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COMISIÓN DE
INVESTIGACIÓN
DE ACCIDENTES
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AVIACIÓN CIVIL

Report A-009/2014

Accident on 25 May 2014, involving an Air Tractor AT-802 aircraft, registration EC-LCA, while fighting a fire in the vicinity of Serón (Almería, Spain)

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

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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) n.º 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.

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Abbreviations

00°	Geometric degrees/Magnetic heading
00 °C	Degrees centigrade
CAMO	Continuing Airworthiness Maintenance Organization
CEDEFO	Forest Defense Center
COP	Provincial Operations Center
CPL	Commercial pilot license
CPL(A)	Commercial pilot license (aircraft)
DGAC	Civil Aviation General Directorate
E	East
g	Gravity force
GPS	Global Positioning System
h	Hour(s)
hPa	Hectopascal(s)
kg	Kilogram(s)
km	Kilometer(s)
km/h	Kilometers per hour
l	Liter(s)
m	Meter(s)
mph	Miles per hour
MTOW	Maximum TakeOff Weight
N/A	Non affected
QNH	Altimeter subscale setting to obtain elevation when on the ground
S/N	Serial Number
SHp	Shaft Horsepower
TOP	Operations Specialist

Synopsis

Owner and operator:	SAETA, SL
Aircraft:	Air Tractor AT-802, S/N 802-0326; registration EC-LCA
Date and time of accident:	Sunday, 25 May 2014; at 14:00 local time[1]
Site of accident:	Vicinity of Serón (Almería, Spain)
Persons onboard:	1; crew member, fatal
Type of flight:	General aviation – Other
Phase of flight:	En route – Cruise
Date of approval:	26 october 2015

Summary of accident

The aircraft, an AIR TRACTOR AT-802, registration EC-LCA, operated by SAETA S.L., had an accident while engaged in firefighting duties in the vicinity of Serón (Almería).

After circling over the fire area several times, while the aircraft was flying over a different area near a hillside, it unexpectedly made a water drop as it banked sharply to the right, causing it to impact the ground.

The pilot was killed and the aircraft was completely charred by the fire that broke out after the impact.

[1] All times in this report are local.

1. FACTUAL INFORMATION

1.1. History of the flight

On 24 and 25 May, there were storms in the province of Almería that produced extensive lightning, with a total of 277 lightning strikes being recorded, of which three ignited fires in the municipalities of Oria, Serón and Fiñana.

Airplane EC-LCA, stationed at the Gérgal (Almería) runway, was involved all morning on the 25th fighting those fires. Its callsign was A1.

According to information provided by the Provincial Operations Center (COP in Spanish) of the Forest Firefighting Operations Service of the Agricultural, Fish and Environmental territorial office of Almería, the sequence of actions involving aircraft A1 up to the time of the accident was as follows:

At 09:00 on 25 May, the Provincial Operations Center received a call from the fire lookout on watch that morning in the Sierra de Estancias, who reported sighting smoke in El Castillo, in the municipality of Oria. The presence of a fire was confirmed at 09:25 by the same lookout, who was now in the area and asked the COP to activate A1. The aircraft took off at 10:04, reaching the site of the fire at 10:25.

Although the pilot did not find the fire at first, after receiving directions from personnel present at the fire, he made an initial water drop at around 10:30, completing the action at 10:35, after which he returned to base, where he landed at 10:49.

At 12:32 the Operations Specialist (TOP) at the Forest Defense Center (CEDEFO) in Serón informed the COP of a fire in the municipality of Serón, in the area of Cortijo de Juan Oller. He requested that the helicopter with callsign C1 be activated, along with aircraft A1, the latter of which was arranged through the CEDEFO in Alhama. A1 took off at 12:44 from the base at Gérgal, reaching the fire at 13:00. After making a water drop it returned to the base at Gérgal at 13:14.

At 13:21 the 112 Emergency Service reported a fire in Fiñana in the area of Cerro Morrón. This was relayed to A1, which left for the area at 13:40. Once airborne and after the small size of the fire in Fiñana was confirmed, the TOP in Serón requested the presence of A1 at the Serón fire once more.

The aircraft's pilot was unable to find the exact place to make the water drop, which forced him to circle several times over the area of the fire.

Subsequently the aircraft was observed away from the area of the fire but flying toward it and making an unexpected water drop near a hillside that was more than one kilometer

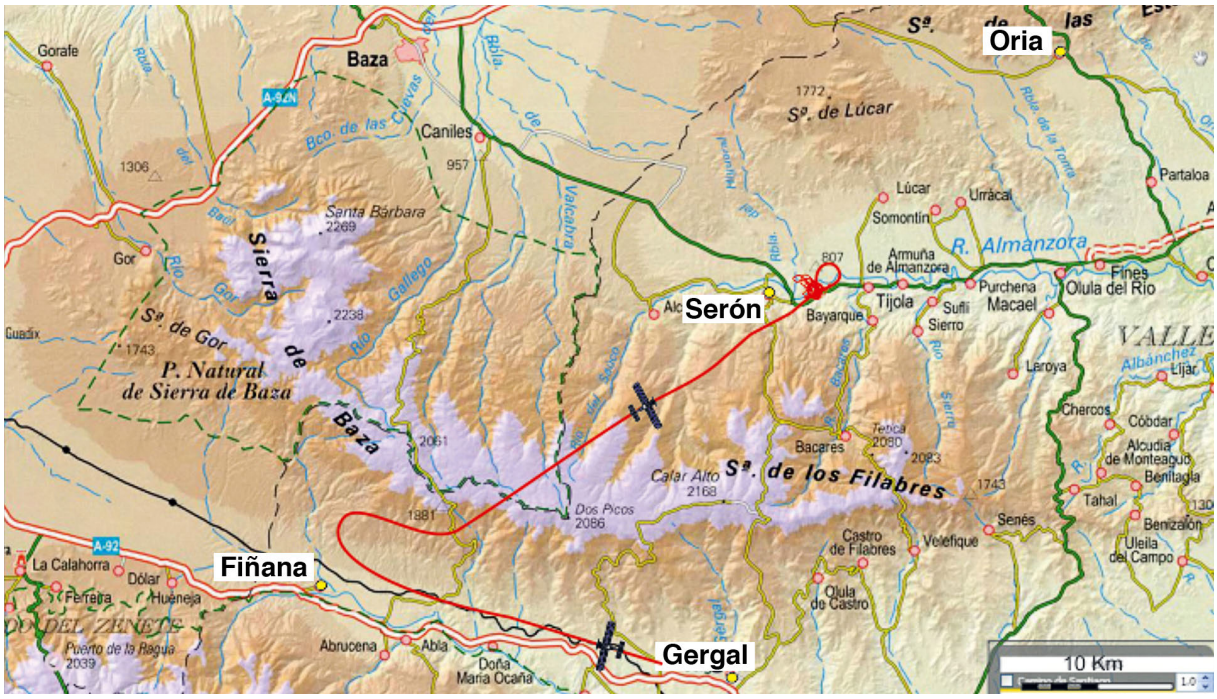


Figure 1. Aircraft's flight path and site of the accident

away from the fire. As it made the drop, the aircraft made a sharp turn and banked hard to the right, causing the aircraft to impact the terrain.

The pilot was killed and the aircraft was completely charred in the fire that broke out after the impact.

The Operations Specialist reported at 14:15 that aircraft A1 had been in an accident in the same area as the fire, in the area of El Reconco. This was relayed to, among others, 112 emergency services, which immediately dispatched an emergency medical helicopter and an ambulance to the site of the accident.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	1		1	
Serious				
Minor				Not applicable
None				Not applicable
TOTAL	1		1	

1.3. Damage to aircraft

The aircraft was completely destroyed and most of it was charred.

1.4. Other damage

There was no additional damage with the exception of a brush fire in the impact site.

1.5. Personnel information

The pilot, a 37-year old Spanish national, had a commercial pilot license (CPL), number E/FCL/00048161, issued by Spain's National Aviation Safety Agency, and an AT-4/5/6/8 rating (Land), valid until 31 October 2014.

He also had an agricultural rating valid until 28 February 2015.

He likewise had the relevant Class 1 medical certificate, which was valid until 26 October 2014.

He had 2,787 total flight hours, of which 1,182 had been on the type. In the previous thirty days he had flown a total of 2:25 h.

According to the documentation provided by the operator, on 29 April 2014 he had taken the recurrent training tests for his theoretical and practical competence in firefighting operations with the Air Tractor AT-802 aircraft, as per the requirements of the DGAC and SAETA's maintenance program.

According to the documentation provided by the operator, the pilot was also given a competency check administered by the operator, the result of which was FIT.

He started flying at the Gérgal base in Almería on 24 May.

1.6. Aircraft information

The aircraft was an AT-802, manufactured by AIR TRACTOR, serial number 802-0326, outfitted with one Pratt & Whitney PT6A-67AG engine, s/n PCE-RD0090, and one 5-blade Hartzell-HC-B5MA-3D propeller, s/n HBA-1230, which rotates clockwise as seen from the pilot's position. The AT-802 is a single-engine, low-wing, fixed-gear aircraft with a tail skid. It is designed for use in agricultural and firefighting work. It is one of the most used airplanes in its category.

At the time of the event the aircraft had 1,068:50 flight hours, the engine 855:20 h and the propeller 1,607:11 h.

The aircraft had an airworthiness review certificate issued by the Angel Martínez Ridao CAMO, reference ES.MG-106. It was valid until 28 June 2015.

According to documentation provided by the operator, the aircraft had undergone the detailed inspections pursuant to its maintenance program, which was approved by the National Aviation Safety Agency. The last of these, a 6-month, 100-hour and 300-hour inspection involving checks of the propeller, engine, the electrical, fuel, hydraulic and induction systems, the main and tail gear and the flight control systems, had taken place on 30 April 2014 with 1,065:20 h on the airplane.

On that same date the engine, which had 849:20 flight hours, received a 100-hr check during which a borescope inspection was carried out, as well as maintenance tasks on the oil, air, fuel and ignition systems.

The maintenance was carried out at the SAETA Part-145 Maintenance Center, authorization ES.145.195 CMAE-502, issued by the National Aviation Safety Agency.

1.7. Meteorological information

According to data from Spain's National Weather agency, based on readings from the station in Abla, some 25 km southwest of Serón, on satellite and radar images and on adverse phenomena warnings, the most probable weather at the time and place of the accident was:

Winds variable at 14 km/h from the East (about 80°), gusting to 30 km/h. Visibility was good on the surface, cloudy, temperature 33 °C, QNH 1,016 hPa and a relative humidity of 40%.

There was no significant precipitation or any adverse weather warnings.

1.8. Aids to navigation

N/A.

1.9. Communications

The aircraft was in radio contact with the coordination helicopter (C1) and with the Operations Specialist on the ground.

1.10. Aerodrome information

N/A.

1.11. Flight recorders

There were no flight recorders onboard, nor were they required for this aircraft type.

The aircraft was equipped with a GPS-based positioning system from which information was extracted that provided position, altitude, speed and heading data. Appendix 1 shows the segment of the accident flight (point A to point D) during which the pilot was trying to locate the fire. Given its complexity, the flight path is shown in three different segments to make it easier to follow (Segment 1 from point A to point B, segment 2 from point B to point C, and segment 3 from point C to point D). From point D until the impact, no information is available that was recorded by the fleet positioning system.

1.12. Wreckage and impact information

The aircraft wreckage was found on the side of a mountain without signs of having moved after the initial impact. Its layout was such that it maintained the airplane's original in-flight position and on a direct collision heading with the mountain.

The wreckage was clustered, with the only significant piece not with the main wreckage being a movable horizontal part of the right rear tail section, which was some 25 meters downhill from the main wreckage.

After the impact the airplane caught fire, which charred the cockpit, the main wing and everything forward of the wing.

The primary structure of the fuselage where the main wing and landing gear are attached was broken.

The continuity of the rudder and elevator control bar cables was verified and revealed nothing out of the ordinary. There was also continuity to the engine control cables.

The engine was completely deformed by the compression force from the frontal impact. All of the magnesium crankcases had been charred by the fire, revealing the gears and other components they housed inside. The blades had detached from the propeller hub and exhibited signs consistent with having impacted the ground.

No readings could be recovered from the navigation or engine control instruments, as these had been charred by the fire.

The aircraft was destroyed and charred by the fire.

1.13. Medical and pathological information

N/A.

1.14. Fire

The fire that broke out after the aircraft's impact burned a small section of brush.

1.15. Survival aspects

N/A.

1.16. Tests and research

1.16.1. *Eyewitness statement*

Various eyewitnesses were contacted who were part of the firefighting teams. Their statements revealed that the accident aircraft had been engaged that morning in fighting the fires in Oria and Serón. After making water drops at each fire, it was dispatched again to fight the fire that had been reported in the area of Fiñana. By the time it arrived at the site, the fire was declared out and the Operations Specialist at Serón asked that the water drop be made at the Serón fire site instead of the drop initially planned at Fiñana to cool down the area.

According to the eyewitness, the pilot was unable to locate the fire site. The TOP instructed him to fly over the area and that he, along with other members of the brigade, would lead him to the fire. Although the pilot was able to locate them when he flew over the area, when he flew back to make the drop he was unable to find the drop point, resulting in the process being repeated three times (the graphs in Appendix 1 show the path taken by the aircraft as it attempted to locate the fire, and Fig. 2 shows how these attempts to locate the fire were being executed). It was then that the eyewitness told the pilot to abort the operation and return to base. Thinking that the aircraft had flown away, he was surprised to see it appear once more, downhill from

Figure 2. Aircraft as the pilot attempts to locate the fire prior to the accident

Figure 3. Sequence of photographs taken by eyewitnesses

his position and flying near the mountain toward their position. They then saw the aircraft turn and bank sharply to the right, even reaching an inverted position, while making the drop. Immediately after this the aircraft disappeared from view and they saw the fire and column of smoke after the impact.

At no point did the aircraft's pilot report an emergency.

Below is a sequence of six photographs taken from the fire brigade's position showing how the water drop was made with the airplane practically inverted, and how it made a sharp right turn causing it to roll and descend almost vertically. This resulted in some of the water falling on top of the aircraft after the impact.

1.16.2. *Relevant accounts*

Information was obtained from pilots who worked for the same company who were experts in firefighting operations on the same type of airplane and who knew the pilot's situation.

Based on their accounts, the accident pilot had been stationed in Andalusia for two campaigns some eight years prior. After that, he had only flown in the area on limited occasions, though his desire to be stationed there was well known.

The day of the accident was his second day at the base, and he flew three missions on that day, lasting 45, 30 and 35 minutes. During the first flight he also had problems locating the fire and he had been flying over the area of the accident on the previous flight. The accident itself took place in the vicinity of the second fire after several failed attempts to locate it.

They noted that even after fighting a small fire locatable through its smoke and flames, it can be very difficult to return to the same fire if the smoke and flames are no longer visible. The fact that there is a single occupant in the aircraft makes the search for a target in highly mountainous areas even more difficult.

They also indicated that sometimes the pilot can alter his behavior based on the expectations that he assumes are placed on him or that he places on himself, resulting in stressful situations that can condition his behavior, affect his perception capability and his decision-making process.

1.17. Organizational and management information

Based on information provided by the operator, the company carried out an internal study after which a series of mitigating measures were implemented in an effort to

try to limit, insofar as possible, the conditions in which firefighting operations take place:

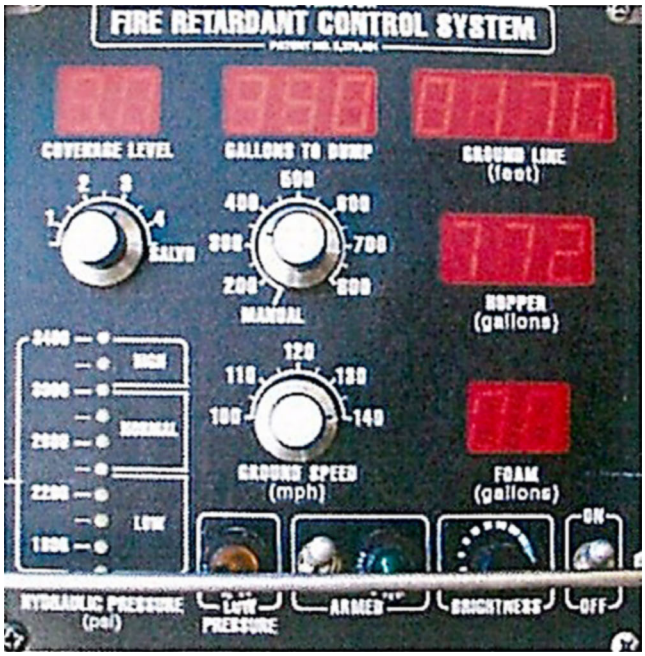
- The organization will improve its danger reporting system to include the human factors that can come into play during an operation.
- Efforts will be made to keep any internal or external forces from affecting the decision-making process.
- Since sometimes the head-on view is lost when looking for the drop point, any flights over the area will be conducted above the highest terrain elevation.
- Drops on a hillside will be made from above the highest elevation, unless the gradient is minimal and the airplane can maintain a safe climb rate even if the drop is not made.

These measures have been disseminated through meetings and discussions with the company personnel directly involved in aircraft operations.

1.18. Additional information

1.18.1. *Computerized water drop system*

From an operational standpoint, the aircraft has a computerized water drop system that hydraulically actuates a door on the underside of the aircraft. The control panel for the system is located on the left side of the instrument panel in the cockpit. The system can be used to set up various drops, going from a complete discharge to partial discharges and including low-density drops that cover more ground. Once the system is programmed and armed, the pilot only has to push the drop button located on the flight control stick.



It has two emergency drop systems, one activated hydraulically and the other pneumatically.

1.18.2. *Amount of fuel and water*

The normal procedure calls for the aircraft to take off with a fuel load between 75% and 100% (1,430 l).

The amount of water or payload, considering that the aircraft has between a 75% and 100% fuel load, depends on two factors:

- MTOW: for the aircraft at hand, this is 16,000 pounds or 7,257 kg at takeoff. As the fuel load is decreased, the payload can be increased.
- Runway length and altitude density.

Under normal conditions with 100% fuel load, the aircraft can carry approximately 660 gallons (2,500 l) of water.

With 75% fuel load, the aircraft can carry 750 gallons (2,840 l) of water.

1.18.3. *Aspects pertaining to firefighting operations and maneuvering limits*

Company's Operations Manual

Although due to the characteristics of the landing gear the airplane is authorized to land with the payload, the company's procedures do not allow it. As a result, if the airplane returns to base without having made the water drop, it will normally be released in a designated area near the base in case a new alarm is declared before the landing.

Flight Manual

The Aircraft Flight Manual contains the following in reference to firefighting operations:

- Do not fly upward at the moment the liquid is dropped on the fire.
- Maintain sufficient speed or altitude so that if the drop operation is aborted (due to the doors not opening), the airplane can climb and get out of the situation.
- Do not make sudden climb maneuvers after releasing the contents.
- Practice emergency procedures such that reactions to emergency situations are fast and automatic.
- Approach the drop site with a plan of action in mind in case the doors of the hopper fail to open.

- Maintain level flight with a constant altitude during and immediately after the drop is made.
- The cruise speeds, or when reconnoitering an area, are between 140 and 155 mph.
- The drop speed is between 125 and 135 mph.

As for the maneuvering limits:

- The load factor limit on this model without flaps and with a payload of 16,000 pounds is 2.54 positive g's. If this limit is exceeded at a speed above the maneuvering speed, structural failure can result.
- The increase in the stall speed is proportional to the square root of the load factor, meaning that at 144 mph, a 2.5-g maneuver will result in a stall.
- A 60° turn at constant altitude results in a 2-g load factor. If on top of this there is a sudden pitch-up maneuver, the aircraft is exposed to a high number of positive g's, which can increase its stall speed.

Considerations on operations to drop fire retardant

The engine power is 1,350 SHp. The engine is quick to react when starting from a torque above minimum, and if it is not carried out gradually with the controls, it can become violent.

When the fire retardant is dropped, the center of gravity shifts drastically in a short period of time.

The approach to the drop should be made so that the speed can be maintained within a suitable range of speeds, as specified in the Flight Manual, with some power to spare. An adequate drop speed is between 125 and 135 mph. A drop at this speed causes the nose of the airplane to pitch up rapidly, with an ensuing loss of speed that must be corrected quickly by the crew as per the procedures so as to make the maneuver much safer.

In light of the flight conditions and the aircraft's characteristics, the following factors must be taken into account during the drop:

- The action of increasing power causes an increase in propeller torque which, since it turns clockwise as seen from the pilot's position, increases the airplane's tendency to turn counterclockwise longitudinally. This requires compensation with the right foot to induce a right turn that will lift the left wing.
- In contrast, pulling back on the stick in an effort to raise the nose makes the airplane yaw right (same effect as applying right rudder). This is because of the gyroscopic effect that pulling back has on the plane of the propeller.

Specifically, for the situation at hand:

- The aircraft was near the hillside, which was to its left, meaning the exit route was to the right. The tendency would thus be to apply right rudder and bank right.
- The aircraft was flying low, meaning that to get out of the situation it had to climb. This implies pulling back on the stick.
- Releasing the water causes a properly trimmed airplane to suddenly pitch up. The airplane also experiences a strong and sudden increase in lift on the order of 64% with a 75% fuel load.

This almost instantaneous increase in lift requires that the airplane be trimmed again due to the change to its center of gravity. The pilot must make a series of inputs to the engine, bank and pitch controls, as well as to the rudder with his feet, all of which complicate the proper and coordinated execution of the maneuver.

1.19. Useful or effective investigation techniques

N/A.

2. ANALYSIS

2.1. General aspects

The pilot was properly qualified to fly the aircraft and had a valid and in force license, ratings and medical certificate.

Since the pilot was coming off a rest period and in light of the activity performed during the day, fatigue is not considered to have been a determining factor in the accident.

The aircraft had a valid certificate of airworthiness and had undergone all of the scheduled maintenance checks. There were no malfunctions or defects pending resolution.

2.2. Aspects involving the inspection of the wreckage

Given the layout of the aircraft wreckage, which was grouped and arranged such that the aircraft was in its normal flight position and on the heading that caused it to collide directly against the mountain, the investigation determined that the aircraft made a complete roll from the start of the drop maneuver until it impacted the terrain.

After verifying the continuity of the steering and elevator bar cables, as well as the continuity of the engine control cables, with nothing out of the ordinary being found, any type of failure involving the aircraft's control cables was ruled out.

2.3. Aspects involving the maneuver

The pilot of the aircraft did not report any emergencies on the radio.

Even though the pilot had received instructions to return to base, he returned to the area with the intention of locating the site of the fire so as to be able to make the drop. In his effort to locate the fire, and as the available images show, the aircraft was flying low between the mountains and close to the hillside.

As the aforementioned images show, at one point the aircraft was making a sharp turn to the right while at the same time making the drop. This happened more than one kilometer away from the site of the fire, meaning the drop was not made with the intention of putting out the fire. It also made no sense to make the drop there to return to the base, since according to the company's Operations Manual, the drop has to be made in a specified area near the base. The images available show that before completing the drop, the aircraft was already at an angle in excess of 90° and going into an inverted position.

Due to the aircraft's position and to the altitude at which it was flying, an evasive maneuver would require a turn to the right (move the stick to the right), an increase in the flight level (pull the stick back) and an increase in engine power. Therefore, to the right turn we must add the tendency to apply right rudder to compensate for the aircraft's longitudinal turn in the opposite direction, due to the effect of the engine torque, and the tendency of the aircraft to yaw right due to the gyroscopic effect of the plane of the propeller to try to lift the nose. All of these actions help drive the aircraft into a sharp right turn that can result in a roll.

As the images show, the aircraft was turning just as it was making the drop. This means that in addition to the above conditions, the aircraft also experienced a sudden increase in lift, which in this case served to push the aircraft toward the terrain. This means that as the aircraft started to roll, it sank to the ground.

In these circumstances, the maneuver became uncontrollable.

It may thus be concluded that both the right bank as well as the release of the water point to an instinctive reaction in response to the unexpected presence of the mountain and the pilot's perception of an imminent collision danger.

2.4. Aspects involving human factors

The fact that the pilot had encountered difficulties locating two of the targets, one of which he had flown over previously, and that the pilot was not known professionally in the area, could have driven the pilot to an emotional state in which the only thing that mattered was finding the fire and making the drop (as evidenced by the fact that he went back to the site even after being instructed to return to the base). The resulting stress could have conditioned his actions to the point that in his zeal to locate the target, he diverted his attention from his main task, which was to fly the aircraft safely, and instead flew the aircraft low and close to the ground.

Situations that should normally be accepted can nonetheless create stressful situations that condition behavior and affect one's perception and decision-making process.

3. CONCLUSIONS

3.1. Findings

- The pilot was qualified and in good condition to fly the aircraft. All of his documentation was valid and in effect.
- The aircraft had a valid and in force certificate of airworthiness and was in good condition to engage in the activity it was involved in.
- There were no emergency reports made.
- After being instructed to return to base, the pilot returned to the area with the intention of locating the site of the fire and making the drop.
- Locating the fire and making the drop became the pilot's main objective, diverting attention away from safely piloting the airplane.
- The aircraft was flying low between mountains and close to a hillside.
- The aircraft made an evasive maneuver, turning right while at the same time releasing the fire retardant.
- The conditions in which the maneuver was carried out led the aircraft to an unmanageable situation in a position very close to the ground.

3.2. Causes/Contributing factors

The accident occurred as a consequence of making an evasive maneuver in response to the proximity of the mountainside and the imminent danger of colliding against it. Contributing to this might have been the decreased attention given to piloting the aircraft, motivated by the pilot's determination to locate the fire.

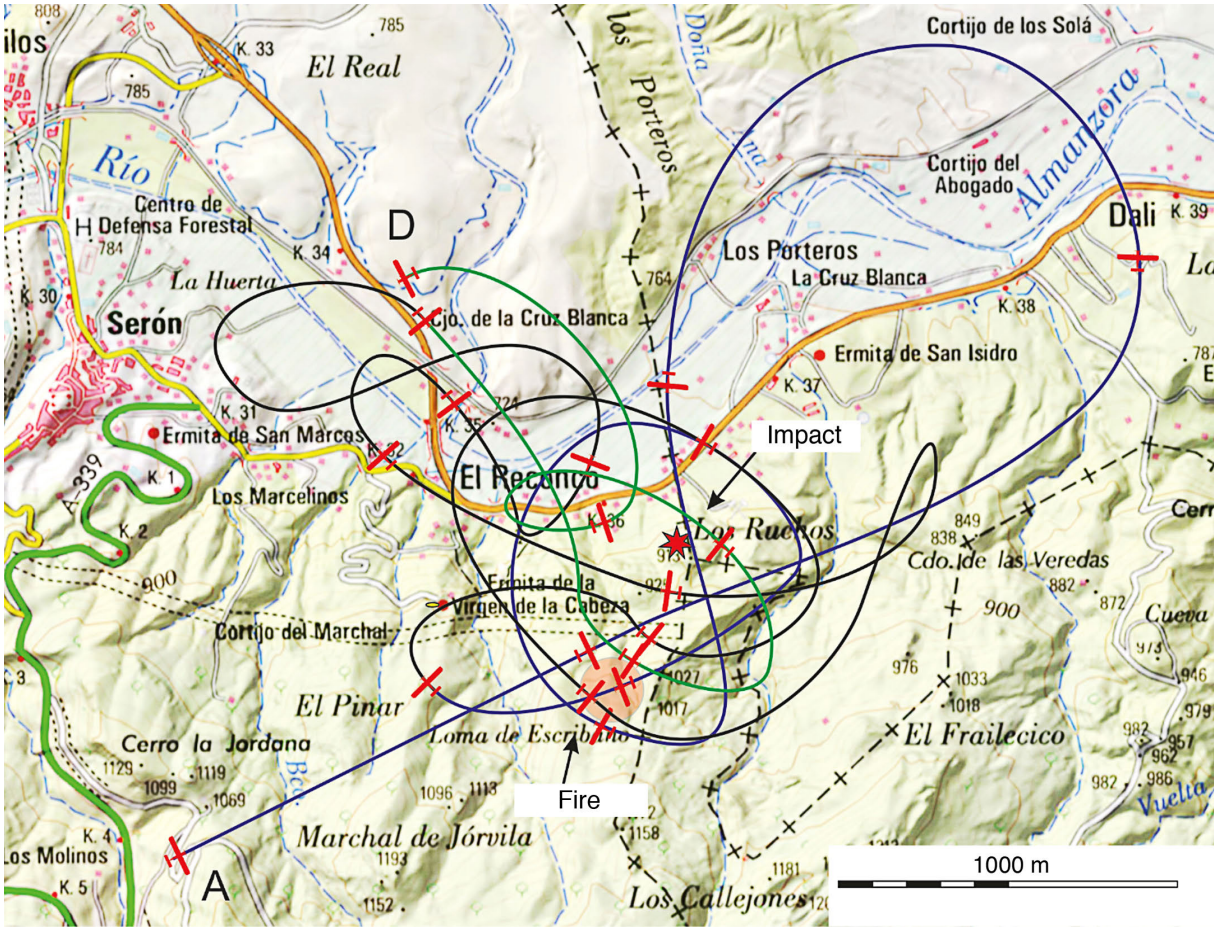
4. SAFETY RECOMMENDATIONS

None.

APPENDICES

APPENDIX 1

Flight path while trying to locate the fire



Due to the complexity of the flight path before the accident, it has been divided into three different segments to make it easier to follow: