

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

October 30, 2020

Electronic Device – Recorded Flight Data

Specialist's Factual Report
By Charles Cates

1. EVENT SUMMARY

Location: Osage Beach, Missouri
Date: August 16, 2020
Aircraft: Cirrus SR22
Registration: N949CG
Operator: Private
NTSB Number: CEN20LA336

Witnesses observed the flight preparing to depart Grand Glaize-Osage Beach Airport (K15), Missouri, for a cross country flight. The pilot was observed "flooding the engine" during startup to the point fuel was observed coming out of the engine cowling and down the nose wheel. Black smoke was seen coming out of the engine compartment after the engine started and before the airplane taxied. The flight was seen conducting a run up prior to takeoff. Black smoke was seen coming from the left side of the engine compartment during takeoff and several witnesses said the engine did not sound normal. The pilot reported on the CTAF frequency that he was returning to the airport. The airplane was seen to enter a left turn back to the airport at about 100 ft above the trees and then descend steeply into the ground. The airplane wreckage was mostly consumed by post-impact fire.

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic device:

Recorder Manufacturer/Model:	Appareo Stratus 2S
Recorder Serial Number:	Unknown

3.1. Appareo Stratus 2S

The Appareo Status 2S device is a self-contained battery powered unit that contains an internal AHRS,¹ GPS/WAAS receiver,² and ADS-B³ receiver in one compact unit. The unit communicates wirelessly with compatible devices to display all the acquired information. In addition to communicating with compatible devices, the Stratus device records GPS position and AHRS information internally on a non-volatile flash memory chip. Internal memory has the space to store over 13 hours of flight data that is sampled at approximately 5 data records per second (5 Hz).

3.2. Appareo Stratus Data Recovery

Upon arrival at the Vehicle Recorder Laboratory it was apparent the device had suffered extreme thermal damage. The case was scorched and melted. Figure 1 shows the extent of the damage as received. Disassembling the device showed that internal silicon components were shielded from the fire, so the memory chips were removed, read, and converted to engineering units using forensic tools. Figure 2 shows the disassembled device prior to removing the memory components.

The raw data was contained in two files, one for AHRS parameters and one for GPS parameters. The two files were time aligned using a common internal system time recorded in both files. The GPS file also contained a GPS timestamp.

3.3. Appareo Stratus Data Description

The extracted data included sessions from September 24, 2019 through August 16, 2020, the date of the accident. The session determined to be relevant to the accident started at 06:07:50 UTC and ended at 06:16:57 UTC on August 16, 2020, which is about two hours from the actual accident time. The reason for this discrepancy is unclear. The Altitude Above Ground Level parameter was invalid.

¹ The Attitude Heading Reference System consists of a set of 3-axis gyroscope, accelerometers and heading reference sensors that enable the unit to compute pitch, roll, and yaw motions.

² The Wide Area Augmentation System (WAAS) is an air navigation aid to augment the Global Positioning System (GPS), by improving its accuracy, integrity, and availability.

³ Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology deployed throughout the national airspace system. The ADS-B system is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft by using the GPS and transmit its position along with additional information about the aircraft to ground stations for use by air traffic control (ATC) and other ADS-B services. This information is transmitted at a rate of approximately once per second. Operators equipped with ADS-B realize additional benefits from ADS-B broadcast services: Traffic Information Service - Broadcast (TIS-B) (traffic information) and Flight Information Service - Broadcast (FIS-B) (weather information).



Figure 1. Appareo Stratus 2S as received by the Vehicle Recorder Laboratory.



Figure 2. Appareo Stratus 2S disassembled revealing undamaged silicon components.

3.4. Appareo Stratus 2S Time Correlation

Both the file of AHRS data and the file of GPS data had an internal system time, recorded in milliseconds from boot time, which allowed the two files to be correlated to each other. The file of GPS data recorded GPS time and date, which was used to correlate the files to Coordinated Universal (UTC) time. However, while the date was consistent with the accident date, the time was two hours off the local time of the accident.

3.5. Appareo Stratus 2S Parameters

Parameter Name (units)	Parameter Description
Accel Lat (g)	Lateral Acceleration
Accel Long (g)	Longitudinal Acceleration
Accel Vert (g)	Vertical Acceleration
Altitude HMSL (ft)	Pressure Altitude Above Sea Level
Ground Speed (kts)	GPS Ground Speed
Ground Track (deg)	GPS Ground Track
Heading (deg)	Aircraft Heading
Latitude (deg)	Latitude
Longitude (deg)	Longitude
Pitch (deg)	Pitch Angle
Roll (deg)	Roll Angle
Turn Rate(deg/s)	Turn Rate
Vertical Speed (fpm)	Vertical Speed

3.6. Plots and Corresponding Tabular Data

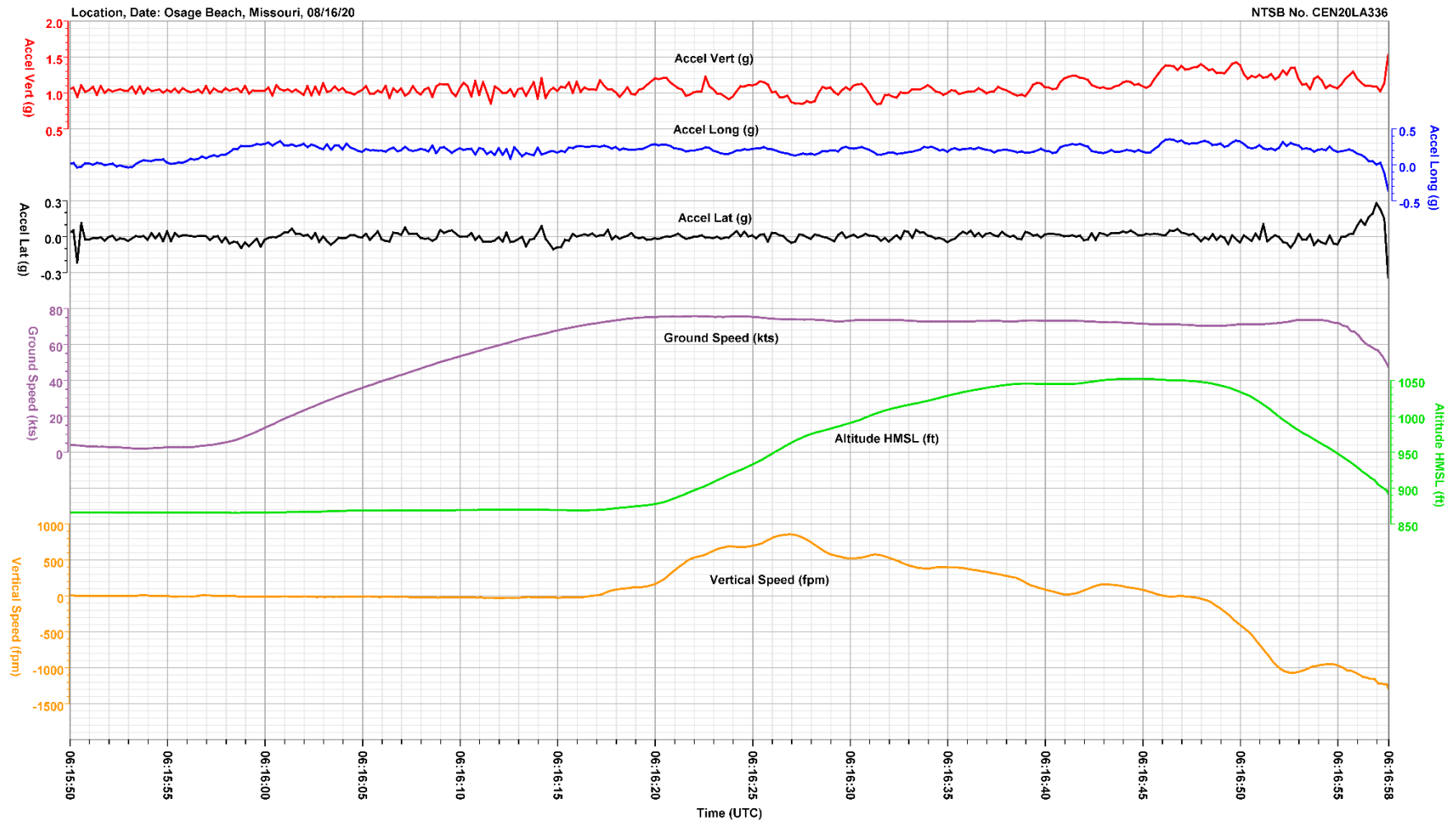
Figures 3, 4, and 5 contain Stratus 2S data recorded during the event. The time interval for all plots is 06:15:50 to 06:16:58. The flight departed Grand Glaize-Osage Beach Airport (K15) at about 06:16:20. The airplane climbed to an altitude of nearly 200 feet above runway level, entered a left turn, and descended. At the peak altitude the left roll increased rapidly from 30 to 50 degrees, then rapidly rolled to the right and became inverted.

Figure 5 is a map overlay using Google Earth. Weather and lighting conditions in Google Earth are not necessarily representative of weather and lighting conditions at the time of the accident.

The corresponding tabular data used to create these three figures are provided in electronic (*.csv⁴) format as Attachment 1 to this report.

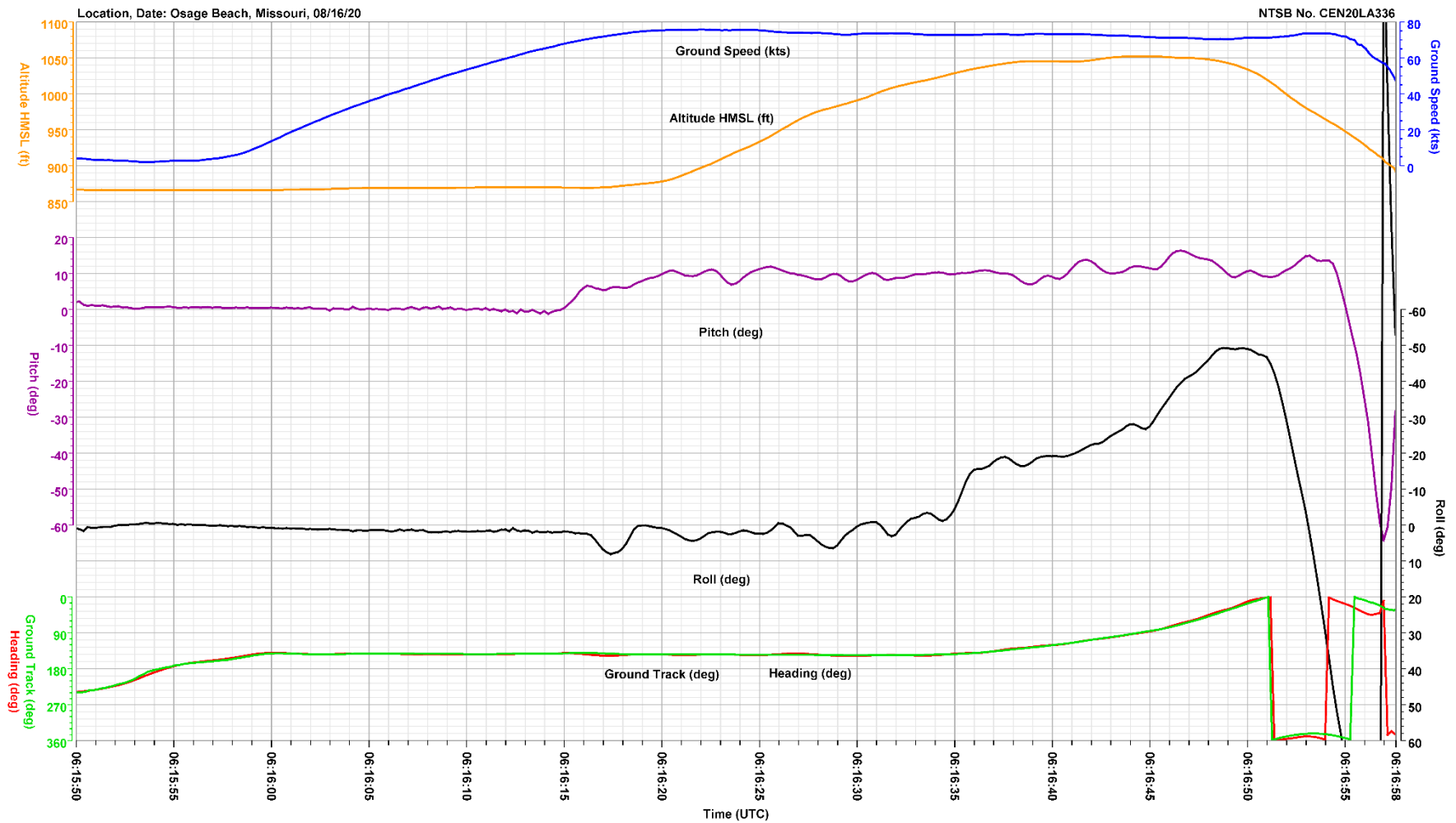
⁴ Comma Separated Value format.

Figure 3. Plot of accelerations, speed, and altitude parameters.



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Figure 4. Plot of aircraft attitude angles.



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Figure 5. Map overlay of position data from Stratus 2S.

