

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



CEN22FA405

SURVIVAL FACTORS

Specialist's Factual Report

August 26, 2024

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A. ACCIDENT

Location: Tomball, TX
Date: September 1, 2022
Time: 1707 Central Daylight Time (CDT)
2207 Coordinated Universal Time (UTC)
Airplane: Cirrus Design Corp SR22-8750, N420SS

B. SURVIVAL FACTORS SPECIALIST

Specialist Amanda Taylor
National Transportation Safety Board
Washington, DC

C. SUMMARY

On September 1, 2022, about 1707 central daylight time, a Cirrus Aircraft SR22 airplane, N420SS, was substantially damaged when it was involved in an accident near Tomball, Texas. The flight instructor was fatally injured, the pilot and passenger sustained serious injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 instructional flight.

D. DETAILS OF THE INVESTIGATION

On April 16, 2024, representatives from the NTSB and Cirrus Aircraft (Cirrus) convened at Air Salvage of Dallas in Lancaster, Texas, to conduct an examination of the accident airplane's structure, seats, and restraints.

1.0 Airplane Configuration

The airplane was equipped with five seat positions, two forward-facing crew seats (1 and 2) and a single bench seat with three forward-facing passenger seats positions (3, 4, and 5) in the aft portion of the airplane, as shown in figure 1. During the accident flight a Cirrus Standardized Instructor Pilot (CSIP) was seated in the front right seat (1), a pilot/owner was seated in the front left seat (2), and one passenger was seated in the rear center seat position (4).

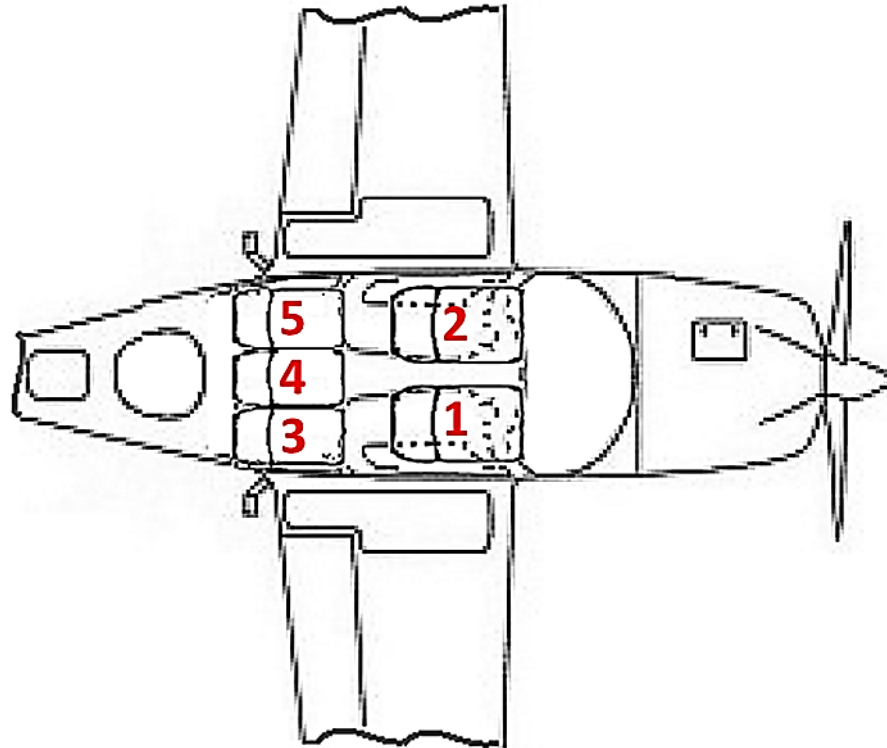


Figure 1. Diagram of N420SS showing the seating configuration.

2.0 Airplane Documentation

2.1 Overall Airplane Exterior

According to the NTSB investigator-in-charge, the accident site was in a wooded mobile home neighborhood and the airplane struck a group of 60-75 foot tall pine trees. Multiple pine trees were knocked over by the airplane and there were numerous tree branches scattered along the wreckage debris path and among the main wreckage. The main wreckage consisted of the main cabin, left wing, aft fuselage, empennage, engine, and propeller (see figure 2). The right wing separated from the fuselage at the wing root and was found on the opposite side of the mobile home. The left aileron was found adjacent to the right wing.



Figure 2. N420SS main wreckage as found at the accident site.

2.2 Seats

The crew seats were mounted on a seat track that was mounted on the wing spar tunnel. Each seat, constructed by Cirrus, was adjustable fore and aft. The front seats were constructed to meet the dynamic seat testing requirements referred to in 14 CFR sections 23.785, 27.561, and 27.562. The seat pan consisted of the following layers (In order from top to bottom) some of which were designed to absorb energy through permanent deformation and fracture:

- Leather upholstery
- Rate sensitive compressible open cell foam
- Aluminum seat pan
- Aluminum honeycomb energy absorption module (EAM) (nominal thickness of 3.5 inches)
- Carbon fiber seat pan (attached to the aluminum frame structure)

The rear seat was constructed by Cirrus as a single module with three-seat positions, composed of a one-piece bench and two seat backs (with a 60/40 split). The seat back had the ability to recline as well as fold forward to allow access to the cargo compartment in the rear. The bench was composed of the following layers (top to bottom) some of which were designed to absorb energy through permanent deformation and fracture:

- Leather upholstery
- Rate sensitive compressible open cell foam
- PVC foam seat pan
- Aluminum honeycomb EAM (nominal thickness of 2.5 inches) with a fiberglass face. The seat positions were isolated from each other by two slits through the top fiberglass face sheet.
- Carbon fiber seat pan (attached to the aluminum frame structure)

Overall, the front seats remained attached to their seat rails, however there was significant disruption of the supporting structure. The front left seat was still connected to fuselage structure, but the front right seat was found separated from the fuselage. It was sitting upright a short distance away (see figure 3). The rear seat, both bench and seat backs, remained attached to the supporting structure in the aft portion of the cabin (see figure 4).



Figure 3. Front seats as found at the accident site.



Figure 4. Rear bench seat.

2.2.1 Front Right Crew Seat (Seat 1)

The front right crew seat was found outside of the fuselage at the accident site. The aluminum seat pan above the EAM was damaged, with dents and tears in multiple places. The EAM exhibited crushing damage at the front. The front right corner measured 2 inches, front left 2.75 inches, rear right 1.8 inches, and the rear left 2.75 inches thick. There was no label on the top surface of the EAM. The front cross tubes were deformed. The lower carbon fiber seat pan, outboard seat frame, and seat rails also had multiple fractures (see figure 5).



Figure 5. Front right seat pan.

2.2.2 Front Left Crew Seat (Seat 2)

On-scene photographs indicated that the front left pilot seat was still connected to fuselage structure, however, it became separated during the recovery operation. The aluminum seat pan above the EAM was dented, but the cross tubes appeared undamaged. The EAM exhibited crushing damage across its leading edge. The front right corner measured 2.6 inches, front left 3.4 inches, rear right 3.1 inches, and the rear left 3.5 inches thick. (The rear left corner was measured to the top of the aluminum honeycomb as the top surface had become disconnected from the honeycomb during the event.) There was no label on the top surface of the EAM. The lower carbon fiber seat pan appeared undamaged (see figures 6 and 7).

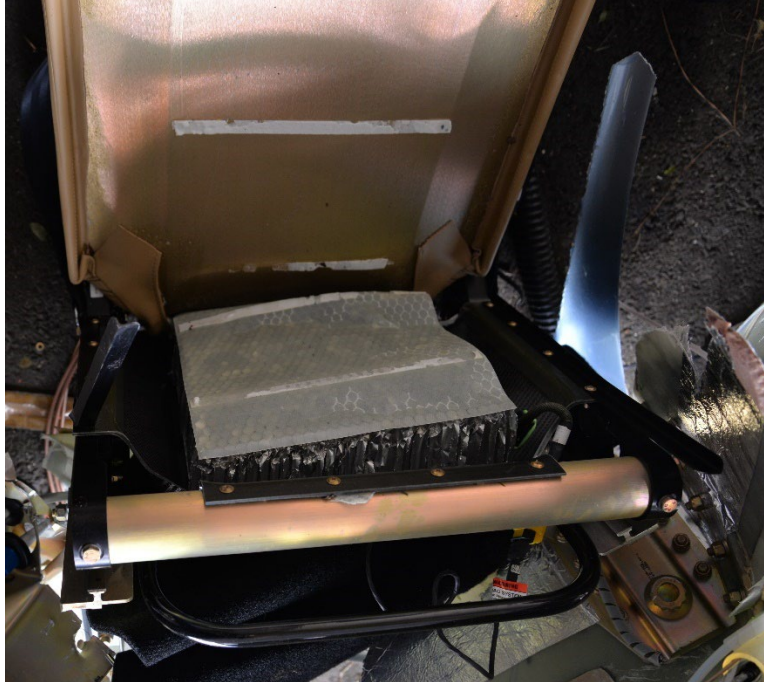


Figure 6. Front left seat EAM, seat pan, and frame.



