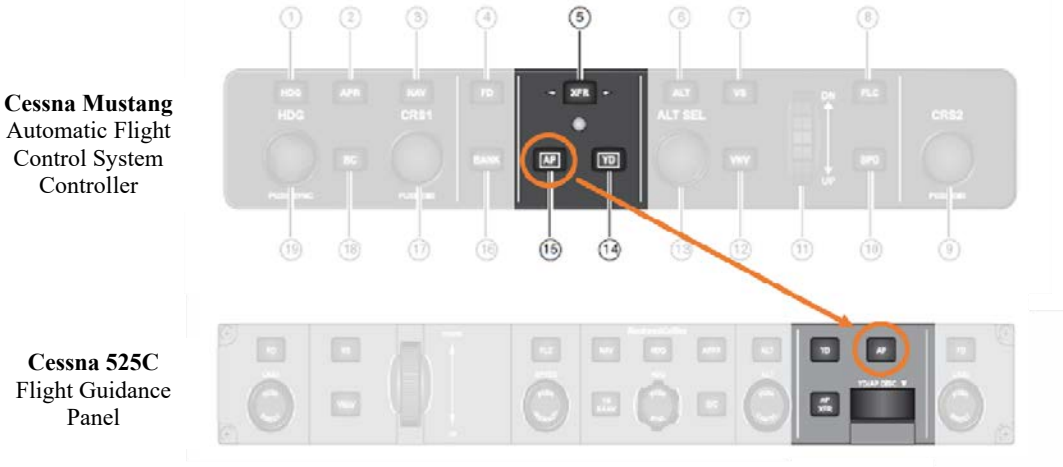
Flight Guidance Panel / Autopilot

The flight guidance panel (FGP), located on the glareshield, allows the pilot to select manual or autopilot guidance for airplane control. The autopilot button is located on the upper row of button controls near the right side of the panel.

Figure 16-16. Flight Guidance Panel

Autopilot engagement is indicated in the flight control system display area along the upper portion of the primary flight display (PFD). There is no indication of the autopilot status on or near the autopilot button on the flight guidance panel.

A comparison of the Cessna 525 systems and those of the airplane previously flown by the pilot, a Cessna 510, revealed that the autopilot engagement button on the Cessna 510 is located in a slightly different location on the Automatic Flight Control System (AFCS) panel. In the Cessna 510, autopilot engagement is indicated along the upper portion of the PFD similar to the accident airplane. In addition, an indicator light adjacent to the autopilot button on the AFCS panel is illuminated when the autopilot is engaged.



Interviews with the pilot's instructor confirmed that the pilot was trained to consistently use the autopilot after takeoff after reaching at least 300 ft agl. The instructor also noted that on two occasions during training, the pilot had inadvertently pressed the autopilot transfer button instead of the autopilot engagement button without recognizing the error.

Primary Flight Display / Attitude Indicator

The attitude indicator presented by the PFD on the Cessna 525 was an ego-centric ("inside out") type display. An "inside out" perspective involves a fixed aircraft symbol and moving horizon similar to what a pilot sees when looking outside of the aircraft. On the other hand, the Cessna 510 utilizes an exo-centric ("outside in") display. An "outside in" perspective involves a fixed horizon and a moving aircraft symbol.

Studies have demonstrated that performance with sole experience using either of these types of displays is similar, however performance degrades when experienced pilots switched between the two types of displays.[11] [12]

Spatial Disorientation

The FAA Civil Aeromedical Institute's publication, "Introduction to Aviation Physiology," defines spatial disorientation as a loss of proper bearings or a state of mental confusion as to position, location, or movement relative to the position of the earth. Factors contributing to spatial disorientation include changes in acceleration, flight in IMC, frequent transfer between visual meteorological conditions (VMC) and IMC, and unperceived changes in aircraft attitude.

The FAA's Airplane Flying Handbook (FAA-H-8083-3A) describes some hazards associated with flying when the ground or horizon are obscured. The handbook states, in part: "The vestibular sense (motion sensing by the inner ear) in particular tends to

[11] Gardner, J. F., & Lacey, R. J. (1954). An experimental comparison of five different attitude Indicators (WADC Tech. Rep. No. 54-32). Wright-Patterson Air Force Base, OH: Wright Air Development Center.

[12] Hasbrook, A. H., & Rasmussen, P. G. (1973). *In-flight performance of civilian pilots using moving-aircraft and moving-horizon attitude indicators. FAA Civil Aeromedical Institute*. Report No. FAA-AM-73-9.

confuse the pilot. Because of inertia, the sensory areas of the inner ear cannot detect slight changes in the attitude of the airplane, nor can they accurately sense attitude changes that occur at a uniform rate over a period of time. On the other hand, false sensations are often generated; leading the pilot to believe the attitude of the airplane has changed when in fact, it has not. These false sensations result in the pilot experiencing spatial disorientation."