CIAIAC

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Report A-012/2009

Accident involving a P-68 OBSERVER II aircraft, registration EC-IPG, in Sant Pere de Vilamajor (Barcelona), on 23 June 2009

GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

Report

A-012/2009

Accident involving a P-68 OBSERVER II aircraft, registration EC-IPG, in Sant Pere de Vilamajor (Barcelona), on 23 June 2009

GOBIERNO
DE ESPAÑA

MINISTERIO
DE FOMENTO

SUBSECRETARÍA

COMISIÓN DE INVESTIGACIÓN
DE ACCIDENTES E INCIDENTES
DE AVIACIÓN CIVIL

Edita: Centro de Publicaciones
Secretaría General Técnica
Ministerio de Fomento ©

NIPO: 161-10-077-1
Depósito legal: M. 23.129-2003
Imprime: Diseño Gráfico AM2000

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Tel.: +34 91 597 89 63
Fax: +34 91 463 55 35
E-mail: ciaiac@fomento.es
http://www.ciaiac.es
C/ Fruela, 6
28011 Madrid (España)

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 event and its causes and consequences.

In accordance with the provisions of Law 21/2003 and pursuant to Annex 13 of the International Civil Aviation Convention, the investigation is of exclusively a technical nature, and its objective is not the assignment of blame or liability. The investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents.

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.

Table of contents

Abbreviations

00°	Degrees true
AENA	Spain's airport and air navigation authority
AIP	Aeronautical Information Publication
ARO	Air Traffic Services Reporting Office
ATPL(A)	Airline Transport Pilot License (Airplane)
CIAIAC	Spain's Civil Aviation Accident and Incident Investigation Commission
CPL(A)	Commercial Pilot License (Airplane)
CRE(A)	Class rating examiner (airplane)
CRI(SPA)	Class rating instructor (Student Pilot Airplane)
CRM	Cockpit Resource Management
DGAC	Spain's civil aviation authority
FE(A)	Flight examiner (airplane) rating
FI(A)	Flight instructor (airplane) rating
FIE(A)	Flight instructor examiner (airplane)
ft	Feet
h	Hour(s)
HP	Horsepower
hPa	Hectopascals
IRE(A)	Instructor Rating Examiner (Airplane)
JAR-FCL	Joint Aviation Regulations - Flight Crew Licensing
kg	Kilogram(s)
KIAS	Indicated airspeed in knots
km/h	Kilometers per hour
kt	Knot(s)
l	Liter
m	Meter(s)
m^3	Cubic meter
METAR	Meteorological Aerodrome Report
MHz	Megahertz
mm	Millimeter(s)
N	North
NM	Nautical miles
PPL(A)	Private Pilot License (Airplane)
QNH	Barometric altimeter setting referenced to sea level
REC	Recommendation
rpm	Revolutions per minute
SCT	Scattered (partial cloud cover of 3 to 4 oktas)
TMA	Terminal Management Area
UTC	Coordinated Universal Time
VFR	Visual flight rules
VMC	Visual Meteorological Conditions
W	West

Synopsis

Owner and operator:	GAVINA
Aircraft:	VULCAN AIR P-68 OBSERVER II
Date and time of accident:	23 June 2009; 10:45 (local time)[1]
Place of accident:	Sant Pere de Vilamajor (Barcelona)
Persons onboard and injuries:	Two (2), deceased (instructor and student)
Type of flight:	General Aviation – Instructional – Check
Date of approval:	28 April 2010

Event summary

The airplane, a VULCAN AIR PA-68-OBSERVER 2, registration EC-IPG, had taken off from Sabadell airport to conduct a local flight.

Onboard were the instructor and a pilot who was being tested for a CRI (SPA) (Class Rating Instructor).

As they were flying over the town of Sant Pere de Vilamajor (Barcelona), the aircraft plunged to the ground, falling within the property limit of a private dwelling (a chalet).

Several eyewitnesses reported that they stopped hearing the engine noise and that they then saw the airplane spinning in a nose down attitude.

The front part of the airplane (cockpit) impacted the ground first. The crash resulted in a fire, the flames from which reached a part of the aircraft and an arbor next to the house, but not the house itself, though it was affected by the smoke.

The two occupants perished immediately and were trapped inside the airplane. They were extracted by emergency personnel.

The aircraft was destroyed by the impact and subsequent fire.

The post-accident inspection did not reveal any signs of a fault or malfunction of any aircraft component.

It has been determined that the accident resulted from a stall caused by flying the aircraft at a low speed.

It has also been concluded that there were three contributing factors: the low altitude, the very likely possibility that the crew did not establish guidelines for action prior to the flight and the absence of an authority gradient between the crew members.

[1] Unless otherwise specified, all times in this report are local. To obtin UTC, subtract 2 hours from local time.

1. FACTUAL INFORMATION

1.1. History of the flight

The airplane, a VULCAN AIR PA-68-OBSERVER 2, registration EC-IPG, had taken off from runway 13 at Sabadell airport at 10:26.

Onboard were an instructor and a pilot who was being tested for a CRI(SPA) (Class Rating Instructor)[2].

The pilot who was being tested had filed a flight plan for a local flight at the airport's ARO office. The scheduled duration was one hour.

At 10:29, they reported being 5 NM away from the field, at which time they were transferred to the ACC Barcelona frequency (125.250 MHz).

As they were flying over the town of Sant Pere de Vilamajor (Barcelona), the aircraft plunged to the ground near kilometer marker 45 on road BP-5107, falling inside the property of an individual dwelling at coordinates 41° 40′ 28″ N – 2° 23′ 16″ E and an elevation of 281 m. The airplane's longitudinal axis was oriented at 40° with respect to magnetic north.

Several eyewitnesses stated that they saw the airplane flying at a low altitude, and how they suddenly stopped hearing the engine sounds. They then saw the airplane spin in a nose down attitude.

Figure 1. Airplane trajectory and accident site[3]

[2] Rating regulated by Order FOM/876/2003 of 31 March, published in the government bulletin of 15 April 2003.
[3] Radar trace superimposed on image taken from Google Earth.

The last radar position recorded was at coordinates 41° 40′ 37″ N – 2° 23′ 22″ E. At that instant the ground speed as recorded by radar was 40 kt. The altitude information was not recorded. Immediately prior to the last position the radar had recorded an altitude of 2,700 ft.

The front of the airplane (cockpit) impacted the ground first. A fire broke out as a result of the crash, affecting the aircraft and a small arbor located 6 m forward of the crash site. The flames did not reach the house.

Both occupants died on impact. Their bodies were trapped inside the airplane and had to be extracted by emergency personnel.

The aircraft was destroyed by the impact and subsequent fire.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	2		2	
Serious				
Minor				Not applicable
None				Not applicable
TOTAL	2		2	

1.3. Damage to aircraft

The airplane fell on the property of a private dwelling, next to its north face, on a trajectory coming in from the southwest. The wreckage was confined to a small area and the longitudinal axis was facing northeast, at a 40° angle to magnetic north. There were no drag marks on the ground.

The right wingtip struck the top part of a porch situated on the north side of the house, breaking four tiles.

The front part of the aircraft showed significant impact damage. The cockpit, which was fully enclosed in glass, was practically destroyed.

There was considerable damage along the front half of the fuselage, affecting the underside. The rear half was mostly undamaged.

