Aviation Investigation Final Report

Location:	Bartow, Florida	**Accident Number:**	CEN18FA061
Date & Time:	December 24, 2017, 07:17 Local	**Registration:**	N247AT
Aircraft:	Cessna 340	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	5 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The instrument-rated private pilot and four passengers boarded the multiengine airplane inside a hangar. The pilot then requested that the airplane be towed from the hangar to the ramp, since he did not want to hit anything on the ramp while taxiing in the dense fog. Witnesses heard the pre-takeoff engine run-up toward the end of the runway but could not see the airplane as it departed; the engines sounded normal during the run-up and takeoff. A witness video recorded the takeoff but the airplane was not visible due to the dense fog. During the takeoff roll the airplane's tires chirped, which is consistent with the wheels touching down on the runway with a side load. The video ended before the accident occurred. The witnesses stated that the takeoff continued and then they heard the airplane impact the ground and saw an explosion. The weather conditions at the time of the accident included visibility less than 1/4 mile in fog and an overcast ceiling at 300 ft above ground level. The airplane's weight at the time of the accident was about 105 lbs over the maximum takeoff weight, which exceeded the center of gravity moment envelope. The excess weight would have likely extended the takeoff roll, decreased the climb rate, and increased the amount of elevator pressure required to lift off of the runway.

A majority of the airplane was consumed by postcrash fire. The ground impact marks and wreckage distribution were consistent with the airplane rolling left over the departure end of the runway and impacting the ground inverted in a nearly vertical, nose-low attitude. Examination of the engines revealed operating signatures consistent with takeoff power at the time of impact. The elevator trim tab and actuator were found beyond their full up travel limits and the trim cable exhibited tension overload separations near the actuator. It is likely that, when the cable separated in overload, the chain turned the sprocket and extended the actuator rod beyond full travel. No anomalies were observed with the airframe, engines, or cockpit instrumentation that would have precluded normal operation. The investigation was unable to determine the status of the autopilot during the accident takeoff.

Based on the evidence it's likely that when the airplane entered instrument meteorological conditions the pilot experienced spatial disorientation, which resulted in a loss of control and descent into terrain.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's loss of control due to spatial disorientation during takeoff in instrument meteorological conditions.

Findings

Personnel issues	Spatial disorientation - Pilot
Personnel issues	Aircraft control - Pilot
Environmental issues	Fog - Effect on operation
Environmental issues	Low visibility - Effect on operation
Aircraft	Airspeed - Not attained/maintained
Aircraft	Maximum weight - Not attained/maintained
Aircraft	Maximum weight - Capability exceeded
Aircraft	CG/weight distribution - Capability exceeded

Factual Information

History of Flight

Takeoff	Loss of visual reference
Takeoff	Other weather encounter
Takeoff	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)
Post-impact	Explosion (post-impact)
Post-impact	Fire/smoke (post-impact)

On December 24, 2017, at 0717 eastern standard time, a Cessna 340 airplane, N247AT, impacted terrain after departure from Bartow Municipal Airport (BOW), Bartow, Florida. The private pilot and four passengers were fatally injured, and the airplane was destroyed. The airplane was registered to Aviation Transportation LLC and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91 as a personal flight. Instrument meteorological conditions prevailed at the time of the accident and an instrument flight rules (IFR) flight plan was filed. The flight was originating at the time of the accident with a planned destination of Key West International Airport (EYW), Key West, Florida.

The pilot filed an IFR flight plan on a Garmin GPS device and received an IFR clearance from the Tampa air traffic control tower. The BOW air traffic control tower was closed at the time of the accident.

According to two fixed base operator (FBO) employees at BOW, the pilot requested that the airplane be towed from the hangar to the ramp. The pilot stated that he wanted a tow so that he did not have to taxi next to the other hangars because of reduced visibility and dense fog. About 0645, the five occupants boarded the airplane and the FBO employees towed it to the ramp.

