CIRRUS DESIGN SR 20

CRI n° : B-2

Issue n° : issue 6

Regulation ref. : JAR 23.221

Date : March 2004

Advisory Material/Policy Ref. :

CRI Status : open

Subject : Equivalent of safety for Spin requirement

Next action by : EASA

CRI Closure target :
April 2004

STATEMENT OF ISSUE

The SR20 was designed to inhibit departure from controlled flight. The FAA has found that this enhances stall performance, and together with an airframe parachute, provides safety at least equal to spin requirement of FAR 23.221. The applicant is requesting an identical equivalent safety finding from the JAA.

The paragraphs FAR and JAR 23.221 are in the SRD list (FAR 23.221 includes the spin resistance concept, the JAR 23.221 does not).

DISCUSSION

JAA Position:

As the regulatory basis is different, the Applicant must show that the aeroplane complies with the paragraph **JAR 23.221** or demonstrate that its concept provides an equivalent level of safety to the **JAR 23.221**.

1- It is asked to Cirrus Design and the FAA to provide additional information on the aeroplane stall characteristics and spin behaviour.
2- It is asked to Cirrus Design and the FAA to propose a clear emergency procedure for the spin departure in the AFM.

The JAA validation team will study the material provided for points 1 & 2. After this review, the granting of an exemption to paragraph JAR 23.221 will be considered taking into account :

- the FAA Equivalent Level Of Safety
- the spin recovery qualities of the SR 20 aeroplane (number of necessary turns and loss of height)
- the position of the JAR 23 Study Group on the concept

The revision of this CRI B-2 will be sent to the NFPs for comments.

CIRRUS DESIGN position:

Basis for Equivalent Level of Safety

Enhanced stall characteristics, providing increased resistance to departure from controlled flight, and the Cirrus Airframe Parachute System provide an equivalent level of safety to FAR/JAR 23.221, Spins.

1. Safety Analysis

Cirrus designed the SR20 aircraft between 1994 and 1998. Cirrus initiated the design program with safety as a primary objective. Cirrus was aware of wing design features that could offer significant improvement to low-speed flight characteristics and stall behavior, and therefore increased safety levels. These features included leading edge extensions at the outboard wing sections set at chord incidence angles less than that at the inboard wing sections. Research conducted by NASA LaRC (ref. AIAA Paper 86-9812) indicated that during low-speed flight the modified aircraft retained improved roll control and increased resistance to stall departure in normal and uncoordinated control configurations. The research also indicated that the design features could contribute to an inverse effect on spin recovery once the aircraft has departed.

Cirrus and the FAA conducted an extensive review of safety statistics. The results of this review can be located in the FAA Equivalent Level of Safety finding ACE-96-5, Appendix 1. The research concluded that "only about 0.5% of the total airplanes, or just short of 1% of those prohibited from spinning, were in an environment that would have allowed a recovery." This result is primarily due to many departures from controlled flight being at altitudes too low to recover through the use of control movement. The FAA research showed that "Stall/Inadvertent" was the second largest cause of US Fixed Gear Fatal Accidents (at about 17%), and that when added to the categories of "Stall/Reckless low altitude" (5%), and "controllability"(2%), these types of stall departure accidents together cause more fatal accidents than the largest single cause category. The FAA concluded that in order to break this longstanding statistical pattern of the largest percentage of fixed gear fatal accidents resulting from a lack of controllability in the stall, they would have to think "out of the box" with new technology or compliance approaches. The FAA was willing to do so because the safety benefit potential is great. (ref. FAA Presentation to JAA General Aviation Sub-Certification Sectorial Team, 26 February 2003). Based on this research and conclusions, the FAA supported Cirrus' alternative wing design approach with the understanding that overall safety levels would be improved through the prevention of departures, by way of improved low-speed characteristics and departure resistance, than by meeting the combined requirements of 23.201 and 23.221.

2. Equivalent Level of Safety

The safety analysis concluded that departure resistance could contribute significantly more to improved levels of safety than departure recovery. The FAA defined a significant increase in low-speed control and departure resistance requirements in the ELOS. These requirements deliver increased levels of safety applicable to both low and high altitude maneuvering. The requirements as stated in the ELOS are as follows:

> a. During the stall manoeuvres contained in § 23.201, if an uncontrollable downward pitching does not occur, the pitch control must be held against the stop and controllability must be demonstrated. Using coordinated rudder and aileron control inputs, it must be possible to maintain wings level flight within 15 degrees of bank of level flight without using exceptional skill or alertness. Additionally, it must be possible to roll the airplane from 15 degrees of bank in one direction to 15 degrees of bank in the opposite direction in the stick full aft condition without the use of exceptional skill or alertness.
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> b. If an uncontrollable downward pitching does occur, it must be possible to hold the stick full aft for at least two seconds after the nose pitches downward while maintaining wings level within 15 degrees of bank. At the end of two seconds, standard stall recovery control inputs must produce an immediate return to unstalled flight without any undue tendencies towards spin entry.
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> c. The stall characteristics must not be unduly sensitive to sideslip during abused stall entries. There must be no uncontrollable tendency to spin with small deviations from coordinated flight during the stall and the recovery. The use of aileron and rudder controls must not require a high degree of skill or

alertness. The ailerons must produce correct, unreversed and effective response throughout the stall and recovery.

d. Following an abused control entry stall controllability demonstration, the aircraft must respond immediately and normally without unreversed use of the controls and without exceeding the temporary control forces specified in § 23.143(c) to regain coordinated unstalled flight.

The FAA also determined, as stated in the ELOS, that the probability of high altitude loss of control is very low. In the event that control is lost, the CAPS system provides an effective means to protect the occupants. The departure resistance aspects of the ELOS are primary, but the presence of the CAPS system is an additional risk mitigating feature due to its ability to recover the aircraft in less than 1000 feet.

In its presentation to the JAA Sectorial Team on February 26, 2003, the FAA re-stated its philosophy. The primary focus is to prevent departure from controlled flight / spin entry, through three aspects.

- First, the FAA found that the enhanced stall handling characteristics are based on the intent of the spin resistance requirements.
- Second, the FAA found that the improved departure resistance addresses the real issue driving the accident rate – inadvertent departure from controlled flight – and that this supports the US Department Of Transportation's safety mandate.
- Third, the FAA concluded that the Cirrus wing treatment and handling characteristics are parallel to NASA research.

The FAA's secondary focus of addressing these accidents is the low altitude departure recovery being possible using the CAPS system, The FAA noted that the CAPS system recovers the airplane in the same or less altitude than airplanes in the same class take to recover from the one-turn spin requirement of sec. 23.221. The FAA saw the stall handling characteristics providing the ability to recover from a stall without losing control or entering a spin, and the CAPS system as a second line of defense. (John Colomy, FAA, address to the Sectorial Team on 26 February 2003)

JAA Requested Items

1. Provide additional information on SR20 Stall characteristics and Spin behavior.

Cirrus engaged in an extensive flight test program to investigate the stall characteristics and spin behavior of the Cirrus SR 20, with over 60 spin entries, and the stall and departure preceding the spin entries.

a. Stall Behavior

i. Requirements. See above ELOS text for requirements. After this flight test program, Cirrus continues to believe that the standards set in the ELOS are correct. The stall departure standards set for the SR20 simulate realistic inadvertent stall situations.

ii. Results. The SR20 meets or exceeds the ELOS requirements in all required configurations. See SR20 TIR for detail on stall results in Appendix 2. The Airplane retains roll control throughout the stall. The airplane can be rolled from 15 degrees of bank in one direction to 15 degrees of bank in the other direction with the stick full back with typical pilot skill.

iii. Comments. FAA and JAA test pilots have formally and informally flown the SR20 and agree that the aircraft meets or exceeds the ELOS requirements, is tolerant of slow speed uncoordinated control movements, and provides the pilot with significant time and indications to apply corrections.

b. Spin Behavior

i. Test Matrix. A limited investigation of the SR20 spin behavior has been completed and results are contained in Cirrus Design reports 12419, title, and 15568, title. The incipient spin and recovery characteristics were examined during more than 60 total spin entries covering the following configurations.

Configuration[1] Normal Spins	**Level Entry**	**C.G.**
Clean-Power Off	1 Left & 1 Right	Fwd[2], Mid, Aft
Takeoff-Power Off	1 Left & 1 Right	Fwd
Landing-Power Off	1 Left & 1 Right	Fwd
Clean-Power On	1 Left & 1 Right	Fwd[2]

1. All spins conducted at gross weight.
2. Also evaluated accelerated entries, 30 degree banked turn entries, and effects of ailerons against the spin direction.

ii. Results. The aircraft recovered within one turn in all cases examined. Recovery controls were to reduce power, neutralize ailerons, apply full rudder opposite to spin, and to apply immediate full forward (nose down) pitch control. Altitude loss from spin entry to recovery ranged from 1,200 – 1,800 feet. Detail results can be found in the above referenced reports.

iii. Comments. No spin matrix less than that prescribed in AC23-8A or AC23-15, can determine that all configurations are recoverable. It must be assumed that the SR20 has some unrecoverable characteristics. In the SR20 proper execution of recovery control movements is necessary to affect recovery, and aircraft may become unrecoverable with incorrect control inputs. These spins enabled Cirrus to gain additional understanding of both the stall departure characteristics of the airplane and the necessary spin recovery techniques.

2. Propose a clear emergency AFM Procedure for CAPS use.

a. Current Procedure. The current procedure is in AFM section 3 – Inadvertent Spiral/Spin Entry, for detail see Appendix 3. The procedure for inadvertent spin entry notes that the CAPS system is the only approved and demonstrated method for spin recovery. The current procedure also provides guidance to determine if the aircraft is in a recoverable spiral/incipient spin or is unrecoverable and, therefore, has departed controlled flight if time and altitude permit. The guidance includes a description of potential recovery controls. The procedure requires CAPS activation if the aircraft cannot be recovered.

b. Discussion. Based on the spin testing conducted to date, the Cirrus SR20 has exhibited the requirement for unique and specific recovery controls. A majority of the general aviation pilot population do not receive any spin recovery training whatsoever, and no type-specific training in the SR20 is made available. Some non-US general aviation private pilots receive limited spin recovery basic and recurrency training, and no type-specific training is available. The Cirrus test pilot performing the spin program noted that while all spins entered were recoverable, they required a method of spin recovery that, while not unique in light general aviation airplanes, is different from that of a light trainer airplane in which a pilot is likely to receive spin training. Significant variability in spin recovery training techniques also exists – ranging from merely releasing the elevator control in some light trainers, to movement of the control to neutral, to brisk forward movement to neutral, to brisk foreward movement past neutral, etc.. In the case of the SR20, the proper spin recovery procedure is to briskly move the elevator control to the full down position. This is an unnatural control movement, when the nose of the aircraft may already appear to the pilot to be pointing down sharply. This is also a movement not typically advocated by spin training instructors due to associated discomfort.

The reliability level of a general aviation pilot to properly react in a loss of control condition in any type of airplane is historically low (see the FAA statistics). Cirrus has determined that the probability of the typical general aviation pilot properly applying the SR20 recovery controls to assess if the aircraft has permanently departed controlled flight is likewise low. While a small percentage of Cirrus pilots may be able to successfully recover from an inadvertent spin, Cirrus contends that the far larger portion of pilots would not do so in a surprise departure spin situation. Cirrus has accordingly concluded, as a result of the further extensive flight test conducted pursuant to the JAA Study Group direction in April 2000, that in an inadvertent spin entry, time and altitude is too critical to allow for any pilot reaction except the simple and quick process of reaching for the CAPS handle and activating the system. Cirrus believes it is better to accept some airframe losses through CAPS activation when the airplane could have been flown away following a successful recovery, in order to save the lives of the far larger number of pilots who would not be able to successfully execute a spin recovery.

c. Proposed Procedure. Cirrus has reached strong conclusion that any spin recovery guidance in the AFM distracts pilot from immediately activating CAPS system when the aircraft has departed controlled flight. Cirrus is removing existing references to spin recovery in its current AFM. The clear AFM procedure will be to activate CAPS system in the event that control is lost. The new proposed procedure can be found in Appendix 4.

Position Summary

1. Cirrus and the FAA reviewed accident statistics and concluded that spin recovery characteristics have minor affect on safety levels, while stall/departure characteristics have significant impact.
2. Cirrus achieved excellent low-speed control and departure resistance through wing design features. Cirrus supplemented this safety level with a standard CAPS system.
3. Cirrus proceeded with spin investigation per JAA direction.
4. Cirrus found that recovery techniques are Cirrus SR20 specific, pilot spin recovery proficiency is generally poor, and critical altitude is wasted in recovery attempt.
5. Cirrus concludes that any pilot reaction other than immediate activation of the CAPS system is promoting a lesser safety level.
6. Cirrus is making AFM changes to clarify loss of control response and CAPS deployment procedure.
7. Any AFM/Training directions regarding spin recovery would promote a lesser safety level than CAPS usage. Inclusion of guidance may save some airframes, but increases risk to many.
8. Cirrus requests the JAA to accept this response to the Study Group and compliance to FAA ELOS, with new AFM language, as the basis for compliance to a JAA exemption or Equivalent Level of Safety to 23.221.

FAA position :

The FAA agrees with the Cirrus position and continues to promote the spin resistance concept as more effective in preventing stall/spin accidents. The FAA stands behind its original Equivalent Level of Safety for section 23.221 and commends Cirrus for stepping up to the additional research, development, flight test, and certification work when compared to a traditional spin program. It is our hope that other manufacturers will see the safety merits of this approach to preventing stall/spin accidents and follow Cirrus's lead so that the FAA can begin to see a reduction in this significant cause of fatal accidents.

During the SR20 certification, the FAA participated in the ELOS stall tests certification. The low speed maneuvering handling qualities are excellent as are the stall and post stall handling qualities. Each production aircraft is evaluated during the production flight tests to verify that it meets the ELOS requirements.

JAA Position:

1- The issue of the additional information on the aeroplane stall characteristics and spin behaviour will be discussed during the November 2003 meeting.
3- The new emergency procedure for the spin departure in the AFM is clear and accepted by the JAA team.

JAA Position (December 2003):

The JAA team has drafted a special condition which is in Annex. As the FAA and the Applicant expressed a strong concern with this position, and in respect to the JAA procedure, an JAA adhoc group will discuss this matter.

JAA Position (February 2004):

The JAA adhoc group has discussed the draft SC. In conformity with the EASA procedures, this SC will be submitted to comments.

CONCLUSION

The CRI is open.

Memorandum

U.S. Department of Transportation

Federal Aviation Administration

Subject: **ACTION**: Equivalent Level of Safety to § 23.221; Cirrus Designs SR-20; Finding No. ACE-96-5

Date:

From: Manager, Chicago Aircraft Certification Office, ACE-115C

Reply to Attn. of: L. Foster
ACE-111
(816) 426-5688

To: Manager, Small Airplane Directorate, ACE-100

This memorandum requests your office to review and provide concurrence with the proposed finding of equivalent level of safety to the spin requirements of § 23.221 of 14 CFR Part 23.

BACKGROUND:

The Cirrus SR-20 is a 2,900 pound single-engine, four-place, fixed-gear airplane powered by a 200 hp reciprocating engine. It has a conventional tractor configuration and utilizes composites for the structure. Some unique features of the SR-20 include sidestick controls and a ballistic recovery system based on the General Aviation Recovery Device (GARD) 150 certificated for the Cessna 150/152 series airplane. Cirrus plans to offer the GARD system as standard equipment, meeting special conditions specifically for a TC'd installation. The special conditions for the GARD prior to the SR-20 were for a supplemental safety device and not a primary safety device. Cirrus is incorporating the GARD as a primary safety device and requests the FAA to give them credit for the system by accepting it as a safety device equivalent to § 23.221 Spins.

APPLICABLE REGULATIONS:

Section 23.221 requires that single-engine, normal category airplanes must demonstrate compliance with either the one-turn spin or the spin-resistant requirements. The airplane, for spin compliance, must recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn after the controls have been applied for recovery. This should be demonstrated for all configurations.

APPLICANT POSITION:

The Cirrus SR20 will include a GARD, emergency aircraft recovery parachute system, as a part of its type design. This system provides an Equivalent Level of Safety to 14 CFR Part 23, § 23.221 Spinning.

1. **Level of Safety Baseline:** Section 23.221 provides for a level of safety to the occupants. This establishes a baseline to which other means of achieving this level of safety may be compared. The level of safety attained provides for a "margin of safety" when recovery from a stall is delayed by one turn or three seconds, whichever is longer. The "margin of safety" must be a recovered aircraft within one additional turn. Significant amounts of data exist, which creates the foundation for the baseline, to substantiate the typical altitude loss for similar class aircraft.

2. **Alternate Equivalent Level of Safety:** The inclusion of the parachute recovery system in the original type design provides for an appropriate "safety margin," or equivalent level of safety. In order for the system to deliver this level of safety, the altitude loss for recognition and deployment of the emergency chute must be shown to be less than or equal to the typical altitude loss for a spin. A three-second delay is recommended to simulate the recognition period of this event.

3**. Compliance:**

Baseline Established

a) Compile historical spin data.
b) Examine spin data for similar class aircraft.
c) Determine typical altitude loss for two turn spins, "A" feet.

Parachute System Level of Safety Established

a) Apply control input during stall to initiate spin.
b) Allow three-second delay from initiation.
c) Complete GARD system activation procedures.
d) Allow for full chute inflation.
e) Measure total altitude loss from initial stall, "B" feet.

Compliance Disposition

If "A" is greater than or equal to "B," the GARD system provides an equivalent level of safety to that of the baseline.

The basic plan outlined above provides a rational means for establishing the equivalent level of safety.

FAA POSITION:

The current rule requires that normal category, single-engine airplanes must recover from a one-turn spin in less than one additional turn with no limit to altitude loss. To show equivalent safety, an applicant must show that the action taken provides a level of safety equal to that established by the regulation from which relief is sought. There has been confusion in the past as to what constitutes "equivalent" safety. The confusion is between using the literal "letter" of the rule and the "spirit" of the rule. Not all rules have one-to-one equivalents. Behind each rule there is an intent, the protection envisioned as a result of the rule. Equivalent safety findings must show equivalency, either by a one-to-one equivalent or by meeting that original safety intent of the rule. The spin recovery requirements of § 23.221 were intended to ensure that the pilot had a chance to safely recover the airplane after inadvertently departing controlled flight into a flight regime that is often fatal. These recovery requirements are only effective if the pilot applies the correct anti-spin controls and there is enough altitude to recover.

The GARD system must meet the special conditions associated with this type certificate. The special conditions include requirements to show that serious injury to the occupants is unlikely, including operation during adverse weather conditions. The landing protection provided by the GARD system meeting these special conditions is assumed to generally allow the occupants to walk away, provided the system was activated above the minimum deployment altitude. All discussion concerning the GARD system is based on the special conditions being met.

DISCUSSION:

From 1945 to 1962, all normal category airplanes under 4,000 pounds had to meet the one-turn spin test. Prior to 1945, the requirement was a six-turn spin with recovery in no more than one and one-half additional turns with controls neutral and power off. Amendment 3-7 of CAR 3, in 1962, eliminated the 4,000 pound limit for single-engine airplanes and deleted the spin requirement for multiengine airplanes. The rationale for deleting the spin requirements for twin-engine airplanes was that spin prevention will contribute more toward reducing stall-spin accidents than spin recovery; therefore, the engine-inoperative stall requirements were revised to preclude inadvertent spin tests. No reason was provided for requiring all single-engine airplanes, regardless of weight, to meet the spin requirement.

The requirement to demonstrate spin recovery for the private pilot's license was eliminated in 1949[1]. Since then, the stall/spin accident rate has only improved. However, the overall fatal accident rate in general aviation is basically unchanged over the past 15 years. The 1994 Nall Report on accident trends and factors indicates that over 40 percent of the serious accidents in fixed-gear, single-engine airplanes today begin in maneuvering flight. A stall/spin accident is almost always the end result, except that most airplanes never get to the spin phase before impacting the ground, indicating that this is really a stall problem. These findings suggest that the FAA should consider new approaches to enhance the stall handling characteristics. Half (864 out of 1771) of the fatal accidents studied by the directorate involving spins are in airplanes certificated in the utility or acrobatic categories and approved for multiple turn spins, unlike normal category airplanes, which are prohibited from intentional spins.

Using FAA accident data that went back to 1972, 1,771 "stall/spin" accidents were reviewed. The single-engine airplanes that were studied had to, as a minimum, demonstrate recovery from one-turn spins. By reading each of the remarks sections of the accident report and correlating that with the "phase of flight" field, it was possible to evaluate whether or not the airplane was above or below pattern altitude. An inadvertent departure below pattern altitude is considered unrecoverable; one above pattern altitude,

[1] Private pilot's license only requires that the pilot know the spin recovery procedure. No requirement to even do a spin. With the exception of flight instructor, all subsequent pilot ratings don't even require full stalls, only recovery from incipient stalls.

especially at a safe training altitude, was considered to be recoverable. Out of the 1,771 accidents, only 7% (130) were above pattern altitude. Almost half of those 7% were in airplanes that had undergone extensive spin testing for certification. These 3.3% were approved for multiple turn spins. The remaining 3.7% of the airplanes that crashed were only tested for recovery from one turn spins and were certificated as prohibited from intentional spins. Further evaluation revealed that, out of the 3.7% of the airplanes prohibited from spinning, 87% of the those involved weather. So, only about 0.5% of the total airplanes, or just short of 1% of those prohibited from spinning (9 airplanes in this study), were in an environment that would have allowed a recovery.

The FAA believes that the GARD system will increase the safety for the low altitude departure cases. The FAA did consider the case that in an inadvertent stall/spin at altitude, pilots may try to recover the airplane and crash before they use the GARD system due to a fear of damaging the airplane. The FAA acknowledges that an unknown percentage of pilots will probably try to recover the airplane and will crash. This is the same scenario as the military experiences with ejection seats. The majority of crews use the ejection seats and survive, but a minority of crews stay with the airplane, passing up the opportunity to safely eject.

The number of inadvertent departures that occur annually are unknown. The FAA could speculate that it is a low number because if the number of inadvertent departures were large, the FAA would be aware of them. One possible explanation that this reported rate is low is because aircraft are required to meet a spin recovery standard. The FAA also sees merit in exploring the post stall flight regime; however, based on a typical flight profile, the opportunity for stall above pattern altitude is very low except for training. Therefore, the FAA believes this high altitude risk of departure is low considering the possible benefits of addressing the low altitude environment, where the risk of stall is much higher.

Our current stall handling characteristic tests were intended to provide a margin of safety from inadvertent stall that results in departing controlled flight. It is clear when reviewing the safety record that the requirement for compliance means does not necessarily assure this margin. The FAA, therefore, is concerned that an applicant installing the GARD system would not conduct any spin or spin entry evaluation and could have little margin of safety from inadvertent departure (using current stall handling characteristic requirements). The result leaves the pilot with little margin from a departure and forces the use of the GARD system. There is unanimous agreement within the FAA that the GARD system was never intended as a routine solution to inadvertent spins. It was intended as device of "last resort" should the airplane ever depart controlled flight. Serious damage to the airplane in an off-field landing is not the same as returning to home base with an undamaged airplane.

The exposure to the hazard of an inadvertent stall/spin at a cruising altitude is very low. Conversely, every flight requires a takeoff and landing. Exposure to the hazard of low altitude inadvertent stall is high. Stall/spin accidents occur at pattern altitude or lower because that is where the airplane is flying at speeds near stall. In all scenarios (see chart - attachment) at low altitude, the GARD system has the potential to provide an equal or greater level of safety than that offered by the spin recovery requirements. In most cases, the airplane will impact the ground before completing one revolution, so spin recovery is not even an issue. Installation of the GARD system creates incentives and encourages new approaches to compliance that may improve the safety over that offered by the existing light airplane fleet.

Based on the foregoing, the FAA will grant relief from the spin requirements of § 23.221. In doing so, the FAA must also consider all possible applications of any position taken, so that policy positions are consistently applied and available to all manufacturers. Even though the FAA believes that the GARD system should increase the level of protection offered for inadvertent stalls at low altitude, the FAA has a responsibility to be conservative concerning the high altitude departures. Therefore, to show equivalent safety from spin recovery, in addition to the GARD recovery system, the FAA believes that the margin of

protection from spin entry provided by the stall handling characteristics requirements must be increased. The current stall requirements, §§ 23.201 and 23.203, are demonstrated in a coordinated stall.

The intention for increasing the margin of protection is to provide a reasonable level of confidence that an unintentional, uncoordinated stall will not result in a spin entry. The FAA's intent is to increase the margin of safety around the stall. This approach should not be confused with the "spin resistance" provision in § 23.221, which requires the airplane to fly through "extreme" cross-controlled maneuvers. Though the stall handling concepts are the same, the spin resistance requirements are very conservative, show equivalency to spins.

COMPENSATING FEATURES:

The FAA finds that the GARD system offers the same level of safety as provided for in § 23.221 spins, provided the following conditions are met.

1. The GARD system must recover the airplane in the same or less altitude than airplanes that are in the same class typically take to recover from the one-turn spin requirement of § 23.221.

2. The GARD system must not be deployed before one turn or three seconds, whichever takes longer, after spin initiation.

3. The Cirrus Model SR-20 must demonstrate enhanced stall characteristics that parallel the following guidelines:

    a. During the stall maneuvers contained in § 23.201, if an uncontrollable downward pitching does not occur, the pitch control must be held against the stop and controllability must be demonstrated. Using coordinated rudder and aileron control inputs, it must be possible to maintain wings level flight within 15 degrees of bank of level flight without using exceptional skill or alertness. Additionally, it must be possible to roll the airplane from 15 degrees of bank in one direction to 15 degrees of bank in the opposite direction in the stick full aft condition without the use of exceptional skill or alertness.

    b. If an uncontrollable downward pitching does occur, it must be possible to hold the stick full aft for at least two seconds after the nose pitches downward while maintaining wings level within 15 degrees of bank. At the end of two seconds, standard stall recovery control inputs must produce an immediate return to unstalled flight without any undue tendencies towards spin entry.

    c. The stall characteristics must not be unduly sensitive to sideslip during abused stall entries. There must be no uncontrollable tendency to spin with small deviations from coordinated flight during the stall and the recovery. The use of aileron and rudder controls must not require a high degree of skill or alertness. The ailerons must produce correct, unreversed and effective response throughout the stall and recovery.

    d. Following an abused control entry stall controllability demonstration, the aircraft must respond immediately and normally without unreversed use of the controls and without exceeding the temporary control forces specified in § 23.143(c) to regain coordinated unstalled flight.

4. An additional limitation must be added to § 23.1583 to require GARD deployment if the airplane departs controlled flight.

5. The GARD must meet the special conditions prescribed for the Cirrus Model SR-20 airplane.

Concurred by:

Manager, Chicago Aircraft Certification Office, ACE-115C	Date
Manager, Standards Office, ACE-110	Date
Manager, Small Airplane Directorate, Aircraft Certification Service, ACE-100	Date

Attachment 1

Figure 1.

Inadvertent Case	Current Spin Req.	GARD Equipped
Training (at altitude)	**recovers**	**recovers**
Takeoff - gust,stall	won't recover	won't recover
Takeoff - crosswind turn	won't recover	may recover
Takeoff - excessive nose-up trim - stall	won't recover	won't recover
turning downwind to base	may recover	**recovers**
turning base to final	won't recover	may recover
landing - gust, stall	won't recover	won't recover
maneuvering - high	**recovers**	**recovers**
maneuvering - low	won't recover	may recover
IFR - disoriented - departs	won't recover	**recovers**
Go around - excessive nose-up trim - stall	won't recover	may recover

Note: A recovery for the GARD system refers to occupant protection only. The airplane will be damaged or destroyed anytime the GARD system is used.

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Appendix 2 – SR20 TIR Stall Data

Appendix 3 – SR20 AFM Section 3

Inadvertent Spin Entry

The SR22 is not approved for spins, and has not been tested or certified for spin recovery characteristics. The only approved and demonstrated method of spin recovery is activation of the Cirrus Airframe Parachute System (See CAPS Deployment, this section). Because of this, if the aircraft "departs controlled flight," the CAPS must be deployed.

While the stall characteristics of the SR22 make accidental entry into a spin extremely unlikely, it is possible. Spin entry can be avoided by using good airmanship: coordinated use of controls in turns, proper airspeed control following the recommendations of this Handbook, and never abusing the flight controls with accelerated inputs when close to the stall (see Stalls, Section 4).

If, at the stall, the controls are misapplied and abused accelerated inputs are made to the elevator, rudder and/or ailerons, an abrupt wing drop may be felt and a spiral or spin may be entered. In some cases it may be difficult to determine if the aircraft has entered a spiral or the beginning of a spin.

If time and altitude permit, the following procedures may be used to determine whether the aircraft is in a recoverable spiral/incipient spin or is unrecoverable and, therefore, has departed controlled flight.

■ WARNING ■

■ In all cases, if the aircraft enters an unusual attitude from which recovery is not expected before ground impact, **immediate** deployment of the CAPS is required.

■ The minimum certified altitude loss for a CAPS deployment from a one-turn spin is 920 feet. Activation at higher altitudes provides enhanced safety margins for parachute recoveries. Do not waste time and altitude trying to recover from a spiral/spin before activating CAPS.

1. Power Lever ..... IDLE
2. Control Yoke ..... Neutral
3. Rudder ..... Briskly Apply Opposite Yaw/Spin Direction

■ **Note** ■

If disorientation precludes visual determination of the direction of rotation, refer to the symbolic airplane in the turn coordinator. If the spiral/spin was entered while applying rudder, then the opposite rudder should be applied for recovery.

4. Just after the rudder reaches the stop, move the yoke briskly forward far enough to break the stall. Full down elevator may be required. Hold these control inputs until rotation stops. Premature relaxation of control inputs may prolong the recovery.
5. After rotation stops, neutralize rudder, and make a smooth recovery from the resulting dive. Add power as required. Be prepared for possible engine power loss if rotation causes fuel starvation.

If the above steps do not recover the aircraft and/or it has been determined that the aircraft has departed controlled flight:

6. CAPS ..... Activate

Appendix 4 – SR20 AFM Section 3 (Proposed)

Inadvertent Spin Entry

The SR22 is not approved for spins, and has not been tested or certified for spin recovery characteristics. The only approved and demonstrated method of spin recovery is activation of the Cirrus Airframe Parachute System (See CAPS Deployment, this section). Because of this, if the aircraft "departs controlled flight," the CAPS must be deployed.

While the stall characteristics of the SR22 make accidental entry into a spin extremely unlikely, it is possible. Spin entry can be avoided by using good airmanship: coordinated use of controls in turns, proper airspeed control following the recommendations of this Handbook, and never abusing the flight controls with accelerated inputs when close to the stall (see Stalls, Section 4).

If, at the stall, the controls are misapplied and abused accelerated inputs are made to the elevator, rudder and/or ailerons, an abrupt wing drop may be felt and a spiral or spin may be entered. In some cases it may be difficult to determine if the aircraft has entered a spiral or the beginning of a spin.

■ WARNING ■

■ In all cases, if the aircraft enters an unusual attitude from which recovery is not expected before ground impact, **immediate** deployment of the CAPS is required.

■ The minimum certified altitude loss for a CAPS deployment from a one-turn spin is 920 feet. Activation at higher altitudes provides enhanced safety margins for parachute recoveries. Do not waste time and altitude trying to recover from a spiral/spin before activating CAPS.

1. CAPS..... Activate per procedures in AFM section 3 – CAPS Deployment

Appendix 5 – JAA proposed special condition

JAA Draft special condition

for the Cirrus SR 20 Validation of the FAA Certification

Edition 3, 29 January 2004

1- Spinning

The aeroplane must comply with the intent of the JAR 23.221. An equivalent level of safety to JAR 23.221 must be shown by a combination of enhanced stall characteristics, additional design features and appropriate demonstration of spins. The aircraft must exhibit enhanced stall characteristics showing it to be reluctant to enter a spin during normal flight operations and has additional feature that ensures survivability for the occupants.

2- Enhanced stall

Enhanced stall behaviour has to be demonstrated which means conformity to the following items.

a. During the stall manoeuvers contained in 23.201, if an uncontrollable downward pitch does not occur, the pitch control must be held against the stop and controlability must be demonstrated….roll from 15° bank to 15° bank in the other direction in the stick full aft position.

b. If a uncontrollable downward pitch occurs, stick full aft for at least 2 seconds after the nose pitches while maintaining wings level whithin 15° bank. At the end of the 2 seconds, standard stall recoverey control inputs must produce an immediate return to unstalled flight without any tendency towards spin entry.

c. Stall from 1.5 Vs1 maintaining a stabilised slip. The slip angle must be equivalent to the value of a landing with an appropriate sideslip angle (typically between 0.1 and 0.2 V_{S0} crosswind component). The roll must be controlled with the ailerons. The stabilised slip must be maintained at constant bank angle until stall break. During the stall, the bank angle must not exceed 60°.

d. Following an abused stall entry controllability demonstration, the aircraft must respond immediately and normally without unreversed use of the controls and without exceeding the temporary control forces specified in 23.143 (c) to regain coordinated unstalled flight.

3- Airframe parachute system

1. The parachute must be fully deployed and a stablized descent rate established in the same or less altitude than airplanes that are in the same class typically take to recover from the one-turn spin requirement of 23.221.

2. The GARD system must not be deployed before one turn or 3 seconds, whichever takes longer, after spin initiation.

4- Emergency procedure

A clear emergency procedure has` to be written in the AFM which would be one of the following ;

A- In case of a spin, deploy the parachute.
B- In case of a spin under (altitude to be determine), pull the handle
In case of a spin above (altitude to be determine), apply the normal spin recovery. In case of no result after 5 seconds, pull the handle.

Appendix 6 – FAA letter

Appendix 7 – Cirrus Design letter