Figure 2. Photograph of the aircraft after the impact

The rear section of the airplane was resting on the ground. The horizontal stabilizer was touching a tree and did not show any significant impact damage.

The engines impacted the ground and were severely damaged. The blades on both propellers, however, were in one piece and were not significantly damaged.

After the crash a fire broke out that affected the cockpit, the wing and the engines. The fire spread to the rear, reaching the halfway point on the fuselage and just into the tail cone, which was affected by the smoke.

1.4. Other damage

The roof of the porch on the north side of the house was damaged when it was impacted by the aircraft's right wing tip.

The fire that broke out immediately following the crash caused damage to the garden and also burned a wooden arbor and a cloth awning situated 6 m forward of the impact site. The space between said arbor and the airplane, however, was not burned, nor were there any signs of fire damage, meaning it is not likely that the fire spread to the arbor on the ground, but rather resulted when an incandescent component was ejected from the wreckage and fell atop the awning. Both the porch and the house proper were severely affected by the smoke.

1.5. Personnel information

1.5.1. *Examiner*

The examiner was 34 years old and was seated in the LH seat. He had a commercial pilot license, CPL(A), and was current on the Airline Transport Pilot License (ATPL(A)) course since 1996. He had also held a flight instructor rating, FI(A), since 1999, as well as the flight examiner, FE(A), instrument flight examiner, IRE(A), class examiner, CRE(A), and flight instructor examiner, FIE(A), ratings since 2002.

He had logged a total of 5,686 flying hours, of which 4,229 had been as the pilot in command in single-pilot airplanes. The rest had been in multi-pilot airplanes. He also had 149 simulator hours. He had 155 h on the type. Most of his professional activity had involved flying as an instructor, and periodically also as an examiner. From April 2006 until late 2008 he had flown as a BOEING 737 copilot for two major airlines.

At the time of the accident, he was the Director of Aerial Operations and Work at the company that owned the aircraft, which was involved in commercial activities that included oblique photography, vertical photography, surveillance and patrol and advertising without banner towing (flyers dropping and decorated aircraft).

1.5.2. *Pilot*

The pilot being tested was 38 years old and was seated in the RH seat. He had been in possession of a private pilot license, PPL(A), since 1994, a commercial pilot license, CPL(A), since 1995 and an airline transport pilot license, ATPL(A), since 2003. He was also type rated on the B757/767 and had the type rating and flight instructor rating, IR(A), for the PA46.

He had a total of 6,689 flying hours, of which 5,348 had been as a pilot in command and the rest as copilot. He had flown on several airplane types with jet, turboprop and piston engines. He had 9:30 h on the type.

He had started in the aviation profession as an aircraft maintenance technician. He then obtained experience first in general aviation and then on passenger airplanes, having worked first in executive aviation before moving on to passenger transport onboard the FOKKER 100, where he gained most of his experience. He had also held the post of operations supervisor and head of operations at two different companies.

1.6. Aircraft information

The aircraft belonged to an operator who occasionally rented it out for check flights and for private general aviation flights.

1.6.1. *General characteristics*

The VULCAN AIR P-68 OBSERVER II, registration EC-IPG, was manufactured in 2003 with serial number 421. Its maximum takeoff weight was 2,084 kg and it had a valid airworthiness certificate.

It is a high-wing aircraft with a capacity for six occupants. It was outfitted with two LYCOMING IO-360A1B6 engines that generated 200 HP at 2,700 rpm. They were located on either side of the fuselage below the wing.

It had a wingspan of 12 m, a length of 9.43 m and a height of 3.40 m.

The crew sat in the forward part of the cabin which, except for the nose cone, was fully enclosed in glass, as shown in the picture in Figure 3.

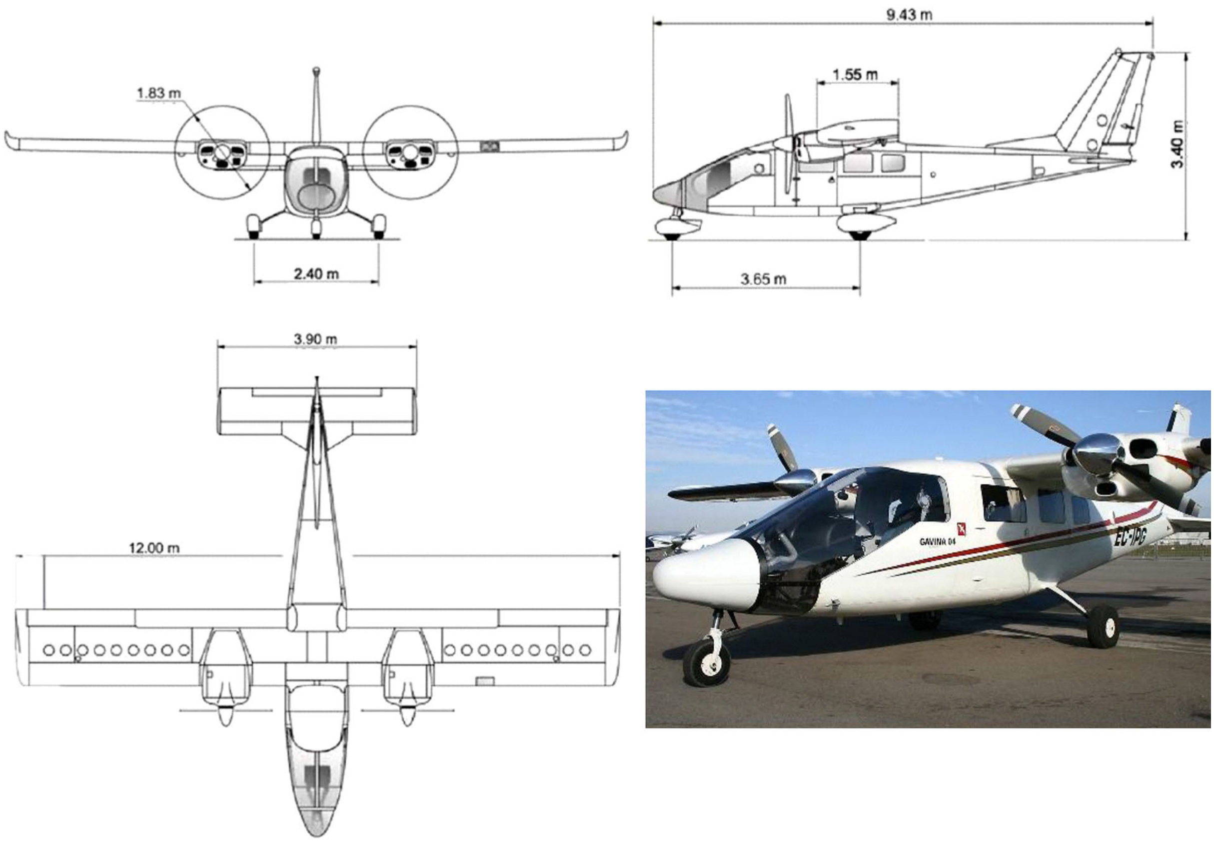


Figure 3. Views of airplane and photograph prior to accident

1.6.2. *Fuel system information*

This airplane type has two fuel tanks, one in each wing, with a total capacity of 538 l, of which 18 l are not usable.

The fuel flows from the tanks to the engine by way of two selector valves that govern the direction of flow. Each valve has three positions, one to cut off the fuel, a normal position (with each engine being supplied from its same-side tank) and a crossfeed position (in which the engine is supplied by the opposite-side tank), as shown in Figure 4.

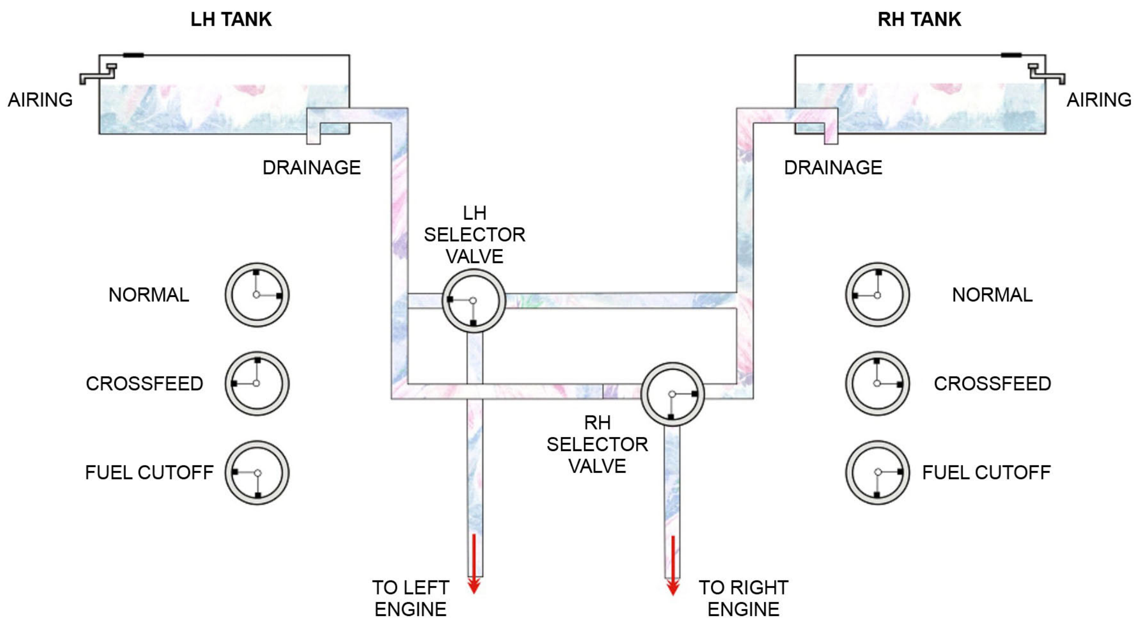


Figure 4. Fuel system diagram

The valves are symmetrical with respect to the airplane's longitudinal axis, meaning that either can be installed on either side. There is a rotating spindle inside each of the three-way valves that can be aligned into one of four different positions, and which can close off one or two of the flow paths, giving rise to one of the three possible valve positions. The valve's state is indicated by a circular metal piece that protrudes from the back and which has a right-angled shape. It can be placed in the first, third or fourth quadrants for the left engine or in the first, second and fourth quadrants for the right engine, corresponding to each of the three positions available. Figure 5 shows the different valve positions as seen from the back (red circle), and the two flow paths that can be closed in each position as seen from the front (red arrows).

The fuel flow mode is selected in the cockpit through the use of two knobs located in the overhead panel, which can be set to any of the three positions described above (see Figure 6).

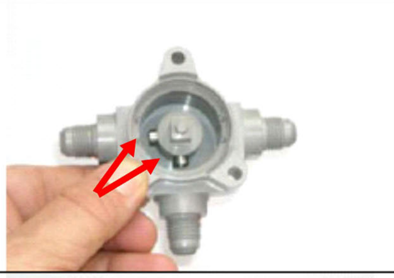
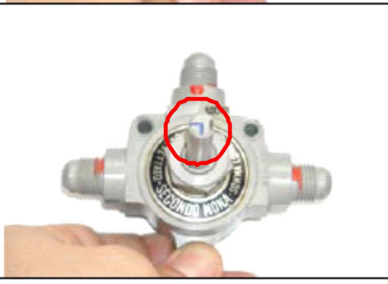
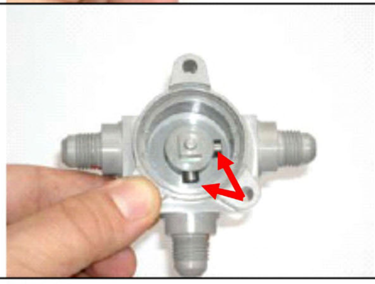
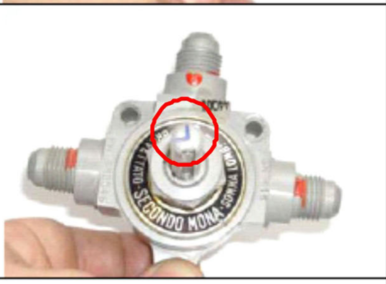
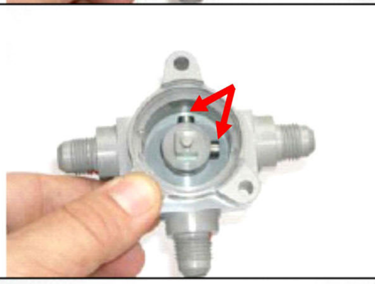
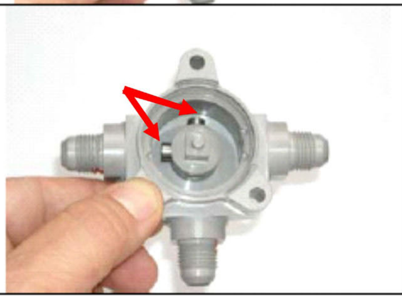
	REAR VIEW	FRONT VIEW	LEFT VALVE	RIGHT VALVE
1				RIGHT ENGINE CUTOFF
2			LEFT ENGINE CUTOFF	
3			CROSSFEED RIGHT TANK FEEDING LEFT ENGINE	NORMAL POSITION RIGHT TANK FEEDING RIGHT ENGINE
4			NORMAL POSITION LEFT TANK FEEDING LEFT ENGINE	CROSSFEED LEFT TANK FEEDING RIGHT ENGINE

Figure 5. Valve positions

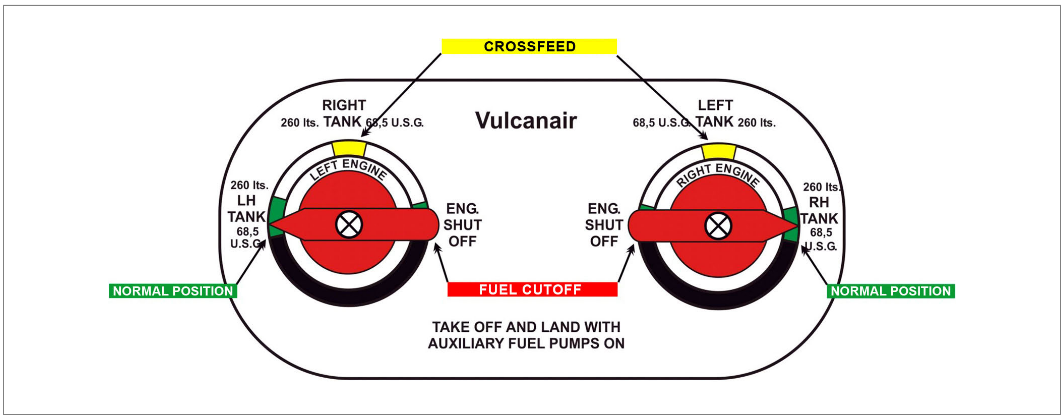


Figure 6. Fuel selected knob

1.6.3. *Emergency procedures*

Section 3 of the Flight Manual describes the Emergency Procedures. Item 3.5 specifies the actions to take in the event of an in-flight engine failure, as shown below:

(a) Directional control	Maintain (Pull back throttle on operative engine if necessary to maintain control)
(b) Speed	Reach minimum 92 KIAS
(c) Trim	Adjust
(d) Inoperative engine	Identify and verify
(e) Air start	Attempt
If not possible	
(f) Engine securing procedure	Completed
(g) As soon as possible	Land

Item 3.6 describes the procedure for securing the engine in flight.

(a) Throttle	Pull back
(b) Propeller	Feathered
(c) Mixture	Cutoff
(d) Fuel selector valve	Cutoff
(e) Alternator switch	Off
(f) Auxiliary fuel pump	Off
(g) Magneto switch	Off
(h) Electrical load	Decreased
(i) Crossfeed	As required

Item 3.7 specifies the procedure for starting an engine in flight.

(a) Fuel selector valve	Selected
(b) Magneto switch	On
(c) Auxiliary fuel pump	On
(d) Throttle	Forward
(e) Propeller	Full forward

(f) Mixture	Rich until fuel flow indicated, then pull back.
(g) Ignition switch	Press. When the engine starts, release ignition switch and set mixture to rich.
(h) Auxiliary fuel pump	Off
(i) Alternator	On

A final note warns that if the engine fails to start, the magneto switch on the inoperative engine must be turned off, the mixture cut off, the throttle opened fully and the ignition switched on for several revolutions. The air start procedure is then repeated.

Item 3.20 in the Flight Manual, emergency procedures, prohibits spins in this airplane. If, however, an inadvertent spin occurs, the pilot can exit from the spin and regain control of the airplane by performing the following procedure:

(a) Pull both throttle levers back to the idle position

(b) Apply yaw control opposite the spin direction

(c) Push the control column full forward

(d) Keep the controls in that position until the rotation stops and then center the rudder

(e) Recover airplane attitude by pulling back gently on the yoke. Movements during these maneuvers must not be sudden since the load factor may be excessive.

The manual warns that the airplane has not been flight tested during spins, and that the above recommendations are based on theoretical studies.

1.6.4. *Performance. Stall speeds*

The airplane stall speeds contained in the flight manual are shown in the tables below:

Max weight	Flaps	Inclination lateral			
		0°	20°	40°	60°
2,084 kg	0°	69	71	80	99
	15°	65	68	75	92
	35°	62	64	71	88

Max weight	Flaps	Inclination lateral			
		0°	20°	40°	60°
2,000 kg	0°	68	70	78	97
	15°	64	67	73	91
	40°	61	63	70	85

Max weight	Flaps	Inclination lateral			
		0°	20°	40°	60°
1,900 kg	0°	66	68	76	94
	15°	62	64	72	88
	35°	59	61	78	83

Max weight	Flaps	Inclination lateral			
		0°	20°	40°	60°
1,800 kg	0°	64	66	74	91
	15°	61	62	70	86
	40°	58	60	67	81

Max weight	Flaps	Inclination lateral			
		0°	20°	40°	60°
1,700 kg	0°	62	64	72	89
	15°	59	61	68	84
	35°	56	58	65	79

Max weight	Flaps	Inclination lateral			
		0°	20°	40°	60°
1,600 kg	0°	61	62	69	86
	15°	57	59	66	82
	40°	55	57	63	77

1.6.5. *Information on the use of the flaps*

The flight manual specifies that the flaps are to be deployed during the climb (15°) until the clearance height is reached, during landing (15° below 161 KIAS or 35° below 111 KIAS) and for slow flying.

1.6.6. *Weight and balance calculation*

An attempt was made to find out how much fuel was onboard the airplane so as to perform the weight and balance calculation, but the amount could not be determined with any certainty.

The data available were not very reliable and indicate that the airplane had between 60 and 150 l of fuel at the time of the accident. In that range, the weight calculation yields values of between 1,655 kg and 1,720 kg, below the maximum authorized. In that range, its center of gravity would be within design limits.

1.7. Meteorological information

The 10:00 Barcelona airport METAR indicated the wind was from 220° at 4 kt, varying between 170° and 270°, visibility in excess of 10 km, few clouds at 1,500 Ft and SCT at 3,500 ft, temperature 22° and QNH 1,016 hPa.

The 10:30 Barcelona airport METAR forecast wind from 200° at 5 kt, varying between 150° and 240°, visibility in excess of 10 km, few clouds at 1,500 ft and SCT at 3,500 ft, temperature 22° and QNH 1,016 hPa.

Meteorological conditions over the accident site were VMC, with the wind from 230° at 7 kt.

1.8. Aids to navigation

Not applicable to the investigation.

1.9. Communications

The crew was in radio contact with the Sabadell airport tower during the taxi and after-takeoff phases. Nothing out of the ordinary was noted. The crew reported that they were going on a local flight in the area of Granollers.

The last contact took place when the crew reported being 5 NM away from the field after takeoff (10:28:58). The tower transferred them to frequency 125.25 MHz and signed off (10:29:03), which the crew acknowledged before signing off (10:29:07).

There were no further communications or emergency calls prior to the accident, which took place at around 10:45.

1.10. Aerodrome information

Not applicable to the investigation.

1.11. Flight recorders

The airplane did not have conventional flight recorders, since it was not required by aviation regulations to have them given its characteristics.

However, the engines did have a data recording system that allowed for certain parameters to be logged, processed and displayed electronically. This system only worked if activated and programmed by the crew prior to the flight. Although the system's data processing units were recovered, it was not possible to obtain any information from them.

The airplane also had two identical navigation and communications units with a built-in GPS receiver. An analysis of these units by the equipment manufacturer revealed that no data had been recorded in their memories.

1.12. Wreckage and impact information

The aircraft hit the ground at about a 30° angle with respect to vertical. The cockpit impacted first, followed by the underside of the fuselage. Last was the vertical stabilizer, which came to rest against a short palm tree. There were no drag or rotation marks on the ground, and none of the airplane's important structures detached during the impact.

The cockpit was completely destroyed on impact. The instrument panel was heavily damaged. Only the two navigation and communications units retained a certain degree of integrity.

A fire broke out after the impact, which spread over the length of the wing and fuselage, affecting mainly the entire cockpit area and, to a lesser extent, the rest of the fuselage and the aft portion, which only suffered minor smoke damage.

The wing was practically destroyed by the fire. The few remaining parts showed accordion-shaped folds from the leading edge back, resulting from the compression stress of the impact. The flap on the right wing was almost intact and was deployed 15°. The aileron was destroyed in the fire. The aileron on the left wing was preserved, but the flap area nearest the aileron was charred over 70% of its surface.

Figure 7. Condition of the wreckage

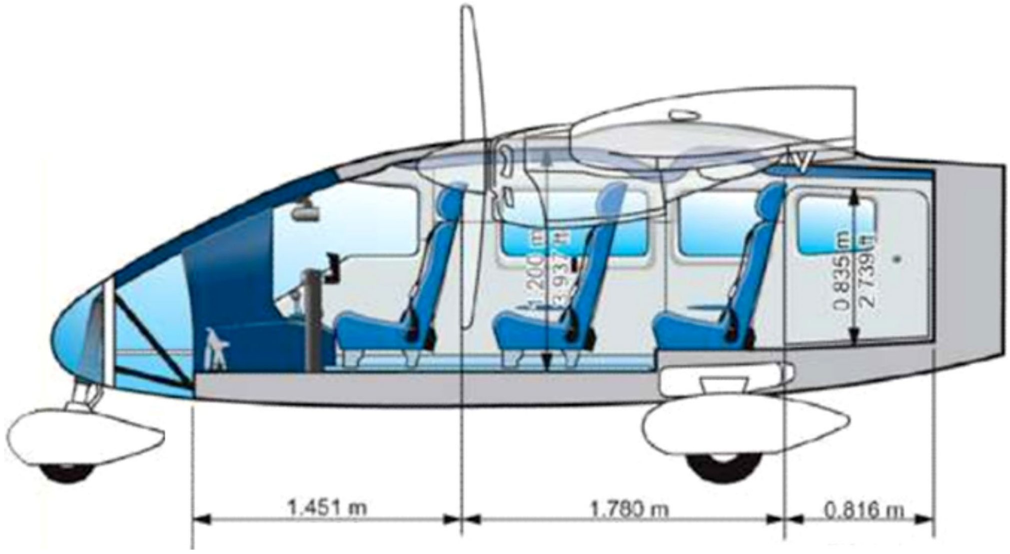


Figure 8. Area affected by the fire

The tail assembly was in one piece and did not show any significant impact damage. It was not directly affected by the fire, though it was exposed to the smoke that originated during the fire. Both the rudder and the elevators were verified to move freely.

The main gear legs were crushed against the ground. The right wheel remained in place, but the left was ejected and landed next to the right wing tip. The nose wheel was under the remains of the cockpit. It was the only wheel affected by the fire, though it did not burn completely.

Both engines had severe impact damage but all of their parts remained attached.

The post-accident inspection did not reveal any damage that might have existed prior to the impact.

The levers in the cockpit were destroyed and their condition could not be checked.

During the investigation the two carburetors were disassembled and the position of the rods that regulate the inlet disc valve were checked in order to determine the position of the throttle lever. In both cases it was found that the rods were at an angle that would indicate that the throttles on the two engines were near the idle position.

A similar effort was made to attempt to determine the status of the mixture controls, checking the position of the slot that house the pins on the servo mechanism. The slot on the left carburetor was in a position that indicated that the mixture was close to its "rich mixture" setting. The servo mechanism had detached following the impact, however, so its position may have shifted after detaching.

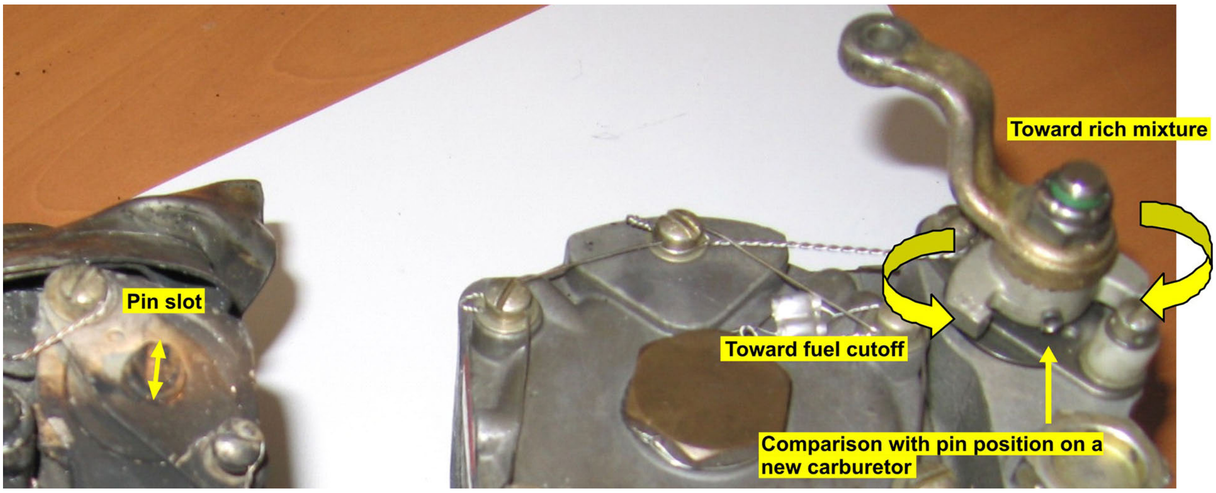


Figure 9. Condition of mixture in left carburetor

In the right engine carburetor, the pin slot was in a more intermediate position, but closer to the cutoff position. The servo mechanism had also broken off, meaning that, as in the left carburetor, it is impossible to say with any certainty what its position was prior to impact.

There was no damage to the two left propeller blades. One of the right propeller blades was also undamaged and the other was bent slightly backwards. They were all in the same, minimum pitch position (short pitch or low pitch).

The regulating linkages on both propellers were in place and were undamaged. Their position corresponded to that of minimum pitch (maximum engine rpm's) for both propellers.

The overhead area of the cockpit that housed the fuel selector knobs was slightly damaged by the impact. The left engine flow valve was selected to its normal position (left tank feeding the left engine) and the right was in an intermediate position between normal (right tank feeding right engine) and crossfeed (left tank feeding right engine).

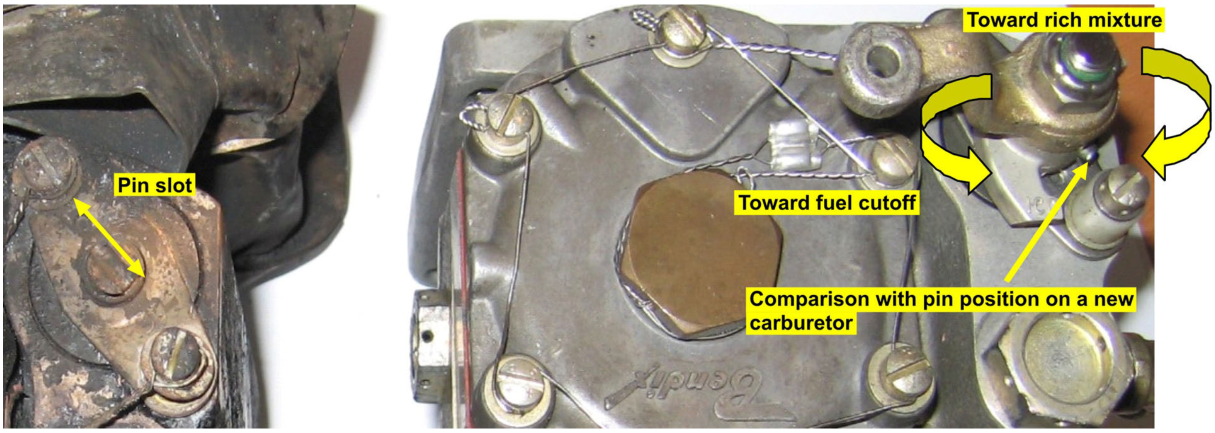


Figure 10. Condition of mixture in right carburetor

Figure 11. Fuel selector knobs

1.13. Medical and pathological information

The autopsy determined that both occupants died from the violent nature of the accident. The bodies exhibited multiple skull fractures with loss of encephalic matter, multiple facial injuries and deformities, a broken back and broken upper and lower limbs.

The cause of death was traumatic shock from a high energy impact resulting in the destruction of organs essential to life.

1.14. Fire

A fire broke out immediately after impact that spread to the wings and back through the fuselage. The fire charred a large portion of the wings and all of the cockpit area, affecting to a lesser extent the rear of the fuselage and the tail cone. The inspection of the wreckage conducted shortly after the accident revealed that no fuel had spilled on the ground.

Eyewitnesses used a garden hose and some small branches that had been torn from nearby trees to douse the flames of the wreckage. Firemen then quenched the burned area with two applications from a 25 mm hose, before covering the area with foam to prevent a possible flaring up of the fire.

The ground closest to the airplane was not affected by the fire. A wooden arbor and a cloth awning situated 6 m forward of the point of impact were completely burned, undoubtedly as the result of a burning component being ejected forward from the wreckage and landing on the awning, since the ground between the airplane and the arbor was not burned. The house was not reached by the flames, though smoke did affect the porch and the entire north wall of the house.

The fire brigade that responded to the scene to aid in the firefighting efforts reported that the fire that broke out after the impact had been of small proportions.

1.15. Survival aspects

The aircraft occupants were wearing their seat belts, though they did not cushion the blow, given the severity of the impact.

The bodies were trapped in the wreckage and had to be extracted by firefighters, who had to resort to special tools to remove the bodies.

1.16. Tests and research

As part of the post-accident inspection, the fuel selector valves, which regulate the fuel flow to the engines, were disassembled.

Neither of the two valves exhibited external fractures, though both had been discolored by the fire. The right valve had detached from its support.

The rotating spindle on both valves was in the same position (see Figures 12 and 13), which would correspond to the fuel cutoff position in the right valve and with none of the three allowed positions for the left.

The two valves were sent to the manufacturer for laboratory analysis to determine whether they had sustained any internal damage. The purpose of this was two-fold: to try to ascertain why the spindle on the left valve was not in one of the three allowed positions; and to verify that the right valve was in fact in the cutoff position, since such a position did not correspond with that selected in the cockpit.

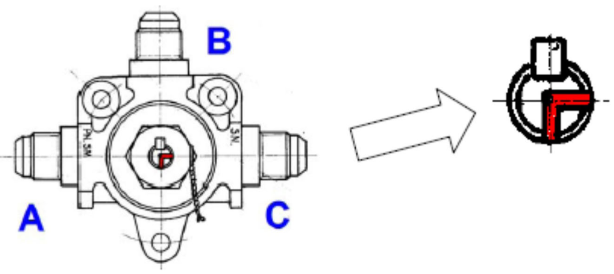


Figure 12. Position of valve shaft

The disassembly of the left valve showed that it had been greatly affected by the fire, particularly the gaskets. It was also noted that the internal ring was burned and that fragments had detached from it. The control cable was also burned and scratched. Some of the gear teeth were broken.

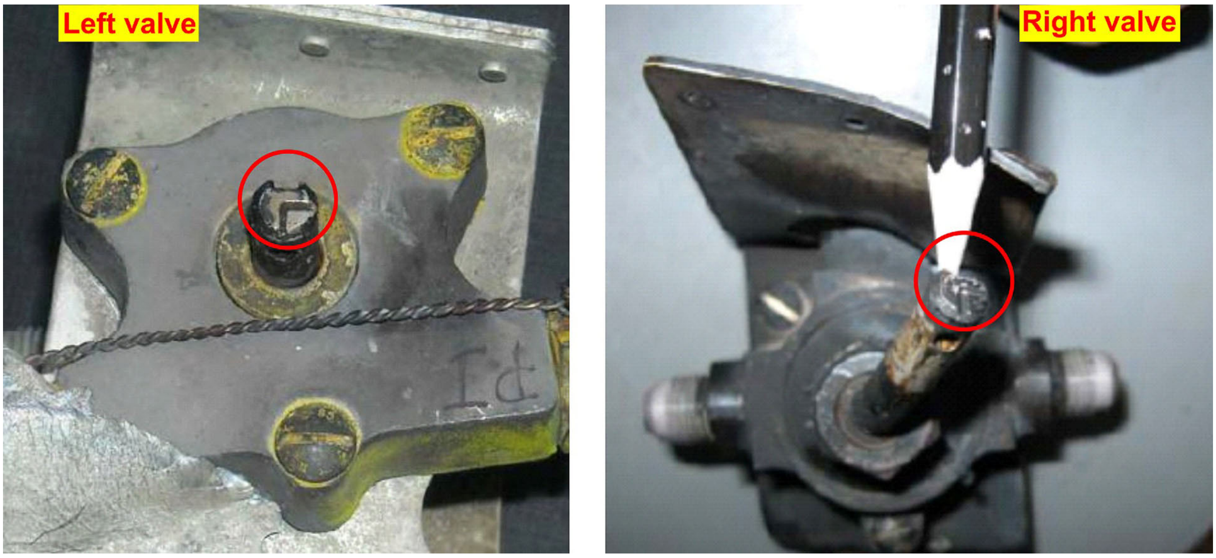


Figure 13. Photographs of the valves, as seen from behind

The right valve was also disassembled. The threaded parts were loose, probably as a result of the high temperatures reached in the post-accident fire. All of the internal components were in good condition.

The analysis confirmed that the position of both valves' rotating spindles was as described above. It also concluded that the spindle on the left valve had become stuck and that the gasket had moved out of the selected position as a consequence of the sharp pull on the control cable during the impact, which would explain why it was found in a position that was not selectable under normal operations.

The tests conducted on this valve revealed that on occasion, there was only partial flow between the different ports on the valve.

With regard to the right valve, it was confirmed that it was in the fuel cutoff position, and that the discrepancy between this position and that selected in the cockpit was probably due to the damage caused by the impact to the part of the cockpit where the selector knob was located.

1.17. Organizational and management information

Nor applicable.

1.18. Additional information

1.18.1. *Performance requirements during CRI (SPA) rating check*

The conditions for the conduct of the class rating instructor (CRI (SPA)) skill test are regulated in Subpart H of Order FOM/876/2003 of 31 March, published in Spain's State

Bulletin on 15 April 2003. This order partially modified that of 21 March 2000, which adopted the joint aviation requirements for flight crew licensing (JAR-FCL) for conditions relating to the exercise of the pilot's functions on civil airplanes, specifically Section 1.375 (privileges), 1.380 (requirements) and 1.385 (revalidation and renewal). The contents of the check are listed in Appendix 2 to JAR FCL 1, 1.330 and 1.345 (Sections 2, 3, 5 and 7). These sections discuss the pre-flight briefing, the flight itself, multi-engine airplane exercises and the post-flight de-briefing, respectively.

The pilot being tested met the pre-requisites for doing the airplane exercises required by the regulation in Sections 1.380 and 1.385.

The section on multi-engine exercises requires handling this type of airplane following an engine failure immediately after takeoff, on approach and on go-around with one engine out, as well as doing an approach and landing with one engine out.

The regulation does not specify whether the exercises are to be conducted by stopping an engine or by running it at minimum power (idle), though the investigation revealed that it is a fairly widespread practice to actually stop the engine instead of simulating it stopped.

There is also no manual approved by the aviation authority for use by examiners that can serve as a guide for the conduct of the various examinations and checks, and that systematically establishes the specific maneuvers to be performed in each case and the conditions under which to execute them.

1.18.2. *CIAIAC recommendations on low altitude maneuvers*

The CIAIAC has issued some recommendations following investigations involving situations that combined in-flight engines stoppages during the performance of low-speed and low-altitude maneuvers.

Along these lines, the following recommendations were issued in 2003:

REC 08/2003. It is recommended that Spain's Civil Aviation Authority establish directives and limitations on those training maneuvers that involve an engine stoppage, especially as refers to the minimum altitude and the phase of flight during which said stoppages are permitted (reference Report A-035/1998).

REC 28/2003. It is recommended that flight academies and instructors emphasize, during dual-control training flights, the mortal risk of entering an unrecoverable nose dive that is posed by flying at low speeds and altitudes, in particular when making even slight turns. To this end, it might be advisable to practice entering in and recovering from not just commanded nose dives, but also involuntary nose dives that initiate during low-speed turns (reference Report A-10/2003).

REC 29/2003. It is recommended that flight academies and instructors develop in their students the ability to recognize in time a developing in-flight situation that poses an imminent risk of death, such as low-speed and low-altitude flying. The aim is to anticipate the possible emergencies associated with each situation so as to avoid having to rely entirely on reflexes by looking for alternatives when faced with a difficult flight situation, giving priority to personnel safety over the integrity of the glider (airplane) (reference Report A-10/2003).

1.18.3. *VFR procedures in the Barcelona TMA*

The VFR procedures for the Barcelona TMA as specified in the AIP published by AENA establish a flight altitude limit of 4,500 ft in the area where the accident took place. In the area to which the crew reported they were heading (Granollers), this limit was even lower, specifically, 3,500 ft.

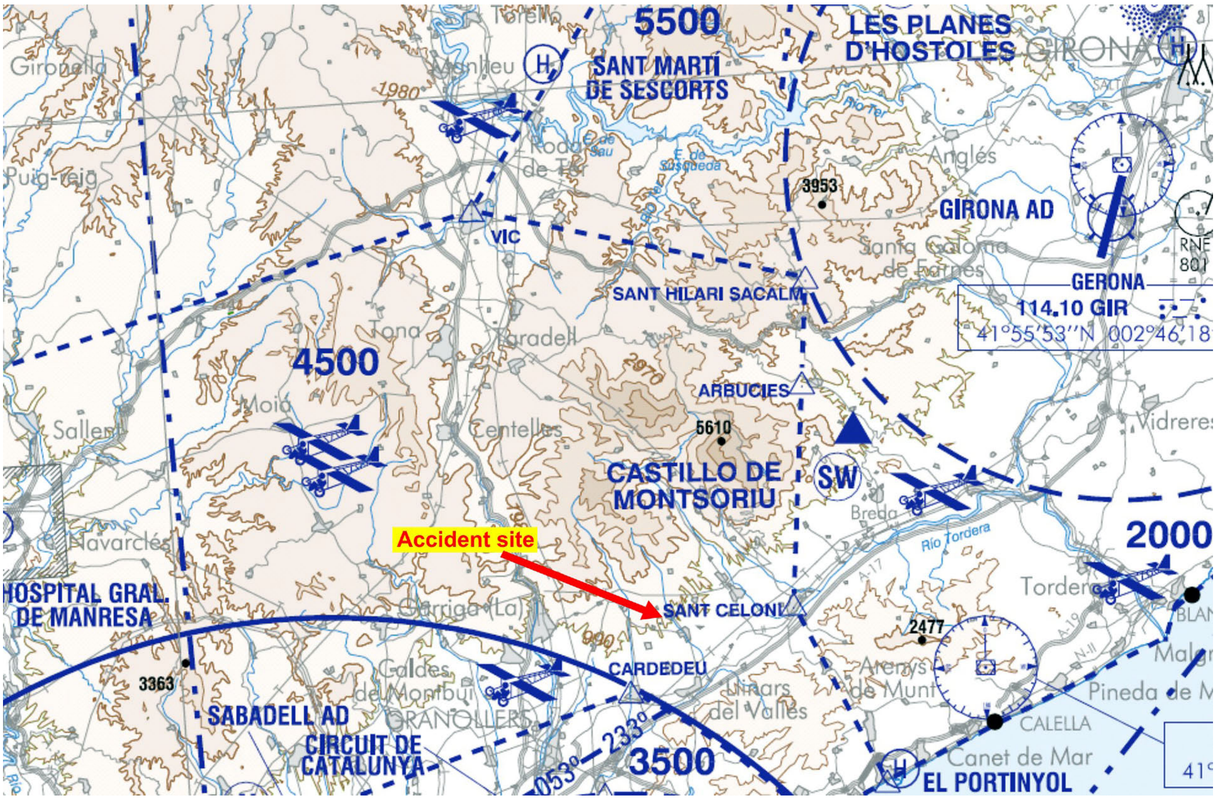


Figure 14. VFR procedures chart for the Barcelona TMA

Further to the north of the area where they were flying when the accident occurred, specifically in the triangle formed by Sant Hilari Sacalm, Vic and Santa Bárbara de Prunedes, the minimum flight altitude rose to 5,500 ft. The altitude limit disappeared altogether to the west of this area.

1.19. Useful or effective investigation techniques

No special investigation techniques were used.

2. ANALYSIS

2.1. Analysis of technical aspects

The airplane's final resting position after the impact and the complete absence of drag marks on the ground indicate that the aircraft hit the ground without any translational speed, and that the forward section impacted first while slightly inclined to the right, in other words, in a nose-down attitude and with a very moderate bank angle. There were no signs on the ground to indicate that the airplane was spinning at the time of impact.

The fire that broke out after the impact was very minor, since the eyewitnesses managed to extinguish it in just a few minutes using only a garden hose and some tree branches. The report drafted by the fire fighters who responded to the scene of the accident also confirmed the insignificance of the fire.

The exact place where the airplane fell (a grass lawn), without any combustible material around, indicates that most of the material that burned immediately after the fire started was in fact the airplane's own fuel. This would suggest that it was probably not carrying much fuel in its tanks, since otherwise the fire erupting following such a high-energy impact would have been of greater proportions.

The calculations performed indicated that the airplane's fuel tanks were between 11% and 27% full.

The state in which the propellers on both engines were found, without any visible structural damage and with barely any deformations of the blades, indicates that the airplane impacted the ground with the blades turning at low or no rpm's, meaning that the engines were either stopped at the time of the crash or at least running at very low power. The fact that one of the blades on the right propeller was curved slightly backwards is also consistent with an impact with a slight bank to the right, as described earlier.

A detailed inspection of the wreckage revealed that the position of the governor linkages on both propellers corresponded to the minimum blade pitch angle (maximum engine rpm's). According to the flight manual, this pitch angle should be used for takeoff, landing and for any maneuver involving low-speed flying.

The analysis of the carburetors indicated that the throttles on both engines were near their idle settings.

By studying the position of the pin slots in the carburetor servo mechanisms, it was determined that the left engine fuel mixture was set to rich, while the right engine was set to an intermediate position, though closer to a lean mixture. However, the actual mixture settings cannot be known for certain since part of the mechanism had been torn off.

As for the fuel system configuration mode, there were discrepancies between the as-found positions for the knobs on the cockpit used to set the fuel flow and the valves that direct the flow to each of the engines.

The fuel flow knob for the right engine was in an intermediate position between normal (right tank feeding the right engine) and crossfeed (left tank feeding the right engine). The valve itself was in the fuel cutoff position.

As for the left engine, its cockpit control was in the normal position (left tank feeding the left engine), whereas the valve was not in any of the three positions allowed.

One explanation for this fact is that the area where the knobs are located in the cockpit had been slightly damaged by the impact, especially in the vicinity of the knob for the right engine, such that the position indicated by this knob was not reliable. The position of the knob for the left engine (normal) is considered reliable.

As for the valves, the one for the right engine showed no external or internal damage, meaning that its position (cutoff) was as determined by the laboratory analysis. The interior of the left valve, however, especially the gaskets, was significantly damaged by the impact, meaning that its position, which did not agree with any of the three possible settings, had resulted from the fracture of the spindle housed in its interior. This could also explain the partial flow noted between the different ports on the valve during some of the tests that were conducted.

Based on the above, then, the most reasonable explanation found to account for the way in which the events unfolded is as follows:

The airplane was flying at a low altitude (below 300 m) when, perhaps as part of the examination, the instructor may have attempted to put the airplane in a special configuration to check the skill of the examinee by cutting the fuel to the right engine, bringing it to a stop. Once in these conditions, they started the slow flying maneuvers, which would be consistent with the fact that the propeller was in the minimum pitch position (as indicated by the pitch linkages) and that the flaps were deployed 15°.

After stabilizing the airplane and before starting the right engine, they may have pulled back on the throttle for this engine, as described in the engine securing procedure in Item 3.6 of the manual. This would agree with the fact that the mechanisms governing the fuel mixture in both carburetors were found near their idle settings.

At that moment it is very likely that the airplane would have stalled, since its speed dropped below that specified in the manual for minimum control for the conditions present.

According to the estimates made, the airplane weighed between 1,655 kg and 1,720 kg. According to the flight manual, the stall speeds with the airplane in straight and level flight with the flaps deployed 15° are between 59 kt at a maximum weight of 1,700 kg and 61 kt at a maximum weight of 1,800 kg.

The final position recorded by radar indicated that the airplane was flying at a speed of 40 kt. Even though this speed was with respect to ground (ground speed) and the speeds listed in the manual are indicated (KIAS), assuming a reasonable margin of error, it may be estimated that the airplane was flying very close to the stall speed for the existing weight and configuration.

The information provided by eyewitnesses also suggest that the airplane was flying at a low altitude when it fell to the ground.

These eyewitnesses reported seeing the airplane turn about its longitudinal axis in a nose-down attitude as it spun to the ground. These reports do not coincide with the final position in which the aircraft was found. It is possible, though, that the airplane went into a spin after stalling and that the occupants, in their efforts to regain control of the airplane, may have managed to stop the rotation by completing some of the operations described in Item 3.20 of the manual but without being able to complete the procedure in full due to the low vertical margin available.

2.2. Operational factors

One of this accident's most significant factors in terms of operations is the fact that the slow flying maneuver was initiated while at a very low altitude.

The CIAIAC has emphasized on numerous occasions the importance of keeping a safe altitude when performing maneuvers that, by their nature, entail a risk of stalling. This has been the subject of several of the safety recommendations issued in recent years.

While it is true that the area where they were flying (Barcelona TMA) specified an altitude limit for VFR flights, the logical course of action would have been to fly to the west or northwest until they reached an area where they could fly with a greater margin of altitude. Also worth noting is the fact that they had only just taken off, meaning they had not had time yet to gain sufficient altitude to attempt these kinds of maneuvers. It is true, however, that commercial flights operating out of Girona airport also limit the operating altitude in that area, which would have made it difficult for them to go in that direction.

Once the airplane stalled, the crew did not have time to complete in full the procedure described in the flight manual for events involving an in-flight engine stoppage since the airplane undoubtedly entered into a nose spin. At that point they would have attempted to perform from memory part of the procedure applicable to inadvertent spins, but without being able to complete it.

Another aspect worth commenting is the fact that they stopped an engine in flight as part of the testing process. While the regulation does not specifically state whether the engine stoppage must be real or simulated, the investigation revealed that it is common practice for many examiners to actually stop the engine. The possibility that the engine was stopped could have complicated the conditions faced by the crew and would have reduced the possibility of correcting the stall situation that probably developed.

2.3. Human factors

The crew consisted of two individuals, both of whom routinely flew as the pilot in command. They had a similar number of flight hours, though their experience was different. Only one was used to being the “pilot flying”.

The examiner, who had ample experience on check flights and average experience on the type, was in the LH seat, playing the role of the student. He was normally used to flying in the RH seat.

The pilot in the RH seat, who was being tested for his CRI(SPA) rating, was handling the communications in addition to the controls (as required for this type of exam). He had ample experience as a airline transport captain, and had also held supervisory jobs at airlines. He generally flew in the LH seat as the pilot flying. His experience on the type, in contrast to the examiner’s, was very limited.

It is not infrequent on this type of instructor check flight to have a crew matching these characteristics.

This situation resulted in the difference between the hierarchies and experiences of both pilots being practically non-existent. This might have resulted in the responsibilities of each not being clearly defined, giving rise to a situation defined as a transcockpit authority gradient.

When this kind of situation occurs, it is of the utmost importance that information be exchanged prior to the flight so as to establish the manner in which the crew will respond, especially when faced with a situation that requires the use of an emergency procedure during the flight.

No information was available that could be used to determine whether the crew held a pre-flight briefing to exchange information and determine their roles during the flight. Interviews of other pilots who worked for the Operator revealed, however, that pilots making occasional general aviation flights and who were not employed by the Operator did not usually hold pre-flight briefings.

It is reasonable to assume, therefore, that since no responsibilities had been assigned prior to the flight, that when the airplane entered an undesirable position, there may have been a lack of coordination in the cockpit that resulted in each crew member acting in accordance with his own training and experiencing in an attempt to correct the situation by taking control without any consideration for hierarchy.

3. CONCLUSION

3.1. Findings

- The aircraft was flying at a low altitude and speed in the moments prior to impact.
- The airplane impacted the ground in a nose-down and slightly right bank position, hitting with the nose first.
- A small fire broke out as a consequence of the impact.
- The airplane was within its weight and balance limits.
- The propellers showed signs of having been stopped, or at least rotating at very low rpm's.
- The pitch of the blades was set for maximum engine rpm's.
- The flaps were deployed 15°.
- The throttle levers were very close to their idle position.
- The right engine fuel valve was in a cutoff position.
- The airplane had passed all maintenance inspections. There were no indications of any component failure or malfunction prior to the crash.
- The testing standard for the check being conducted does not specify whether the engine failure maneuver should be real or simulated.
- The altitude in the area where the flight was being conducted was limited to 4,500 ft for VFR flights.
- The examiner was in the LH seat and the pilot being tested was in the RH seat acting as the "pilot flying" and handling communications.
- Both crew members had ample and similar flight hours, though they had been obtained in very different ways.
- The authority gradient between the crew members was practically non-existent.

3.2. Causes

The accident was caused when the aircraft stalled during the performance of a slow flying maneuver with the right engine stopped.

Factors that contributed to the accident were the low altitude, the possibility that the crew did not define the responsibilities of each prior to the flight and which may have resulted in a lack of coordination when faced with the circumstances in the final moments of the flight, and the lack of an authority gradient between the crew members.

4. SAFETY RECOMMENDATIONS

None.