Aviation Investigation Final Report

Location:	Dallas, Texas	**Incident Number:**	CEN13IA285
Date & Time:	May 16, 2013, 11:20 Local	**Registration:**	N715CD
Aircraft:	Cirrus SR22	**Aircraft Damage:**	None
Defining Event:	Sys/Comp malf/fail (non-power)	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that he lost airplane control during cruise flight in instrument meteorological conditions (IMC) and turbulence. He subsequently activated the airplane's parachute system, but the parachute failed to deploy. The pilot regained control of the airplane after exiting IMC and landed the airplane without further incident.

Certification tests were performed from level flight at speeds ranging from 62 to 137 knots indicated airspeed, and one test included deployment of the parachute system after a one-turn spin. The testing showed that to minimize the chances of parachute entanglement and reduce aircraft oscillations under the parachute, the parachute system should be activated from a wings-level, upright attitude if possible.

Postincident examination of the parachute system did not reveal any system component failure. Postincident testing showed that off-axis deployment of the parachute could exceed the forces required for a successful deployment of the parachute. If the airplane has a large pitch or bank angle or angular rates (or a combination of these) as the parachute rocket leaves the airplane, the airplane will rotate and cause the rocket tether to pull at an angle other than that intended, and the parachute will fail to deploy. Radar data showed that the airplane was in a very dynamic flight pattern with extreme pitch and bank angles when the parachute system was activated. Thus, the parachute likely failed to deploy when activated due to the dynamic maneuvering of the airplane at the time of the activation, which exceeded the parachute system's certification requirements.

Probable Cause and Findings

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

The failure of the airplane's parachute to deploy when activated during a loss of control in cruise flight due to the dynamic maneuvering of the airplane at the time of the activation, which exceeded the parachute system's certification requirements.

Findings

Aircraft	Parachute - Capability exceeded
Aircraft	(general) - Not specified

Factual Information

History of Flight

Enroute-cruise	Other weather encounter
Enroute-cruise	Loss of control in flight
Maneuvering	Attempted remediation/recovery
Maneuvering	Sys/Comp malf/fail (non-power) (Defining event)

On May 16, 2013, about 1120 central daylight time, a Cirrus Design Corp (CDC) SR22, N715CD, airplane ballistic parachute was activated by the pilot during flight near Dallas, Texas, following a loss of control in cruise flight. The parachute pack remained in its compartment, its rocket was deployed, and the rocket propellant was expended. The airplane received no damage. The private pilot was uninjured. The airplane was registered to Jeramiah 2911 Inc and operated by the pilot under the provisions of 14 Code of Federal Regulations (CFR) Part 91. Marginal visual flight rules conditions prevailed and the flight was operating on instrument flight rules (IFR) plan for the flight that originated from Addison Airport (ADS), Dallas, Texas, about 1055 and was destined for Independence Municipal Airport (IDP), Independence, Kansas. The flight returned to ADS and landed without further incident.

The pilot said that he did not have any pressure that resulted from any need to arrive at IDP. He said that he received a weather briefing in the morning of the incident day. He delayed his original planned departure time of 1000 for about 45 minutes because he waited for a weather cell to move.

He said that the cloud ceilings were 1,200 feet and he did not remember and did not know the height of the cloud tops. Shortly after takeoff from ADS, he encountered IFR weather conditions. He received radar vectors around the back of a thunderstorm, flying direct to IDP at a cruise altitude of 7,000 feet mean sea level, which was beneath the cloud tops.

He said that he did not remember the altitude at which he engaged the autopilot (AP). He said that the AP was set to the heading mode (HDG), and he switched over to navigation (NAV) mode. The autopilot was not selected to track airspeed and was not selected to GPS steering mode (GPSS). The airplane encountered moderate turbulence, which he said was not unusual, while it was in dark clouds. He said that he felt like he and the airplane were "porpoising"/"bouncing." He was using his seat belt and was not being thrown around in the cockpit, but the airplane was going up and down. He said he experienced a loss of control of the airplane based upon instrument indications, the airplane bouncing, and the horizontal situation indicator (HSI) was spinning in circles. He said there was a horizontal situation indicator (HSI) flux gate excitation failure message, the HSI turned red, the HSI card started turning in circles, and there was an "X" at the bottom of the HSI, which he said meant that heading information was not being received. There were no annunciations, cautions, or warnings, only the flux gate excitation message. There were no problems with the multi-function display (MFD).

The attitude indicator (AI) appeared as if it was caged or stuck and was not moving around as the airplane porpoised. He said that the blue and brown colored segments of the AI formed an "X." The brown portion of the AI was on the bottom, and the blue portion of the AI was on the top. He said that he knew that the airplane was in level flight at the time of this AI indication. The airplane's wet compass was not spinning. When the pilot was asked how he knew that the airplane attitude was not being displayed correctly on the AI, he said that he does not know and it was based on his memory. The pilot did not know whether the AI was electrically or pneumatically powered.

The pilot said he realized that he was "fighting spatial disorientation, he was in over his head and pulled the chute" after he turned the airplane away from a red weather cell off the airplane's right wing because he did not want the airplane to float into that cell. He slowed the airplane from 167 knot to about 120-127 knots by pulling back on the control yoke to pitch up using the altimeter and vertical speed indicators, which were working, as speed/pitch references. He was asked what he used for bank attitude reference so that he would not pitch into a turn; he said he did not know. He had taken his hands off the controls when he activated the parachute. He said that he did not know the pitch attitude because he did not have an instrument to indicate pitch nor did he know the bank attitude of the airplane. The airspeed decreased to 120 knots "pretty quick". He heard the rocket motor fire, but the parachute did not deploy.

