Aviation Investigation Final Report

Location:	Hampton, South Carolina	**Accident Number:**	ERA15LA062
Date & Time:	November 28, 2014, 11:58 Local	**Registration:**	N227RR
Aircraft:	CIRRUS DESIGN CORP. SR22T	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Serious, 3 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot was conducting a personal cross-country flight with three passengers on board. The pilot reported that, during the preflight inspection, he checked the quantity of engine oil and verified that there was an adequate supply of engine oil on board. During cruise flight, about 9,000 ft mean sea level (msl), the oil pressure indication decreased to 0, which resulted in both audible and visual warnings. The engine power then reduced to idle, and the pilot's attempts to restore engine power by moving the throttle were not successful. The pilot subsequently diverted to a nearby airport about 7.5 nautical miles (nm) away. He stated that he descended the airplane slightly faster than the published best glide airspeed. When the airplane was at 800 ft msl and he realized it would not be able to land at the intended runway, he deployed the ballistic parachute. The airplane descended under the canopy, hit trees, descended to the ground, and then came to rest about 3/4 nm from the approach end of the intended runway.

A postaccident examination and test run of the engine revealed no evidence of preimpact mechanical failures or malfunctions. Further, normal engine oil pressure was noted during the engine run; however, subsequent examination of the oil pressure transducer revealed that it was faulty and would have resulted in an erroneous oil pressure indication, as reported by the pilot. Further, although the pilot indicated that the engine lost power following the loss of oil pressure indication, which was supported by data downloaded from the onboard recording devices that showed decreased readings for fuel flow, exhaust gas temperature, and cylinder head temperature, the loss of engine power was consistent with the pilot's operation of the engine controls not with a mechanical malfunction or failure of the engine.

Although the pilot reported that he descended the airplane slightly above the published best glide speed after first locating the alternate airport, the recorded data indicated that he descended at an indicated airspeed far greater than the published best glide speed for the majority of the descent. If the pilot had slowed to and maintained the published best glide speed either at the time of the first abnormal indication or after first locating the alternate airport, it is likely that the airplane would have been able to reach the intended runway and land successfully.

Further, although the pilot reported that he deployed the parachute at 800 ft msl, it was actually deployed when the airplane was at 453 ft msl, or about 340 ft above ground level (agl), excluding the treetop heights. Although the successful deployment of the parachute has been demonstrated at less than 400 ft agl, the low-altitude deployment likely contributed to the severity of the accident by not allowing the parachute to fully deploy and adequately decelerate the airplane into an approximately level attitude.

Probable Cause and Findings

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

The pilot's improper decision to descend the airplane at an airspeed greater than the published best glide speed following an erroneous oil pressure indication, which resulted in an off-airport landing. Contributing to the erroneous oil pressure indication was the faulty oil pressure transducer. Contributing to the severity of the accident was the pilot's late deployment of the ballistic parachute system.

Findings

Personnel issues	Decision making/judgment - Pilot
Personnel issues	Use of equip/system - Pilot
Aircraft	Pressure - Malfunction
Personnel issues	Delayed action - Pilot

Factual Information

History of Flight

Enroute-cruise	Miscellaneous/other
Enroute-cruise	Loss of engine power (total) (Defining event)
Emergency descent	Miscellaneous/other
Landing-flare/touchdown	Hard landing

On November 28, 2014, about 1158 eastern standard time, a Cirrus Design Corporation SR22T, N227RR, descended under the canopy of the Cirrus Airframe Parachute System (CAPS) and landed into a wooded area near Hampton-Varnville Airport (3J0), Hampton, South Carolina. The private pilot and two passengers sustained minor injuries, while one passenger sustained serious injuries. The airplane was substantially damaged. The airplane was registered to and operated by Header Bug LLC, under the provisions of 14 Code of Federal Regulations (CFR) Part 91 as a personal flight. Visual meteorological conditions prevailed at the time and an instrument flight rules flight plan was filed. The flight originated from Sarasota/Bradenton International Airport (SRQ), Sarasota, Florida, about 0933, and was destined for Orangeburg Municipal Airport (OGB), Orangeburg, South Carolina.