Figure 7. Left rear measurement of the EAM for seat 2.

2.2.3 Rear Seat (Seat Positions 3, 4, 5)

The rear seat remained attached to the aft fuselage. The bench was removed from the airframe and the leather cover and foam were removed to allow for documentation of the EAMs. The thin piece of aluminum on the leading edge was

also removed and measurements were taken from the bottom of the EAM to the lower surface of the PVC foam (see figure 8).

Seat 3

Front right - 2.1 inches

Front left - 0.5 inches

Rear right - 2.4 inches

Rear left - 2.2 inches

Seat 4

Front right - 0.5 inches

Front left - 1.8 inches

Rear right - 2.1 inches

Rear left - 2.3 inches

Seat 5

Front right - 2.1 inches

Front left - 0.5 inches

Rear right - 2.4 inches

Rear left - 1.9 inches



Figure 8. Rear seat with leather cover and foam removed.

2.3 Restraints

The front crew seats were equipped with four-point restraint systems with inertia reels that were manufactured by AmSafe. Each restraint included an airbag

installed on the outboard shoulder harnesses and a lift latch buckle. The airbags were designed to deploy in front of the occupant when a deceleration event occurred, and both deployed in the accident (see figure 9).

On April 24, 2023 AmSafe issued Service Letter (SL) 7041, Issue:1 for Cirrus Aircraft inflatable restraint assemblies. In the SL, AmSafe noted customers reported an in-service problem of incorrect or missing anti-rattle plugs found on the belt buckle assemblies (see figure 10). Cirrus issued the SL to describe the procedure for removing and correctly installing replacement buckle/connector anti-rattle plugs. Cirrus subsequently issued Service Advisory SA23-06R1 on April 25, 2023, to notify customers of the issue and describe how to conduct a visual inspection of the buckles. The advisory stated that incorrect installation of the plugs may result in the seat belt web load bar not functioning correctly, potentially allowing the belt to loosen under load. It also referenced the SL on how to correct the issue.



Figure 9. Front crew seats with deployed airbags.

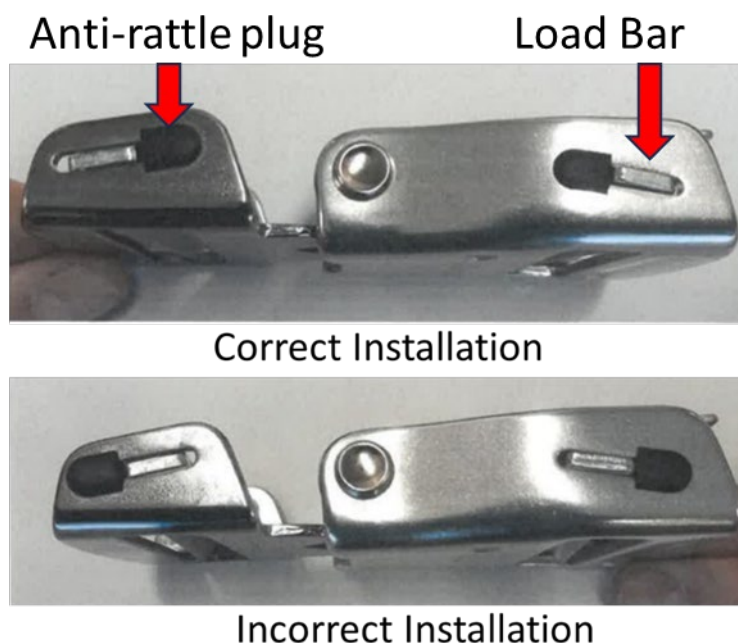


Figure 10. Photographs from the Cirrus service letter showing the correct (top) and incorrect (bottom) installation of the anti-rattle plugs.

The rear seat was equipped with three-point restraint systems with a push button buckle at each seat position. While the restraints had an inertia reel, none of the rear seat restraints included airbags.

The pilot stated that his restraint was fastened during the accident, and he was able to release the latch to evacuate after coming to a stop. The surviving passenger stated her restraint was also fastened and held her in place until the pilot came and helped support and unbuckle her. According to first responders, the flight instructor separated from his crew seat and was found on a nearby covered porch with railing.

When investigators arrived at the accident site both front crew seats, the rear center seat position, and rear left outboard seat position were unbuckled. Only the rear right seat position restraint was buckled. All five inertia reels functioned as expected (locked) when rapidly pulled.

2.3.1 Front Right Crew Seat Restraint (Seat 1)

The front right crew seat restraint buckle anti-rattle plugs were in the incorrect position (see figure 11). The buckle tang had the plugs in the correct position. The left lap belt segment measured 23.8 inches from the webbing attachment to the center of the load bar. The webbing was almost completely pulled through and was twisted around the load bar (see figure 12). No witness marks indicating rubbing, discoloration or fraying was noted on the webbing. The right lap belt portion

measured 17.75 inches from webbing attachment to center of the load bar. The buckle functioned and no anomalies or damage were noted.



Figure 11. Seat 1's buckle with anti-rattle plug in the incorrect position.



Figure 12. Seat 1's buckle with webbing twisted around the webbing load bar.

The airbag had "10214B" printed on it. The webbing label noted that it was manufactured by AmSafe (ASSY: 7041-1-021-2396, DMF A0322, C/PN 39676-002-

2396, ID# 3608241, conforms to FAA TSO-C114, rated 3000 pounds, to be repaired by AmSafe only). Squaring¹ was noted on the lower airbag vents (see figure 13), but not on the upper.

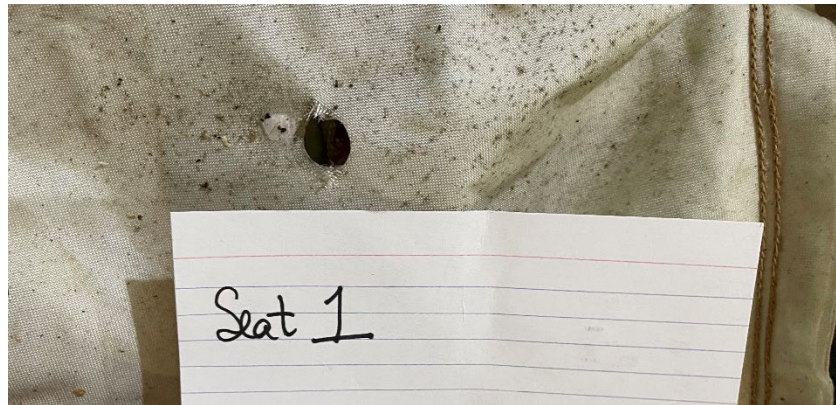


Figure 13. Seat 1's lower airbag vent with squaring.

2.3.2 Front Left Crew Seat Restraint (Seat 2)

The front left crew seat restraint buckle anti-rattle plugs were in the correct position (see figure 14). The buckle tang also had the plugs in the correct position. The left lap belt measured 17.4 inches and the right measured 17.2 inches from the webbing attachment point to the center of the load bar. The buckle functioned and no anomalies or damage were noted.



Figure 14. Seat 2 showing plugs in the correct position.

The airbag had "10959B" printed on it, and the webbing label noted that it was manufactured by AmSafe (ASSY: 7041-1-011-2396, DMF A0222, C/PN 39876-001-

¹ Squaring refers to fraying around the circumference of the circular vent holes of the airbag. Nominally they are round but will take on a square appearance when loaded by an occupant.

2396, ID# 36068231, conforms to FAA TSO-C114, rated 3000 pounds, to be repaired by AmSafe only). Squaring was noted on the lower airbag vents (see figure 15), but not on the upper.

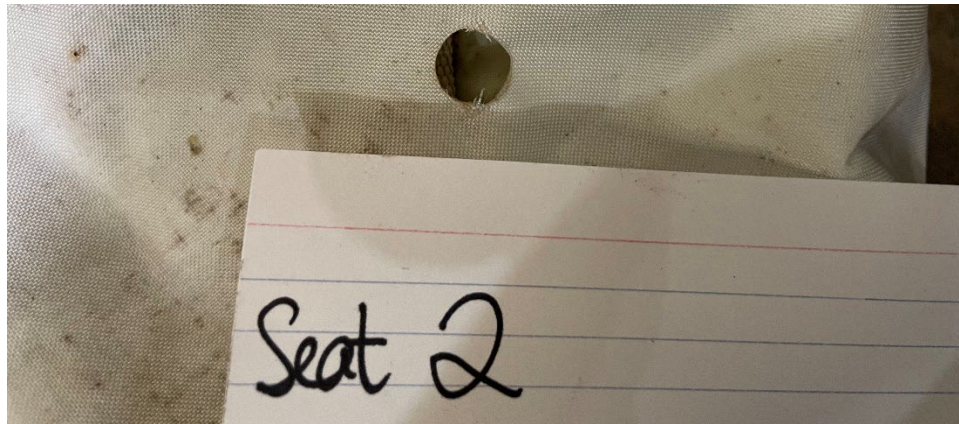


Figure 15. Seat 2's lower airbag vent with squaring.

2.3.3 Rear Center Seat Position Restraint (Seat 4)

The left portion measured 21.2 inches from the webbing attachment point to the center of the load bar. The push button buckle (see figure 16) functioned, and no anomalies or damage was noted. The torso webbing label noted that it was manufactured by AmSafe (PNR: 3228-2-011-2396, MFR: 35FB9, DMF: A0522, S/A: 3228-2070112396, S/O: S457335-16, C/PNR: 39684-002-2396, conforms to FAA TSO-C114, rated 3000 pounds, to be repaired by AmSafe only). The buckle webbing label noted the following: PNR: 3228-2-011-2396, MFR: 35FB9, DMF: A0422, S/A: 3228-2010112396, S/O: S457335-6, C/PNR: 39684-001-2396, conforms to FAA TSO-C114, rated 3000 pounds, to be repaired by AmSafe only.



Figure 16. The push button buckle for the rear seat positions.

3.0 Emergency Locator Transmitter (ELT)

The airplane's Artex ELT 1000 was found by investigators still secured to the airframe in its cradle (although the cradle latch was undone) in the armed position (see figure 17). According to the National Oceanic and Atmospheric Administration's records the ELT activated during impact and an alert was received by the Air Force Rescue Coordination Center (AFRCC) at 22:07:51. AFRCC then "contacted the Fort Worth authorities who reported emergency services were already on scene." The coordinates of the first satellite detection were 30 04.9N, 95 33.4W which was approximately 0.09 miles from the accident site.



Figure 17. ELT information, including the ARM/OFF switch position.

4.0 Parachute

The airplane was equipped with the Cirrus Airframe Parachute System (CAPS), which was a whole-plane ballistic parachute recovery system. According to Cirrus, the CAPS consists of a large ballistic rocket-fired parachute attached to the airframe. In order to activate the CAPS, the pilot must remove the activation handle cover, and pull straight down with both hands (see figure 18). It takes approximately 45 pounds of force to activate the CAPS.



Figure 18. Cirrus employee demonstrating the location and how to operate the CAPS handle.
(Source: Cirrus website)

According to the NTSB investigator-in-charge, the CAPS rocket motor deployed upon ground impact, with the deployment bag and canopy found suspended in the surrounding trees. The parachute enclosure cover separated from the aft cabin and was found near the main wreckage. The parachute canopy did not inflate during deployment and was found stretched-out on a linear trajectory into the surrounding treetops (see figure 19).



Figure 19. The CAPS parachute as found at the accident site.

A data tag was found in the parachute that read:

Packed Parachute Assembly
CDC P/N: 29696-004
S/N: 2024-L W
Canopy Color: Orange/White
Repack Due: 05-05-2032
Date: 05-05-2022
CDC Quality Assurance
Cirrus Design Corporation
4515 Taylor Circle
Duluth, MN 55811
USA
PC 338CE

5.0 Medical And Pathological Information

5.1 Injury Table

Type of injury	Crew	Passengers	Total
Fatal	1	0	1
Serious ²	1	1	2
Minor	0	0	0
None	0	0	0
TOTAL	2	1	3

5.2 Injury Information

The occupants were transported via Harris County Emergency Services Department ambulance to Memorial Hermann Emergency Department. The CSIP in the front right crew seat (seat 1) was fatally injured due to multiple blunt force trauma. The CSIP's autopsy, conducted by the Montgomery County Forensic Services Department, indicated that he sustained multiple injuries to the head, chest, multiple ribs, pelvic fractures, a right ulna fracture, a right femur fracture, and fractures of the vertebral bodies of the lumbar spine. The pilot in the front left crew seat (seat 2) sustained serious injuries including sensorimotor polyneuropathy, general abrasions to the body and face, as well as a laceration to the posterior head. An EMT on-scene reported that the rear passenger (seat 4) had an open fracture of her right lower leg. The passenger confirmed to the NTSB that she sustained right tibia and fibula fractures.

Submitted by:

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² 49 CFR § 830.2 defines serious injury as "any injury which: (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date of the injury was received; (2) results in a fracture of any bone (except simple fractures of the fingers, toes, or nose); (3) severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; (5) involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface."