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COMISIÓN DE
INVESTIGACIÓN
DE ACCIDENTES
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AVIACIÓN CIVIL

Report
ULM A–016/2016

Accident involving a RANS S6 Coyote II aircraft, registration EC-YDQ, in the vicinity of the “Los Garranchos” airfield (San Javier - Murcia, Spain) on 15 July 2016

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Foreword

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1., 4. and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

Contents

Abbreviations

AESA	Spanish National Aviation Safety and Security Agency
AMC	Acceptable Means of Compliance
DGAC	Spanish Civil Aviation General Directorate
EASA	European Aviation Safety Agency
EW	Empty Weight
FCO	Fast Cook Off- simulation of a fast spreading fire
Ft	Feet
GEDEX	Explosives Unit
GM	Guidance Material
h	Hours
ICAO	International Civil Aviation Organization
Km	Kilometer
Km/h	Kilometers per hour
Kg	Kilogrames
Kt	Knots
L	Liters
LEMT	Casarrubios del Monte aerodrome (Spain)
m	Meters
MAF	Fixed-wing multi-axis
MTOW	Maximum Take Off Weight
N	North
N/A	Not applicable
S/N	Serial Number
SCO	Slow Cook Off- simulation of a fire nearby
SERA	Standardised European Rules for the Air
SIA	Safety Investigation Authority of Finland
STC	Suplementary Type Certificate
TC	Type Certificate
TULM	Powered ultralight license
UTC	Coordinated Universal Time
W	West

Sinopsis

Owner and Operator:	Private
Aircraft:	RANS S6 COYOTE II, EC-YDQ
Date and time of accident:	Friday, 15 July 2016 at 20:28 local time[1]
Site of accident:	Vicinity of "Los Garranchos" Airfield (San Javier - Murcia, Spain)
Persons onboard:	1, killed
Type of flight:	General aviation - Private
Date of approval:	27 September 2017

Summary of the accident:

The pilot was flying a second traffic circuit of the "Los Garranchos" airfield, in the municipality of San Javier (Murcia). Based on information provided by eyewitnesses, during the final phase of the circuit the engine misfired and seemed to stop. The aircraft pitched up and veered to its right, vertically impacting the terrain. The pilot was killed as a result of the impact. The aircraft was outfitted with a ballistic parachute. While this parachute was being deactivated by specialized personnel, a fire broke out that affected the aircraft.

The investigation concluded that the accident occurred due to a loss of control of the aircraft after the downwind leg of the airfield circuit. No signs were found that the aircraft and/or its components malfunctioned, although it could not be ruled out that a drop in power at the most critical point in the circuit surprised the pilot, who did not have experience on the aircraft.

The following factors contributed to the accident:

- the wind conditions that day at the airfield, with moderate wings and strong gusts that could have affected the aircraft's behavior at the most critical point in the circuit if the engine failed,

[1] All times in this report are local unless otherwise specified. To obtain UTC time, subtract 2 hours from local time.

- the pilot's lack of experience on this aircraft type, which was less powerful and had an opposite direction of propeller rotation than his usual aircraft and
- the fact that the pilot had been tuning up the engine before making the first flight with the aircraft, which might have contributed to a possible engine failure.

The investigation also conducted an analysis on the use of ballistic parachutes on aircraft and the lack of knowledge that emergency personnel (firefighting, rescue, etc.) have regarding this system. Several safety recommendations are issued in this regard on the need to warn, inform and train said personnel in order to avoid an inadvertent ignition of the system, which could compromise the physical integrity of nearby individuals in the event of an aircraft accident or incident in which the parachute does not deploy.

1. FACTUAL INFORMATION

1.1. History of the flight

According to the statement from the flight manager at the Mar Menor Aeroclub (sited in "Los Garranchos" airfield), the pilot had purchased the aircraft around May and had taken it on a truck to the facilities of the flying club at the "Los Garranchos" airfield, where he had been assembling and inspecting the aircraft. According to various accounts, his first flight with the aircraft had been on the day of the accident. Apparently, he had earlier asked the flight manager at the Ontur aerodrome to test the aircraft. When the taxied the aircraft around the airfield, he said the engine did not sound right and recommended to the owner to have a mechanic inspect it. It is not known if a qualified mechanic ever conducted said inspection, but the pilot had noted that one of the carburetor floats was somewhat degraded by a crack. On the day of the accident, the flight manager at Ontur was on vacation in the area and upon finding out, went to the site. As a precautionary measure he informed the CIAIAC that he had locked the ballistic parachute by attacking a wire on the handle to act as the safety pin, which was lost among the wreckage.

On the day of the accident there was nobody in the airfield. The Civil Guard contacted the flight manager to inform him of the accident. Upon his arrival, there were two eyewitnesses helping the pilot. One of the passersby told him that the aircraft's engine had stopped and the aircraft was moving erratically.

Figure 1. Aircraft after the accident

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	1		1	
Serious				
Minor				N/A
None				N/A
TOTAL	**1**		**1**	

1.3. Damage to aircraft

The aircraft was seriously damaged. As a result of the efforts made by Murcia GEDEX[2] personnel to deactivate the ballistic parachute, the aircraft caught fire and was destroyed.

Figure 2. Aircraft after the accident before GEDEX personnel took any actions

[2] GEDEX- Explosives Unit.

1.4. Other damage

There was no damage beyond that caused to the aircraft.

1.5. Personnel information

The pilot, a 50-year old Spanish national, had had an ultralight (TULM[3]) license since 2013 and a fixed-wing multi axis (MAF) rating, both valid until 30 September 2017. He had a class-2 medical certificate that was valid until 15 October 2016. Based on information provided by the flying club where the used to fly, he had about 35 h of experience at that airfield, plus the hours flown while getting his license (15-20 h approximately) and the hours flown at other airfields. With this information, and lacking a record of his flight hours logged, it is estimated that he had a total of 70 flight hours. His experience at the airfield was on another aircraft type, a SKY RANGER, equipped with a tricycle landing gear and a more powerful (4-stroke) engine than that of the accident aircraft and whose propeller turned clockwise.

1.6. Aircraft information

1.6.1. General information

The amateur-built RANS S6 COYOTE II ultralight, with a tricycle landing gear, registration EC-YDQ and serial number (S/N) 58/91, was manufactured in 1991. According to information in AESA's registration registry, its maximum takeoff weight (MTOW) was 400 kg and its empty weight (EW) was 197 kg. It had a Rotax 582 two-stroke engine, whose propeller turned counterclockwise.

It was not able to access the aircraft's original documentation. Copies were available of the Registration Certificate and the Insurance Certificate, both of which were valid. The copy of the Private-Normal category of the Restricted Certificate of Airworthiness was valid until 12/02/2014, though it has probably been renewed since otherwise, the Insurance Certificate would not be up to date and the change of owner recorded on the Registration Certificate, which took place in June 2016, also would not have occurred. According to information from airfield officials, the accident aircraft had been at that airfield for one month. Prior to that, as per its documentation, the aircraft had been based at the Casarrubios aerodrome (LEMT) and at the Brunete airfield (Madrid). According to the Hobbs meter, the aircraft had 778:4 hours of use. The aircraft was equipped with a ballistic parachute (see Section 1.18.4 Information on the ballistic parachute).

[3] TULM Title of Ultralight Motorised Aircraft – ULM pilot (as per license).

1.6.2. Maintenance information

It was not possible to have access to the aircraft's maintenance information, and they were unable to determine for sure if any work had been done on the engine, although it seems that the pilot himself had been tuning its performance on the day of the accident. According to information from eyewitnesses (see Section 1.18.2 Account from eyewitness 2), the pilot had stated that "*the carburetor was almost to his liking*".

1.6.3. Fuel system information.

The gas tanks are installed at the root of each wing. Both tanks feed an auxiliary (supply) metal tank with a two-liter capacity that is located vertically behind the cockpit seats. There is a stopcock between each wingroot tank and the supply tank.

1.6.4. Information from the User Manual and Maintenance Manual

According to information contained in User Manual, in the section on Operations with the RANS S-6ES Coyote, it states that "the Coyote II behaves like a conventional airplane, with the exception that it loses speed more quickly when power is reduced". The Manual warns that if the airplane stalls, rudder may have to be applied to keep the wings level due to engine torque. It should be noted that on this aircraft, the propeller turns[4] , meaning that the left rudder pedal would have to be applied. The User Manual addresses this topic explicitly for takeoff, stating that on takeoffs, the pilot should start applying some left rudder in order to counteract the engine torque.

It also states that: "*A prolonged mode at high power and low velocity must be avoided. This flight mode produces an airflow of violent and turbulent nature over the tail, with associated "tail blasts". This can be felt as a shake in the lever. It is a warning of an imminent stall and thus the pilot must reduce the angle of attack and increase speed.*"

The User Manual also makes reference to the reasons for the loss of power, warning of the possibility of this occurring if a spark plug is dirty or worn, or if the air filter is clogged. The Manual also includes the same WARNING as in the engine manual (ROTAX 582): "*The engine in your Coyote II, by its design, is subject to sudden stoppage! Engine stoppage can result in crash landings. Such crash landings can lead to serious bodily injury or death. An aircraft equipped with this engine never flies in places, speeds, altitudes or circumstances that do not allow a safe landing without engine, in case of an engine failure.*

[4]Counterclockwise, as seen from the cockpit.

"Never fly an airplane equipped with that engine in places, speeds, altitudes or circumstances that do not allow performing a safe landing without engine, during an engine failure.

This is a non-certified aviation engine. It has never passed any safety or durability test, and it is not in accordance with the aviation standards. Its only use is for ULM and amateur-built airplanes, whose application does not compromise safety.

The user takes the risk inherent to its use and accepts, when running it, the possibility of a sudden stoppage".

1.7. Meteorological information

The weather information provided by Spain's national weather service was from the automated station in San Javier, based on which, in concert with satellite and radar images and adverse phenomena advisories, the most likely conditions were as follows: moderate winds (16 km/h (8.6 kt) from the east, gusting to approximately 22 km/h (11.89 kt), clear skies with good visibility on the surface, a temperature of 24° C and relative humidity of 70%. There was no significant precipitation or adverse phenomena advisories.

The information on the aerodrome's website indicated that the wind speed could have been 28 km/h from the east.

1.8. Aids to navigation

Aids to navigation were not used.

1.9. Communications

There were no communications in the vicinity of the airfield.

1.10. Aerodrome information

According to official AESA information, the "Aeroclub Mar Menor" ULM school operates out of this airfield. Based on information found online, the Los Garranchos-San Javier airfield is located in the municipality of San Javier (Murcia) along the San Javier-Santomera highway, 9 km away from San Javier, at coordinates 40° 14' 06'' N, 04° 01' 53'' W and an elevation of 210 ft. It has one 500-m long, 15-m wide asphalt runway in a 06/24 orientation. The runway used for takeoff on the day of the accident was 06. The aerodrome circuit is to the north (see Appendix 1). Morning flights on weekdays are prohibited. Flights are allowed throughout the day on weekends and holidays.

1.11. Flight recorders

The aircraft was not equipped with flight recorders, nor was it required to.

1.12. Wreckage and impact information

The aircraft was found in the vertical position with the nose touching the ground and the tail in the air in a nose-down attitude. It was at coordinates 37° 50′ 41.33″ N and 0° 52′ 54.95″ W and facing 280° (opposite heading to the flight path it was taking to reach the runway, *see Photograph 1 and Appendix 1*). The main wreckage was confined to a small area. A few centimeters away were wooden fragments from the propeller. The inside of the cockpit was crushed and the control panel broken.

All of the control surfaces were in good condition. The cables and control linkages were visible, provided continuity and moved freely. The flaps were not deployed and the right aileron was deflected upward, though it could have been moved into this position by the impact or when the pilot attempted to exit the aircraft.

The cloth covering the wings was not torn. The fuel tank in the left wing was empty and there were no signs that any fuel had spilled on the ground. The right tank did have fuel. The stopcocks between the two tanks and the common supply tank located behind the seats were open. The supply tank had fuel.

An inspection of the engine did not reveal any loose fittings, bolts or hoses. Apparently the fuel from the supply tank was reaching the engine, though it was not possible to check for a clogged filter or some other component in bad condition.

The aircraft had a ballistic parachute that had not been deployed. The activation handle has been secured by the flight manager from the Ontur aerodrome with a wire acting as the safety pin. Subsequently, the Murcia GEDEX personnel decision to carry out a controlled explosion of the parachute caused a fire that burned the aircraft.

1.13. Medical and pathological information

A test conducted to check for toxicological substances was negative.

1.14. Fire

There was no fire after the accident. Subsequently, GEDEX personnel, in response to the presence of a ballistic parachute, decided to carry out a controlled explosion, which resulted in the aircraft catching fire.

1.15. Survival aspects

The pilot was outside, on the right side of the aircraft, without the safety harness, which was not broken. According to eyewitnesses who reported to the crash site, the pilot probably released the harness to exit the aircraft. The emergency personnel who responded to the scene were unsuccessful in their efforts to resuscitate the pilot.

1.16. Tests and research

N/A.

1.17. Organizational and management information

N/A.

1.18. Additional information

1.18.1. Account from the flight manager of the Mar Menor Aeroclub at the "Los Garranchos" airfield

The flight manager at the "Los Garrachos" airfield reported to the accident site and was present during the field inspection. He had known the pilot since 2003, when he went to the aerodrome to get his ultralight pilot license. According to his account, the pilot had some 55 flight hours logged through the middle of 2015, though he probably had more, since he thinks the pilot would have flown a few hours at the aerodrome of Los Martínez del Puerto. The flight manager reported that the pilot bought the ultralight in mid-May, and requested his permission to keep it in a hangar at the airfield. In his opinion, the aircraft was in good condition, but that type of aircraft has a two-stroke engine, which he thought had a lot of accidents since due to their configuration an experienced pilot is required to solve any problems that come up in flight. A few months prior the pilot had told him that he was planning to buy that ULM, and the manager recommended not to do it because he thought it was a problematic aircraft. Despite this, the pilot had decided to buy it, so the manager recommended that he invest in an engine change and buy a more powerful four-stroke engine.