The pilot stated that after arrival at SRQ, the airplane was removed from the hangar and, as part of his preflight inspection, he checked the quantity of engine oil, which was indicating 8 quarts, or full. After engine start, he taxied to the run-up area, and while there performed an engine run-up using the checklist. It included a check of the magnetos at 1,700 rpm, and a check of the load on the alternators. When the checklist was completed he obtained his IFR clearance, and departed from runway 04.

After takeoff the flight proceeded towards the destination airport while remaining in contact with air traffic control. About 3 minutes after last checking the engine parameters, noting all engine parameters (specifically, oil temperature, oil pressure, and CHT) were in the green, or at 1153:02, the oil pressure indication first began to decrease from the steady state reading. The oil pressure decreased to zero over the next 2 seconds and was annunciated by an audible warning. The airplane at that time was at 9,000 feet mean sea level (msl), or 8,542 feet pressure altitude and was about 9.5 nautical miles and 168 degrees from 3J0. The pilot reported the engine power went to idle, and he did not hear any sounds from the engine, which was running smooth but was idled back. He reported he had no control over the power, and did not observe any oil or mist coming out of the engine and did not notice any smoke from the engine from oil getting onto a hot exhaust. He also reported he did not hear a change in sound from the propeller as if the propeller had changed pitch, and the propeller never stopped. The passenger in the right front seat read the display on the multi-function display (MFD) that the oil pressure displayed in the red showing 0 oil pressure. In addition, on the primary flight display (PFD) a red highlighted "WARNING" about the oil pressure displayed. He fully enrichened the mixture control and moved the throttle in an attempt to restore engine power but there was no response.

Using the on-board avionics he confirmed the nearest airport was 3J0, and declared an emergency with air traffic control, advising the controller at 1153:39, "…I got an oil pressure going haywire." The controller advised the pilot that 3J0 was the nearest airport and was located 7.9 miles from the aircraft's

present position. The pilot informed the controller at 1154:09 that the airport was in sight; the airplane at that time was at 7,647 feet msl and was located about 7.5 nautical miles and 163 degrees from the approach end of runway 29 at 3J0. The controller then asked the pilot if he needed assistance on the ground at 3J0, and he indicated he did. The controller subsequently informed the pilot that emergency crews were on their way to 3J0.

The pilot reported that with the engine at idle, he descended at 98 knots, although the best glide speed was reported to be 88 knots. After realizing he was unable to land at 3J0, he informed the passengers to tighten their restraints (seatbelts and shoulder harnesses) before activating the CAPS. At 1157:36, the pilot informed the controller that he was "…inches from making this uh runway before I have to deploy this chute on here so." He indicated that he pulled the CAPS activation handle at 800 feet but could not recall the airspeed at chute pull. While under the canopy, the tail came down just as the airplane hit the trees. He attributed this to the altitude of deployment. A portion of a wing was knocked off and the tail was almost separated. The airplane descended to the ground, and he reported the contact was hard. He later indicated securing the fuel selector while on the ground.

The airplane came to rest in a wooded area about ¾ nautical mile and 110 degrees from the approach end of runway 29 at 3J0.

According to the individual involved with the recovery of the airplane, there were no obvious discrepancies noted with the engine, and no oil was observed inside the engine compartment. In the resting position of the airplane (slight nose low), a total of four quarts registered on the oil dipstick (actually called an oil gage rod and cap assembly, part number (P/N 656616-2); which was tightly secured. After the airplane was raised from the ground to a level attitude, no oil streaking or stains were noted on the bottom of the fuselage or airframe. In that position, the oil quantity registered slightly above the "8" mark on the oil gage rod cap assembly, which was full. A copy of the NTSB Record of Conversation with the individual is contained in the NTSB public docket.

