To pull or not? Understanding airframe 'chutes

Pull the chute or fly your aircraft into the ground? The decision is yours. Adrian Norris and Rick Beach look at the reality and the myths surrounding the Cirrus parachute system… and consider the psychology involved in making the decision

When Cirrus launched its SR20 in 1998, one feature attracted more comment than any other – it had a parachute which would bring the whole aircraft gently to the ground in an emergency. With more than 5,600 aircraft delivered, most of them the more powerful SR22 model, and 54 parachute deployments, CAPS (Cirrus Airframe Parachute System) still causes controversy and febrile discussion wherever it's mentioned.

As Cirrus aircraft become older, depreciation is making them affordable for many more pilots. What should prospective Cirrus pilots and owners make of the controversy that breaks out after each CAPS deployment, and how can they separate myth from reality?

History and myths

Cirrus was the brainchild of Alan Klapmeier, who founded the company with his brother Dale in 1984. Alan had survived a mid-air collision in which the other pilot died, and he had seen too many pilots pay for mistakes with their lives. He was determined to include a range of safety features in his aircraft: good handling and visibility; a strong and crashworthy airframe; spin resistance; and a parachute that could save all the occupants when no other options were available. The parachute was not an add-on; it was part of the design from day one.

The Cirrus has a spin-resistant design. The cuffed wing with its distinctive, split leading-edge means that the ailerons remain effective after the wing has stalled. During the certification process, the FAA determined that the combination of the spin-resistant design and the parachute meant the Cirrus did not need to undergo a full spin test programme. It was deemed to have an 'equivalent level of safety' to aircraft that had demonstrated spin recoveries.

This led to one of the more enduring Cirrus myths – namely that the parachute was required because the aircraft couldn't recover from a spin. It is a myth that has been reinforced by some respected writers including the distinguished former editor of Flying magazine, Richard L Collins, who has written that deploying the chute 'is the only way a pilot can recover from a spin in a Cirrus'. The reality is that in a series of 60 spins ▸

Cirrus SR22 that cartwheeled during an attempted off-airport landing. The pilot and his wife perished while their niece walked out of the wreckage. According to the NTSB the pilot had stated that he would only pull the chute following a structural failure

I pulled the chute

ON 6 JUNE last year, Peter Patel took off from Denham. He was heading to Gloucester, to pick up a passenger and bring him back to Denham, a short flight that he had made many times before. "It should have been a perfectly routine flight", recalls Peter. It was not.

There were light northeasterly winds at Gloucester, with scattered clouds at 500ft and broken at 800ft. Peter had planned for an instrument approach to R09. In IMC, about 30 miles from Gloucester, Peter asked to begin his descent.

"I was unexpectedly told to climb," he explained, "which put me off a bit. Then I was asked to do the RNAV approach to Runway 27 when I was already close to the initial approach fix."

The workload was high as Peter reprogrammed the FMS, got the ATIS and configured the aircraft for the approach. It then became difficult to make timely radio calls on Gloucester's busy frequency on what happened to be Peter's first RNAV approach in IMC conditions.

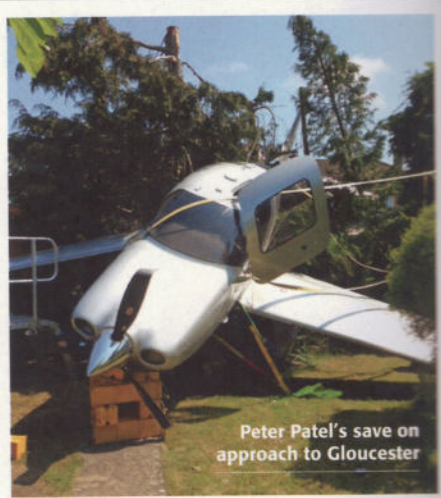
"It all meant higher than normal stress levels, but I got to the initial approach fix at the correct altitude. Knowing that I was on the approach and everything was fine, I made a serious mistake," says Peter. "I felt I was nearly there, about to break clear of the clouds, so why not switch off the autopilot? Force of habit!"