The FBO employees stated that the pilot started the engines and that they watched as the airplane very slowly taxied toward the end of runway 9L. The fog limited their visibility to about 400 ft. They could no longer see the airplane in the dense fog, so they moved to an area on the ramp closer to the runway. The pilot contacted Tampa Approach at 0710 for his IFR clearance. The FBO employees heard an increase in engine noise consistent with an engine run-up, and about 0715, they heard the airplane take off but they could not see the airplane because of the dense fog. The engines "sounded strong and [were] operating at full power" during the takeoff. They heard two tire "chirps" on the runway, then the sound of the airplane was consistent with a climb. They then heard an explosion on the east side of the airport and drove toward the explosion to find the airplane on fire. One of the FBO employees recorded a video of the airplane taxiing on the ramp toward the runway and another video of the takeoff.

The video captured by the FBO employee was 46 seconds long. While recording the video, the employee was located near the middle of the ramp and about 1/2 mile from the end of runway 9L. The accident airplane is not visible due to the dense fog. The sound of the engines is audible. The video pans

from right to left and appears to follow the sounds of the airplane during the takeoff roll. At 26 and 28 seconds, two distinct chirps are heard. The video ends while the engines are still audible.

A helicopter pilot based at BOW observed the airplane taxiing on the ramp toward the runway. He recorded a video of the airplane taxiing on the ramp in the dense fog. He heard the airplane take off about 12 minutes later. During the takeoff, he heard a 'pop' similar to an engine backfire and about 3 seconds later, heard the explosion near the end of runway 9L. He and a colleague drove to the accident site, where they found the airplane engulfed in flames and saw the FBO employees nearby. He estimated that the runway visual range at the time was 600 to 800 ft due to the fog.

Pilot Information

Certificate:	Private	**Age:**	70,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	August 31, 2016
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 1600 hours (Total, all aircraft)		

The pilot's logbooks were not located, and the pilot's instrument currency or proficiency could not be determined.

The mechanic who maintained the airplane stated that the pilot always flew with his feet flat on the floor and not on the rudder pedals. He also stated that the pilot never flew dangerously or recklessly. He added that the pilot's personal logbooks were always kept on the back shelf in the airplane.

The pilot's personal assistant stated that he always flew the airplane a couple of days before a flight with passengers. She stated that everyone she talked to described him as a good pilot and diligent with his pilot duties.

An acquaintance of the pilot, who also was the pilot's flight instructor in 2002, recounted flying the accident airplane with the pilot. He stated that the pilot mentioned an in-flight engine failure he experienced in the accident airplane. The pilot told him that he continued to his destination rather than making a precautionary single-engine landing because the logistics of diverting were too difficult. The acquaintance also stated that he and the pilot were supposed to fly the accident airplane together in early 2017. On the morning of the planned flight, he checked the weather conditions, which were about 1/4 mile visibility and 100 ft ceilings with dense fog. He told the pilot that they could not complete the flight because of the weather, and the pilot responded that, legally, they were allowed to fly under Part 91. The acquaintance had not talked to the accident pilot since that canceled flight.

A local airplane mechanic, who was a business acquaintance of the pilot, stated that he flew with the pilot one time and then refused to fly with him again. The acquaintance stated that he was not a safe pilot and took unnecessary risks.

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N247AT
Model/Series:	340	**Aircraft Category:**	Airplane
Year of Manufacture:	1973	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3400214
Landing Gear Type:	Tricycle	**Seats:**	6
Date/Type of Last Inspection:	January 2, 2017 Annual	**Certified Max Gross Wt.:**	6390 lbs
Time Since Last Inspection:		**Engines:**	2 Reciprocating
Airframe Total Time:	1607.5 Hrs as of last inspection	**Engine Manufacturer:**	Continental Motors
ELT:	Installed, not activated	**Engine Model/Series:**	TSIO-520-NcNB
Registered Owner:	On file	**Rated Power:**	335 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The mechanic who maintained the airplane stated that, 2 days before the accident, at the request of the pilot, he moved the co-pilot seat aft and adjusted the rear seats forward. He also stated that the accident airplane had a known autopilot issue; if the autopilot was engaged on the ground, it would command the elevator trim full nose-down. He understood this issue was a result of the autopilot's gyros not being level on the ground, which caused the autopilot to sense and attempt to compensate for a high pitch attitude. He stated that the accident pilot was aware of this autopilot issue.

The airplane logbooks did not reveal any past maintenance discrepancies or write-ups related to the autopilot or elevator trim.

