Hitting the Silk

Ballistic recovery systems have proven invaluable many times over the past 20 years, but even so, there is still resistance within the aviation industry. **Paul Southwick** examines the arguments for and against.

In one of the world's best brand-positioning videos, a Cirrus SR22 owner's wife, talking about the aeroplane's parachute system, says "I think every aircraft should have it. It kept my family together". Her husband, who flies five days-a-week for business and had recently survived a night-time engine failure says "In any other aircraft, in the dark, from 5000 feet, I had zero chance of survival."

It is a powerful advertisement, cleverly told as an emotion-stirring, tear-jerk story, such that on watching it the author's wife, who had hitherto been a happy passenger, declared "You're never allowed to fly yourself, me, or our son Max, in any other aircraft!"

Despite these endorsements and those from people whose lives have been saved by ballistic recovery systems (BRS), sometimes branded as the Cirrus Airframe Parachute System or CAPS, starting with Jay Tipton of Colorado in 1983, there has been far from universal agreement about their worth. There are strong BRS detractors. Indeed most general aviation aircraft manufactured today do not have parachute systems.

To understand the arguments for and against BRS we need to go back, way back in history, and look at not just aircraft parachute systems, but also the introduction of life-saving devices in other forms of transport. It is also important to use a little imagination, but more on that later.

Car seat belts

Although invented much earlier, seat belts in cars first started to appear widely in the US and Europe in the 1950s. The world's first law making wearing seat belts compulsory for those in the front was introduced in Victoria, Australia, in 1970. Early versions with buckles and manual length adjustment quickly spread through Australasia.

Seat belts were not without detractors, with claims including: they squashed women's breasts and caused cancer, they could strangle or decapitate the wearer in a crash, and if the buckle was crushed, a driver could be trapped and burn to death in a fiery accident.

Nevertheless it was clear belts saved lives. Even today the US Center for Disease Control and Prevention reports that seat belts reduce serious crash-related injuries and deaths by about half.

Similar statistics apply for airbags, but they too faced detractors. A federal requirement for "passive restraints" in the US was introduced in the 1980s but was vigorously opposed by all the major vehicle manufacturers. The US Department of Transportation estimated at the time that a delay in their introduction would cost more than 10,000 lives per annum in the US alone.

Pilot parachutes

Perhaps the best parallel for BRS is that of the pilot parachute. Invented and sketched by Leonardo Da Vinci (1452 and 1519), Jean Pierre Blanchard (1753-1809) used one to jump from a balloon in 1793. He also developed a foldable parachute made from silk.

Fascinating then, that despite their well-demonstrated ability to save lives, by the time the air battles of WWI began, pilots–with the exception of observation balloonists–on both side of the trenches were, much to their disgust, denied parachutes by the bureaucrats. The thinking

The integrity of the CAPS was demonstrated many times during the certification of the SR20.

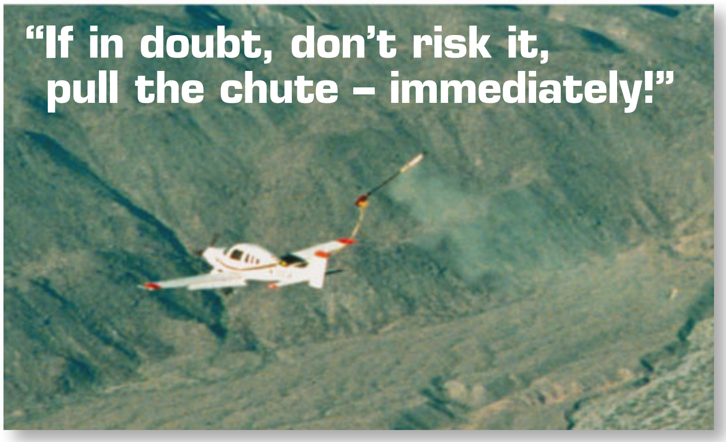
CIRRUS AIRCRAFT

was that the pilots would bail out of their highly-flammable, wood, canvas and string bag death traps in an emergency and not try to save the aeroplane. This ignored the fact that a trained pilot, especially an ace, was much more valuable than his aircraft.

The famous World War 1 ace and racing driver, Eddie Rickenbacker, wrote in his diary after a fatal mid-air crash that killed two friends "it was criminal negligence on the part of those higher up for not having exercised sufficient forethought and seeing that we were equipped with parachutes for just such emergencies."

Towards the end of the war German pilots were equipped with parachutes, one saving the life of the highest-scoring ace to survive the war, Ernst Udet, who went on to play a major role in the development of the Luftwaffe.

In WWII parachutes were widely used. With the development of high-speed jets at the end of the war, another need arose and that was for ejector seats. It would be years before the "optimal" solution was developed, one that would safely eject pilots and allow them to float to safety without injury, from any height or speed.



CIRRUS AIRCRAFT

There would be few pilots today, who when a friend or colleague finds out they fly has not heard "I would never go up in one of those things without a parachute" or the question "Does your aeroplane have parachutes [for pilot and passengers]?"

BRS history

The concept of whole-of-aircraft parachutes has been around as long as aeroplanes. It seems strange, therefore, that it was not until the 1970s that American Boris Popov, who survived a very scary 120 m fall in a failing hang glider, invented the whole-of-aircraft parachute system, and founded Ballistic Recovery Systems (BRS) in 1980.

It took another 13 years for BRS to be granted the first Federal Aviation Administration (FAA) approval to install a parachute on a certified aircraft, the Cessna 150/152.

In 1998, BRS worked with Cirrus to develop the CAPS system for the SR20 after Cirrus' founder and US National Aviation Hall of Fame member, Alan Klapmeier, had survived a fatal (for the other aircraft) mid-air collision in 1985.

Two years later, a BRS type certificate was issued for the SR22, followed by a Supplemental Type Certificate (STC) for Cessna's C172 and C182 in later years. The CAPS will also be extended to the Cirrus SF50 Vision when it is certified sometime before the end of 2015.

Today both Cirrus in the US, with the world's number one selling single engine aircraft, and Flight Design in Germany, with the number one selling Light Sport Aircraft (LSA) both ship aircraft with BRS systems as standard. BRS is available for a wide range of LSAs, more than 300 ultra-lights, and many experimental models.

How does a BRS work?

Using the most well-known installation as an example, the pilot, or passenger in a Cirrus pulls down on a T-shaped handle on the ceiling of the aircraft with at least 40 pounds of load. A solid-fuel rocket then fires the parachute. Deployment takes place within a second and the canopy inflates rapidly. The canopy is attached to the airframe via emerging 6800 kg breaking strain Kevlar lines initially hidden below the surface of the fuselage.

A key feature of the system is a patented sliding ring around the parachute lines, which slowly descends downwards. By initially remaining high it prevents the chute fully deploying at too high a speed and forces exceeding aircraft design limits. As the aircraft is slowed the ring slides down the lines, enabling full chute deployment.

Once deployed, the chute cannot be cut away and the aircraft is lowered to the ground at about 25 fps – similar to a drop from two or three metres. The undercarriage, and especially designed 26-g seats take much of the impact. It is not unusual for damage to be so light that the aircraft can be repaired to fly again.

With the increase in the MTOW of the Cirrus G5 model, a larger diameter chute of 19.8 m was required, compared to the 16.7 m diameter original parachute.

Cirrus says that the demonstrated altitude loss for the G5 is 561 feet from straight and level, and 1081 feet from a spin. The G5 descends at an even slower rate than the 3400-pound earlier model aircraft.

Counter-arguments

Detractors offer several reasons why they are against BRS. The most common argument is that knowing the system is there causes pilots to be careless, sloppy, or even dangerous; cognisant that the BRS is there to save them. This might be true of a very small minority of pilots but runs counter to all of the training and professionalism instilled into pilots, wherever they learn to fly.

What does appear true is that a BRS requires specific training to ensure the system is used when it should be. Since 2011, Cirrus has greatly increased the focus on CAPS training resulting in significantly lower fatal accident rates, as detailed below.

The second argument sometimes used by sales people in favour of aircraft with two engines is that it is much better to buy a twin so that if one engine fails you can simply fly home on the good engine, saving the aeroplane and persons on-board. This argument loses water, however, when considering the wide range of reasons a BRS might and has been deployed, including pilot incapacitation, stall/spin on approach, structural failure, loss of control, icing, component failure, pilot error, or a mid-air collision.

Another argument is cost. This category includes the cost of the system built into a new aircraft of between US$10,000 and US$30,000. However things do not always play out so simply. The Cessna TTx, without a BRS, but with similar performance to the Cirrus SR22, is actually more expensive.

Then there is the compulsory 10-year, US$10,000 re-pack cost and US$1,000 new rocket cost, as well as the weight penalty, which reduces useful load. The cost to "cheat death", as some deployment survivors have described it, is clear: about US$1100 per annum. The pilot choice then comes down to imagination – of what could or might happen, and personal preference.

Might some other reasons for opposition be envy and self-denial? The Cirrus, although the top seller, is expensive – more than US$650,000 for an Australis, and A$400 plus per hour to rent. Is there a degree of resentment by those who will never be able to buy or rent one that spills over into self-denial that the detractor's non-BRS aircraft is really as safe? That's a question for the psychologists.

Stating the facts

The BRS and Cirrus websites, as of August 2015, show that 324 lives have been saved using BRS. Of those, 107 were in Cirrus aircraft, showing that pilots of other makes have benefited from airframe parachutes as well.

What is amazing and sobering in reading through the list of deployments is the incredible variety of predictable, unpredictable and sometimes seemingly random events that led to BRS use.

Before 2011 Cirrus experienced a "low in absolute terms" but nevertheless above industry average fatal accident rate. No doubt this was the source of much early BRS criticism, especially in relation to claimed pilot complacency or over confidence. Some even claimed that CAPS was a cover for an otherwise unsafe aeroplane, perhaps driven by the fact that the Cirrus has no type certification without the CAPS because of issues with spin recovery. This seems unfair to the majority of pilots who never take an aircraft anywhere near the edge of the flight envelope.

Cirrus, together with the Cirrus Owners and Pilots Association determined that the high fatality rate was not because pilots were using the CAPS system, but exactly the opposite, that they were not using it when they should.

In response, a very comprehensive CAPS education program, including an intensive half-day training module that encompassed both ground theory and extensive simulator time was developed. This was strongly promoted to both existing pilots and those doing conversion courses.

Without wanting to understate the quality, depth and professionalism of the program a layperson's summary would be: "If in doubt, don't risk it, pull the chute – immediately!" This program has had a positive effect and dramatically reduced Cirrus fatal accidents to the point that they are now very well below the general aviation average.

Insurance

Having a BRS does *not* lead to lower insurance aircraft premiums. The insurance section of the Aircraft Owners and Pilots Association in the US advises that there is no difference in premiums for two aircraft of the same value where one has a BRS and one doesn't.

Changing minds

Traditionally, being able to land an aircraft with the engine stopped, either internationally as aviatrix Jean Batten used to do at the end of her flights, or unintentionally in case of engine failure, receives much

CIRRUS AIRCRAFT

BALLISTIC RECOVERY SYSTEMS

TOP: The CAPS is configured to lower the aircraft to the surface as level as possible.

ABOVE: The smooth surface of the Cirrus Australis doesn't betray the parachute lines hidden beneath.

RIGHT: A BRS system fitted to an ultralight.

OPPOSITE PAGE: A testing sequence showing the stages of CAPS deployment.

STEVE HITCHEN

A parachute system fitted to the A32 Vixxen demonstrator.

attention when learning to fly or at flight renewal.

Pilots are taught to always look out for a forced landing spot, and then, if something necessitates it, to put the aircraft down on a sixpence. "Fly the aeroplane first" is drummed into most pilots during training.

Undertaking the Cirrus CAPS course, especially post-2011, pilots need to undergo a mindset change, almost a brain transplant. With rare exceptions, in an emergency situation, above 4-500 feet, which may well happen before the aircraft crosses the end of the runway, pilots are taught to deploy the chute immediately.

Once the chute is deployed, mixture, throttle and fuel are moved to zero, the electrics are turned off, the ELT on, and it's "brace for impact", which even in a realistic full motion simulator, is surprisingly soft. After "landing" brakes are applied to prevent being dragged and aircraft evacuation must be upwind.

As part of the training pilots are taught and practice multiple scenarios, multiple times. A take-off briefing is memorised for all flights where pilots call out what they will do: before the CAPS deployment height; between the deployment height and 2000 feet AGL; and above that height. Also important are decision heights when descending from above rather than take-off.

Perhaps the most surprising element is how a total loss of control so quickly results in downwards acceleration of the aircraft and the need to quickly deploy the chute before the maximum (V_{pd}) speed of 133 KIAS. The chute has been successfully deployed at speeds of up to 190 KIAS.

Cirrus says no person has died when the CAPS system was deployed higher than 1000 feet AGL and slower than 200 KIAS.

Conclusion

The author was given very strict instructions from the wise editor not to come to any conclusions in this article about BRS. However, for any pilot who has done the CAPS course it becomes hard not to be a disciple.

On a less personal level, with the dramatic reduction in fatal Cirrus accidents since 2011, the ongoing sales success of Cirrus and Flight Design, the continual emergence of stories by those whose lives have been saved by BRS and the planned inclusion of a BRS in multiple light jets, perhaps the tide has turned.

BRS has been awarded four research awards by NASA to develop lightweight materials that will reduce chute weight by up to 50%. This too will likely speed adoption.

The final contemplation then for pilots to make up their own minds: Given Aircraft A with a BRS, or Aircraft B without a BRS, what would your thoughts be if you were in Aircraft B and one of those unfortunate events described above happened to you?