He then nosed over the airplane to descend below the cloud ceiling, which he did not know the height of. He was in "hard IMC," getting "knocked around," and was extremely nauseous and sweating profusely. He said he did not trust himself and did not know if he was going to have a heart attack. He preferred to descend the airplane below the cloud ceilings rather than be in this situation. He reduced throttle and lowered pitch to descend below the overcast layer to visual meteorological conditions, which he encountered about 800 feet above ground level. He said that the HSI started working after the airplane exited instrument meteorological conditions. He said that the HSI and AI started working again "shortly" after that exit. He had not reset any of the airplane circuit breakers. He did not climb back into the clouds since he did not trust the airplane instruments. He requested a visual approach to runway 15 at ADS for the flights return because he had not previously flown into Denton Municipal Airport (DTO), Denton, Texas.

Pilot Information

Certificate:	Private	**Age:**	50
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
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:**	June 4, 2012
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

Pilot Information

The pilot, age 50, held a private pilot certificate with airplane single-engine and instrument airplane ratings.

The pilot did not have a Federal Aviation Administration (FAA) record of previous accidents, incidents, or enforcement actions.

The pilot stated that his total flight experience in N715CD was about 1,425 hours, of which about 136 hours were in actual instrument conditions, and 44 hours were in simulated instrument conditions. He said that he had flown about 400 hours a year, mostly from the Dallas area.

The pilot said that he has used Cirrus Standardized Instructor Pilots for his pilot training and had practiced flying partial panel and using various AP configurations. He said that they would cover up his AI, and have him look away and recover the airplane from unusual attitudes. He was not required by his aircraft insurer to receive annual pilot training due to the number of hours he flies.

Private Pilot Certificate

On November 28, 2001, he passed the private pilot airplane airman knowledge test on his third attempt with a score of 77 percent. The subject matter knowledge codes in which questions were incorrectly answered were:

G11 - Initial Notification of Aircraft Accidents, Incidents, and Overdue Aircraft

H300 - Forces Acting on the Airplane in Flight

H307 - Engine Operation

H308 - Propeller

H312 - The Pitot-Static System and Associated Instruments

H348 - Radio Navigation

I22 - Atmospheric Pressure and Altimetry

I56 - Pilot and Radar Reports, Satellite Pictures, and Radiosonde Additional Data (RADATs)

J08 - Controlled Airspace

J13 - Airport Operations

J27 - Wake Turbulence

J37 - Sectional Chart

On February, 28, 2002, he was issued a private pilot certificate with a single-engine land rating, after passing the practical test for the certificate on his first attempt using a Cessna 150. At the time of the test, the pilot reported a total time of 66 hours, all of which were in Cessna 150 airplanes.

Instrument Airplane Rating

The pilot said that he received instrument training that was 5 ½ - 6 weeks in duration at ATA Flight School, Miami, Florida. He said they attempted to fly IFR [IMC], if it was available, during training. He flew with his primary instrument instructor about two years ago using the incident airplane. During that training, they had an emergency while 13,000 feet and 100 miles from shore over the Atlantic where they lost the alternator and later landed without incident. The pilot said that his primary instrument flight instructor told him that he was cool under pressure, and the instructor also said that he knew guys in the military that would have not been that cool under pressure.

The pilot's primary instrument instructor stated that the pilot's instrument training began January 7, 2011 and was about a month in duration. Training consisted of about 30-40 hours of ground instruction and about 24 flights. He said the training was not "quick and dirty," and the flights were in excess of one hour. He said the pilot received partial panel instrument instruction, which he had to demonstrate during his instrument check ride. The flight instructor's flight experience in Cirrus airplanes was a "couple of hours" and "not many." The flight instructor did not have any experience in the Sandel avionics system, and he had another instructor, who was Cirrus certified, come in to provide instruction on the Sandel system for several hours to the pilot. The pilot's instrument instructor said that the pilot was a "good" and "cautious" instrument pilot and "very confident."

On January 30, 2011, the pilot passed the instrument airplane rating airman knowledge test on his first attempt with a score of 73 percent. The subject matter knowledge codes in which questions were incorrectly answered were:

PLT052 - Interpret information on a Departure Procedure Chart

PLT058 - Interpret information on a Low Altitude Chart

PLT083 - Interpret information on an Instrument Approach Procedures

PLT088 - Interpret speed indicator readings

PLT091 - Interpret VOR / ADF / NDB / CDI / RMI - illustrations / indications / procedures,

PLT102 - Recall aeronautical charts - terminal procedures

PLT128 - Recall aircraft performance - effects of icing

PLT141 - Recall airport operations - markings/signs/lighting

PLT161 - Recall airspace classes - limits/requirements/restrictions/airspeeds/equipment

PLT274 - Recall icing - formation / characteristics

PLT296 - Recall instrument procedures – holding/circling

PLT300 - Recall instrument/navigation system checks/inspections - limits/tuning/identifying/ logging

PLT354 - Recall radio - GPS / RNAV / RAIM

PLT379 - Recall regulations - alternate airport requirements

On February 2, 2011, the pilot was issued an instrument airplane rating, after passing the practical test for the rating on his first attempt using a Cirrus SR22. The pilot had a total time of 1,762 hours, of which 793 hours were in Cirrus SR22 airplanes at the time of test. The test was conducted by a designated pilot examiner (DPE).

Pilot's Instrument Instructor and Designated Pilot Examiner

The NTSB IIC requested the FAA to provide the pass rates, number of pilots recommended for examination, and any enforcement actions, accidents, and incidents for three or more years for the pilot's primary instrument instructor and DPE. FAA inspector comments related to the DPE's checks were also requested.

Provided information showed that on November 7, 1994, the primary instrument instructor had his commercial pilot certificate revoked. On August 19, 2009, he received a "waiver penalty ASRP" on commercial pilot certificate. On September 2, 2010, he had his commercial pilot certificate suspended for 30 days.