One of the aforementioned BOW FBO employees reported that, on December 22, 2017, he received a fuel order from the pilot. He filled the airplane's tip tanks and auxiliary tanks with 100LL fuel; the nacelle tanks were already full. Later that day, he removed the airplane from the hangar; the pilot flew the airplane for about 30 minutes, then the employee towed the airplane back to the hangar.

A review of the left and right engine maintenance logbooks revealed entries for annual inspections that included an oil change and oil filter inspection and replacement on January 2, 2017, at 1,582.9 hours tachometer time. The previous two entries, dated December 20, 2015, and November 17, 2014, at 1,558.4 hours and 1,543 hours, respectively, noted an annual inspection was completed with oil and oil filter changes.

The oil filter found on the left engine at the accident site was marked with 1,543 hours tachometer time and dated January 6, 2014. When questioned about the discrepancy, the mechanic stated that the oil was

actually not changed on either engine during the two previous inspections as noted in the logbooks and that the entries were not accurate. The mechanic stated that he planned to change the oil and replace the filters during the next annual inspection, which was due in January 2018.

The logbooks also revealed that the most recent IFR certification for the transponder and pitot static system was completed on June 20, 2014. To fly in IFR conditions the system must be inspected and certified every 24 calendar months.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KBOW,125 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	07:15 Local	**Direction from Accident Site:**	295°
Lowest Cloud Condition:		**Visibility**	
Lowest Ceiling:		**Visibility (RVR):**	600 ft
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/ Unknown
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.18 inches Hg	**Temperature/Dew Point:**	12°C
Precipitation and Obscuration:	Heavy - None - Fog		
Departure Point:	Bartow, FL (BOW)	**Type of Flight Plan Filed:**	IFR
Destination:	KEY WEST, FL (EYW)	**Type of Clearance:**	IFR
Departure Time:	07:16 Local	**Type of Airspace:**	Class E

The automated weather observation station at BOW reported consistent weather conditions from 0635 to 0715, which included visibility less than 1/4 mile, fog, an overcast cloud layer at 300 ft, temperature 56°F, and an altimeter setting of 30.18 inches of mercury.

An area forecast discussion was issued for the region by the National Weather Service (NWS) that identified widespread shallow fog. An NWS dense fog advisory was in effect for Polk County, Florida. A center weather advisory was in effect for the accident area and advised of ceilings below 500 ft agl and visibilities below 1 mile in fog and mist. An AIRMET for IFR conditions was in effect for the accident area.

There was no evidence that the pilot obtained a preflight weather briefing from a recorded source.

Airport Information

Airport:	BARTOW MUNI BOW	**Runway Surface Type:**	Asphalt
Airport Elevation:	124 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	09L	**IFR Approach:**	None
Runway Length/Width:	5000 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	4 Fatal	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	On-ground
Total Injuries:	5 Fatal	**Latitude, Longitude:**	27.946388,-81.773887(est)

The accident site was located on airport property about 190 yards east-northeast of the departure end of runway 9L and 10 ft south of taxiway delta (figure 1).

Figure 1 – Aerial View of Accident Site

The debris path was about 230 ft long and oriented northeast. The beginning of the debris path was defined by several ground impact craters in a line perpendicular to the debris path and the main wreckage. The middle impact crater contained pieces of the airplane's nose cowling and baggage door. Immediately to the right was the left engine's propeller. To the left of the middle crater was the right engine's propeller. A portion of the left wing tip fuel tank was found on the far right side of the initial impact area, and a portion of the right wing tip fuel tank was found on the far left side of the initial impact area. The main wreckage came to rest upright and oriented southeast about 30 ft from the initial impact craters. The fuselage was mostly consumed by fire and the empennage remained mostly intact with significant thermal damage. Both engines separated from the airplane and came to rest near the main wreckage. Airplane debris was found on the taxiway northeast of the main wreckage. The nose landing gear was separated from the airplane and found about 200 ft northeast of the main wreckage.