Peter generally hand-flew approaches, dispelling a stereotype about Cirrus pilots. "As soon as I disconnected the autopilot, the aeroplane banked left – presumably because it was badly trimmed. This gave me a fright, which is when I made my second mistake. I re-engaged the autopilot. If you do that without telling the flight director what you want it to do, it will just maintain whatever it's doing in pitch and roll mode."

Peter was 1,500ft above the ground, in IMC, accelerating in a descending left turn and fighting his autopilot.

"At that stage I got a whole series of warnings. I can't remember them exactly – there were overspeed warnings, underspeed warnings, pull-up warnings, terrain warnings and displays on my PFD which I had never encountered – namely these big red chevrons that appear."

Analysis by the AAIB showed that, in less than a minute, the airspeed fluctuated between 54kt and 144kt. Roll varied from 82° right to an almost fully inverted 148° left. The Cirrus bottomed out of one dive at 850ft, and at one point the rate of descent was 10,000fpm. The Garmin autopilot famously has a blue 'Level' button, which brings the aircraft back to straight and level flight. But it can only be used if the bank angle is less than 75° and pitch less than 30°. Peter's SR22 was frequently beyond these limits.



Peter Patel's save on approach to Gloucester

BRS airframe location and deployment sequence

A Cirrus SR22 that descended under canopy into a field in Arizona following a mechanical failure in the oil system

"After struggling for a bit and realising that I was close to the ground near a busy airport, I made a very conscious decision and pulled the chute." This was done at 1,400ft as the aircraft accelerated through 95kt with a rate of descent of 5,000 fpm. As it came out of the clouds, it was filmed by a passer-by and Peter's SR22 became the star of that evening's news bulletins, coming to rest in a suburban back garden with the tail resting in a tree. Peter was unhurt.

Peter had recently visited Aero Poznan in Poland, which operates Europe's only full-motion Cirrus simulator. He had practised use of the parachute in several emergency situations.

"I'm not sure I would have made the same decision before the simulator training. I think I would have hesitated longer, and I would probably have acted too late," he says.

Peter had been flying aeroplanes for seven years, having previously flown helicopters. He had nearly 700 hours total time, and 443 in the Cirrus. He still flies, and has recently returned from his latest simulator training in Poland. He is very candid that he made mistakes which led to the loss of his aircraft last June. Without CAPS, the penalty for those mistakes would have been death.

carried out for European certification of the SR20, the aircraft always recovered within one turn. But the altitude loss ranged from 1,200-1,800ft. The altitude loss recovering from a one-turn spin with CAPS is 920ft. The European authorities ended up agreeing with the FAA that spin resistance combined with CAPS provided the required level of safety, and it did not request a full spin programme.

Another myth is that the parachute takes away useful load. Like most light aircraft, a Cirrus cannot carry full fuel and a full cabin load at the same time. Many people have said that they would rather have 80lb of extra payload than a parachute, ignoring how integral the parachute is to the aircraft. The original SR22 had a gross weight of 3,400lb, which was increased to 3,600lb in the latest G5 variant. What changed? The company installed a bigger parachute so that the rate of descent would be safe at the higher weight.

Cirrus accidents

Cirrus aircraft are still all relatively new by GA fleet standards, and they generally fly a lot of hours. Accidents caused by lack of maintenance or ageing are therefore relatively infrequent, with pilot error the most common cause.

"Cirrus pilots crash for the same reasons as any other pilots," says Travis Klumb, the Director of Flight Operations at Cirrus, "but the aircraft's capability means that they are flying complex missions, dealing with weather and terrain over long distances. They are used like airliners, but with private pilots at the controls."

Despite the safety features and the parachute, it is indisputable that in the first years of production the Cirrus fatal accident record was slightly worse than the average for GA aircraft. Comparisons are difficult, as the fleet size was small and Cirrus aircraft are used predominantly by private pilots for cross-country flights, while many other GA types are used extensively for training, which has extraordinarily few fatal accidents. But too many pilots made bad decisions. At the time of writing, there have been 104 fatal Cirrus accidents, which have killed 205 people.

"Fatal accident trends have shown a dramatic decrease recently, and they are continuing to decline," says Travis Klumb. NTSB data for all GA accidents shows an average of 1.24 fatal accidents per 100,000 hours of flying time. Over the past 36 months, the accident rate for Cirrus aircraft was 1.57, but in the last 12 months it has improved to 1.07.

A lot of low-time pilots have bought a Cirrus, as have a significant number of non-pilots who have learnt to fly in their new aircraft. An enduring insult on Internet discussion forums is that many Cirrus ▸

"The change in mentality that is required to use CAPS should not be underestimated. Pulling a handle and sacrificing the aircraft is not a natural reaction for many pilots"

CAPS deployments

TO DATE THERE have been 54 CAPS deployments above the ground One of these was the result of impact forces in a mid-air collision. The remaining events were initiated by the pilot or by a passenger. Most had a successful outcome, but not all.

Seven deployments were left until too late and the parachute did not have time to inflate; 11 people died and three were seriously injured. One deployment was way above Vne; the parachute detached from the aircraft and the pilot died.

Two deployments failed. In the first, deployed at about 120ft agl, the rocket flew an anomalous trajectory and the two occupants suffered serious injuries in a forced landing; an AD was issued which should prevent recurrence of the failure. The second happened last year in Texas, and is being investigated by the NTSB; the pilot was able to recover in IMC and land without injury.

But 43 of the deployments were what COPA calls 'saves', i.e. intentional deployments where the occupants survived. There has only been one fatality among these, in an event where a passenger deployed CAPS in a spin at 500ft, well below the required height for a safe recovery. The remaining 87 pilots or passengers all survived incidents which would almost certainly have resulted in death or serious injury without CAPS, and 78 of them were uninjured or had only minor injuries.

These 43 deployments can be categorised as follows:

- 19 following some sort of mechanical problem – engine failure or power loss, instrument failure in IMC or a flight control problem
- 12 due to loss of control, sometimes following icing or flight into IMC by VFR pilots.
- Four following disorientation entering IMC or as a result of vertigo
- Three aircraft were unable to maintain altitude after icing
- Two ran out of fuel
- One suffered a mid-air collision.
- One medical incapacitation
- One under investigation in Brazil

Possibly some of these flights would have landed safely had CAPS not been an option, but undoubtedly the majority of the 87 would have died.

Boris Popov and Alan Klapmeier

IN 1975, BORIS POPOV was being towed by a boat in his hang-glider. He tried to signal to the boat's crew that his airspeed was too high, and that they needed to slow down. 400ft below in the boat, his gestures were misunderstood. The crew thought he wanted to go faster.

As the boat accelerated, the airspeed increased beyond the fragile hang-glider's limits, and the wings folded. Boris has described the anger he felt as he fell to what he thought would be his death; if his hang-glider had had a parachute, he would have lived. Remarkably, he survived the fall unhurt, and that same day he made his first sketches for a whole aircraft parachute.

In 1980, he founded Ballistic Recovery Systems (BRS); since then over 25,000 parachutes have been fitted to microlights and certified aircraft. 1% of them have been used.

On 26 April 1985, a Piper PA-17 was flying towards the setting sun, in a descent towards Sauk Prairie Airport in rural Wisconsin. The pilot had no radio, so could not know that a Cessna 182 had just taken off and was turning east. In the Cessna, an instructor was training a student for his instrument rating. The student was wearing an instrument training hood for the short flight to the regional airport at Madison. The instructor was responsible for lookout, but in a climbing right turn in the high-wing Cessna he was unable to see the Piper.

The pilot of the Piper probably saw the Cessna at the last minute and banked sharply left – but it was too late. Two miles from the airport, at 800ft above the ground, the two aircraft collided. The right wing of the Cessna sliced through the Piper's wing strut, and the Piper crashed. In the Cessna, despite the loss of over three-feet of the right wing and most of the right aileron, the pilots were able to retain some control. Holding full left aileron, they landed safely.

The student pilot that day was Alan Klapmeier. Alan was the creative inspiration behind the company he had just created with his brother Dale: Cirrus Design. Alan became determined to offer a last hope to pilots of stricken aircraft, and from the outset he incorporated a parachute into the design of the Cirrus SR20, which made its first flight 10 years after his collision.

pilots have 'more money than brains', and rely on the aeroplane's systems to fly through weather that would keep wiser pilots grounded. However, the accident statistics show that over half the fatal accidents involved pilots with more than 800 hours total time, which must be several years of flying experience. Over half the accident pilots also had less than 200 hours of time in type. Why do these relatively experienced pilots, who have generally served their aviation apprenticeships in traditional aircraft, die in an aircraft which should be inherently safe?

One reason is clear: pilots are reluctant to use CAPS. "We believe that many of the fatal accidents could have been prevented if pilots had simply reached up and pulled that handle," says Travis. "Pilots get tunnel vision and focus on recovery."

It is a message that is reinforced by Piotr Dlugiewicz, the founder of Aero Poznan, which operates the only full-motion Cirrus simulator in Europe. "In the simulator we see pilots becoming fixated on problems, often until it is too late. Pilots have been trained to resolve problems, and they can forget that they have another option with CAPS." There is an urge to save the aeroplane, and perhaps an underlying feeling that 'real pilots don't need a parachute'.

A detailed analysis of Cirrus fatal accidents by COPA (Cirrus Owners and Pilots Association) suggests that 120 people have died in 58 fatal Cirrus accidents where other pilots had used CAPS and survived. In similar scenarios, one pilot pulled and everyone lived, another didn't pull and everyone died. Examples of these accidents include disorientation when flying VFR into IMC or on an IFR approach in IMC, mechanical failures, avionics failures and icing.

The change in mentality that is required to use CAPS should not be underestimated. Pulling a handle and sacrificing the aircraft is not a natural reaction for many pilots, who have been trained to rely on their skills in an emergency. Internet discussion of CAPS deployments often sees pilots castigated for giving up. "I'm astonished they didn't make any attempt to land," is one of the more common, and more polite, criticisms made of Cirrus pilots who have used CAPS instead of attempting a forced landing. But CAPS is almost invariably a better option than an emergency landing for a Cirrus pilot.

An SR22 with a windmilling propeller is a poor glider. At its best glide speed of 88kt, it has nearly three times more kinetic energy than a gliding Cessna 172 and the rate of descent is significantly higher. At touchdown speed of 60kt, there is 12 times more energy to dissipate than in a CAPS arrival at 17kt. A slight misjudgement, or a rough field surface, and the results will be catastrophic. "It is a game of Russian roulette," says Piotr Dlugiewicz, a sentiment that is confirmed by looking at what happens to pilots of other high-performance aircraft when they attempt forced landings.

Out of the last 100 fatal Mooney accidents, 16 occurred during attempted forced landings, killing 22 people – either hitting obstacles, landing on rough terrain or spinning while trying to stretch the glide. It is a similar story for the Beech Bonanza, in which 19 of the last 100 fatal accidents were ▸

during attempted forced landings, and 34 people died. Overall, between 40% and 60% of the fatal Mooney and Bonanza accidents were in situations where an airframe parachute could have prevented loss of life, remarkably similar to the statistic for Cirrus fatal accidents.

COPA has promoted the mantra 'pull early, pull often' to encourage pilots to use CAPS before a bad situation develops into an unrecoverable one, and in situations where an emergency landing might be possible – but might end in disaster. Indecision can be fatal. There have been five fatal accidents where the parachute was deployed just before ground impact, and one failed deployment in a loss of control situation far beyond Vne. It is a message that seems to have worked, as COPA members are involved in significantly fewer accidents than non-members.

Does CAPS encourage risk-taking?

Does a safety feature like CAPS encourage pilots to take risks that they wouldn't otherwise? It is a question that is difficult to answer. Any safety feature will change the way that a pilot uses an aircraft, whether it is dual magnetos, a heated pitot or back-up instruments for flight in IMC, personal parachutes for aerobatics or life-jackets for sea crossings.

Undoubtedly CAPS provides reassurance in some situations such as night flight over rough terrain or in IMC, and allows passengers to survive if the pilot is incapacitated (there have been two CAPS deployments by passengers). However, of the 54 CAPS deployments (1% of all aircraft delivered), the overwhelming majority involved some form of mechanical failure (for example, power loss, maintenance-induced failures or incorrect fuel), loss of control, icing or medical incapacitation. Exactly the same things which cause fatal accidents in other high-performance aircraft. There is nothing to suggest Cirrus pilots are systematically doing things that other pilots don't.

A ride under the canopy and into the canopy! Four people survived following this catastrophic engine failure

Training for new pilots

Training by the Cirrus factory for new owners and training initiatives run by COPA have contributed to a reduction in Cirrus accident rates. Every new aircraft comes with simulator training so pilots can practise the exercises that will make CAPS deployment automatic in an emergency. However, with older SR22s changing hands for less than £100,000 more pilots now have the opportunity to fly a Cirrus, and many of them will not receive specific transition training.

In the autumn of 2011, there was a particularly bad spate of eight fatal Cirrus accidents, three of them happening in one 24-hour period. Five of the accidents involved used aircraft or rentals. "We're very afraid that some pilots are not getting properly trained," says Travis Klumb, "not only in the use of CAPS but also in how to get the most out of the aircraft." Cirrus will soon be launching new training initiatives that will focus on pilotage and airmanship as well as CAPS, and it plans to incentivise pilots to take them. COPA is also very active in pilot training, with its Cirrus Pilot Proficiency Program and Critical Decision Making seminars.

CAPS is not a passive safety system. It requires active intervention by a pilot who is likely to be experiencing an extreme level of stress. Nobody has ever died after deploying CAPS within its certification parameters, and nobody on the ground has ever been hurt by a parachuting Cirrus. Lots of people have died in a Cirrus with a perfectly good parachute behind them. Some of them may have been influenced, if only subconsciously, by the myths surrounding CAPS and by the scornful derision they have read on Internet discussion forums. ■

How does CAPS work?

IN THE CEILING between the front seats of a Cirrus is the CAPS activation handle, protected on the ground by a locking pin. A 45lb pull on the handle is sufficient to activate the system.

Deployment begins with the firing of a rocket located above and behind the baggage compartment. The rocket dislodges the protective cover on the roof of the aircraft, and pulls out the deployment bag containing the packed parachute. As the parachute begins to fill with air, the forward harnesses are extracted from channels beneath the fuselage skin, and the rear harness is kept short to induce drag from the nose-low attitude.

There is a slider ring around the parachute lines, which is positioned at the top of the parachute suspension lines. This limits how far the parachute can open initially, limiting the loads on the lines and on the aircraft. As the parachute inflates, the ring gradually slides down the suspension lines and the parachute inflates more fully. During inflation, the aircraft adopts a nose-low attitude and line cutters extend the rear harnesses to their full length. The aircraft then adopts a level attitude and descends at less than 1,700fpm, depending on weight and density altitude.

Every 10 years the rocket needs to be replaced, and the parachute must be inspected and repacked.

During certification testing, CAPS was demonstrated at 133kt, and the slightly larger parachute on G5 models has a higher demonstrated speed of 140kt. There is no minimum speed and the slowest successful deployment was at just 34kt – while inverted. One of the fastest successful deployments was at 187kt, in the UK in August 2010. There is no minimum deployment altitude, but the demonstrated loss of altitude from level flight was 400ft. Cirrus pilots are advised to set a higher 'hard deck' altitude to deploy CAPS, although deployment is suggested regardless of altitude if no survivable alternative exists. One pilot deployed CAPS at 13,000ft above the ground.

The writers

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