



National Transportation Safety Board Aviation Accident Final Report

Location:	Fayetteville, Georgia	Accident Number:	ERA15LA006
Date & Time:	October 5, 2014, 12:55 Local	Registration:	N536EM
Aircraft:	Socata TBM 700	Aircraft Damage:	Substantial
Defining Event:	Fuel starvation	Injuries:	1 Serious, 1 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot was conducting a personal cross-country flight. The pilot reported that, during cruise flight at 6,000 ft mean sea level, he observed a crew alerting system oil pressure message, followed by a total loss of engine power. An air traffic controller provided vectors to a local airport; however, the pilot reported that the airplane would not reach the runway. He did not attempt to restart the engine. He feathered the propeller and placed the power lever to "idle" and the condition lever to "cut off." The pilot subsequently attempted a forced landing to a sports field with the gear and flaps retracted. The airplane collided with trees and the ground and then came to rest upright.

Examination of the engine revealed that it displayed contact signatures to its internal components and evidence of ingested unburned organic debris, consistent with the engine likely being unpowered and the engine gas generator and power sections wind-milling at the time of impact. No evidence of any preimpact mechanical anomalies or malfunctions to any of the engine components was found that would have precluded normal operation.

Recorded GPS flight track and systems data showed that the loss of engine power was preceded by about 5 minutes of flight on a constant heading and altitude with an excessive lateral g force of about 0.17 g and a bank angle between about 8 and 10 degrees, consistent with a side-slip flight condition. The airplane then entered a right turn with the autopilot engaged, and it lost power at the end of the turn. The data indicated that, even though the autopilot was engaged, the lateral g forces increased as the airplane leveled off and accelerated, indicating that the automatic rudder trim feature of the yaw damper system was not engaged. Given that the yaw damper system operated normally after the flight, it is likely that the pilot inadvertently and unknowingly disengaged the yaw damper during flight with the autopilot engaged. During a postaccident interview, the pilot stated that he was not aware of a side-slip condition before the loss of engine power.

Although the fuel tank system was designed to prevent unporting of the fuel lines during momentary periods of uncoordinated flight, it was not intended to do so for extended periods of uncoordinated flight. Therefore, the fuel tank feed line likely unported during the prolonged uncoordinated flight,

which resulted in the subsequent loss of engine power. If the pilot had recognized the side-slip condition, he could have returned to coordinated flight and prevented the engine power loss. Also, once the airplane returned to coordinated flight, an engine restart would have been possible.

Probable Cause and Findings

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

The pilot's inadvertent deactivation of the yaw damper in flight, which resulted in a prolonged side-slip condition that led to fuel starvation and the eventual total loss of engine power. Contributing to the accident was the pilot's failure to attempt to restart the engine.

Findings

Aircraft	Yaw control - Incorrect use/operation
Personnel issues	Use of equip/system - Pilot
Aircraft	Fuel - Fluid level
Personnel issues	Lack of action - Pilot

Factual Information

History of Flight

Enroute-cruise	Fuel starvation (Defining event)
Enroute-cruise	Loss of engine power (total)
Emergency descent	Off-field or emergency landing
Landing-flare/touchdown	Collision with terr/obj (non-CFIT)

On October 5, 2014, about 1255 eastern daylight time, a Socata TBM 700 (850), N536EM, was force landed onto a high school sports field near Fayetteville, Georgia. The commercial pilot received minor injuries and one passenger, his wife, had serious injuries. The airplane was registered to TBM 850 536 LLC and was operated by pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Day, visual meteorological conditions prevailed for the flight, and an instrument flight rules flight plan was filed. The flight originated from Dekalb-Peachtree Airport (PDK), Atlanta, Georgia about 1240 and was destined for Pine Mountain, Georgia (PIM).

The pilot reported the following. During cruise flight at 6,000 feet above mean sea level (msl), he observed an oil pressure message on the crew alerting system (CAS) and a total loss of engine power. The air traffic controller provided vectors to Falcon Field, Peachtree City, Georgia (FFC), and later the pilot reported that he would not make the runway. An engine restart was not attempted. He feathered the propeller, placed the power lever in idle, and the condition lever to cut off. The landing gear and flaps remained in the retracted positions. Radar contact was subsequently lost and the pilot force landed the airplane. The airplane collided with trees and the ground before coming to rest upright. There was no fire. The pilot and his wife exited the airplane and were transported to a local hospital for treatment.

Pilot Information

Certificate:	Commercial	Age:	66, Male
Airplane Rating(s):	Single-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	3-point
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 3 Without waivers/limitations	Last FAA Medical Exam:	October 2, 2014
Occupational Pilot:	No	Last Flight Review or Equivalent:	January 24, 2014
Flight Time:	4244 hours (Total, all aircraft), 411 hours (Total, this make and model), 4111 hours (Pilot In Command, all aircraft), 9 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft)		

The pilot, age 66, held a commercial pilot certificate with ratings for airplane single engine land and instrument airplane. He reported a total flight experience of 4,244 hours, including 411 hours in the accident airplane make and model. He possessed a class 3 Federal Aviation Administration (FAA)

medical certificate with no limitations.

The pilot completed a TBM 850 recurrent training course at SIMCOM, Orlando, Florida on January 24, 2014.

Aircraft and Owner/Operator Information

Aircraft Make:	Socata	Registration:	N536EM
Model/Series:	TBM 700 850	Aircraft Category:	Airplane
Year of Manufacture:	2010	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	536
Landing Gear Type:	Retractable - Tricycle	Seats:	6
Date/Type of Last Inspection:	January 8, 2014 Annual	Certified Max Gross Wt.:	6579 lbs
Time Since Last Inspection:	135 Hrs	Engines:	1 Turbo prop
Airframe Total Time:	719 Hrs at time of accident	Engine Manufacturer:	P&W
ELT:	Installed	Engine Model/Series:	PT6A66D
Registered Owner:		Rated Power:	850 Horsepower
Operator:	On file	Operating Certificate(s) Held:	None

The accident airplane was a Socata model TBM 700 (850), serial number 536, manufactured in 2010. It was a single engine low-wing monoplane of mainly aluminum construction. It had a retractable tricycle landing gear and was configured to seat six occupants. The airplane was powered by a Pratt & Whitney Canada PT6A-66D engine, serial number RV0159, rated to produce 850 shaft-horsepower. It was fitted with a Hartzell HC-E4N-3, four-bladed, constant speed propeller.

An examination of available maintenance records revealed that an annual inspection was completed on the airframe and engine on January 8, 2014. The airframe total time at the time of the accident was 719.8 hours. The time since the last annual inspection was 135.6 hours.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	FFC, 808 ft msl	Distance from Accident Site:	3 Nautical Miles
Observation Time:	12:53 Local	Direction from Accident Site:	290°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	/	Turbulence Type Forecast/Actual:	/ None
Wind Direction:		Turbulence Severity Forecast/Actual:	/ N/A
Altimeter Setting:	30.05 inches Hg	Temperature/Dew Point:	18° C / 2° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Atlanta, GA (PDK)	Type of Flight Plan Filed:	IFR
Destination:	Pine Mountain, GA (PIM)	Type of Clearance:	IFR
Departure Time:	12:40 Local	Type of Airspace:	

The 1253 surface weather observation for FFC, located about 3 nautical miles west-northwest of the accident site, included sky clear, wind calm, visibility 10 statute miles or greater, temperature 64 degrees F, dew point 36 degrees F, and altimeter setting 30.06 inches of mercury.

Airport Information

Airport:	Falcon Field FFC	Runway Surface Type:	
Airport Elevation:	808 ft msl	Runway Surface Condition:	
Runway Used:		IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Minor	Aircraft Damage:	Substantial
Passenger Injuries:	1 Serious	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Serious, 1 Minor	Latitude, Longitude:	33.341945,-84.519165(est)

An inspector with the Federal Aviation Administration (FAA) responded to the accident site and examined the wreckage. The wreckage came to rest, upright, on level ground at a high school sports complex. The fuselage and both wings exhibited structural damage and both wing fuel tanks were ruptured from impact forces. The landing gear and wing flaps were found in the retracted positions. There was evidence of fuel spillage throughout the wreckage path. The propeller and gearbox were broken free from the engine. The engine remained attached to the firewall.

All major airframe structural and flight control components were accounted for within the wreckage debris field. Flight control continuity was established from the cockpit controls to the ailerons, elevator, and rudder. The fuel tank selector handle was found in the "L" (left) tank position.

Additional Information

Fuel Tank Design

The airplane had integral fuel tanks formed by sealing of the structure in each wing. Each tank was divided into an inboard (feeder) area and an outboard (storage) area. The feeder section of each fuel tank was formed by the root rib and the second rib outboard from the root. This rib contained one-way valves that would allow fuel to flow from the outboard storage area into the inboard feeder area, but prevented fuel from flowing outboard. The fuel capacity of the feeder section of the tank was about 33 liters or about 8.7 gallons. The one way valves in the feeder section were intended to prevent unporting of the fuel tank pickup due to momentary periods of uncoordinated flight as would be encountered during turbulence, but were not intended to do so for extended periods of uncoordinated flight.

Autopilot and Yaw Damper Systems

The airplane was equipped with an automatic flight control system (AFCS) that included an autopilot and yaw damper. The autopilot controlled the aircraft pitch and roll attitudes following commands received from the flight director. The yaw damper system operated independent of autopilot and was designed to monitor lateral acceleration to achieve coordinated flight. The system was also designed to automatically actuate the rudder trim to achieve trimmed flight. The automatic trim feature was only enabled when the yaw damper system was engaged. The rudder trim system also included a manual electric yaw trim (MEYT) switch on the pilot yoke that enabled the pilot to trim the rudder without yaw damper engagement. The yaw damper system could be enabled independent of the autopilot by depressing the "YD" button. In addition, if the pilot selected the "AP" key, the autopilot, yaw damper

and flight director would be activated simultaneously. The yaw damper system could be disengaged by activating the MEYT switch located on the yoke, or by depressing the "YD" button. The parameters recorded by the G1000 avionics system did not include a discrete parameter indicating yaw damper engagement or trim motor actuation.

The G1000 indications of extended flight in a slip condition were indicative of the yaw damper being disconnected while the autopilot was engaged. Steady heading side slips occur with no trim action on the yaw axis as the aircraft increases speed and maintains a steady heading and altitude. Rudder trim was provided automatically with the yaw damper on, or manually using the rudder trim. During a post-accident interview with the pilot, he stated that he was not aware of a side-slip condition prior to the loss of engine power.

On September 8, 2014, TBM issued Service Information (SI) 2014-006, which provided an upgrade (version 14.02) to the G1000 version 14.01 software. Included in the upgrade was a new CAS caution message, "AP ON YD OFF" that illuminated when the autopilot was on while the yaw damper was off. This condition would include a scenario of inadvertent pilot deactivation of the yaw damper. An aural warning was also incorporated to direct the pilot to the CAS message. At the time of the accident, the accident airplane did not have the upgrade to version 14.02 installed. The owner reported that he planned to install it at the next annual inspection, due in January, 2015.

Chapter 3 of the TBM 850 Pilot's Operating Handbook addresses engine failure in flight. Step number 8 of the ENGINE FAILURE DURING FLIGHT checklist calls for an air start attempt and directs the pilot to the air start procedure (section 3.4). The pilot reported that he did not attempt an air start.

Flight recorders

The airplane was equipped with a Garmin G1000 all-glass avionics suite. The unit held a Secure Digital (SD) card and investigators confirmed that the card recorded flight and systems data before and during the accident sequence.

GPS track data, retrieved from the Garmin G1000 system, depicted the airplane departing PDK about 1240. About 18 seconds after takeoff, the autopilot was turned on. G1000 data indicated that during the climb portion of the flight, the lateral acceleration values were near neutral. This indicated that the rudder trim was appropriately set for the climb portion of the flight.

About 1244:52, the airplane reached 6,000 feet above mean sea level, leveled off, and began to accelerate. During the next 5 minutes, the airplane's lateral acceleration reached 0.17g while the airplane maintained a left bank of about 8-10 degrees while on a heading of about 190 degrees. These roll, lateral acceleration, and heading values indicated that the airplane was flying in a side-slip.

At 1249:53, the airplane started a right turn with the autopilot engaged, to a heading of 240 degrees. At the end of the turn, at 1250:16, the engine lost power. A sudden drop of NG (gas producer speed), torque, and fuel flow was observed. At 1251, the pilot disconnected the autopilot and the airplane

returned to near-coordinated flight until the airplane completed its descent to the forced landing.

Tests and Research

Fuel System

The aircraft fuel system was examined after recovery of the wreckage to a storage facility. The cockpit fuel selector was in the LEFT tank position and the fuel selector valve indicated that fuel was feeding from the left tank. Both inboard wing fuel doors were opened to inspect the pickup area; no anomalies were found. The fuel screen, low fuel sensor, and flapper valves all appeared normal.

The fuel lines from the left tank to the engine were examined for obstructions with forced air; none were found. The fuel filter was removed and examined; no contamination was found. The fuel selector valve operated in a normal manner.

Engine

The engine was removed and sent to the manufacturer's facility for disassembly and examination. The engine displayed moderate impact damage including structural separation of the forward reduction gearbox, impact fracture of the propeller shaft, and light compressional deformation of the exhaust duct.

The gas generator rotor and accessory gearbox turned freely by hand. Light circumferential rubbing was displayed by the compressor turbine shroud due to contact with the adjacent blade tips. Unburned organic debris was distributed in the combustion section. The power section was seized due to the deformation of the exhaust duct. Circumferential rubbing was displayed by the first and second stage power turbine shrouds due to contact with their adjacent blade tips. None of the engine mechanical components displayed any indications of any pre-impact anomalies or distress.

Investigation of the engine controls and accessories included functional testing of the fuel pump, fuel control unit, flow divider, fuel nozzles, and torque limiter. The propeller governor was disassembled and inspected as impact damage precluded functional testing. None of the components showed any conditions that would have precluded normal operation.

Rudder Trim System

The electrical rudder trim actuator was found positioned slightly left of neutral. Electrical power was applied to the rudder trim and yaw damper systems after the accident and both operated in a normal manner.

Administrative Information

Investigator In Charge (IIC):	Hicks, Ralph
Additional Participating Persons:	Mark Astin; FAA/FSDO; Atlanta, GA Philippe Santoro; Daher Socata; Pompano Beach, FL Thomas Berthe; Pratt & Whitney Canada; St. Hubert
Original Publish Date:	June 29, 2016
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=90208

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