Aviation Investigation Final Report

Location:	Oceanside, California	**Accident Number:**	WPR22FA197
Date & Time:	June 3, 2022, 13:47 Local	**Registration:**	N7581F
Aircraft:	Cessna 208B	**Aircraft Damage:**	Substantial
Defining Event:	Landing area undershoot	**Injuries:**	1 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Skydiving		

Analysis

The pilots were performing skydiving flights while the right-seated pilot was training the left-seated pilot on the operation. The pilots completed six flights without incident and completed the drop of the skydivers on the accident flight normally. The right-seated pilot could not completely recollect the minutes leading up to the accident due to his injuries. He did recall that airplane was descending as expected with the power at idle. The recorded ADS-B data revealed that after turning onto final approach, the airplane then completed a right 360° turn presumably because the altitude was too high. The right-seated pilot attempted to increase the power by slightly nudging the throttle forward and thought the engine power did not increase as expected.

A performance study revealed that in the last 70 seconds of recorded data, the airplane underwent a series of speed and thrust oscillations consistent with a pilot increasing and then decreasing the power lever. The right seat pilot recalls aiming for an open dirt field and observing a berm in the immediate flight path. In an effort to avoid the berm, he maneuvered the airplane into a right turn. The airplane landed short of the runway, resulting in a collision with the berm.

The engine was producing power at the time of impact. Postaccident examination of the airplane revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation.

The right-seated pilot was in the process of training the left-seated pilot and stated that he took over the controls during the final approach. It is unknown when he took over the controls, so it is unknown which pilot was at the controls during the speed oscillations. The right-seated pilot likely took over the controls too late and the airplane impacted the terrain. The left-seated pilot's ability to hear the changes in engine power might have been hindered because she was listening to music through her headset at an elevated decibel level.

The airplane was modified by a Supplemental Type Certificate that replaces the original Pratt & Whitney PT-6 turbine engine with a Honeywell TPE331 turbine engine. The TPE331 engine's characteristics are

such that if the airplane is on final approach with the power near idle, the throttle sensitivity (change in thrust per unit of power lever movement) increases around the transition between the propeller-governing and underspeed-governing modes of the engine, which corresponds to a zero-thrust condition. Near this transition point, small movements of the power lever (about ¼ to ½ inch of deflection) can result in relatively large thrust changes that can surprise pilots inexperienced with this behavior and result in pilot-induced oscillations (PIO). Given the thrust oscillations observed shortly before the end of the ADS-B data, it is likely that the left-seated pilot was at the controls and experienced such a PIO on a short final approach to land.

Probable Cause and Findings

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

The right-seated pilot's failure to correct the left-seated pilot's mismanagement of the engine thrust, which resulted in undesired speed and thrust oscillations during the final approach and a subsequent descent into terrain.

Findings

Personnel issues	Delayed action - Instructor/check pilot
Personnel issues	Incorrect action performance - Student/instructed pilot
Aircraft	Descent/approach/glide path - Not attained/maintained
Aircraft	Powerplant parameters - Incorrect use/operation
Personnel issues	Total experience w/ equipment - Student/instructed pilot

Factual Information

History of Flight

Approach-VFR pattern final	Altitude deviation
Landing	Landing area undershoot (Defining event)
Post-impact	Collision with terr/obj (non-CFIT)

On June 03, 2022, about 1347 Pacific daylight time, a Cessna 208B, modified as a Supervan Systems. LLC 900 airplane, N7581F, was substantially damaged when it was involved in an accident near Bob Maxwell Memorial Airfield, Oceanside, California. The left-seated pilot was fatally injured and the right-seated pilot was seriously injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 skydiving flight.

On the day of the accident, the pilots were performing skydiving flights while the right-seated pilot was training the left-seated pilot on the operation. A flight consisted of two pilots taking a group of approximately 17 skydivers to an altitude of about 11,500 feet mean sea level (msl) to jump out and then returning to the airport. The flights started about 1015 and were airborne for an average of 17 minutes, with about 15 minutes on the ground between flights, during which the airplane's engine was kept operating while a new load of skydivers boarded the airplane. The pilots completed six flights without incident and departed on the accident flight at 1331.

The right-seated pilot stated that he could not recall many of the details leading up to the accident. He remembered that, on the accident flight, everything was normal with the departure and the unloading of the skydivers. The airplane was descending as expected with the power at idle. As the airplane turned onto final approach, about 2-3 miles from the approach end of runway 25, the left-seated pilot either had her hand on the throttle or began to reach up to the throttle. The right-seated pilot thought the airplane was low and attempted to increase the power by taking the controls and slightly nudging the throttle forward. He noticed that the engine power did not appear to change in response to the movement of the lever and he moved the throttle lever further forward. The lever was still unresponsive, and he estimated the airplane was about 400 ft above ground level (agl). He aimed for an open dirt field and observed a berm in the immediate flight path. In an effort to avoid the berm, the pilot maneuvered the airplane into a right turn.

Investigators reviewed the automatic dependent surveillance – broadcast (ADS-B) flight track data covering the area of the accident during the time surrounding the accident. After departing from runway 25, the airplane made a gradual climb to 11,575 ft msl as it circled to the right, back to the airport. The airspeed was reduced to about 80 KCAS (presumably to unload the skydivers) and then the airplane made a steep, turning descent reaching 130 KTAS (110 KCAS) when transitioning to the downwind leg of the traffic pattern. The airplane was at an altitude of about 2,400 ft msl and 2.5 nautical miles (nm) from the approach end of runway 25 when it turned onto final approach. When the airplane was about 2 nm from the runway, it made a 360° right-turn which was about 0.5 nm in diameter (see Figure 1 below).

Figure 1: Accident Flight Path

At 1346:10, about 1,025 ft msl, the airplane rolled out of the 360° turn and continued west toward the runway. For the remainder of the flight (one minute), the airplane was roughly following Highway 76 making a gradual descent toward the runway (see Figure 2 below).

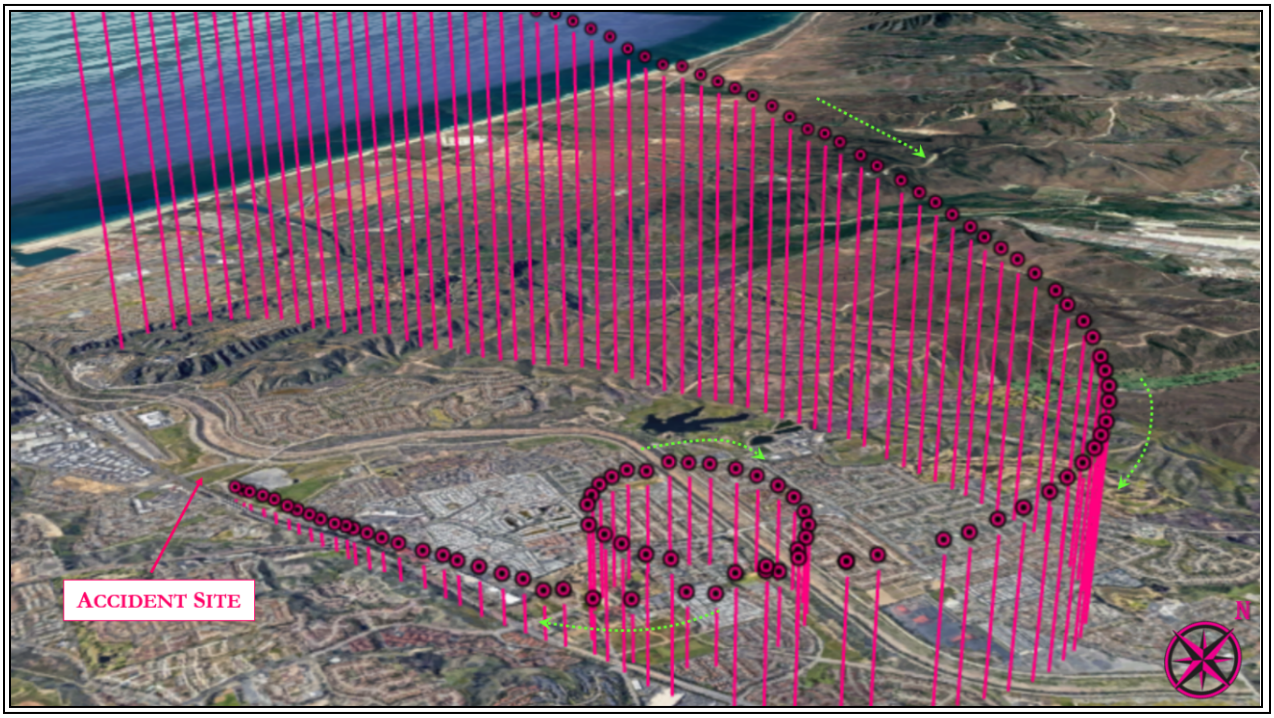

Figure 2: Flight Path on Final Approach

The last recorded ADS-B point was at 1347:10 about 975 feet east of the accident site. At that time, the data indicated that the airplane was at 230 msl (190 feet above ground level) at a ground speed of 68

kts (76 KCAS). Witnesses stated that they observed the airplane flying at a very low altitude (see Figure 3). The airplane then pitched down in a nose-low attitude and banked to the right. The airplane impacted terrain and collided with the side of a berm. A security camera captured the airplane seconds before impact (see Figure 3 below).

Figure 3: Video Footage Showing the Airplane Before Impact

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	52,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	None
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	March 29, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 6880 hours (Total, all aircraft), 161 hours (Last 90 days, all aircraft)		

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	24,Female
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	June 11, 2021
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	805 hours (Total, all aircraft), 25.8 hours (Total, this make and model), 725 hours (Pilot In Command, all aircraft)		

The right-seated pilot was employed by Desert Sand Aircraft Leasing Co. Inc., the airplane owner, and had been a pilot for the company for over 20 years. He was training the left-seated pilot how to fly the airplane and learn the operations. He stated she started about two weeks before the flight and estimated she would have needed about two more weeks before she would have been proficient to the company standards. He stated that she was doing very well and that he was comfortable with her piloting abilities.

The left-seated pilot was undergoing training; she had six days of experience flying a modified Cessna 208, equating to 25.8 hours. All the pilot's known flight time in a Cessna 208B was accumulated in a 208B equipped with a TPE331 engine. This was her third day in the left seat. All her training in the airplane was conducted by the right-seated pilot. She had numerous photos of the airplane systems (including the throttle quadrant) on her phone and notes about the operation of the airplane. According to the pilot's iPhone application, she was listening to music in her Bose A20 Aviation headset at about 79 decibels during the accident flight. The headset is designed such that the primary source of audio is from the airplane's intercom and the secondary source of audio is the device connected (in this case, the iPhone). Only one source can be heard at a time and the audio from the secondary source will never override intercom communications.

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N7581F
Model/Series:	208B Supervan	**Aircraft Category:**	Airplane
Year of Manufacture:	1994	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	208B0389
Landing Gear Type:	Tricycle	**Seats:**	12
Date/Type of Last Inspection:	June 2, 2022 100 hour	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1
Airframe Total Time:	13379 Hrs as of last inspection	**Engine Manufacturer:**	
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	
Registered Owner:	DESERT SAND AIRCRAFT LEASING CO INC	**Rated Power:**	
Operator:	GoJump	**Operating Certificate(s) Held:**	None

The airplane was modified in 2012 by the Supervan Systems, Ltd. (Texas Turbines) with a TPE331 engine and 4-blade aluminum propeller installation via Supplemental Type Certificate (STC) SA10841SC.

The airplane's engine is managed by the pilot through the power lever and speed lever located in the cockpit center console. The engine power lever (black) connects to the propeller pitch control and the manual fuel valve. The engine speed lever (blue) connects to the propeller governor and to the underspeed fuel governor (USFG).

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KOKB,30 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	13:52 Local	**Direction from Accident Site:**	258°
Lowest Cloud Condition:	Clear	**Visibility**	8 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	230°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.85 inches Hg	**Temperature/Dew Point:**	21°C / 13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Oceanside, CA	**Type of Flight Plan Filed:**	None
Destination:	Oceanside, CA	**Type of Clearance:**	VFR
Departure Time:		**Type of Airspace:**	

Airport Information

Airport:	Bob Maxwell Memorial Airfield OKB	**Runway Surface Type:**	Asphalt
Airport Elevation:	28 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	25	**IFR Approach:**	None
Runway Length/Width:	2712 ft / 75 ft	**VFR Approach/Landing:**	Full stop

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious	**Latitude, Longitude:**	33.219797,-117.34196(est)

The accident site was located about 1,615 feet east of the approach end of runway 25 on flat terrain composed of soft, dry dirt. The wreckage was found distributed over an approximate 125-foot distance with the nose pointed on a heading of about 335°. The right wing was partially separated from the fuselage root and had folded forward and over upon itself, coming to rest inverted. The first identified

piece of debris was a fragment of the right wingtip light lens, consistent with the right wingtip contacting the ground at the beginning of the accident sequence.

All flight control surfaces were at the main wreckage and attached at their respective fittings. The left flap was found in the retracted position, and damage at the inboard end of the right flap was consistent with it being retracted at the time of impact. Investigators established flight control continuity during the postaccident examinations. The left side of the center pedestal was crushed and a majority of the fuselage deformation was near the left pilot seat.

The engine teardown revealed that several compressor blade tips were curled in the opposite direction of rotation and there was metal splatter on the turbine discs and stators, all of which is consistent with the engine rotating and operating at the time of impact. There was no evidence of mechanical malfunctions or failures that would have precluded normal operation.

There was about 50 gallons of fluid, consistent in appearance and odor with Jet A fuel, recovered from the right wing; no fluid was recovered from the left wing, but the fuel line had separated from the connection into the fuselage, allowing fuel to drain from the left wing tank. The fuel system remained unbreached from the header tank to the engine's fuel nozzles. Fluid was found in the header tank, in the airframe fuel filter, and in several fuel lines before and after the fuel control unit.

Seat Belts

The right-seated pilot stated that he was wearing a lap-belt, but not the shoulder harness; he could not recall if the left-seated pilot wore a seat belt. He stated that he normally does not wear a shoulder harness because he gets too hot and the belts cut into his neck. He thought that because the headrest was removed on the right seat, it was not really possible to use the shoulder harness on that side. The left seat remained in its tracks and did not show evidence of crush deformation. The left-seat belts were intact and investigators found them unbuckled; it could not be determined whether the seat belts were unbuckled during the flight or whether they were buckled and the first responders unbuckled them in order to extricate the pilot from the wreckage. The buckles functioned as expected when locked in place and then released via the release mechanism. The lap belt portion exhibited signs of stretching. The right-seat lap belt was cut in several areas consistent with post-accident first responder actions; there was no evidence of stretch. The right seat had been removed as part of the first responder efforts.

Medical and Pathological Information

Toxicology testing performed by the Federal Aviation Administration Forensic Sciences Laboratory detected ketamine in the left-seated pilot's cavity blood and in her liver tissueconsistent with it being administered post-accident for resuscitation purposes.

Body camera video footage and first responder's reports indicate that when arriving on scene, both pilots were unresponsive. The right-seated pilot was found partway through the left window, supported by the window frame and the left side of the instrument panel. The left-seated pilot was found under the right-seated pilot. The police officer who extricated the right-seated pilot stated that the pilot did not appear to be wearing a seatbelt and that the officer did not have to unbuckle anything to remove him from the wreckage. He noted that the right-seated pilot's shoulder harness was not used and he observed the right seat belts hanging behind the seat; he could not recall if the lap belt was secured.

Tests and Research

Performance Study

The National Transportation Safety Board (NTSB) Vehicle Performance division performed a study of the engine thrust during the accident descent. Comparisons were made between the thrust coefficients of the accident descent, the two preceding descents, and descents flown in other Supervans at known power settings. ADS-B data for these flights included time, altitude, north and east ground speed components, and vertical speed. Using this data together with winds-aloft information and the Cessna 208 drag characteristics, the true and calibrated airspeeds and corresponding thrust required during each descent were calculated.

The results revealed that the negative thrust coefficients developed during the accident descent and the three previous descents performed in the airplane are similar. The coefficients are also similar to those developed on the descents for which the power settings are known to have been kept within the operating limitations of the engine (that is, the power lever kept at or above the "flight idle" gate in flight). At the end of the accident descent, the thrust coefficient recovers from a negative value to approximately zero or positive values, as it does on the other flights examined. However, around 1346:36 the thrust coefficient decreases to a negative value and then returns to a positive value at 1346:48. Following this recovery, the computed thrust coefficient reaches negative values again at 1346:55 and then comes up to almost reach a zero value at 1347:07 before going negative again until the end of the data at 1347:10.

The speed oscillations observed in the final 50 seconds of the flight directly correlate to the computed thrust oscillation. The cause of the thrust oscillations was unable to be determined, but might have been the manipulation of the power lever in the cockpit.

Throttle Quadrant

The airplane's engine is managed by the pilot through the power lever and speed lever located in the cockpit center console. The engine power lever (black) connects to the propeller pitch control and the manual fuel valve. The engine speed lever (blue) connects to the propeller governor and to the underspeed fuel governor (USFG). If the pilot reduces the power lever to idle while maintaining the speed lever at 100% speed, the reduction in engine power will result in the propeller governor reducing the propeller blade angle to maintain propeller RPM until the propeller reaches its low pitch stop

(typically around 5.5° or where appropriate as set via maintenance flights). When the propeller governor can no longer maintain 100% propeller speed (1591 rpm), then the propeller rpm will decrease until reaching 97% (1543 rpm), at which point the underspeed governor adds power/fuel as needed to maintain that rpm.

According to a Texas Turbine representative, the throttle sensitivity (change in thrust per unit of power lever movement) increases around the transition between the propeller-governing and underspeed-governing modes of the engine, which corresponds to a zero-thrust condition. At low airspeeds (80-100 knots), thrust changes in this transitional area require only small physical movements in the power lever (about ¼ to ½ inch of deflection). The representative stated that this relatively small movement can result in large speed fluctuations (±10-15 knots) and can be challenging for lower-time or inexperienced pilots. He stated that many pilots experienced with the TPE331 engine in this airplane fly with their hand braced on the side pedestal and grip the side of the power lever to help make small power lever movements smoothly, as opposed to placing their hand on top of the power lever. He additionally stated that pilots who grip the top of the power lever handle tend to make larger power lever inputs and that the resulting fluctuations in thrust would have a greater effect on lightly loaded airplanes.

The Texas Turbine representative further stated that he has trained over 150 pilots to fly the Supervan. He stated that during the approach, there is a tendency for pilots to create a pilot-induced oscillation because they are not familiar with the response time of the engine. Typically, in this scenario, he would observe that when the airplane is on approach (about 80 knots) if the power lever were reduced to idle, the drag would increase (as the propeller blade angle goes to the low pitch stop), and the pilot would then advance the power lever in response to the increasing drag. During this response, the pilot would over-correct and add too much power and the airplane would surge forward and accelerate above 80 knots with full flaps. The pilot would then reduce the power lever rapidly in response to the acceleration and that rapid power lever reduction would cause a significant amount of drag and deceleration. The oscillation could occur for several cycles until the pilot could begin to limit the amount of power lever movement during the power on and off applications.

According to Hartzell, the zero thrust condition required about 150-170 horsepower depending on airspeed. Both positive thrust conditions required about 300 horsepower. During the last 70 seconds of recorded data, there were three thrust reversals between idle and 300 horsepower (equating to 30% change in torque), all of which were done rapidly (without a pause), which is consistent with power-lever handle changes. As noted by the Texas Turbine representative, such changes in engine power do not necessarily require large power lever changes when the engine is operating around the transition between the propeller-governing and underspeed-governing modes.

Administrative Information

Investigator In Charge (IIC):	Keliher, Zoe
Additional Participating Persons:	Tom Shaw; Federal Aviation Administration; San Diego, CA Andrew Hall; Textron Aviation; Wichita , KS John Eller; Honeywell; Phoenix, AZ Les Doud; Hartzell Propellers; Piqua, OH Bobby Bishop; Texas Turbine Conversions; Celina , TX Jim Rosplock; Woodward; Rockford, IL
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