Records pertaining to the number of pilots that passed or failed an examination for an aircraft certificate/rating that were recommended by the primary instrument instructor from 2009 – 2012, showed the following:

2009: 5 records - 4 pass and 1 fail

2010: 9 records – 7 pass and 2 fail

2011: 14 records – 14 pass and 0 fail

2012: 16 records – 14 pass and 2 fail

Records pertaining to the number of pilots that passed or failed an examination for an aircraft certificate/rating that was conducted by the DPE from 2009 – 2012, showed the following:

2009: 218 records – 190 pass and 28 fail

2010: 246 records –213 pass and 33 fail

2011: 258 records –235 pass and 23 fail

2012: 342 records – 319 pass and 23 fail

On March 25, 2013, the DPE's examining authority was removed as a result of action taken under the provisions of 49 CFR Part 44709 (Amendments, modifications, suspensions, and revocations of certificates) of two of his applicants.

Pilot's Post-Incident Training

Following the incident, CDC loaned the pilot an airplane equipped with an Avidyne primary flight display (PFD). CDC wanted the pilot to undergo transition training and receive an Instrument Proficiency Check in order for him to fly the Avidyne-equipped airplane under IFR.

The pilot's post-incident flight instructor stated that she had been flying for about 10 years and provided flight instruction for about 7 years. Her total flight time was about 3,500 hours and more than 2,000 hours of dual instruction given. In 2004, she owned her first Cirrus airplane, and the majority of her flight time was in Cirrus airplanes. The flight instructor expected the pilot to be proficient IFR pilot and the flight instructor's goal was to train the pilot on the Avidyne system. The flight instructor wanted him to learn how to set up the Avidyne system based upon how he set up his avionics in his airplane, which was equipped with a Sandel system. The flight instructor planned for the pilot to complete transition training in 1 – 1 ½ days. The flight instructor said that he trained for 2 days and did not complete the transition training. The flight instructor said that the pilot said he had a business meeting to attend, and the flight instructor had no further contact with him again.

Aircraft and Owner/Operator Information

Aircraft Make:	Cirrus	**Registration:**	N715CD
Model/Series:	SR22	**Aircraft Category:**	Airplane
Year of Manufacture:	2001	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	0016
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	January 19, 2012 Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	2801.2 Hrs at time of accident	**Engine Manufacturer:**	Continental
ELT:	Installed, not activated	**Engine Model/Series:**	IO-550N
Registered Owner:	Jeramiah 2911 Inc	**Rated Power:**	
Operator:	Pilot	**Operating Certificate(s) Held:**	None

The 2001 Cirrus SR22, serial number 0016, was registered to Jeramiah 2911 Inc., which the pilot was listed as president on the Aircraft Registration Certificate with an issue date of November 5, 2007.

The airplane avionics included an ARNAV multifunction display, two WAAS Garmin navigators, a Sandel HSI, and a VOR indicator.

The airplane was equipped with an L-3 Avionics Systems Model 1100 AI (28.0 Vdc unit) that used an electrically driven two-degree-of –freedom vertical gyroscope. Gyroscope verticality was maintained by pneumatic erection and provided for the manual fast-erect with caging knob.

The rocket motor was labeled with the following information:

First line was unreadable due to label damage

Serial number: 0580

Manufacturing date: January 4, 2012

Expiration date: January 4, 2022

The deployment bag was labeled with the following information:

Cirrus Design Corporation part number: 14242-101

Serial number: 00465-R1

Repack due: December 2021

Date: December 2011

A logbook entry dated January 19, 2012 indicated the airplane underwent an annual inspection at a total time since new of 2,419.4 hours and at a Hobbs time of 2,419.4 hours. The entry also stated that parachute assembly, serial number 00309, and rocket assembly, serial number 00162, were removed and parachute assembly, part number 14242-101, serial number 00465-R1, after being repacked by CDC was installed.

Autopilot Modes and Unusual Attitude Recovery

The post-incident flight instructor stated that new autopilots have a straight and level button, which levels the airplane's roll and pitch and can be used by a pilot if he/she feels disoriented or dizzy. An airplane with an S-Tec autopilot, which has a heading and altitude button, can be operated with a three-button sequence (push-to-synchronize heading and altitude). Once selected, the airplane will stop rolling and stop diving, but engine power may have to be added. The flight instructor stated that the autopilot knows what straight and level is because your brain is not telling you the correct attitude and it gives a pilot time to get reoriented. The flight instructor learned of using the autopilot in unusual attitude recovery when after receiving transition training. The flight instructor stated that if the Sandel and MFD avionics systems are not functioning on Cirrus airplanes equipped with such systems, autopilot selection of the GPSS mode will provide tracking of navigation information from GPS 1 (GPS1 is numerically suffixed to refer to the cockpit instrument panel location of an avionics unit with a "- 1" indicating the top most unit).

As stated in the History of Flight section of this report, the pilot had AP mode(s) selected to HDG mode and then switched to the NAV mode for the flight. The autopilot was not selected to track airspeed and was not selected to GPSS. According to the Meggitt Avionics S-Tec System Fifty Five X Autopilot Pilot's Operating Handbook (POH), when operating in HDG mode, the system is not coupled to any navigation aid. It merely flies the heading bug. It will be necessary to monitor navigation instruments for course deviation due to wind drift and wind correction angles. With aircraft equipped with an HSI, the S-TEC autopilot will receive both left/right deviation and course information while in NAV mode. In GPSS mode, heading bug and course arrow has no effect on the autopilot. POH, Section 4.2.4, GPSS mode, states in part:

NOTE: The Autopilot is equipped with a GPSS mode that can be used for normal GPS course tracking or for GPS approach. In GPSS mode, the heading bug and / or course arrow position has no effect on the autopilot and may be preset for the missed approach heading, etc..., as desired.

NOTE: When operating in the GPSS mode and properly coupled to the GPS receiver, the autopilot will automatically steer the aircraft around the GPS approach without further heading or course inputs required by the pilot.

NOTE: The autopilot will track only those segments of the approach contained in the GPS Navigator database.

Airplane Roll Rate

The Cirrus SR22 G1 average roll rate with flaps retracted, at airspeed of approximately 145 knots indicated airspeed (KIAS), is approximately 43 degrees/second using a maximum effort aileron roll without rudder input. With flaps extended 50 percent, at airspeed of about 76 KIAS, the average roll rate is approximately 24 degrees per second. With flaps extended 100 percent, at an airspeed of about 78 KIAS, the average roll rate is approximately 36 degrees/second.

