Aviation Investigation Final Report

Location:	Marana, Arizona	**Accident Number:**	WPR21LA145
Date & Time:	March 28, 2021, 14:28 Local	**Registration:**	N644SR
Aircraft:	CIRRUS DESIGN CORP SR22	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that after a normal takeoff and upon reaching 10,000 ft, the engine shuddered, stopped producing power, and began violently shaking the airplane. The pilot turned toward the closest airport and shut down the engine controls; however, the propeller continued to windmill, which resulted in the engine continuing to shudder. Air traffic control issued a heading to the closest airport, but the pilot realized he was not going to be able to reach the airport, so the controller issued a heading to a nearby glider port.

The pilot reported that he was able to reach the glider port but instead elected to activate the airplane's parachute system upon reaching an altitude of 2,000 ft above the ground. The pilot pulled the activation handle several times, but the parachute did not deploy so he turned his attention to landing the airplane. The pilot made a forced landing on a dirt road and the left wing contacted brush alongside the road, spinning the airplane 180° before it came to rest. The airplane sustained substantial damage to the underside of the wings and fuselage

A postaccident examination of the engine revealed the No. 2 main bearing had rotated and the corresponding main bearing seal was not positioned properly in the saddle bearing support, which resulted in oil starvation and subsequent catastrophic failure of the engine. The reason for the bearing and bearing seal shift could not be determined due to the extent of the engine damage.

Postaccident examination and testing of the airplane's parachute system found that the firing process was initiated, as indicated by the open circuit and broken bridge wire. However, undetermined inconsistencies within the ignition primer charge material prevented the subsequent ignition of the rocket propellent, which in turn prevented the activation of the parachute.

Probable Cause and Findings

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

A total loss of engine power resulting from a catastrophic engine failure caused by a shift of the No. 2 main bearing and bearing seal, which resulted in oil starvation to the crankshaft; the reason for the bearing and bearing seal shift could not be determined due to the extent of the engine damage. Contributing to the accident was the failure of the airframe parachute system to deploy due to undetermined inconsistencies within ignition material in the rocket igniter assembly/squib.

Findings

Aircraft	Oil - Fluid level
Aircraft	Parachute - Failure
Aircraft	(general) - Unknown/Not determined

Factual Information

History of Flight

Enroute	Loss of engine power (total) (Defining event)

On March 28, 2021, at 1428 Pacific daylight time, a Cirrus SR22 GTS, N644SR, was substantially damaged when it was involved in an accident near Marana, Arizona. The pilot and passenger were uninjured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The flight originated from Tucson, Arizona, and the pilot reported the takeoff and climb were normal until reaching 10,000 ft mean sea level when the engine shuttered, lost all power, and began to shake the airplane violently. The pilot shut down the engine controls; however, the propeller continued to windmill which resulted in the engine continuing to shudder.

Air traffic control provided a heading to the Marana Regional Airport. When the pilot realized he was not going to make it to the airport, the controller issued a heading to a nearby glider port. The pilot reported he was “confident” that he could make it but instead he elected to deploy the airplane’s Cirrus Airframe Parachute System (CAPS) upon reaching 2,000 ft above ground level. The pilot reported he pulled the parachute deployment handle three times, but the parachute did not deploy. He subsequently landed the airplane on a dirt road. The left wing contacted tall brush and spun the airplane 180° resulting in substantial damage to the underside of the wings and fuselage.

Wreckage and Impact Information

The empennage, upper fuselage, engine, and propeller were intact and received very little damage. The landing gear was bent and collapsed, and the left flap was deformed. The compartment for the ballistic parachute was intact and unopened.

A postaccident examination revealed that about 5 quarts of dark oil were drained from the oil sump. The oil sump was removed, and it contained broken aluminum and steel engine components. The Nos. 1 and 3 cylinders through bolt and deck stud nuts had torque seal. The remaining cylinders did not have torque seal applied. The 8-through bolts nuts were retorqued to the manufacturer’s specified torque setting and none of the nuts tightened before the specified torque was reached. The Nos. 2 and 4 cylinders could not be removed from the crankcase due to internal mechanical damage to their cylinder skirts.

Figure 1. – Crankcase damage and view of interior engine components.

The No. 2 connecting rod and piston were separated from the crankshaft. The left half of the No. 2 main bearing was found rotated about 15° within the saddle area and overlapping the right half of No. 2 bearing. The left bearing half was shifted forward about 1/8 of an inch from its original position.

The corresponding main bearing seal was not positioned properly in the saddle bearing support, which resulted in a lack of oil lubrication and the discoloration of the connecting rod journal.

The last annual inspection was performed on April 20, 2020, at recorded Hobbs time of 2130.0 hours. The No. 1 cylinder and piston assembly was removed, repaired, and reinstalled during the inspection due to low compression.

Figure 2. No. 2 connecting rod, piston, crankcase pieces, and piston material.

Cirrus Airplane Parachute System

A postaccident examination of the Cirrus Airplane Parachute System revealed the chute had been packed properly but the rocket motor initiating device (squib) was inoperative. It was determined that the squib circuit was “open”, and not “closed” as it should have been had the system not been fired. No other anomalies were initially identified that would have contributed to the system not firing.

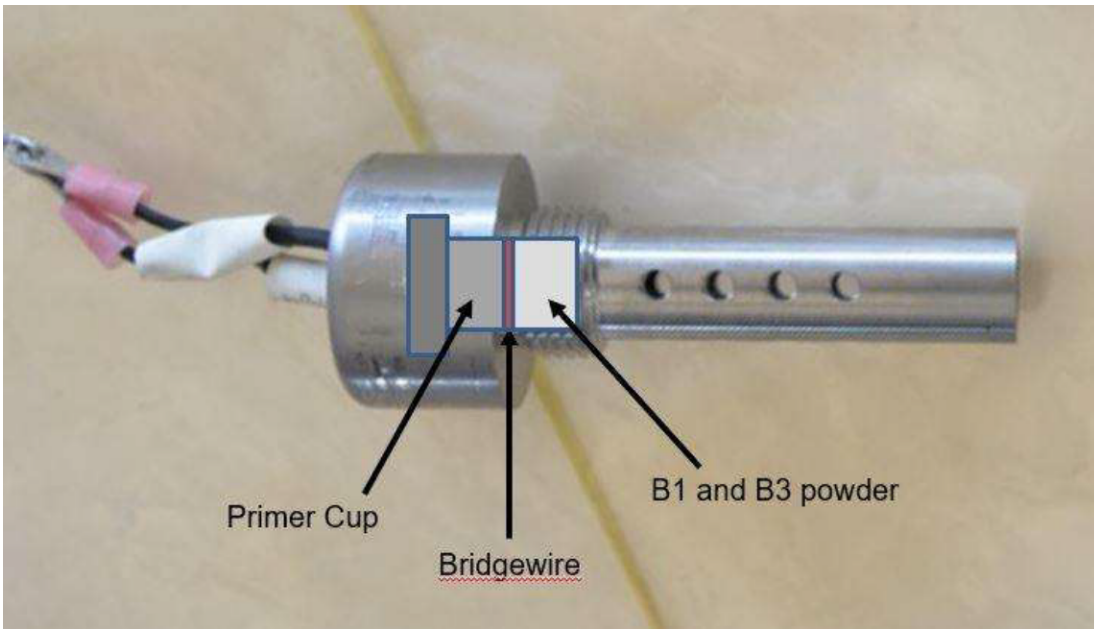

Figure 3. CAPS Igniter Assembly (Exemplar), courtesy Cirrus Aircraft

The squib utilizes an internal bridge wire that heats up and ignites a primer charge, a Boron-Barium Chromate mixture (B1), within the squib. Activation of the B1 then ignites the output charge (B3) which subsequently ignites the $BKNO_3$ pellets. The flame from the burning pellets exits the igniter through holes drilled in its sides and ignites the rocket propellent grains.

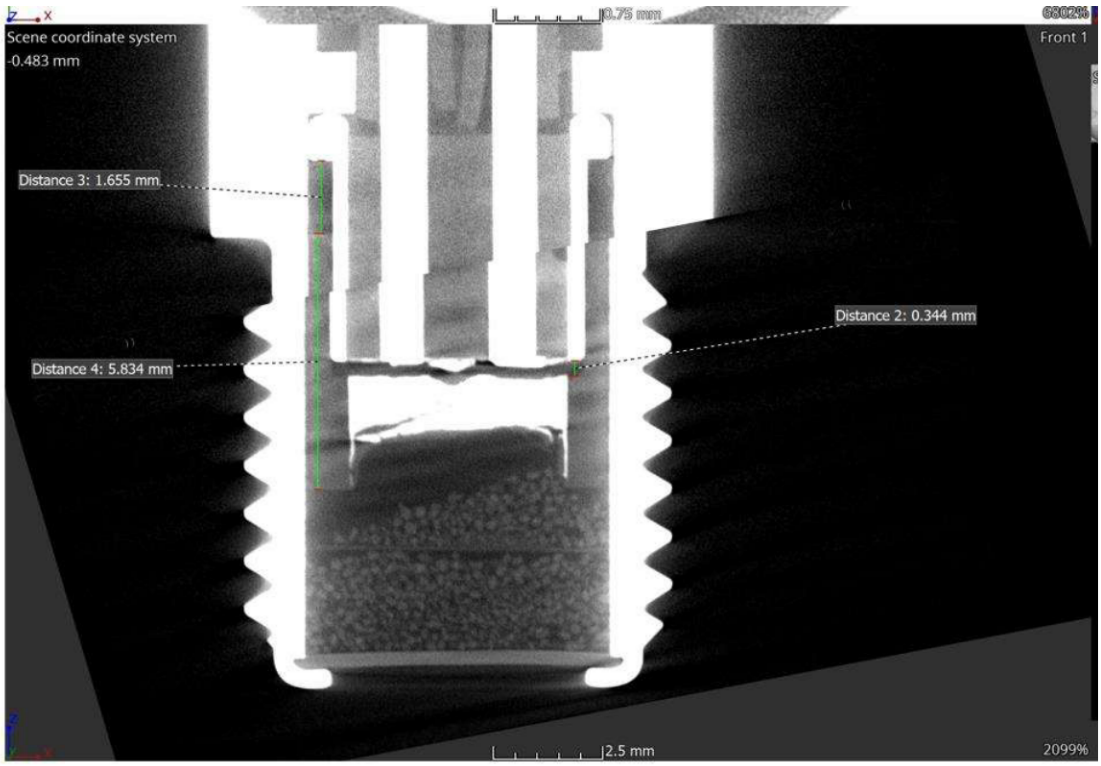

Figure 4. CT Scan of squib showing B1 and B3 powder and void in cap.

CT scans of the squib revealed the bridge wire was broken/activated (fused); however, the B1 did not ignite properly which subsequently prevented the $BKNO_3$ from igniting. The specific reason for the failure of the B1 to properly ignite was not determined during this investigation; however, several possible factors were identified.

The ration of boron versus barium chromate used in squib manufactured in 2015 was different and provided a different fuel/oxygen ratio.

It was noted that pieces of boron were larger in the B1 produced in 2015 which could have provided for a less homogenized mixture.

The accident squib recorded high moisture levels, although this may have resulted from when the squib was opened.

Additional Information

On June 9, 2021, Cirrus issued SB2X-95-27, "SNS SUBJECT SPECIAL PURPOSE EQUIPMENT – Replacement of CAPS Rocket Igniter." This service bulletin called for the removal of 25 squib assemblies produced from the same lot as the accident squib. Testing of the returned parts demonstrated additional "no-ignition" squibs from the same lot. On December 10. 2021, SB2X-95-27R2 was subsequently issued, which expanded the number of recalled squibs to 347. These squibs had been installed in SR20 and SR22 airplanes and were manufactured with the same batch of B1 as the accident squib.

The suspect batch of B1 was tracked from the manufacturer and it was determined that 27 SF50 airplanes would have received squibs with potentially the same issue. SF50-0010 was included in the original (27) but it has since been removed from service due to a ground fire. SB SB5X-90-13 defined removal of the remaining (26) suspect igniter assemblies from fielded SF50 airplanes.

All squibs removed as a result of SB2X-95-27 and FRA000017186 (additional random sample size of 90 that included 30 new, 30 mid-age, and 30 old), were returned to either Cirrus or Vulcan Systems for further testing.

In August 2022, testing on returned squibs resulted in another no-fire squib (SN 0416-3617). This serial number was outside the previously understood scope of suspect parts. As a result, SB20X-95-27R3 was issued on October 14, 2022, which expanded the scope of the previous SB by an additional 925 igniters.

As a result of this accident, Cirrus also issued Service Advisory SA21-16, "SUBJECT: Verification of CAPS Electric Ignition Checkout Procedure at Annual Inspection." The Service Advisory states, "… the Inspection/Check – Cirrus Airplane Parachute System in AMM 95-00 must be completed in its entirety and can be completed by technicians performing the

scheduled maintenance checks listed in AMM 5-20. Cirrus training and authorization (CAPS re-pack certified) is not required to perform the tasks in this section of the AMM."

Pilot Information

Certificate:	Private	**Age:**	52,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	October 2, 2019
Flight Time:	(Estimated) 827 hours (Total, all aircraft), 770 hours (Total, this make and model), 770 hours (Pilot In Command, all aircraft), 14 hours (Last 90 days, all aircraft), 7 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	CIRRUS DESIGN CORP	**Registration:**	N644SR
Model/Series:	SR22 GTS	**Aircraft Category:**	Airplane
Year of Manufacture:	2006	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	2070
Landing Gear Type:		**Seats:**	4
Date/Type of Last Inspection:	March 12, 2021 Continuous airworthiness	**Certified Max Gross Wt.:**	3400 lbs
Time Since Last Inspection:	2.9 Hrs	**Engines:**	1
Airframe Total Time:	2197 Hrs at time of accident	**Engine Manufacturer:**	
ELT:	C91A installed, not activated	**Engine Model/Series:**	
Registered Owner:		**Rated Power:**	
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KTUS,2019 ft msl	**Distance from Accident Site:**	23 Nautical Miles
Observation Time:	14:00 Local	**Direction from Accident Site:**	310°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.25 inches Hg	**Temperature/Dew Point:**	11°C / -3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Tuscon, AZ (KTUS)	**Type of Flight Plan Filed:**	None
Destination:	Santa Ana, CA (KSNA)	**Type of Clearance:**	VFR
Departure Time:	14:00 Local	**Type of Airspace:**	Class E

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	32.45,-111.2(est)

Administrative Information

Investigator In Charge (IIC):	Bledsoe, James		
Additional Participating Persons:	George Burgher; FAA FSDO; Scottsdale, AZ Brannon Mayer; Cirrus ASI		
Original Publish Date:	March 29, 2023	**Investigation Class:**	3
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=102822		

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available here.