The flight controls exhibited impact and thermal damage but did not reveal any preimpact anomalies. The wing flap position could not be determined due to the extensive damage. The elevator trim tab was found beyond its full up limit. The elevator trim cable exhibited tension overload separations near the actuator and the other side of the cable was intact in the aft fuselage area. The elevator trim actuator was found at 2 ¼ inches, which was beyond the full length of travel (1.9 inches). The round hole in the trim

tab surrounding the actuator rod was damaged and pushed aft by the rod end and bearing. The damage on the rod end matched the damage to the hole. The trim cable and chain on the top side of the actuator sprocket was pulled during the examination to test its functionality. When the cable was pulled, the actuator retracted and the trim tab lowered from its full-up position.

The landing gear actuator and the left and right main landing gear were all retracted.

Two attitude indicator gyros and one directional gyro were disassembled and examined. All three gyros exhibited rotational scoring inside the housings and along the circumference of the gyros. An electric turn-and-bank indicator gyro was disassembled and examined; it also exhibited rotational scoring.

The two vacuum pumps were separated from the engines and sustained significant impact damage. The right engine vacuum pump drive remained attached to the right engine and was melted by the postimpact fire. The left engine vacuum pump was separated from the engine, and the pump body and drive were intact. A portion of the vacuum manifold, which consisted of one of the end caps but no flapper valves, was found in the wreckage.

The left engine was separated from the airframe and was identified based on the data plate and maintenance records. The crankshaft was completely fractured at the nose oil seal and the propeller flange remained attached to the propeller hub. The crankshaft fracture surface displayed tearing, shear lips, and discoloration consistent with an overstress separation on impact. The top sparkplugs displayed a normal worn appearance with no signs of lead or carbon fouling. The bottom sparkplugs were examined via a lighted borescope with no anomalies noted. The return line from the fuel pressure regulator to the fuel pump remained in place and, when removed, residual fuel poured from the pressure regulator. The pump was disassembled, and the pump vanes were intact with no anomalies noted with the internal components.

The fuel manifold valve remained secured to the top of the engine and the fuel lines remained attached to the housing. The fuel lines remained secured to their nozzles and the upper deck reference line remained secured to the nozzles. The nozzles were free of obstructions. The fuel manifold screen was clear of contaminants and residual fuel was observed in the housing. The No. 2 intake inner valve spring was fractured. Residual oil was observed in each rocker cover. The cylinders were inspected and documented utilizing a lighted borescope. The No. 3 exhaust valve displayed two areas of green discoloration; otherwise, the pistons, valves, and valve seats were unremarkable. Manual rotation of the crankshaft was not possible due to impingements on the crankshaft and camshaft at the front of the crankcase and the oil sump, respectively. Sand and dirt from the accident site were embedded in the right exhaust slip joint area. The exhaust riser system on the aft end of the engine was crushed forward.

The left propeller hub remained intact and the piston was compressed aft. All three blades remained attached to the hub, but they were free to rotate in the hub, indicative of pitch change link fractures. The blades were labeled 1, 2, and 3 according to their hub location and for identification purposes only. Blade 1 was missing its counterweight, was bent aft slightly, and exhibited overstress signatures. The leading edge exhibited some light gouging and the cambered side exhibited chordwise scrapes and paint erosion. Blade 2 exhibited a small twist toward low pitch, paint erosion on the cambered side and leading edge gouges. The counterweight remained attached to the blade shank. Blade 3 was missing its counterweight, showed signs of overstress, and exhibited light chordwise paint erosion aft of the deice

boot but was otherwise unremarkable.

The right engine was separated from the airframe and was identified based on the data plate and the maintenance records. The crankshaft was fractured at the nose oil seal and the propeller flange remained attached to the propeller hub. The crankshaft fracture surface displayed tearing, shear lips, and discoloration consistent with an overstress separation on impact. The engine sustained thermal damage.

The left magneto was separated from the engine and the ignition leads were separated from the harness cap. The right magneto remained in place and did not rotate with manual manipulation of the housing. The ignition harness remained secured to the right magneto and each terminal remained secured to their respective sparkplugs. The left magneto harness cap was removed and replaced with the right ignition harness cap from the left engine. Rotation of the drive shaft resulted in a spark from each lead in firing order during the audible snap of the impulse coupling. The right magneto was removed and the thermally damaged leads were cut near the harness cap. The magneto produced a spark from each of its leads in firing order when the drive shaft was manually rotated and the impulse coupling snapped.

The top sparkplugs were removed from the cylinders and all displayed a normal worn condition with no signs of lead or carbon fouling. The bottom sparkplugs were examined via a lighted borescope with no preimpact anomalies noted. The engine-driven fuel pump was separated from the engine; the mounting flange and drive coupling were displaced to one side and the metal was smeared in the same direction. The fuel manifold valve screen was free of obstructions and residual fuel was observed in the housing.

The cylinders remained attached to the crankcase with no external signs of operational distress. The cylinder rocker covers were removed and all of the valve springs remained intact. The cylinders were inspected and documented utilizing a lighted borescope. The pistons, valves, and valve seats were unremarkable. A tool was fitted to the backside of the crankshaft and partial crankshaft rotation was achieved, with continuity confirmed to the front of the engine and to the connecting rods. Impingements on the crankshaft and camshaft were noted at the front of the crankcase and the oil sump, respectively, which prevented full crankshaft rotation. The exhaust riser system was deformed forward on the aft end of the engine.

The right propeller hub remained intact and the spinner dome was crushed aft over the hub. All three blades remained attached to the hub, but they were free to rotate in the hub, indicative of pitch change link fractures. The blades were labeled 1, 2, and 3 according to their hub location and for identification purposes only. Blade 1 was missing its counterweight, was bent aft slightly, and exhibited overstress signatures. The leading edge exhibited gouging and the cambered and face sides displayed chordwise scrapes and paint erosion. Blade 2 exhibited a small twist toward low pitch, paint erosion on the cambered side, and light leading edge gouges. Blade 3 was missing its counterweight and exhibited overstress signatures. The blade exhibited light chordwise paint erosion aft of the deice boot, but was otherwise unremarkable.

Medical and Pathological Information

The Office of the District Medical Examiner, 10th Judicial Circuit of Florida, Winter Haven, Florida, completed an autopsy on the pilot, which attributed the cause of death to blunt impact. The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, conducted toxicology testing, which revealed 20 mg/dL of ethanol in muscle, ibuprofen in the muscle, and no ethanol detected in the kidney. The toxicology samples exhibited putrefaction.

Ibuprofen is in a class of medications called non-steroidal anti-inflammatory drug and are not considered impairing.

After absorption, ethanol is uniformly distributed throughout all tissues and body fluids; therefore, the finding in one tissue but not another is most consistent with post-mortem production.

Tests and Research

Weight and balance

The airplane's maximum gross takeoff weight was 6,390 lbs. The weight at the time of the accident takeoff was about 6,495 lbs, about 105 lbs over the maximum takeoff weight (figure 2). Due to the excessive weight, the airplane was outside of its center of gravity moment envelope (figure 3).

Weight and Balance at Departure				
Loads		Weight (Pounds)	Arm (Inches)	Moment /1000
Empty Aircraft:		4453.3	151.2	673.4
Front Passengers:		400	137.0	54.8
Center Passengers:		300	175.0	52.5
Rear Passengers:		235	204.0	47.9
Forward Baggage:			77.0	
Aft Baggage:			242.0	
Locker Baggage:			184.0	
Main Fuel (Gal.)	84.0	504	150.3	75.8
Aux. Fuel (Gal.)	63.0	378	162.3	61.3
Locker Fuel (Gal.)	37.5	225	166.0	37.4
*Totals (6390 lb max):		6495		1003.1
CG = Total Moment / Total Weight:				154.4

Figure 2 – Calculated Weight and Balance

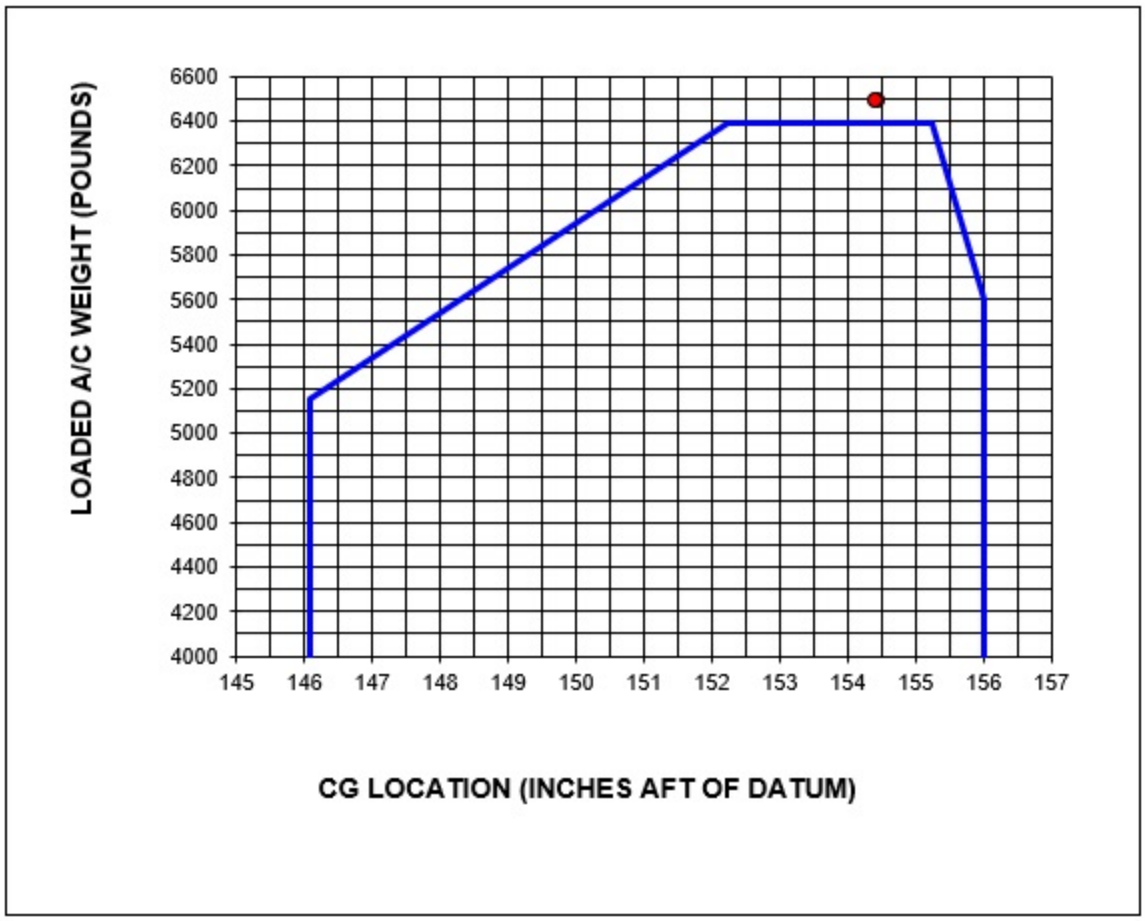

Figure 3 – Center of Gravity Moment Envelope

Additional Information

Spatial Disorientation

According to FAA Safety Team literature, pilots flying under both instrument and visual flight rules are subject to spatial disorientation and optical illusions that may cause a loss of aircraft control. Sight, supported by other senses, allows a pilot to maintain orientation while flying. However, when visibility is restricted (i.e., no visual reference to the horizon or surface detected) the body's supporting senses can conflict with what is seen. When this spatial disorientation occurs, sensory conflicts and optical illusions often make it difficult for a pilot to tell which way is up.

Contributing to these phenomena are the various types of sensory stimuli: visual, vestibular (organs of equilibrium located in the inner ear), and proprioceptive (receptors located in the skin, muscles, tendons and joints). Changes in linear acceleration, angular acceleration, and gravity are detected by the

vestibular system and the proprioceptive receptors, and then compared in the brain with visual information.

In a flight environment, these stimuli can vary in magnitude, direction, and frequency, resulting in a sensory mismatch that can produce illusions and lead to spatial disorientation.

Administrative Information

Investigator In Charge (IIC):	Lindberg, Joshua
Additional Participating Persons:	Michael Corrigan; Federal Aviation Administration; Orlando, FL Nicole Charnon; Continental Motors; Mobile, AL Andrew Hall; Textron Aviation; Wichita, KS Rick Roper; RAM Aircraft L.P.; Waco, TX
Original Publish Date:	February 26, 2019
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=96534

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The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available here.