The flight manager reported that there were no mechanics at the airfield to perform the maintenance of the aircraft. Each owner carried out the maintenance and repair tasks on their own aircraft. In this particular case, the pilot performed his own maintenance and a relative from him, who was a motorcycle mechanic, apparently could have carried out some repairs or engine tune-up.

The flight manager also reported that the day of the accident was probably the pilot's first time flying the accident aircraft because he had been tuning it up for a few days and testing it on the runway to check the operation of the engine.

1.18.2. Account from eyewitness 1

This eyewitness reported that he was driving on the highway toward San Javier (see Appendix 1). Some 800 m earlier, he had seen the aircraft take off, fly over the highway and turn right. This eyewitness, who had a knowledge of aviation, stated that "he noticed it because the aircraft as moving erratically, turning with the rudder and the aircraft was tilting down with the aileron. It then pitched down and did a sort of corkscrew". The terrain obscured the runway, but he thought that "with a maneuver like that (like a spin) that the aircraft had crashed". He immediately proceeded to the crash site, where he saw the aircraft oriented away from the runway to which it was supposedly heading. He tried to help the pilot, who was outside the aircraft in a semi-conscious state and without his harness on, which he assumed the pilot had taken off. As an aside, he noticed that the pilot's hands were dirty from grease or soot. According to his account, the aerodrome chief, who had also gone to the accident site, said that the pilot had told him that "the carburetor was almost to his liking".

1.18.3. Account from eyewitness 2

This eyewitness was in a truck on the access road to the greenhouses. He did not actually see the aircraft fall. At the accident site there was an eyewitness on a tractor who was making a telephone call, and eyewitness 1 was helping the pilot. He saw the aircraft's battery 1 meter away from the aircraft, and there was what seemed to be a vent hose on the tank leaking fuel, which eyewitness 1 plugged. The pilot was not wearing his seatbelt and he was semi-conscious. Judging by his position with respect to the aircraft, he thought he would have been able to release it himself. He also noticed that the pilot's hands had grease stains.

1.18.4. Information on the ballistic parachute

The accident aircraft was equipped with a ballistic parachute. The model could not be ascertained since after the GEDEX personnel manipulated the system, the aircraft caught fire, and there was no record of the system's installation in the documents provided to investigators. After the accident, the handle used to activate the system had been lockwired by the airfield manager, since the safety pin, which was probably among the aircraft wreckage, could not be located.

The full system generally comprises several main elements:

- Activation handle
- Activation cable and housing
- Igniter
- Rocket/engine
- Parachute and its container

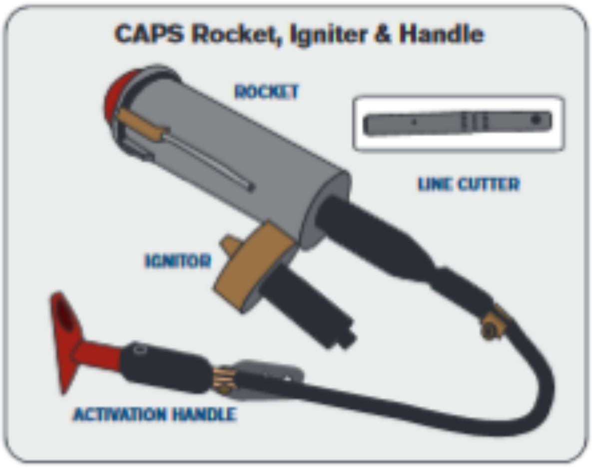

Figure 3. Activation components for the ballistic parachute system

The purpose of this system is so that in the event of an emergency (engine failure, pilot incapacitation, mid-air collision, structural failure, loss of control, etc.), the rocket ignites, which deploys the parachute. This allows the aircraft to fall slowly to the ground at a descent rate that ensures the survival of its occupants. Before the flight, the pilot has to remove the safety pin on the activation handle (situated in an accessible location in the cockpit). Then, if the need arises to use the system during flight, the pilot can pull on the handle to ignite the rocket that deploys the parachute.

More recent models also feature an electronic deployment, supplied by the aircraft's battery, and as a result disconnecting the battery in these cases is crucial.

The use of this system has become widespread in recent years among users of ULMs and amateur-built aircraft, even though there is no legislation regarding its installation and maintenance. For some time now, this Commission has been encountering several cases of accident aircraft that were equipped with this system, a fact that no one knew except the owner, and in the best of cases the acquaintances of the owner in the airfields where the owner flew.

Although this system was not used in this specific accident, a safety problem did occur after the fact in this particular case when the Murcia GEDEX team, while attempting to trigger a controlled ignition of the system, set the aircraft on fire.

This isolated incident, as well as several more cases investigated by the Commission, leads to the concern, first of all, about the generalized lack of knowledge on the existence of this system on accident aircraft, and second of all, with about to proceed if such a situation arises.

In the event of an accident or incident involving an aircraft with this system, there are various teams and individuals who report to the site and who expose themselves to the potential risk of unwittingly igniting the ballistic parachute. These are rescue, medical and firefighting personnel, accident investigators and even eyewitnesses or airfield/aerodrome personnel. In the best of cases, people from the airfield community will know that the aircraft is equipped with a ballistic parachute and will take steps to lock the activation handle by using its safety pin or, failing that, a suitable alternative. However, any movement or change to the structure of an accident aircraft, whether to rescue the victims or to access them, could unwittingly move the cable along its path to the igniter without the need to pull on the handle directly. If there is a fire, the igniter could also be triggered involuntarily, with the ensuing danger this would pose to any personnel near the aircraft.

In summary, there are two fundamental problems:

- How to identify an aircraft that has this system installed, and
- What steps to take if it does.

In point SERA.4005 in section 4005 of the SERA[5] regulation, "Contents of a Flight Plan", the EASA specifies the following:

a) A flight plan shall comprise information regarding such of the following items as are considered relevant by the competent authority:

1) Aircraft identification;

[5] SERA- Standardised European Rules of the Air.

2) Flight rules and type of flight;
3) Number and type(s) of aircraft and wake turbulence category;
4) Equipment;
5) Departure aerodrome or operating site;
6) Estimated off-block time;
7) Cruising speed(s);
8) Cruising level(s);
9) Route to be followed;
10) Destination aerodrome or operating site and total estimated elapsed time;
11) Alternate aerodrome(s) or operating site(s);
12) Fuel endurance;
13) Total number of persons on board;
14) Emergency and survival equipment;
15) Other information.

The ICAO, in its Doc. 9756 Manual of Aircraft Accident and Incident Investigation (*Part I - Organization and Planning*) states the following in the paragraph 5.4.5, "Hazards posed by aircraft wreckage": *Recent safety equipment. Other safety equipment is being introduced into civil aircraft, for example, rocket-deployed emergency parachute systems and airbag restraint systems are being installed across a range of aircraft. Often these systems are not clearly marked and may not be marked at all. The armed and unfired rocket of a rocket-deployed recovery parachute system may pose a potential hazard to investigators and rescue personnel.*

Along these same lines, the Part III-Investigation includes in the paragraph 13.16.4 the following "*An armed and undeployed rocket-deployed emergency parachute system presents a potentially serious safety risk to personnel attending the site of an accident. There is also inconsistent identification and marking of the hazards posed by the rocket and the associated equipment on the external surfaces of the aircraft. Any failure to correctly identify the hazard posed by the rocket at an accident site could result in serious injury or death*".

Already in its Circular 315, Hazards at Aircraft Accident Sites, the ICAO stated the following: "*3.3.5. Recent safety equipment. Other safety equipment is being introduced into civil aircraft, for example, rocket-deployed emergency parachute systems and airbag restraint systems are being installed across a range of aircraft. Often these systems are not clearly marked and may not be marked at all. The armed and unfired rocket of a rocket-deployed recovery parachute system may pose a potential hazard to investigators and rescue personnel*".

"3.3.6 Pyrotechnics and explosives. Most commercial and many private aircraft carry custom-built explosive charges to initiate escape slides, parachutes, fire extinguishers, cable cutters, flotation gear, deployable emergency locator transmitters, etc. Whilst the activation of these charges may pose only a small direct risk to personnel, the unexpected initiation of the systems that they operate may present a more significant risk. Pyrotechnics are carried by a variety of aircraft and therefore may be discovered amongst the aircraft wreckage. They sometimes sustain impact damage and, as a result, pose an increased risk of initiation.[…]. In the early stages of the crash investigation, perhaps at the reporting phase, co-ordinating personnel should seek information about any pyrotechnics or explosives known or thought to be on board the crashed aircraft and the information passed to the Investigator-in-charge. These hazards also support the need for adequate police resources to restrict the public and media from access to the accident site for their own protection."

There are no further instructions nor guidance on how to identify this type of device except for the paragraph 13.16 "Rocket-deployed emergency parachute system" from ICAO Doc 9756 Manual of Aircraft Accident and Incident Investigation (*Part III- Investigation*) where some examples of equipped aircrafts are included.

While investigating and gathering information from the manufacturers of these ballistic parachute systems to include in this report, we found that there were manufacturers of these devices (BRS[6]), and even aircraft manufacturers (Cirrus[7]), that had issued guidelines and information intended for users and emergency personnel, as well as worthwhile vídeos[8] on the inherent risks present at an aircraft accident site. One example of a quick guide is provided in Appendix 2.

6 http://www.brs-service.de/BRSFirstResponder.pdf
http://www.brs-vertrieb.de/wp-content/uploads/pdf/owners_manual.pdf

7 http://firstresponder.cirrusaircraft.com/Safety_Guide.pdf
http://firstresponder.cirrusaircraft.com/2013-11-04Cirrus1stResponderInformationManual.pdf

8 https://www.youtube.com/watch?v=KL2m4hHTflE

DO NOT CLIMB ON OR MOVE THE WRECKAGE UNTIL YOU KNOW THE STATUS OF THE ACTIVATION SYSTEM AND ROCKET!

The system **MUST BE DISABLED** in order to make it safer to work around.

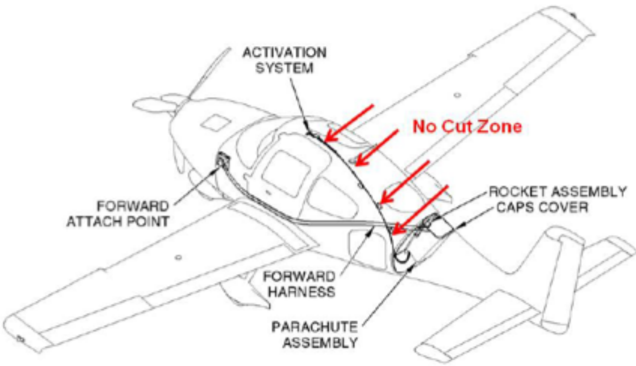

Figure 4. Examples of warning provided by Cirrus on possibility of inadvertently activating the parachute system, both on the handle and on the cable run to the igniter

In the case of amateur-built aircraft and ULMs (aircraft considered in Annex II of Regulation (EC) no. 216/2008 of the European Parliament and the Council), the installation of these devices is not recorded and once a Certificate of Airworthiness or Restricted Certificate of Airworthiness is issued, there is no regulation that entails the requirement to notify the national authority.

Already in 2014, as a result of the investigation into a ULM accident, the Finnish authority[9] expressed its concern in this regard and took measures nationally, questioning the EASA on the subject of those aircraft that exceeded its authority (remaining aircraft not considered in Annex II of Regulation (EC) no. 216/2008 of the European Parliament and the Council). The EASA replied that ballistic parachute systems for certified aircraft were regulated in the "Certification Specifications and Acceptable Means of Compliance for Light Sport Aeroplanes"[10] CS-LSA), which were based on regulation ASTM F2316-12 (see Appendix 3), which were based on regulation ASTM F2316-12, which it is not free (you have to pay to get it).

- ASTM F2316-12 includes the specifications for presence and location (paragraph 11.2).
- ASTM F2316-12 does not include any speciation about:
  - routing of the components of the system along the airframe, neither
  - heat indicator that could change its color in case the rocket reached a dangerous temperature to cause its detonation.

As for the training of emergency and firefighting personnel, it had been incorporated into GM1 ADR.OPS.B.010(a)(3)[11]) on the AMC and GM to "Authority, Organization and Operations Requirements for Aerodromes".

This information was only considered for aerodrome/airport personnel and did not take into account the other emergency services personnel who might report to the site of an aircraft accident or incident outside an airport environment.

Australia[12] has also analyzed this same subject, issuing a recommendation to the EASA and the ICAO to standardize criteria for labeling these systems. The need to internationally identify and standardize signs warning of the presence of these systems in aircraft, markings showing the exact location along the airframe of their components as well as of heat indicators that warn about a possible detonation due to temperature reached in the event of a fire is similarly presented in this report. Some manufacturers, like Cirrus, already have their own system, and other states have also taken measures with aircraft regulated at the national level, but there is no generalized regulation for all aircraft except for ASTM F2316-12.

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[9] http://www.onnettomuustutkinta.fi/material/attachments/otkes/tutkintaselostukset/en/ilmailuonnettomuuksientutkinta/2014/lSQu5blvz/L2014-01_Nummela_eng.pdf

[10] "Certification Specifications and Acceptable Means of Compliance for Light Sport Aeroplanes".

[11] "Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Authority, Organisation and Operations Requirements for Aerodromes"

[12] https://www.atsb.gov.au/publications/recommendations/2004/r20040095/

In general, various authorities in some States (Canada[13], USA[14], Australia[15], Ireland[16], Finland[17], Switzerland[18]…) had already warned about the dangers of involuntarily activating the system, and in some cases, a more exhaustive analysis of these systems had been carried out. Such is the case of the Swiss report, a safety report that included a description of the system, the current manufacturers and a study on the different responses of the rocket to increased temperature (FCO[19] test and SCO[20] Test), sensitivity to electrostatic discharge and sensitivity to friction and impact. It also issued several recommendations identified during the study as that one about heat indicators.

3.3 Temperature monitoring BPS aircraft

3.3.1 Safety deficit

BPS rockets exposed to slowly rising temperatures (SCO) may explode, as section 2.2.3 shows.

The same applies if an aircraft is exposed to heat close to a fire.

3.3.2 Safety recommendation no. 446

3.3.2.1 BPS rocket

BPS rockets must be fitted with heat indicators as close to the rocket motor as possible (e.g. Telatemp). These heat indicators change colour if they exceed a given temperature.

Checking the heat indicators must be included in aircraft ground checklists, for example.

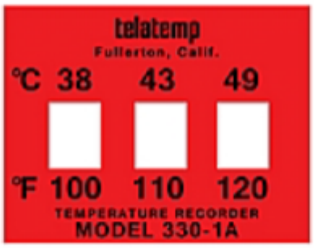


Figure 5. Recommendations about heat indicators

1.19. Useful or effective investigation techniques

N/A.

[13] https://www.tc.gc.ca/eng/civilaviation/opssvs/nationalops-audinspmon-program-safetycirculars-2006028-871.htm

[14] https://www.faa.gov/aircraft/gen_av/first_responders/
https://ntsb.gov/safety/safety-recs/_layouts/ntsb.recsearch/Recommendation.aspx?Rec=A-04-036

[15] https://natsar.amsa.gov.au/documents/Hazardaataccidentsites.pdf

[16] http://www.aaiu.ie/node/866

[17] http://www.onnettomuustutkinta.fi/material/attachments/otkes/tutkintaselostukset/en/ilmailuonnettomuuksientutkinta/2014/ISQu5blvz/L2014-01_Nummela_eng.pdf

[18] https://www.ctif.org/sites/default/files/news/files/bps-system_bericht_engl.pdf

[19] Fast Cook Off- simulation of a fast spreading fire.

[20] Slow Cook Off- simulation of a fire nearby.

2. ANALYSIS

2.1. Analysis of the accident

On 15 July 2016 at around 20:28, the pilot was alone in the airfield. He had purchased the aircraft earlier in the year and, according to information provided by those close to him, he had been "fine tuning" the engine. The flight manager at the Ontur aerodrome had told him that the engine did not sound right and recommended that he have a mechanic inspect it. The flight manager at the "Los Garranchos" airfield told him that he did not like those engines much and recommended that he replace it with a higher power engine. Investigators were unable to confirm if a mechanic inspected the engine, but apparently the pilot had said that one of the floaters in the carburetor had been degraded by a crack, and that subsequently the engine was "almost to his liking". According to eyewitnesses who reported to the crash site, the pilot had grease or soot stains on his hands. It seems likely, then, that the pilot had been adjusting the engine on the day of the accident and in the end decided to test it by flying it. That was the pilot's first flight with that aircraft.

At the accident site, the left fuel tank was found empty and there were no signs that fuel was leaking to the ground. The right tank did contain fuel. The fuel system on this aircraft is arranged in such a way that both tanks feed an auxiliary, or supply, tank, which then feeds the engine. The stopcocks between both tanks and the supply tank were open, and thus fuel starvation of the engine can be ruled out.

When the engine was inspected, no loose fittings were found, though it was not possible to see if a filter was clogged or if some other component was in bad condition.

One of the eyewitnesses, who had a knowledge of aviation, reported that he was driving on the highway toward San Javier and saw the aircraft take off. It flew over the highways and turned right. He noticed that the aircraft was moving erratically, turning with the rudder and tilting down with the aileron. It then pitched down and did a sort of corkscrew. At some point someone seemed to indicate that the engine had stopped, though this claim could not be confirmed by any of the eyewitnesses who were interviewed.

Investigators confirmed that the pilot was used to flying another aircraft with a more powerful engine and a propeller that turned clockwise. The accident aircraft had a two-stroke ROTAX 582 engine and the propeller rotated counterclockwise, meaning that in order to correct for the torque generated by the propeller, the pilot had to apply left pedal, exactly opposite what he was used to doing. The fact that an eyewitness with a knowledge of aviation stated that the aircraft's rudder was moving strangely indicates that the pilot was not entirely in control of the aircraft, especially since it was his first time flying it. There was a moderate wind in the area (16 km/h, gusting to 22 km/h), another fact that could have influenced the aircraft's destabilization, especially during the crosswind, downwind and base legs in the circuit, when the aircraft appeared to stall and crash to the ground. Investigators could not determine if the engine stopped, though they could not rule out that it was functioning irregularly at some point, with the ensuing surprise factor and increased work load for the pilot during the most critical phase of the circuit.

2.2. Analysis of the presence of a ballistic parachute.

The accident aircraft was equipped with a ballistic parachute. If this system is activated in an emergency (engine failure, pilot incapacitation, mid-air collision, structural failure, loss of control, etc.), a rocket is ignited that causes a parachute to deploy. The aircraft can thus drift slowly to the ground at a descent rate that ensures the survival of its occupants. In this case, the handle used to activate the system had been lockwired by the flight manager of the Ontur aerodrome when he was unable to find the safety pin. This pin, by procedure, is removed from its position before flight to allow for the system's immediate use by pulling on the handle if necessary during flight. The pin was most likely among the wreckage of the cockpit, though it was not recovered.

There has been an evident increase in the use of these devices in ultralight and amateur-built aircraft, without a corresponding presence of legislation relating to their installation, maintenance and reporting to the authorities (AESA or EASA). This Commission has, for some time now, been encountering cases of accident aircraft that were equipped with this system, a fact that no one knew except the owner, and in the best of cases the acquaintances of the owner in the airfields where the owner flew. If the parachute does not deploy during the accident, a twisted or deformed fuselage could tension the activation cable, leading to the involuntary ignition of the rocket. The same thing would happen in the event that an aircraft caught fire after impact if the ignition temperature were to be reached. As a result, concerns arose some time ago that the system could be inadvertently and involuntary activated, which, in the event of an accident, could affect someone approaching the wreckage, either to help the victims, to remove them from the wreckage or to conduct a field investigation of the accident.

Investigating further, it was discovered that other States have expressed this same concern and have conducted studies in this regard. To date, the most detailed information on the warnings and uses of these systems involves one of the largest manufacturers of these devices (BRS) and one of the aircraft that employs them the most (Cirrus). However, in the case of amateur-built aircraft and ULMs, these devices can be installed before or after the Certificate of Airworthiness or Restricted Certificate of Airworthiness is issued without having to notify the authority. In other words, there is no official registry of aircraft that can be checked to see if an aircraft has such a system installed, though AESA does have an aircraft registration registry that lists basic parameters involving their manufacture, takeoff weight, engines and so on. Thus, adding information on the installation of a ballistic parachute to this database could be useful to all of the groups that are affected by an aircraft accident or incident. However, users have to be required to report this and the aircraft's documentation has to indicate that this device has been installed. The presence of such a system could also be included as part of the information contained in a flight plan, if one is filed. Point 14 of SERA.4005 on emergency and survival equipment could apply to cases in which an aircraft is equipped with a ballistic parachute system so that information could be provided to the personnel involved in the event of an aircraft accident or incident. In the remaining cases, such as for aircraft without a flight plan or beyond the authority of the EASA, to which Annex II of Regulation (EC) no. 216/2008 of the European Parliament and the Council does not apply, this information would continue to be unavailable. Five safety recommendations are issued in this regard later in this report.

Along these same lines, it seems prudent to launch campaigns to inform, raise awareness and train on the existence of ballistic parachutes, and identifying, locating and deactivating them in the event of an accident or incident. These campaigns would be directed at personnel who might respond to an aviation accident and be exposed to this hazard, such as rescue, medical and firefighting personnel, accident investigators and even eyewitnesses or airfield/aerodrome personnel, and not just at specific aerodrome personnel, as the EASA indicated in its response to the recommendation issued by the Finnish Commission (SIA[21]). As a result, two safety recommendations are issued in this regard.

Furthermore, there is not only a need for the personnel mentioned above to be aware of the presence of these devices, but to provide them with the visual information needed to locate them. In this regard, and in concurrence with the information analyzed and gathered by other states, there should be a single system for marking the locations of the system's components as well as visible warnings that an aircraft is equipped with such a system. The presence of indications informing of the maximum temperature reached in the igniter would also be of vital importance to warn firefighting personnel or any other individuals in the vicinity. Three safety recommendations are made in this regard later in this report.

[21] SIA-Safety Investigation Authority (Finland).

3. CONCLUSIONS

3.1. Findings

An analysis of all the information available yields the following findings:

3.1.1. Findings involving the accident

- The available aircraft's documentation was valid and in force.

- The pilot's license and medical certificate were valid in force.

- The pilot had a total experience of 70 flight hours.

- His verified experience in the airfield was on an aircraft with a more powerful (four-stroke) engine whose propeller turned clockwise (engine torque compensated for by applying the right rudder pedal).

- The accident aircraft had a two-stroke engine and the propeller turned counterclockwise.

- The pilot had purchased the aircraft at the start of the year and had moved it to the airfield a month before.

- The pilot had asked two flight managers for their opinion. One recommended that he change the engine for a more powerful one, and the other did not like the noise it was making and recommended that he have a mechanic inspect it.

- The pilot had told his closest acquaintances that he had the engine "almost to his liking".

- After the accident, the eyewitnesses who assisted the pilot reported that he had grease and soot stains on his hands.

- The accident flight was the pilot's first flight with that aircraft.

- On that day, the wind was from the east, of moderate intensity and gusting to 22 km/h (28 km/h according to information on the aerodrome's website).

- According to an eyewitness, the aircraft was moving erratically, turning with the rudder and tilting down with the aileron (it was a left-hand circuit), until it pitched down in a sort of corkscrew.

- The aircraft had fuel.

- No signs were found of a technical or mechanical malfunction in the aircraft, though a possible lack of engine power cannot be ruled out.

3.1.2. Findings involving the use of the ballistic parachute

- The aircraft had a ballistic parachute installed.
- This parachute had not deployed as a result of the impact.
- There were no visibly identification marks of this system in the aircraft.
- The flight manager at the Ontur aerodrome, who knew this equipment, was installed on the aircraft, lockwired the actuation lever.
- Locking the lever does not completely disable the system.
- There is a risk that the system can be activated inadvertently and involuntarily either when the wreckage is moved to assist victims, or if a high temperature is reached as the result of a fire.
- In general, rescue, medical and firefighting personnel are unaware that such a system can be installed on aircraft.
- Other States and investigation authorities have studied and analyzed the need to inform and train these personnel on this system.
- Some manufacturers of these devices, and of the general aviation aircraft equipped with them, have taken steps to inform about the presence of these devices.
- In the case of ULMs and amateur-built aircraft, however, no such initiatives exist.
- There is no regulation that requires reporting that such a system is installed on these aircraft.
- There is no regulation that requires informing of the presence of such a system or of the location of its components so as to avoid the involuntary activation of the system as for the ASTM 2316-12.

3.2. Causes

The accident occurred when the pilot lost control of the aircraft after flying the downwind leg of the circuit at the airfield. Investigators could not rule out that a drop in power at the most critical point in the circuit surprised the pilot, who did not have experience on the aircraft.

The following contributed to the accident:

- the wind conditions that day at the airfield, with moderate wings and strong gusts that could have affected the aircraft's behavior at the most critical point in the circuit if the engine failed,
- the pilot's lack of experience on this aircraft type, which was less powerful and had an opposite direction of propeller rotation than his usual aircraft and
- the fact that the pilot had been tuning up the engine before making the first flight with the aircraft, which might have contributed to a possible engine failure.

4. SAFETY RECOMMENDATIONS

As concerns the use of the ballistic parachute, there is no reference documentation available to determine which aircraft (EASA and non-EASA) have this kind of device installed. Emergency and firefighting personnel and general aviation users have to be able to know if an accident aircraft that they will be working on poses a safety hazard and if so, what actions and precautions to take. Adding information on the installation of a ballistic parachute to the aircraft registration registry database could make it easier to inform the relevant personnel in the event of an accident. However, this would require users to report the installation and for the aircraft's documentation to include a mention that this device has been installed. The presence of such a system could also be included in the information supplied on a flight plan, if one is filed. As a result of the above, the following safety recommendations are issued:

REC 34/17. It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) establish the necessary measures so that aircraft operating in Spanish territory and that have installed or will install a ballistic parachute report it to the authority.

REC 35/17. It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) seize the regulatory initiative for the installation of ballistic parachutes in the following cases be legislated:

- In nationally regulated aircraft (ULM and amateur-built aircraft) with a Type Certificate (TC), through this certificate (if the ballistic parachute was included in the original configuration) or through the Supplemental Type Certificate (STC) (if the ballistic parachute was installed later)
- In nationally regulated aircraft (ULM and amateur-built aircraft) that do not have a type certificate and that include it in the design of the aircraft.

REC 36/17. It is recommended that the Spanish Civil Aviation General Directorate (DGAC) take the relevant regulatory procedures to legislate the installation of ballistic parachutes in the following cases:

- In nationally regulated aircraft (ULM and amateur-built aircraft) with a Type Certificate (TC), through this certificate (if the ballistic parachute was included in the original configuration) or through the Supplemental Type Certificate (STC) (if the ballistic parachute was installed later)
- In nationally regulated aircraft (ULM and amateur-built aircraft) that do not have a type certificate and that include it in the design of the aircraft.

REC 37/17. It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) establish the measures necessary to indicate the presence of a ballistic parachute as a parameter on the list of aircraft registered in Spain.

REC 38/17. It is recommended that the European Aviation Safety Agency (EASA) lay out the measures required so that aircraft equipped with a ballistic parachute reflect this in the flight plan as part of point SERA.4005, Contents of a flight plan, "Emergency and survival equipment".

REC 39/17. It is recommended that the Spanish National Aviation Safety and Security Agency (AESA) establish the measures necessary to start an awareness, information and training campaign in Spain targeted at general aviation users and emergency personnel involving the presence of ballistic parachutes and identifying, locating and deactivating them in the event of an accident or incident.

REC 40/17. It is recommended that the European Aviation Safety Agency (EASA) lay out the measures required to initiate, at the European level, an awareness, information and training campaign directed at general aviation users and emergency services personnel on the existence, identification, location and deactivation of ballistic parachutes in the event of an accident or incident.

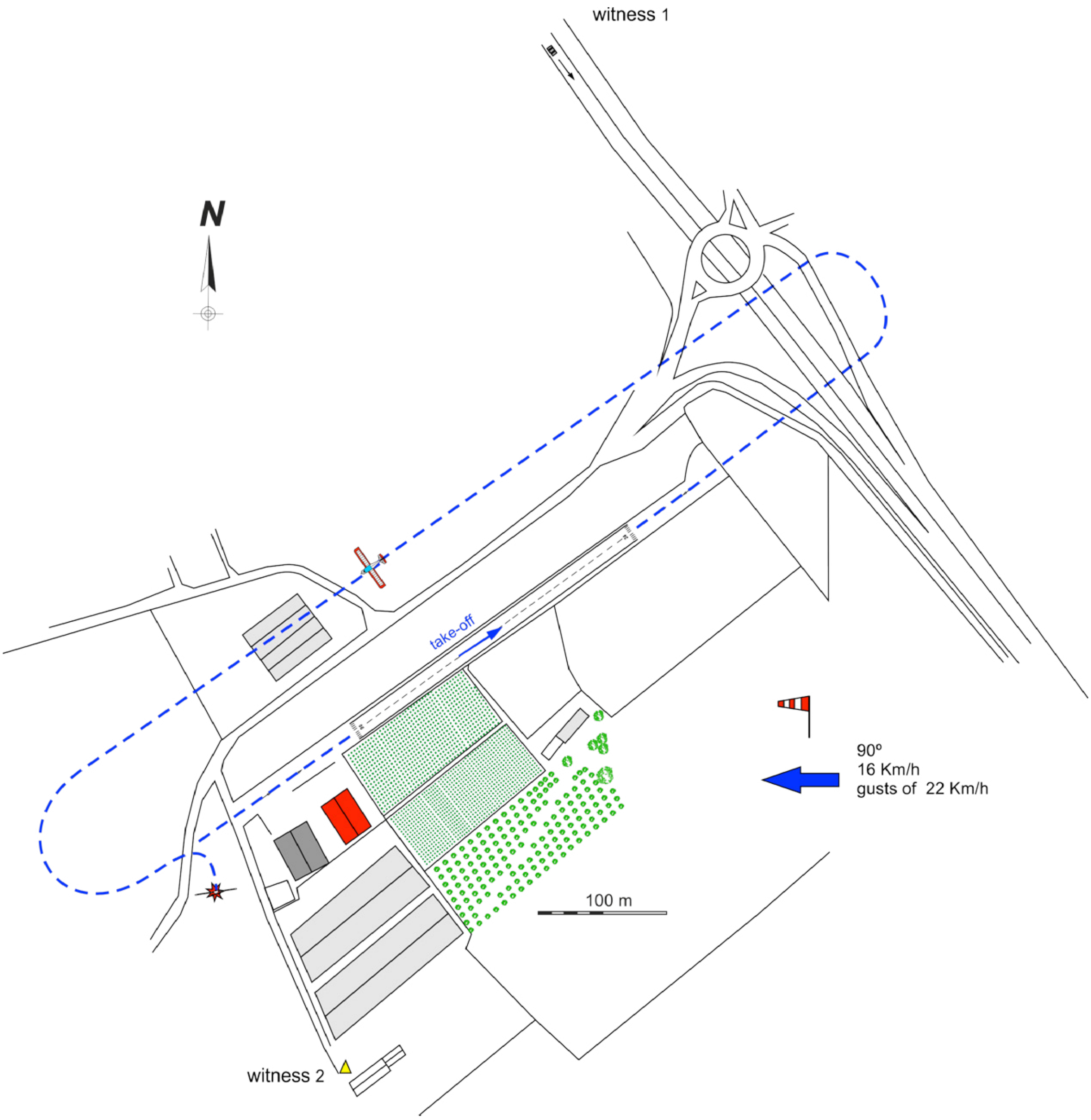
In concert with having general aviation and other users become aware of the presence and hazards of aircraft equipped with ballistic parachutes, there should be warning labels in aircraft informing of their presence and location, and of the temperatures that can be reached in case of fire. Even though some states have undertaken national initiatives and some manufacturers have their own markings, there is no international standard for this type of warning except for the ASTM F2316-12 that allow to identify the presence and the location of this safety equipment. However, the marking of the routing of the components of the system (along the airframe) and some thermal exposure indicator (that could change its color in case the rocket reached a dangerous temperature to cause its detonation) are not considered in such regulation. Therefore it would be convenient to have a homogenization of this type of markings. As a result, the following safety recommendations are issued.

REC 41/17. It is recommended that the International Civil Aviation Organization (ICAO) should liaise with the European Aviation Safety Agency (EASA) to include standards for the design (conspicuity, coloration, visibility, and content) in the installation of ballistic parachute systems. This should include, as compulsory for pyrotechnical systems, specifications of the routing of the components of the system and a thermal exposure indicator to enable emergency responders to quickly and safely disable the system, and fully alert persons to the hazards and the danger areas on the aircraft."

REC 42/17. It is recommended that the European Aviation Safety Agency (EASA) should liaise with International Civil Aviation Organization (ICAO) to include standards for the design (conspicuity, coloration, visibility, and content) in the installation of ballistic parachute systems. This should include, as compulsory for pyrotechnical systems, specifications of the routing of the components of the system and a thermal exposure indicator to enable emergency responders to quickly and safely disable the system, and fully alert persons to the hazards and the danger areas on the aircraft."

APPENDIX 1

FLIGHT PATH AND MARKS LEFT BY THE IMPACT


witness 1
N
take-off
90º
16 Km/h
gusts of 22 Km/h
100 m
witness 2

APPENDIX 2

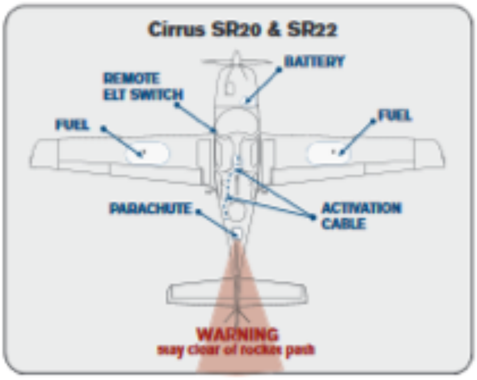
INFORMATION ON LOCATION OF BALLISTIC PARACHUTE

Cirrus Airframe Parachute System [CAPS™]

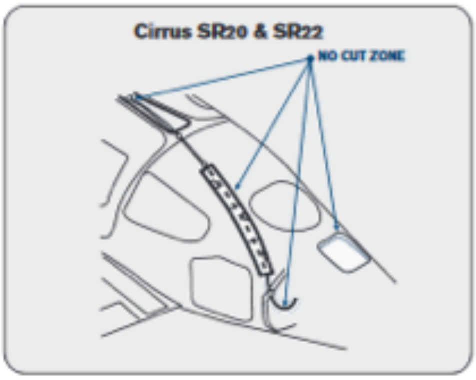
1– **Call 800.279.4322 or 952.988.1940 for help.** DO NOT CUT INTO CABIN ROOF.

2– Brief all persons on site about the potential hazards the system(s) may present.

3– In case of smoke or fire, wear oxygen breathing equipment.

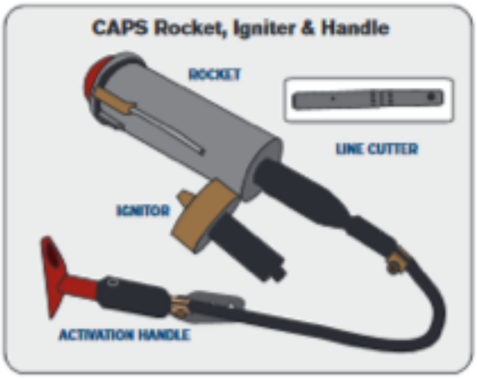


4– Always approach the aircraft from the front or sides.

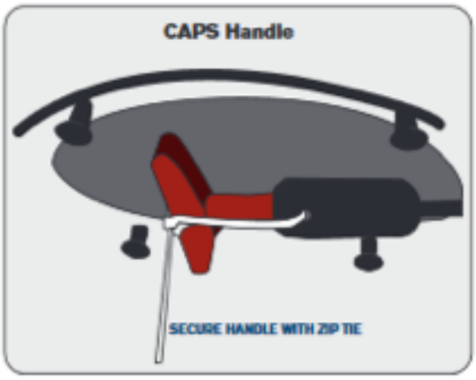


5– Determine if there is a Ballistic Parachute System on board the aircraft.

6– If deployed, deflate parachute canopy with water and anchor it with a heavy vehicle.



7– Locate, mark and isolate all BRS system components:
- Rocket
- Igniter
- Reefing line cutters



8– Secure the red activation handle with an 11-inch plastic zip tie.

9– Hazardous system components should be removed from the aircraft by trained personnel before any portion of the wreckage is moved.

APPENDIX 3

ASTM 2316-12

other handle is inoperable.

6.3.6.4 It must be shown that activating the system can only be accomplished in a manner that makes inadvertent deployment extremely improbable.

6.3.6.5 Some means to safety the activation system must be implemented when the aircraft is not in service.

6.3.7 *Occupant Restraint*—Each seat in an airframe modified or fitted with the emergency parachute system must be equipped with a restraint system that will adequately protect the occupants from head and upper torso injuries during parachute deployment and parachute landing. The restraint system must be designed in accordance with the relevant airframe requirements considering the accelerations to be expected in response to the parachute opening, descent and parachute landing.

7. Workmanship

7.1 Workmanship must be of a high standard and performed in accordance with QA standards. When no other requirements are made applicable for a specific project, QA requirements as per S3 of this standard apply.

8. Design and Construction

8.1 The installation design and location of the extraction device must consider fire hazards associated with the activation

10. Operating Limitations

10.1 Operating limitations must be prescribed to ensure proper operation of the parachute system.

11. Product Marking

11.1 Key components of the parachute system must be marked on the outside of the parachute container with the following information:

11.1.1 Manufacturer's identification,

11.1.2 Part number and revision,

11.1.3 Serial number,

11.1.4 Date of manufacture, and

11.1.5 Service interval date.

11.2 *Labels*—The parachute or airframe manufacturer shall supply conspicuous placards or labels for placement in unobstructed view to anyone near the egress point (exterior). These placards are to be displayed such that they provide a visual warning to rescue or other personnel at the scene of an accident or incident. Reference Appendix X1 for samples of these labels.

11.2.1 *Installation and Size of Placard or Label*—The airframe manufacturer shall permanently install the warning placards or labels in a manner defined by this specification and documented in the PIM.

char 12
Font Times-Bold
Color red

11.2.2 *Label Size and Color*—All placards or labels shall follow the coloration methods described below. The three sizes of placards or labels will address different locations for installation.

11.2.2.1 *Danger Placard*—Danger placards or labels shall be printed with a red border with white (or reverse type) letters with a descriptive graphic element.

(1) Danger Placard for Interior Parachute Installation—A 7.62-cm (3-in.) minimum triangular placard or label with the word "Danger" (see sample placard Figure X1.1 of Appendix X1) must be placed adjacent to the parachute egress point for enclosed aircraft where the parachute system may not be visible from the exterior.

(2) Danger Placard for Exterior Parachute Installation—A 5.08 cm (2-in.) minimum triangular placard or label (see sample label Figure X1.1 in Appendix X1, label must be resized to fit the size as per this requirement) shall be applied directly on any ballistic extraction device on aircraft that do not have the parachute system inside the aircraft enclosure and that therefore should be visible from the exterior. This placard or label will warn rescue personnel in the event the ballistic device may become separated from the aircraft due to high G forces at impact.

NOTE 4—Not all ballistically deployed emergency parachutes egress the upper surface of an aircraft. Some systems egress the side or underside of the aircraft.

(3) Danger Placard Text Explanation—An explanatory box shall be printed next to the "Danger" placard or label.

(4) The danger explanatory box shall describe the type of ballistic deployment device and provide contact information for rescue personnel to seek help from the manufacturer of the ballistic device.

11.2.2.2 *Identifying Placard*—A label shall be attached to the body of the extraction device (for example, the rocket body itself) so first responders and safety investigators can identify the device should it become separated from the parachute (discharged or live). This placard shall have contact information as well as graphic images (sample placard is shown in Figure X1.2 of Appendix X1).

11.2.2.3 *Warning Placard*—A 2.54-cm (1-in.) minimum triangular placard or label (sample placard is shown in Figure X1.3 of Appendix X1) shall be applied to the aircraft adjacent to the door(s) or place(s) where the occupant(s) enter the aircraft or where rescue personnel can readily see it. Warning placards or labels shall be printed with a black border with orange letters surrounding an orange center with a descriptive graphic element.

(1) Warning Text Explanation—An explanatory box shall be printed next to the "Warning" placard or label.

11.2.3 External placards or labels shall be printed, employing a reflective background material for enhanced visibility in low light or obscured conditions.

11.3 All producers of ballistically deployed rescue systems shall provide on their website or by printed goods made available as requested, explanations or instruction about safetying their systems or disabling their systems as required for the safety of rescue personnel arriving at the scene of an incident or accident.

NOTE 5—These explanations or instructions need not inform about handling or disabling ballistic devices, but rather about how to render them not dangerous to rescue personnel.

12. Keywords

12.1 aircraft; airframe; ballistic recovery; parachute