Following recovery of the wreckage, an examination of it and the engine was performed by representatives of the airframe and engine manufacturer with NTSB oversight. The avionics that recorded and retained data were downloaded with NTSB permission by a representative of the airframe manufacturer. The downloaded data was then provided to the NTSB Vehicle Recorder Division. Examination the engine revealed the oil quantity was approximately 8 quarts and the oil was "like new." At the request of the NTSB investigator-in-charge, the oil pump cover was removed to inspect the oil pump; no discrepancies were noted. Crankshaft, camshaft, and valve train continuity was confirmed. Examination of the wiring associated with the oil pressure transducer revealed the connection at the transducer was properly connected and strain relief of the wire harness at the transducer was noted. Electrical continuity was confirmed from the plug at the transducer for the supply and output pins to the appropriate pins at the firewall connection; however, continuity was not confirmed for the ground pin at the transducer connector. No damage to the wiring harness was reported and the condition of each connector and pins were satisfactory. A portion of the wiring harness was removed for further examination of the ground connection related to the oil pressure transducer.

Examination of the throttle and mixture controls in the cockpit revealed the throttle was full forward and the mixture control was in a mid-range position between full rich and idle cut-off, which matched the positions at each respective control in the engine compartment. Examination of the engine controls in the engine compartment revealed they were properly secured and once documented, full, unrestricted

stop-to-stop movement was observed by activation of the cockpit controls. Examination of the engine-driven fuel pump revealed the drive coupling was intact and fuel was noted in the flexible hose from the outlet of the pump to the fuel metering unit. No fuel was noted at the inlet to the fuel pump. Examination of the CAPS revealed the rear harness remained snubbed. The fuel selector was found in the off position. The engine was removed from the airplane for an attempted engine run at the manufacturer's facility. Additional items retained by NTSB included the oil pressure transducer, the Cirrus Recoverable Data Module (RDM), and the SanDisk 4GB SDHC Card from the Garmin G1000. Additional details concerning the airframe and engine examination results are contained in NTSB field notes or report from the engine manufacturer representative that are contained in the NTSB public docket.

At the engine manufacturer's facility, while in the presence of NTSB personnel, the engine was removed from the crate and impact damaged components were replaced. Additionally, the oil pump cover which had been previously removed was reinstalled with new silk thread. The engine was mounted in a test stand with a test club propeller installed and included the engine oil cooler, but did not include the accident oil pressure transducer. A flexible fluid carrying hose was attached to the outlet of the oil cooler (same location at the oil pressure transducer location) and connected directly to the test bench analog oil pressure gauge. During the initial run, an oil leak was noted at the oil pump. The engine was secured and the silk thread at the oil pump cover was repositioned. The oil pump cover was re-installed and the engine was started and found to operate normally. During the second engine run normal oil pressure and engine operation was noted. Examination of the retained electrical wiring associated with the oil pressure transducer revealed continuity of the ground from the plug at the oil pressure transducer to the bundled location also shared by the tachometer sensor, fuel flow sensor, and manifold pressure sensor. A copy of the NTSB report and report from the engine manufacturer's representative concerning the engine run and wiring harness examination are contained in the NTSB public docket.

Following the engine run, the oil pressure transducer was examined at the manufacturer's facility with FAA oversight. The transducer was marked in part with "12-635-004" which is the Cirrus part number (P/N), and "G1014" which indicates it was manufactured July 10, 2014. The examination began with a visual examination which confirmed the transducer did not appear damaged. The pressure port was not obstructed or damaged, and there was no damage on the connector and no signs of fretting on the pins. The transducer was then subjected to x-ray examination which revealed there was no evidence of a loose contact or damage inside the sensor. The transducer was then subjected to bench testing which involved applying up to 5 volts DC power and 150 PSIG. The transducer worked with no discrepancies and was subjected to a tap by a mallet which did not change the output voltage. The transducer was then subjected to a parametric test at specific pressures from 0-150 PSID and at specified test temperatures between -30.0 degrees Celsius to +100.0 degrees Celsius. The unit passed testing at all test temperatures and pressures up to testing at +100.0 degrees Celsius and 100 PSID, but failed the remainder of the pressure testing at that temperature. A copy of the report from the transducer manufacturer is contained in the NTSB public docket.

The specification for the oil pressure transducer identified as Cirrus Part Number (P/N) 12-635-004, indicated the input pressure range was 0 to 150 PSIG, and the operating temperature range was -30 degrees to +100 degrees Celsius. The expected vibration was 10 to 2000 Hz, and the expected operating life was 10 million full pressure cycles minimum.

A review of the maintenance records revealed the airplane was manufactured in September, 2014. Since manufacture, there was no record of any work performed to the oil pressure transducer or any reported

discrepancy (excluding the accident flight) with the oil pressure indication. The engine oil and filter were noted to have been changed twice. The first occurred on November 14, 2014, at tachometer time of 31.40, and the second occurred on November 20, 2014, at tachometer time of 44.10. The airplane hour meter and flight meter were reported to be 62.7 and 51.7 hours, respectively. Excerpts of the maintenance entries are contained in the NTSB public docket.

According to the Maximum Glide Chart found in the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH/AFM), the best glide speed at gross weight is published to be 92 KIAS, resulting in a glide ratio of 8.6:1. Based on the location and altitude being flown when the pilot reported 3J0 was in sight (7,647feet msl), and subtracting the airport field elevation (113 feet), flying at the published best glide speed would have allowed a glide distance of approximately 10.6 nautical miles. The calculations did not take into account the affect of wind. Further review of the emergency procedures section of the POH/AFM revealed that it contained a section related to oil pressure warning and revealed the checklist items indicated that if the oil pressure was low to reduce power to minimum required for sustained flight and land as soon as possible. The amplification section of that checklist indicated that low oil pressure may be caused by a loss of a significant amount of its oil and engine failure may be imminent. The emergency procedures section for "Engine Failure In Flight" of the POH/AFM indicated to establish best glide speed, and then to trouble shoot to restore engine power.

Further review of the POH/AFM pertaining to the deployment characteristics of the CAPS indicated that about 8 seconds after deployment, the rear riser stub line would be cut and the airplane tail would drop down into its final approximately level attitude. The descent rate was expected to be less than 1,700 feet-per-minute with a lateral speed equal to the velocity of the surface winds. Chapter 10 of the POH/AFM related to the CAPS indicated that although no minimum altitude for deployment had been set, "A low altitude deployment increases the risk of injury or death and should avoided. If circumstances permit, it is advisable to activate the CAPS at or above 2,000 feet AGL." The POH/AFM also indicated that as a data point, altitude loss from level flight deployments had been demonstrated at less than 400 feet. Eight seconds after deployment, the rear riser snub line would be cut and the airplane tail would drop down into its final approximately level attitude. The ground impact was expected to be the equivalent to touchdown from a height of approximately 13 feet. Excerpts from the POH/AFM are contained in the NTSB public docket.

According to the NTSB Recorded Flight Data Specialist's Factual Report concerning the Recoverable Data Module (RDM), downloaded data recorded in 1 Hz increments began at 0931:00, and ended at 1158:20, which contained the takeoff to about 8 seconds after deployment of the CAPS. Further review of the downloaded data revealed normal engine indications were noted from acceleration for takeoff at 0933:01 until about 1153:01, at which time the oil pressure was recorded to be 57 PSI. One second later, or at 1153:02, the oil pressure was recorded to be 38 PSI, while at the same time the recorded readings for rpm, fuel flow and manifold pressure, which share the same ground connection as the oil pressure ground, remained about the same as the recorded values 1 second earlier. The oil pressure indication decreased to 0 at 1153:04, and remained at that value for the remainder of the recorded data. The data for rpm, fuel flow and manifold pressure at 1153:04, remained at or near the previous recorded values. For about 34 seconds after the oil pressure indication was first recorded to be zero, the pressure altitude remained nearly the same while the indicated airspeed decreased from 143 knots to 109 knots. During the same time frame, the manifold pressure and fuel flow readings decreased, but the engine rpm remained about the same value. Beginning about 1153:38, or about 34 seconds after the oil pressure indication was noted to be 0, the pressure altitude began to decrease with a corresponding increase in

airspeed which attained the highest value of 148 knots about 2 minutes later; the airspeed remained above 140 knots until 1156:09. At this time the airspeed began to decrease with a continual decrease in pressure altitude. At 1158:00, or about 5 minutes since the oil pressure began to decrease, and about 13 seconds before the CAPS was deployed, the airspeed was first noted to be less than the published best glide speed value of 92 knots. The CAPS activation handle was noted to be pulled at 1158:13, while the airplane was at 453 feet msl and 87 knots, or approximately 340 feet above ground level. A total of 7 seconds elapsed time between the CAPS deployment and the end of recorded data was noted; the last recorded airspeed and ground speed values were 42 and 29 knots, respectively. Closer review of the recorded data from the time when the oil pressure indication was noted to be 0 revealed the engine rpm was noted to remain nearly the same for the next 4 minutes 6 seconds, while the fuel flow and manifold pressure indications were noted to begin to decrease about 2 and 3 seconds after the no oil pressure indication, respectively, and continued to decrease. Thereafter, the exhaust gas temperature and cylinder head temperatures began to decrease. A copy of the NTSB Recorded Flight Data Report and downloaded data are contained in the NTSB public docket.

A search of the Federal Aviation Administration (FAA) Service Difficulty Report (SDR) data was performed using the base Cirrus part number for the transducer. The data indicated there were a total of 8 reports; none of which were the specific complete part number of the pressure transducer in the accident airplane model. Closer review of the 8 reports indicated a total of the 6 reports were specified to be the transducer for oil pressure. Of the 6 reports, only one indicated the oil pressure went to 0. In that instance, the report indicated the oil pressure transducer was found to be inoperative. A copy of the SDR is contained in the NTSB public docket.

Cirrus personnel reported that beginning in 2010, they noticed an increase in warranty claims and customer satisfaction survey results showed a high replacement rate for oil and manifold pressure transducers which are similar and used on SR20, SR22, SR22TN, and model SR22T aircraft. The identified issue was erratic indication, which was attributed to be associated with connectors (baffler connector and connector at the transducer). Subsequently in August 2012, Service Bulletin (SB) 2X-77-04 was introduced which specified replacement in part of the oil pressure transducer and installed strain relief at the connector of the oil pressure transducer, and also removed the baffler connector. The actions of the SB were incorporated into production aircraft including the accident airplane. Cirrus personnel reported that after issuance of the SB, the number of warranty claims decreased in 2013, but increased again in 2014 and 2015. Cirrus is currently investigating and evaluating possible product improvements.

Pilot Information

Certificate:	Private	**Age:**	71
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	March 17, 2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	October 20, 2014
Flight Time:	300 hours (Total, all aircraft), 250 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	CIRRUS DESIGN CORP.	**Registration:**	N227RR
Model/Series:	SR22T	**Aircraft Category:**	Airplane
Year of Manufacture:	2014	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	0884
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	3600 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	62.7 Hrs at time of accident	**Engine Manufacturer:**	Teledyne Continental
ELT:	C126 installed, activated	**Engine Model/Series:**	TSIO-550-K
Registered Owner:	Header Bug LLC	**Rated Power:**	315 Horsepower
Operator:	Header Bug LLC	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	BNL,246 ft msl	**Distance from Accident Site:**	29 Nautical Miles
Observation Time:	11:55 Local	**Direction from Accident Site:**	326°
Lowest Cloud Condition:	Clear	**Visibility**	
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots / None	**Turbulence Type Forecast/Actual:**	/ Unknown
Wind Direction:	30°	**Turbulence Severity Forecast/Actual:**	/ Unknown
Altimeter Setting:	30.39 inches Hg	**Temperature/Dew Point:**	7°C / 3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Sarasota, FL (SRQ)	**Type of Flight Plan Filed:**	IFR
Destination:	Orangeburg, SC (OGB)	**Type of Clearance:**	IFR
Departure Time:	09:33 Local	**Type of Airspace:**	

Airport Information

Airport:	Hampton-Varnville 3J0	**Runway Surface Type:**	Asphalt
Airport Elevation:	113 ft msl	**Runway Surface Condition:**	
Runway Used:	29	**IFR Approach:**	None
Runway Length/Width:	3580 ft / 60 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Serious, 2 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Serious, 3 Minor	**Latitude, Longitude:**	32.860553,-81.061668

Administrative Information

Investigator In Charge (IIC):	Monville, Timothy
Additional Participating Persons:	Daryl L McMillan; FAA/FSDO; West Columbia, SC John Kent; Continental Motors, Inc.; Mobile, AL Bradley T Miller; Cirrus Design Corp.; Duluth, MN
Original Publish Date:	June 29, 2016
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=90435