FAA Special Condition for Cirrus Ballistic Recovery System

The FAA Special Condition, AC-23-88, effective November 17, 1997, was issued to become part of the type certification basis for the Ballistic Recovery Systems, Inc. (BRS) parachute recovery system that was to be installed on Cirrus SR20 and subsequently made applicable to SR22 models. The system was also referred to as the General Aviation Recovery Device (GARD). Airplanes modified to use this system will incorporate novel or unusual design features for which applicable airworthiness regulations do not contain adequate or appropriate safety standards. These special conditions contain the additional airworthiness standards that the FAA Administrator considers necessary to establish a level of safety equivalent to the original certification basis for these airplanes.

The parachute recovery system was intended to recover an airplane in emergency situations such as mid-air collision, loss of engine power, loss of airplane control, severe structural failure, pilot disorientation, or pilot incapacitation with a passenger on board. The GARD system, which is only used as a last resort, was intended to prevent serious injuries to the airplane occupants by parachuting the airplane to the ground.

The special conditions for the basis of the airplane's certification were flight test demonstration, occupant restraint, parachute performance, system function and operations, system protection, system inspection provisions, and operating limitations. The parachute performance conditions cited only aircraft structural load and occupant survivability requirements for parachute deployment and subsequent aircraft touchdown.

The conditions for flight test demonstration were:

(a) The system must be demonstrated in flight to satisfactorily perform its intended function, without exceeding the system deployment design loads, for the critical flight conditions.

(b) Satisfactory deployment of the parachute must be demonstrated, at the most critical airplane weight and balance, for the following flight conditions:

(1) One of the two maneuvers, (i) or (ii), must be performed for the low speed end of the flight envelope;

(i) Spin with deployment at one turn or 3 seconds, whichever is longer; or

(ii) Deployment immediately following the maneuver that results from a pro-spin control input held for one turn or 3 seconds, whichever is longer.

(2) A minimum of maneuvering speed, Vo or higher;

CAPS Developmental and Certification Flight Testing

CDC performed a total of 8 in-flight tests of the Cirrus Airframe Parachute System (CAPS) to meet requirements set forth by AC-23-88. These tests were comprised of five developmental and three certification deployments of the CAPS system that were performed between April 24, 1998 and July 17, 1998. All of the tests were performed from level flight at speeds ranging from 62 – 137 KIAS in addition to one deployment of the CAPS system after a one-turn spin. The developmental flight deployments were at the following speeds: 80 knots, 82.7 knots, 107.6 knots, 132.3 knots, and 132.6 knots. The certification flight deployments were at the following speeds: 137.3 knots, 62 knots with full flaps, 82 knots (spin).

Flight Manual Cirrus Airframe Parachute System Safety Information

Revision 4 of the airplane flight manual, section 10, contained information relating to deployment speed and attitude of the CAPS. The section stated that the maximum demonstrated deployment speed was 133 KIAS and higher speeds could result in structural failure. Deployment attitude information stated:

The CAPS has been tested in all flap configurations at speeds ranging from Vso to Va. Most CAPS testing was accomplished from a level attitude. Deployment from a spin was also tested. From these tests it was found that as long as the parachute was introduced to the free air by the rocket, it would successfully recover the aircraft into its level descent attitude under parachute. However, it can be assumed that to minimize the chances of parachute entanglement and reduce aircraft oscillations under the parachute, the CAPS should be activated from a wings-level, upright attitude if at all possible.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	ADS	**Distance from Accident Site:**	
Observation Time:	10:47 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Overcast / 1000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	150°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.84 inches Hg	**Temperature/Dew Point:**	20°C / 17°C
Precipitation and Obscuration:			
Departure Point:	Dallas, TX (ADS)	**Type of Flight Plan Filed:**	IFR
Destination:	Independence, KS (IDP)	**Type of Clearance:**	IFR
Departure Time:	10:55 Local	**Type of Airspace:**	Class E

The closest official NWS reporting location to the incident site was from Denton Municipal Airport (DTO), Denton, Texas, located approximately 15 miles southwest of the incident site at an elevation of 642 feet. The airport had an Automated Surface Observation System (ASOS) and reported the following conditions near the time of the accident:

At 1053 CDT, wind from 170° at 10 knots, visibility 10 miles, ceiling overcast at 1,200 feet, temperature 21° C, dew point temperature 18° C, altimeter 29.81 inches of mercury (Hg).

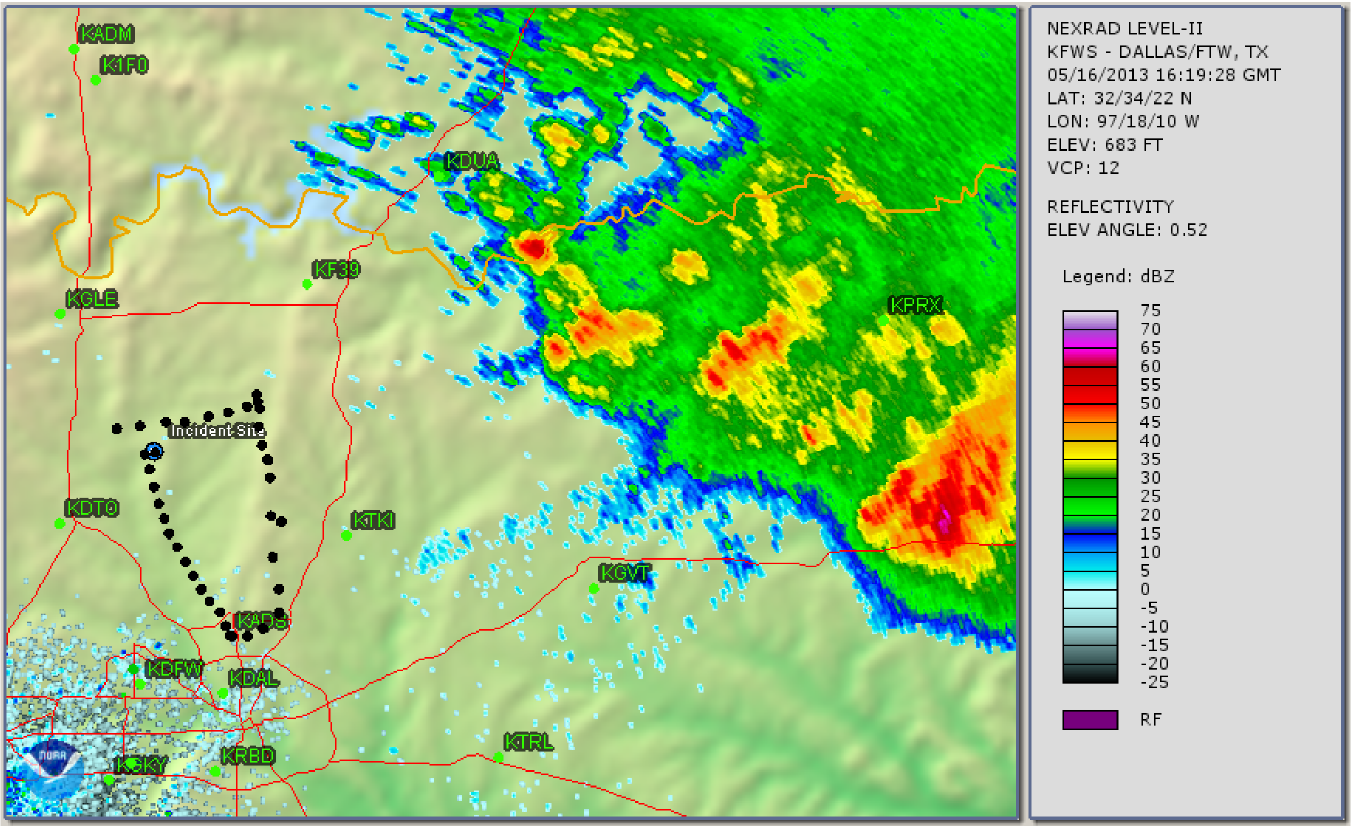


Figure 1 - FWS WSR-88D 0.5° base reflectivity imag

The pilot said that he had weather depicted on a tablet using Anywhere Map, and he was about 20 miles on the backside of the cell. He said that Anywhere Map showed that the cell was moving east, "fairly fast."

The pilot was asked what the delay of weather information on Anywhere Map was, he said that was a good question and he could not provide an answer. He said it changes and that a critical decision making class taught to use a minimum of 10 minutes.

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	None
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	32.960517,-96.829177(est)

Post-incident examination of the airplane revealed that the expended rocket motor, with a fully extended incremental bridle, was draped over the right horizontal stabilizer. There was no airplane skin damage consistent with rocket motor impact. There were no perforations of the fuselage skin surface or paint chipping in this area. The deployment bag was resting within the CAPS enclosure compartment. The incremental bridle sheath did not display thermal damage, and all of the bridle to bridle stitching was torn through. All of the component attachments were in their correct positions. The CAPS enclosure compartment cover was not found. Remaining adhesive material used to secure the cover was consistent with a uniform separation of the cover during deployment. Remaining adhesive material did not display excessive thickness.

Two approximately vertical and parallel marks consistent in color and width of the D-ring nut, which attached the rocket lanyards to the incremental bridle, were located on the right side of the fuselage between the right horizontal stabilizer and CAPS compartment. The D-ring was able to be placed over the parallel marks by lifting the deployment back approximately 1/2 way out of the CAPS compartment.

The deployment bag (D-bag) was not wet and weighed approximately 53 pounds. The bag was lifted out of the compartment using a spring-scale and gantry. The bag was pulled in an aft wise direction that paralleled the aft portion of the compartment, which had a slope of about 55 degrees.

Movement of the bag began with a pull force of about 52 pounds and reached a maximum of about 62 pounds. The force reduced as the bag exited the compartment.

None of the circuit breakers were in an extended position consistent with a tripped circuit breaker.

There were no static wicks installed on the airplane.

The Hobbs meter indicated 2,801.2 hours.

Flight recorders

The incident airplane was not equipped with a remote data module.

Tests and Research

Materials Examination of CAPS Components

CAPS components from the incident airplane were submitted to the NTSB Materials Laboratory for examination. The examination revealed a hole present on the on the retaining harness cover located where the cover rested at the upper aft corner of the parachute enclosure compartment. The exterior surface in the area around the hole appeared to have a light to dark gray tint. The fabric in the vicinity of the hole was wrinkled and felt relatively stiff. The red retaining strap adjacent to the hole was displaced, wrinkled, and stiff. The edges of the hole were relatively rough, and some of the edges were folded over. Individual fibers were visible at the hole edges when viewed under optical magnification. Broken fibers near the area of the hole tended to accumulate at the weave intersections. The accumulated fibers were rounded and globular consistent with heating. The accumulated fibers at the weave intersections were darkened and fused together. The accumulated fibers were rounded and globular consistent with heating.

The grommets in the retaining straps exhibited impressions on the forward faces of the grommets corresponding to contact with the release pins. The fabric around the grommets appeared stretched around the grommets and fibers were pulled out at the upper side of the grommets.

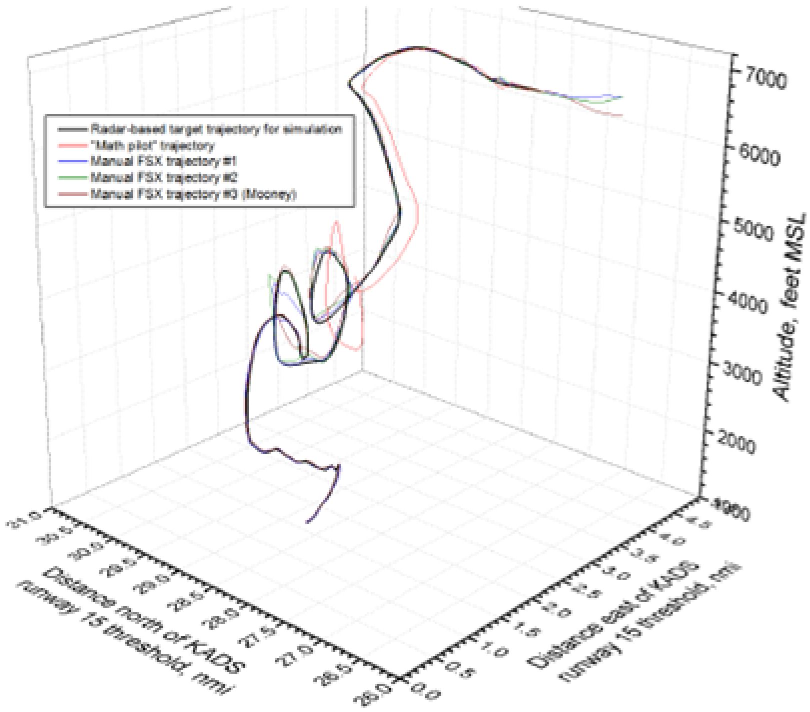
A series of sliding contact marks were observed on the release pin at the right side of the D-bag assembly. The marks had parallel scratches and lipped edges consistent with heavy sliding contact with a relatively hard object and were not consistent with vibration wear. The locations of the marks were near the base of the pin. The location and shape of the marks were not consistent with contact with the grommet on the retaining straps.

Aside from the grommets, the only other metal item in the vicinity of the release pins was the quick connector link between the incremental bridle and the D-bag lanyards. However, no corresponding contact marks were observed on the quick connector link. Also, the quick connector link had a zinc coating. The contact marks on the release pin were analyzed using energy dispersive x-ray spectroscopy (EDS) in a scanning electron microscope. The EDS spectrum showed peaks that were consistent with the stainless steel. No evidence of zinc was observed on the release pin.

Plots of Radar Data and Performance Estimates

Plots of radar data and performance estimates for the flight were prepared by a National Transportation Safety Board (NTSB) National Resource Specialist, Aircraft Performance. These plots used secondary radar returns and relevant primary radar returns in the area of the incident, curve fits through that data to estimate airplane position, performance parameters computed from curve fits, and 'math pilot' and 'manual' attempts to match the curve fit trajectories with simulations.

CEN13IA285: Cirrus SR22, N715CD, Dallas, TX, 05/16/2013
3D view of radar data and simulation flight tracks



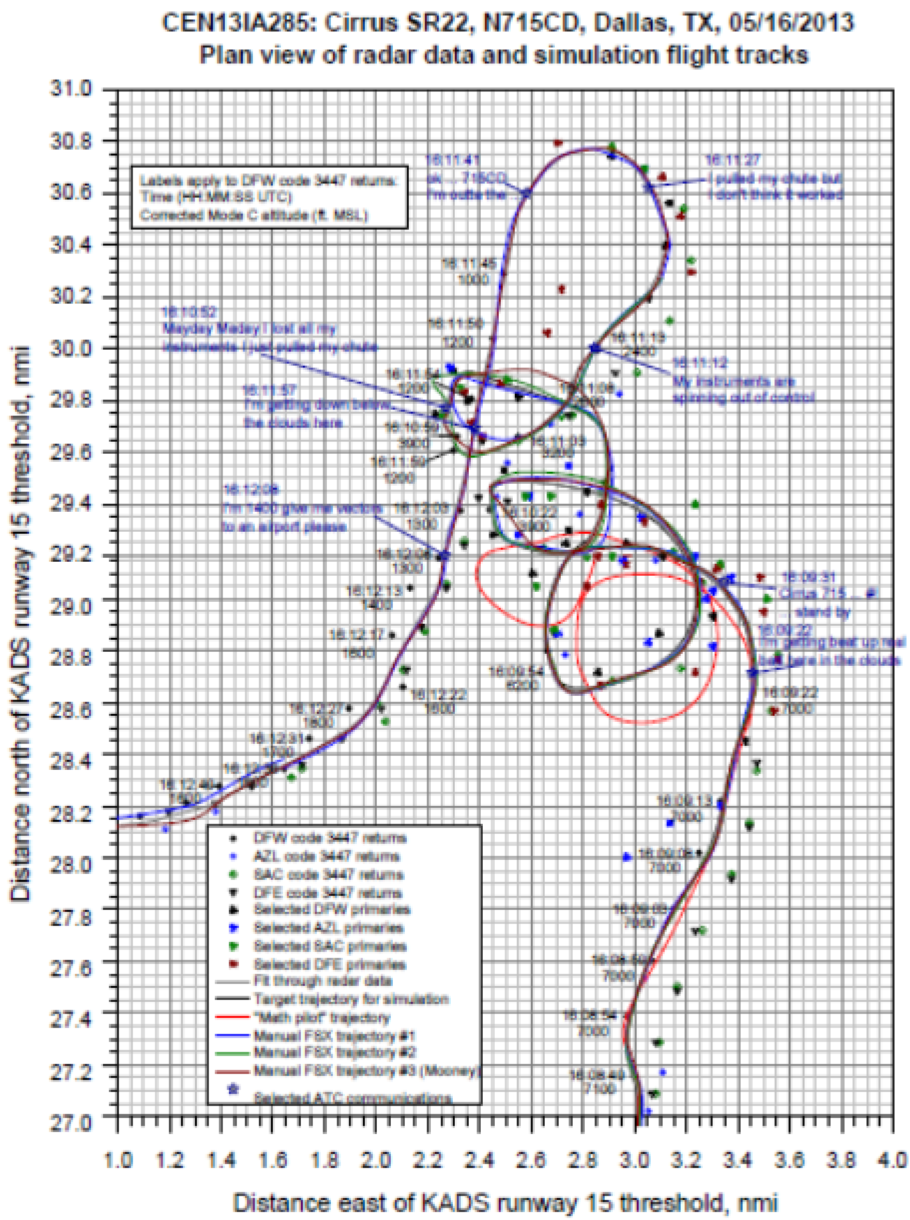


Figure 2 – Plan and 3D Views of Radar Data and Simulation Flight Tracks

(Note: The 3D view uses an exaggerated vertical scale)

Modeling of the airplane's flight path through the radar data revealed that the flight was very dynamic with extreme pitch and bank angles (knife edge flight, bank angles greater than 90°, etc.). It appeared that the pilot's radio call about having deployed the parachute comes near the apex of a very steep climb, at which almost all the airplane's energy is sacrificed to make the climb (this was one of the places in the manual (simulation) flights where the airplane ran out of energy and could not match the target climb). Because of all the twists and turns that precede this point, it seems possible that the parachute rocket may not be pulling the parachute from the airplane at the intended angle after it is deployed. If the airplane has a large pitch or bank angle or angular rates (or combination of these), as the parachute rocket leaves the airplane, the airplane will rotate and cause the rocket tether to pull at an angle other than that intended.

Off-Axis D-Bag Pull Tests

After the incident airplane was ferried to CDC, Duluth, Minnesota, the NTSB IIC requested that off-axis pull tests of the D-bag be performed. The incident D-bag was used for testing, which was carried out at various trajectories using a gantry, a cable attachment to the bag, a load cell, and a hand-crank. The vertical trajectories were 5 to 55 degrees relative to the horizontal in 10 degree increments and later trajectories from the aft direction, 45 degrees from aft, and 90 degree from aft. The results of pull force and D-bag distance movement were recorded. Testing was stopped when the D-bag reached a point where it would begin to pivot on the compartment edge or to prevent damage to the bag/airplane. The NTSB IIC requested that CDC graphically plot the recorded results relative to the airplane diagram. A quarter spherical plot centered over the CAPS compartment was defined with three zones. The green zone depicted a trajectory with an extraction force of 150 lbs or less. The yellow zone depicted a trajectory with an extraction force exceeding 150 lbs. The red zone depicted an extraction force exceeding 200 lbs.

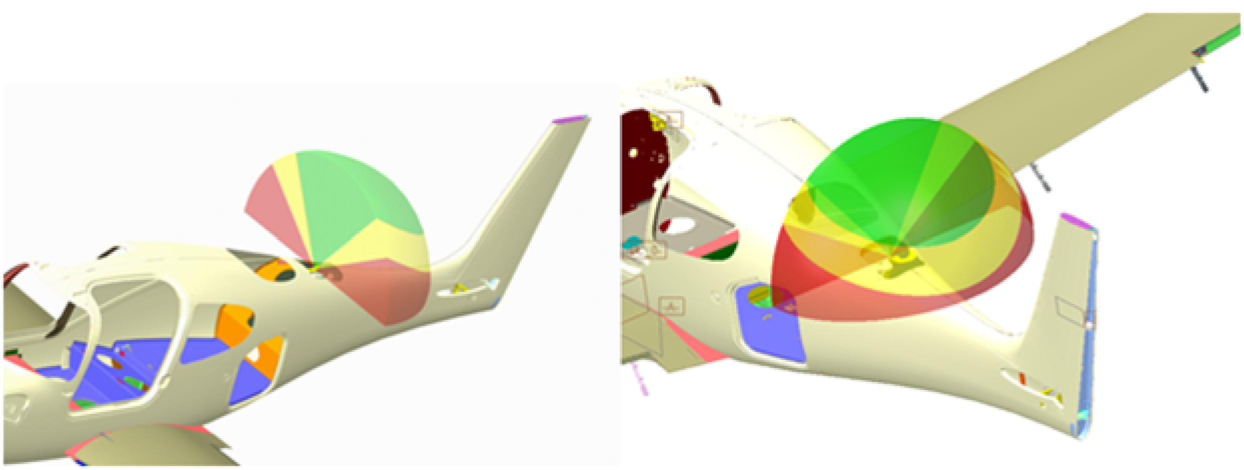


Figure 3 - 3D Representation of Extraction Results

D-Bag Dimensional Measurements

Using a tape measure, perimeter lengths of the incident D-bag were taken between the five straps (four band areas) that wrapped the bag. Band one was referenced as the nearest band from the D-bag bottom. Band numbering was increasingly incremented toward the top of the deployment bag. The perimeter lengths were as follows:

Band 1: 36 3/8 inches

Band 2: 36 5/8 inches

Band 3: 36 1/2 inches

Band 4: 36 3/8 inches

Comparison measurements of the perimeter lengths were made with four packed D-bags located at CDC, two of which were repacked and two that were returned for repack. Measurements were taken at the number three band. The perimeter lengths were as follows:

BRS repack: S/N - 00866RI, pack date - December 2013, 35 3/8 inches

Cirrus repack: S/N - 00908RI, pack date - June 2013, 35 7/16 inches

Return for repack: S/N – 935, manufacturing date - May 2003, 35 7/8 inches

Return for repack: S/N – 943, manufacturing date – May 2003, 36 1/16 inches

Rocket Motor Information

Four rocket motors of the same lot (110819) as that of the rocket motor that was installed on the airplane were test fired at an ambient temperature of 72 degrees F. Statistical analysis, in part, showed the following:

	Peak Thrust (Pounds)	Average Thrust (Pounds)	Total Impulse (Newton Seconds)	Full Time (Seconds)	5% Time (Seconds)	50% Time (Seconds)
Sample Size	4	4	4	4	4	4
Samples Missing	0	0	0	0	0	0
Mean	241.925	189.050	994.303	1.224	1.182	1.106
Std. Deviation	2.121	1.722	2.477	0.00971	0.00998	0.00879

Figure 4 - Statistical Values of Thrust and Impulse

Plots of rocket thrust at three ambient temperature curves at 240 degrees F, 67 degrees F, and -27.5 degrees F, showed peak thrusts of about 240 lbs, 220 lbs, and 190 lbs, respectively.

Avionics/Instrument Examination

An external source of power was connected to the airplane. The AI up righted itself and displayed an approximate 0 degree pitch and bank angle indications with no anomalies and no displays of the unit's power warning flag. The AP was operated through clockwise and counterclockwise heading and in upward and downward pitch selections. All of the selections resulted in positive correlated changes in control surface movements. Wires leading to the flux gate were shaken by hand pressure and no error messages appeared. The AI was then removed for bench testing.

The AI had an unbroken original seal in place on the AI case. The AI was placed on a test bench and powered with 28.0 Vdc for functional testing in accordance with L-3 Avionics Systems Component Maintenance Manual AIM Model 1100. The test results were within test specifications.

Precipitation Static (P-Static)

The pilot stated that during the incident, the radios were not working and he made radio calls to a Southwest Airlines flight since he did not receive a response to his calls from air traffic control. He said that the sound he heard over the radio sounded as if it was from squelch. The pilot stated that his Anywhere Map was also not working due to the electrical problem the airplane had encountered.

When the pilot was asked if he heard precipitation static from the radios, the pilot said that he did not know that it was P-Static until the day after the incident when he had talked to an aircraft maintenance/avionics facility. The pilot was asked if the airplane static wicks were checked and connected; the pilot said he did not know.

The Instrument Flying Handbook (FAA-H-8083-15B) stated that precipitation static occurs when accumulated static electricity is discharged from the extremities of the aircraft. This discharge has the potential to create problems for the instrument pilot. These problems range from the serious, such as erroneous magnetic compass readings and the complete loss of very high frequency (VHF) communications to the annoyance of high-pitched audio squealing and St. Elmo's fire.

P-Static is caused when an aircraft encounters airborne particles during flight (e.g., rain or snow) and develops a negative charge. It can also result from atmospheric electric fields in thunderstorm clouds.

When a significant negative voltage level is reached, the aircraft discharges it, which can create electrical disturbances. This electrical discharge builds with time as the aircraft flies in precipitation. It is usually encountered in rain, but snow can cause the same effect. As the static buildup increases, the effectiveness of both communication and navigation systems decreases to the point of potential unusability.

The post-incident flight instructor stated that she experienced P-static in some airplanes and also in Cirrus airplanes. She said that P-static often occurs in hard rain. She said not all airplanes experience P-static and thought that P-static effects on an airplane was due to grounding issue. She has never experienced P-static affecting avionics instruments on Cirrus airplanes that she has flown, but it would affect the communication radios making it hard to hear, and the avionics instruments would continue to function normally.

A search of the FAA's Service Difficulty Reporting (SDR) database for P-static and Cirrus SR22 airplanes yielded one report of an occurrence on November 30, 2007. There were no other instances of P-static reports for Cirrus SR22 airplanes in the SDR database. The reported that was submitted stated:

PFD and GPS/NAV1 both rebooted at the same time. Restarted without going through either its standard initialization or its fast start routine. The autopilot seemed to be still engaged but the VS selection, QNH, altitude pre-select and heading were reset and these reset values appeared to be passed to the autopilot. This occurred at low level, in the climb, in IMC with heading and altitude acquire set on the autopilot. There was some electrical activity within 10 miles. The aircraft was flown safely back to the departure field using backup instruments. Engineers suspect either a spike from alternator 2 or [manufacturer] believes this could be a bonding issue and was caused by static. MFG incident reference: 871500HQ. Engineers suspect that the AHRS did not reboot, but this was no apparent to the pilot.

Post-incident static testing of the airplane was performed using an electrostatic diagnostic test set capable of 60 kV. An Ion streamer for spraying charge onto the airplane's composite structure was used to initiate streaming and for charging the metal structures to determine bonding integrity. A handheld communication receiver was monitored continuously for degradation in performance while the airplane was subjected to ion charge. The charge was also applied over the area of the flux gate located in the wing and no avionics anomalies were noted. Test findings were reported as:

1. Cowling - When subjected to charged ions the decorative strips which had conductive flakes arced from the cowling to the airframe where the strip continued. Interference was monitored on communication receiver. No degradation of instrumentation in the cockpit was observed.

2. Decals - When subjected to charged ions, flashover to airframe occurred causing interference on communication receiver. No degradation of instrumentation in cockpit occurred.

3. A reference of 100 uA at 25 kV was established on the propeller hub which would enable the ideal disbursement of the charge. Spraying the remainder of the composite airframe required voltages as high

as 50 kV in order to see 10 uA of current. The voltage level on the airplane will be retained longer in a charged atmospheric condition. There are no static dischargers installed which would lower the threshold voltage for the most efficient dissipation of the energy on the airplane.

CDC issued service bulletin (SB) SB2X-23-03, Optional Modifications to Dissipate P-Static on May 22, 2014 applicable to the following airplanes: SR20 serial numbers 1878, 1886 thru 2262; SR22 serial numbers 2334, 2420, 2438 thru 4096, 4100; SR22T serial number 0001 thru 0799. The SB described the installation of optional modification to dissipate P-Static and included procedures for static wick installation, electrical bonding, and EVS camera installation modifications.

Additional Information

Post-Incident Maintenance

Work orders of post-incident maintenance of the airplane showed work performed for discrepancies related to a Sandel 'Flux Gate Excitation Lost' message and light static in headsets. The corrective action for the flux gate message noted a broken wire at the back of the Sandel plug. The plug pin was removed and replaced. The corrective action the light static addressed P-static by installing copper conductive tape to the inner surface of the lower cowls.

Administrative Information

Investigator In Charge (IIC):	Gallo, Mitchell
Additional Participating Persons:	Gavin Hill; Federal Aviation Administration; Dallas, TX Brannon Mayer; Cirrus Desgin; Duluth, MN Rick Beach; Cirrus Owners and Pilots Association; Las Vegas, NV Gregg Ellsworth; BRS Aerospace; St. Paul, MN Scott Dixon; Vulcan Systems, Inc.; Colorado Springs, CO
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