CIAIAC

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Report A-042/2011

Accident involving a Diamond KATANA DA20-C1, registration EC-KDS, in Amurrio (Álava), on 14 October 2011

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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.

Table of contents

Abbreviations

00 °C	Degrees centigrade
AESA	Agencia Estatal de Seguridad Aérea
AGL	Above ground level
APP	Approach
ATC	Air Traffic Control
ATPL(H)	Airline Transport Pilot License (helicopter)
CPL(A)	Commercial Pilot License (airplane)
FI(A)	Flight instructor rating (airplane)
FNPT	Flight Navigation Procedure Training
FS	Flight Simulator
ft	Feet
FTO	Flight Training Organization
GCA	Ground Movement Control
GMC	Airport Tower Controller in charge of ground movement
GPS	Global Position System
h	Hour(s)
hPa	Hectopascal(s)
IR(A)	Instrument rating (airplane)
JAR-FCL	Joint Aviation Requirements-Flight Crew License
km	Kilometer(s)
kt	Knot(s)
l	Liter(s)
LDG	Landing
LEBB	Bilbao Airport.
LEPP	Pamplona Airport.
LEVT	Vitoria Airport
LL	Low Lead
m	Meter(s)
MEP	Multiengine Piston Rating
MHz	Megahertz
N	North
PPL(A)	Private Pilot License (airplane)
rpm	Revolutions Per Minute
SEP	Single-engine piston rating
TMG	Touring Motor Glider
T/O	Takeoff
TWR	Tower
UTC	Coordinated Universal Time
VMC	Visual Meteorological Conditions

Synopsis

Owner and operator:	Aero Link Air Services, S.L.
Aircraft:	Diamond Katana DA20-C1
Date and time of accident:	14 October 2011; 12:30 local time[1]
Site of accident:	Amurrio (Alava)
Persons onboard:	2, killed
Type of flight:	General aviation. Instruction flight
Date of approval:	30 May 2013

Summary of accident

On 14 October 2011, a Diamond Katana aircraft, registration EC-KDS, was on an instruction flight. There were two people onboard, an instructor and a student in a helicopter commercial pilot license course.

The crew arrived at the airport at 10:30 to plan the flight. They then proceeded to the south apron, where they did the pre-flight check and later, at around 11:30, went to the north apron to refuel the airplane. The aircraft took off from the Bilbao Airport at 12:01 and headed south to conduct a visual flight around the province of Burgos. At 12:37 the pilot reported on the Bilbao approach frequency that they had an engine fault and were making an emergency landing.

The aircraft was seen gliding toward a field on the outskirts of the town of Amurrio, and then impacting violently against the ground.

Both aircraft occupants were killed as a result of the impact.

The aircraft was destroyed.

[1] All times in this report are local. To obtain UTC, subtract two hours from local time.

1. FACTUAL INFORMATION

1.1. History of the flight

At around 10:30 on 14 October 2011, the instructor and the student arrived at the offices of the Aero Link Services S.L. flight academy in Bilbao to prepare the navigation plan, the corresponding flight plan, the load and balance sheet, check the weather information and all the other prerequisites necessary for the flight, which was scheduled to last two hours.

Figure 1. View of the aircraft

The aircraft assigned was a DA20, registration EC-KDS and callsign ARK 206 A.

Once they completed the planning, they went to the south apron at the Bilbao Airport where they did the pre-flight check. They then taxied the aircraft to the refueling area located on the north apron.

The refueling was begun at 11:36 and completed at 11:46. According to the operator who refueled the aircraft, the pilot asked him to fill the tank, which required a total of 40 l.

At 11:54 the pilot called Bilbao ground (GMC) on 121.7 MHz to request taxi. He was cleared to taxi to the runway 30 hold point and was transferred to the Bilbao Tower frequency of 118.5 MHz. At 12:01, the controller cleared the aircraft for takeoff on runway 30, turning left as filed direct to Vitoria.

At 12:07 the crew reported climbing to 4,000 ft. At that point they were climbing through 1,300 ft over point S1.

At 12:11 they reported reaching point S and being level at 4,000 ft, proceeding to point N in Vitoria. The tower transferred them to the Vitoria TWR frequency on 118.45 MHz.

The aircraft contacted the Vitoria TWR at 12:23 and reported their intention to visually navigate around Burgos at a constant altitude of 4,000 ft. Three minutes later the crew re-established contact with the Vitoria TWR and requested to return to the Bilbao frequency and proceed toward Santander and then to the destination aerodrome, as a result of which the Vitoria TWR transferred them to the Bilbao frequency.

At 12:37 the crew reported on the Bilbao APP frequency of 120.7 that they had an engine failure, that they were at 2,000 ft and could not reach the airport and that they were going to make an emergency landing at an alternate field.

The field they chose was a meadow in the outskirts of Amurrio, where the aircraft impacted the ground violently.

The occupants died as a result of the impact and the aircraft was destroyed.

1.2. Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	2		
Serious			
Minor			Not applicable
None			Not applicable
TOTAL	2		

1.3. Damage to aircraft

The aircraft was destroyed as a result of the impact.

1.4. Other damage

There was no additional damage since the emergency landing took place in a field that had already been harvested.

1.5. Personnel information

The 27 year old instructor had a commercial pilot license (CPL(A)) with single-engine (SEP), multi-engine (MEP), instrument (IR(A)) and flight instructor (FI) ratings. He also had a valid medical certificate.

The instructor had completed his initial pilot training at the Aero Link Service S.L. school, where he obtained his PPL(A) and CPL(A) licenses, along with the SEP (land), MEP (land), IR and FI ratings. He had spent some time flying in California (USA) at Aerodynamic Aviation, where he accumulated flight hours and took courses on aerobatic flying and flying tail skid aircraft. Shortly after obtaining his FI rating, he started working as an instructor at Aero Link Service S.L. He had a total of about 500 flight hours, of which 330 had been on the type.

The student, age 24, had a valid student pilot permit and was taking an approved helicopter CPL course. He was doing the 20 h of dual-control training that can be completed on an airplane or a TMG as part of an integrated ATPL (H) course, in compliance with JAR-FCL 2.160, 2.165 and 2.170[2].

1.6. Aircraft information

The Diamond DA20-C1, serial number C0256 and registration EC-KDS, has a single Continental IO-240-B18B engine, serial number 1001637, tricycle landing gear, low wing and T-tail and is designed for training flights.

The DA20 relies on a control stick for flight inputs. It has three positions for the flaps, CRUISE (0°), T/O (15°) and LDG (45°), and a 93 liter fuel tank located behind the seats. The engine uses AVGAS 100 LL.

The aircraft's documentation was up to date on the date of the accident.

The last inspection of the aircraft was conducted on 6 October 2011, corresponding to a 50 h inspection. It was done with 2,549:55 flight hours on the aircraft. The last entry in the aircraft's log book was made with 2,571 flight hours. The engine log book recorded a flight time of 371 h.

There was no maintenance performed on the airplane in the period between the four flights made the day before and the accident flight.

1.6.1. *Fuel system*

The fuel tank is behind the pilots' seats. It is made of aluminum and has a 93-liter capacity, of which 91 are useable.

[2] Flight instruction shall include a total of at least 135 h, to include all progress tests. The 135 h total shall include:

(a) 100 h of dual instruction.
(b) Of the 100 h of dual instruction, up to:

– 90 h of visual instruction, which may include:

- 40 h in a helicopter FS level /C/D, or
- 30 h in a helicopter FNPT II/III, or
- 20 h in an airplane or TMG.

The tank inlet is on the left side of the fuselage. At the bottom of the tank are a fuel filter and a sump drain valve. The tank must be drained before each flight by pushing up on the tube that protrudes from the bottom of the fuselage, in front of the trailing edge on the left wing. Fuel gravity drains from the tank to the fuel filter and to the electric fuel pump. The fuel filter has to be drained before each flight by pushing up on the black rubber tube located on the underside of the fuselage next to the fuel tank drain.

The electric fuel pump is a two speed pump constant flow, vane type pump. The high speed (Fuel Prime) setting is used to prime the engine prior to starting. The low speed

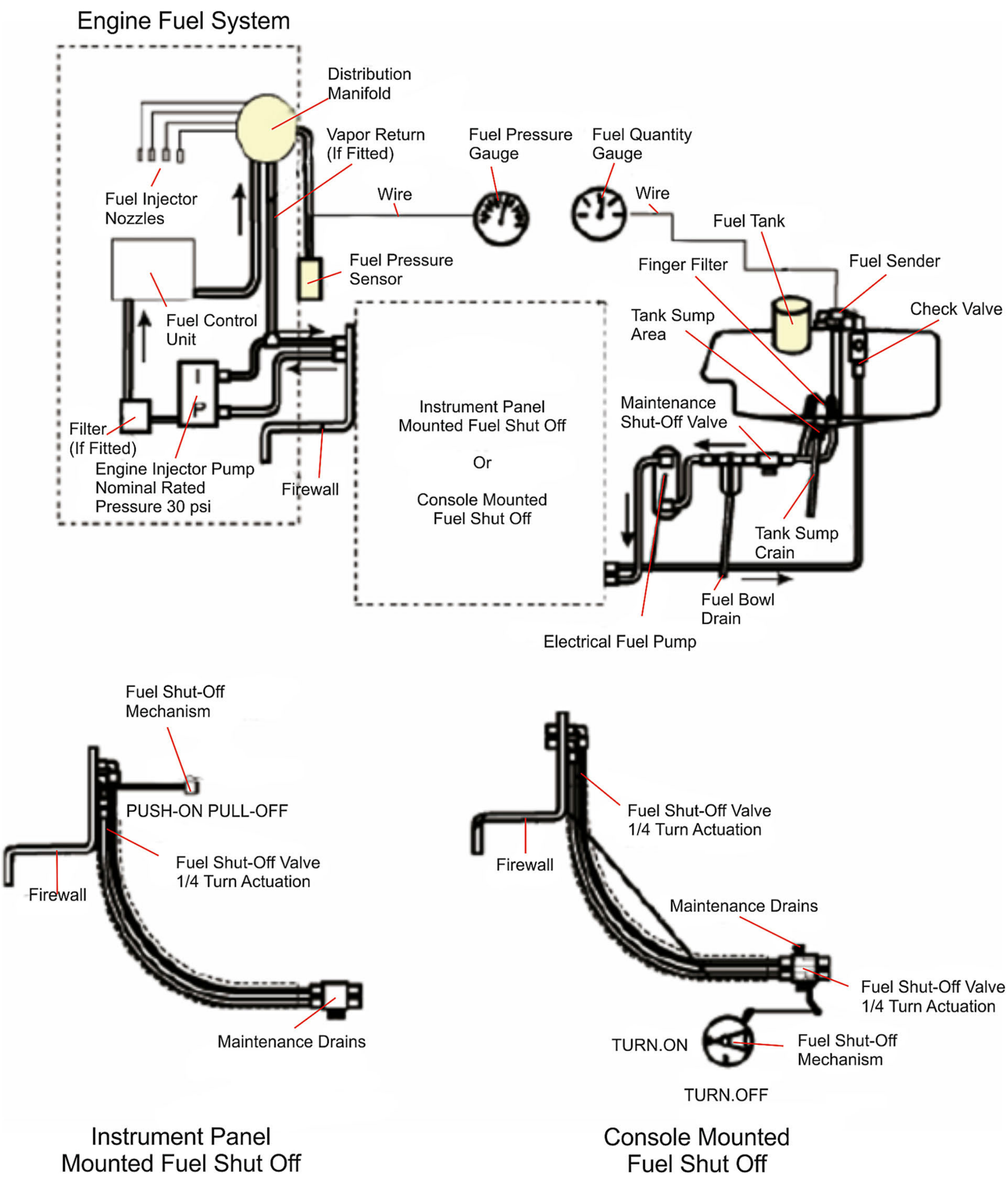

Figure 2. Fuel system

(Fuel Pump) setting is used in low throttle operations, T/O, landing, unusual attitudes, and/or any environment where fuel supply to the engine may be in question (emergency procedures). Pump speed is controlled by separate switches on the instrument panel. Other than the aforementioned conditions, the mechanical, engine-driven fuel pump is responsible for the supply of fuel from the fuel tank to the engine. The fuel then continues to the fuel control unit and the distribution manifold to the injectors.

1.6.2. *Fuel drainage points*

The system features a drain for the fuel tank sump on the lower left side of the fuselage, in the same section as the fuel fill. Next to this drain is the fuel filter drain (figure 3). These drains are opened by squeezing upward on the tubes protruding from the fuselage.

There are two additional drains located between the wings at the bottom center of the fuselage. One drains from the return line from the mechanical pump to the tank and the other drains from the supply line. These drains are used during maintenance, as noted on the yellow sticker posted next to them. This sticker is not easy to see unless the pilot looks up from underneath the airplane. The drains consists of two taps that are opened by overcoming spring pressure and turning a quarter turn, at which point a notch allows them to remain open.

There is a modification to the Flight Manual dated December 1999 stating that as part of the pre-flight check, these maintenance drains must be inspected to make sure they are not leaking.

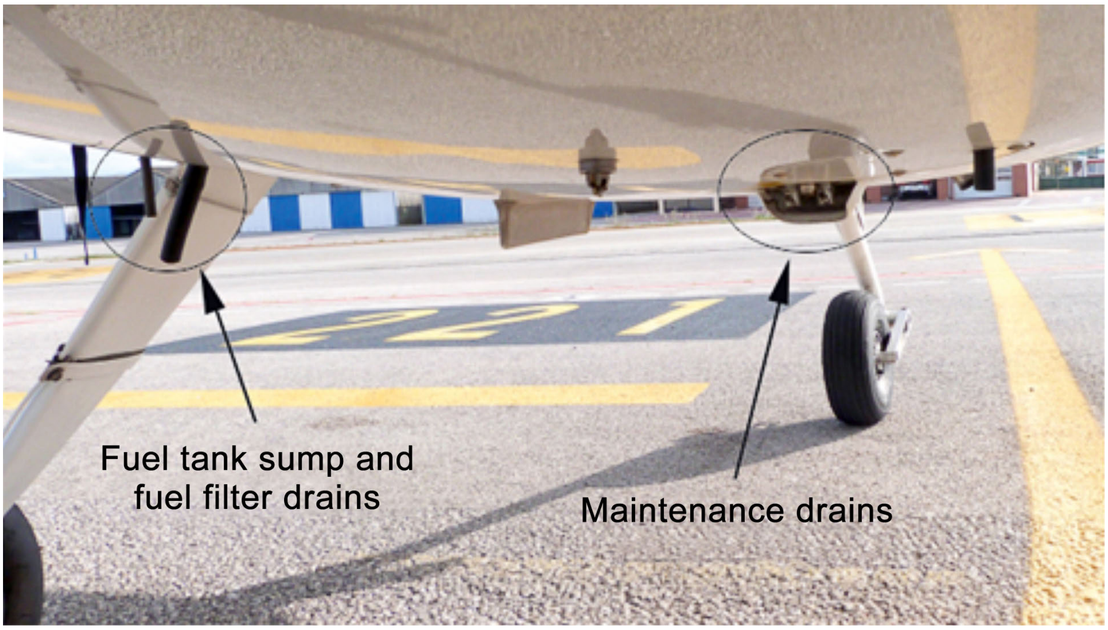

Figure 3. Fuel drains

1.6.3. *Fuel consumption*

The crew refueled before the flight, meaning there were 93 l of fuel in the tank, of which 91 were usable.

According to the tables in the Aircraft Flight Manual, fuel consumption at 4,000 ft at 20 °C and 2,400 rpm is 20 liters per hour.

1.7. Meteorological information

The weather conditions at 12:30 at the Bilbao Airport on 14 October 2011 were as follows: wind calm, visibility in excess of 10 km, no clouds below 5,000 ft, temperature 19 °C and atmospheric pressure 1,022 hPa.

At 12:00 at the Vitoria Airport, the wind was calm, visibility was 800 m, visual range at runway 04 was 800 m and increasing, there was fog, vertical visibility was 200 ft, the temperature was 9 °C and the atmospheric pressure was 1,023 hPa.

1.8. Aids to navigation

The crew was navigating visually. There is no indication that they were using any instruments to aid with the navigation.

1.9. Communications

The communications available include those held by the aircraft's occupants with various frequencies for the Bilbao and Vitoria airports, and which are summarized below:

- At 11:54 the crew contacted LEBB ground to request taxi instructions. They were cleared to taxi to the runway 30 hold point and to transfer to the LEBB TWR frequency.
- At 12:01 the aircraft was cleared to take off.
- At 12:07 the pilot reported climbing to 4,000 ft and leaving via point S1.
- At 12:11 LEBB TWR cleared them to contact LEVT TWR.
- At 12:23 they contacted LEVT TWR to report their intentions. LEVT TWR informed them of the weather conditions at the aerodrome.
- At 12:26 LEVT TWR returned them to the Bilbao frequency.
- At 12:37 they reported the engine failure on the LEBB APP frequency and informed of their intention to do an emergency landing.
- This was the last transmission from the aircraft.

1.10. Aerodrome information

Not considered relevant.

1.11. Flight recorders

The aircraft was equipped with a Garmin GNS 430 GPS unit. Efforts were made to recover and analyze the information it contained with the aid of a representative from the equipment manufacturer in Spain, but it was determined that the GPS unit did not have any information of use to the investigation.

1.12. Wreckage and impact information

The aircraft was found in a field in the vicinity of the town of Amurrio.

The debris field was compact. The nose and front part of the airplane were destroyed, the fuselage was broken in two places and the tail assembly was tipped toward the right wing. There were no drag marks on the ground, only a scratch on the ground followed by a hole with marks from the propeller to the right, where the aircraft's nose had impacted.

The onsite inspection revealed that:

- The ailerons moved freely and were connected to the flight controls.
- The right flaps were in the landing position (45°) and the left in the takeoff position (15°). This asymmetry was caused by the right flap impacting the elevator.
- The rudder was on its hinges but loose since one of its cables had broken on impact.
- The rudder was commanded full left. The attachment cables on the right pedal had broken on impact.
- The elevator was on its hinges and attached to its control bars. When it fell forward, it struck the trailing edge and flap on the right wing.
- The right wing had almost detached. There was an impact mark at the root and it was covered in dirt.
- The fuel gauge in the cockpit read 0.
- There was no trace of fuel left in the tank, engine or the fuel system. There was also no fuel spilled in the vicinity of the aircraft.
- The maintenance drains on the underside of the fuselage were closed.

Figure 4. Aircraft after the impact

- The propeller blades were damaged. One was broken at the hub and the other at about its halfway point.
- There were no indications as to the possible cause of the engine failure and stoppage.
- As a result, arrangements were made to transport the aircraft to a workshop for inspection.

An inspection of the cockpit revealed that:

- The master was on.
- The avionics master was off.
- The electric fuel pump was off.
- Both magnetos were on with the key broken inside.
- The throttle was fully open.
- The mixture was set to rich.
- The navigation, landing and strobe lights were on.
- The fuel selector was closed.

1.13. Medical and pathological information

The student still showed signs of life when rescue personnel arrived. He was hospitalized in critical condition and remained in a coma. Given the irreversible damage from his injuries, he died within 72 h.

1.14. Fire

There was no fire after the impact.

1.15. Survival aspects

Given the characteristics of the aircraft's impact with the ground at a high incidence angle, the occupants had practically no chance of survival.

1.16. Tests and research

No obvious anomalies or defects were found during the onsite visual inspection of the wreckage that could have caused the engine to stop. It was noted that the tank was empty. A leak test was conducted onsite by filling the tank with 10 l of water. No leaks were found, but there was a break in the system since the water leaked out when the wreckage was moved. This break had been caused by the impact.

The aircraft wreckage was taken to a hangar for disassembly and inspection. The engine was tested on another aircraft of the same type in the presence of a representative from the manufacturer (Continental). The engine was determined to be working correctly. The fuel supply and return lines between the tank and engine were also inspected. No anomalies or signs of fuel leaks were found.

Another test conducted involved checking the operation of the fuel drains, specifically of the maintenance drains, which were confirmed to be working normally. These drains were found closed at the accident site, though the possibility that they may have been closed by emergency personnel working on the aircraft or as a result of the strong impact could not be ruled out.

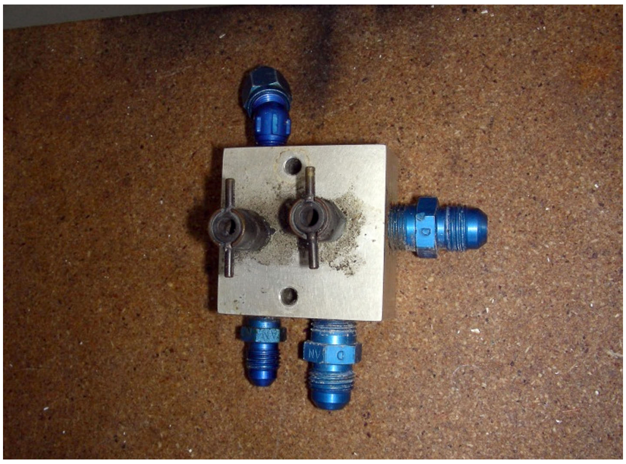

Figure 5. Fuel drain from the accident aircraft

On another aircraft of the same type, it was noted that with the engine stopped and the drain on the fuel return line open, no fuel leaked out, which could make the crew think it was closed. When the engine or priming system was started, fuel started issuing out from this drainage point. A pilot in the cockpit of the airplane would not be able to detect this loss of fuel. The test determined that the fuel was lost at a rate of 1.0 to 1.2 l per minute. This flow rate was measured with the airplane stationary on the ground and did not take into account the additional suction that would occur under flight conditions.

1.17. Organizational and management information

1.17.1. *Pre-flight checklist*

According to the Aircraft Flight Manual, the pre-flight checklist requires a check of the following items:

Fuselage

- Visual inspection of the surface.
- Fuel tank ventilation.
- Fuel tank drain (for possible water contamination).
- Structural temperature gauge (temperature must not exceed 55 °C).
- No leaks from the maintenance drains.
- Visual check of the fuel amount (with a measuring pipette).
- Visual check of the antennas.

The last four items were added to the manual as part of Revision 8 in December of 1999.

1.17.2. *Emergency landing procedure*

According to the Aircraft Flight Manual, the procedure to be followed in the event of a power-off emergency landing is:

- Glide speed with cruise flaps (0°): 62 kt.
- Glide speed with T/O flaps (15°): 58 kt.
- Glide speed with LDG flaps (45°): 62 kt.
- Fuel valve closed.
- Mixture cutoff.
- Magnetos off.
- Seat belts fastened.
- Transmit position and intentions by radio.
- Flaps as required by pilot.
- Master off.
- After landing apply brakes.

Section 3.5.6.c, Forced Landing, of the operator's Operations Manual states:

- Select a field for landing.
- Take into account surface winds.
- Approach: if possible, fly a short downwind leg and check for obstacles on final.
- Speed 70 kt.
- Time permitting notify ATC on last used frequency or on 121.5 Mhz.
- Fuel selector off when landing assured.
- Flaps LDG (45°).
- Magnetos off.
- Master off.
- Harness tight.
- As soon as the airplane touches down release the canopy.

1.17.3. *Engine failure as per the operator´s Maneuvering Analysis*

As a general rule, all maneuvers require a minimum AGL of 2,500 ft in single- and twin-engine airplanes under normal operations. When maneuvering in a twin-engine airplane on a simulated single engine (minimum intake pressure of 15 inches in the inoperative engine), the minimum AGL shall be 3,000 ft and when maneuvering with an actual inoperative engine the minimum AGL shall be 5,000 ft.

The only exceptions are approach and landing operations in aerodromes when the maximum altitudes allowed in the visual corridors by ATC do not permit compliance with the FTO's regulations, in which case VMC and 1,000 AGL shall be maintained at a minimum, and when simulating an engine failure in a single-engine airplane (always and exclusively with an instructor onboard), in which case landing is not permitted.

1.17.4. *Applicable regulation for training power-off forced landing and precautionary landing*

The applicable JAR-FCL 1 regulation provides guidelines for, among others, two maneuvers involving an engine failure and/or a forced landing: power-off forced landing and precautionary landing.

When simulating a power-off forced landing, the maneuver is stopped for safety reasons at 500 ft AGL, while for a precautionary landing above an airfield, the airplane is glided with the power off to the runway and then landed if necessary. These maneuvers are also included in JAR-FCL form 1240, which is a reference for instructors evaluating student applicants for their ratings.

The Aerolink flight school lists and applies these criteria in the Maneuvering Analysis section of its Operations Manual, which is approved by Spain's civil aviation Authority, AESA (National Aviation Safety Agency).

At its base in Sabadell, where there are suitable runways for practicing precautionary landings in the area (Manresa, Calaf and Igualada), said landings were prolonged practically to ground level. In the case of the Bilbao base, where there are no such runways in the county, this maneuver was only practiced at the airport itself.

1.18. Additional information

1.18.1. *Eyewitness statements*

Statements were taken from five individuals who saw the aircraft's final minutes of flight.

They all agreed that it was approximately 12:40 when they saw the aircraft flying over the urban area, first in one direction and then in the opposite direction.

The aircraft was descending in a straight line and heading for the field that it eventually impacted. The nose and right wing struck first. The aircraft then spun around to the right and stopped in the opposite direction to which it was flying without practically any further forward motion.

They heard a very loud sound. The impact kicked up a large amount of dust.

Statements were also taken from all of the students the instructor had at the time of the accident. Almost all of them were in their initial hours of flight training. When asked if they were aware of the maintenance drain, only one knew what it was. He said that the pre-flight check was done jointly by the instructor and the student and that during the check they drained all of the drainage points with a drainer.

The drainer used, which was onboard the aircraft, is shown in figure 6.

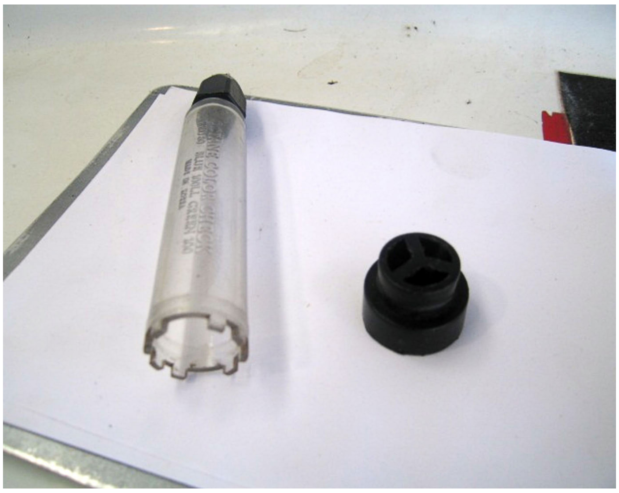

Figure 6. Drainer for the aricraft

1.18.2. *Similar accidents*

There is a record of another airplane owned by the same company that started taxiing with the maintenance drain open. On that occasion, the crew of a nearby airplane warned of the fuel leak and the drain was closed before the aircraft departed.

1.18.3. *Measures taken by the operator*

In the wake of the accident the operator took a series of measures intended to prevent repeat accidents in the future:

- The checklist to inspect the outside of the aircraft was modified by adding an item at the end to check the drains by using the priming pump to verify there are no leaks.
- A recommendation was made to do a cross-check of the engine gauges and the fuel level every 15 minutes.
- A human factors analysis emphasized two concepts:

  – In aviation, instrument gauges always have to be trusted given their high degree of reliability.
  – If in doubt, the crew should proceed to the nearest alternate aerodrome, whatever the reason. No factor is more important than flight safety.

2. ANALYSIS

2.1. History of the flight

The crew arrived at the airport at 10:30 to prepare for the scheduled two-hour flight.

Once the preparations were complete, they headed for the airplane to do the pre-flight check. Once on the north apron at the Bilbao Airport, they fully refueled the airplane, meaning they had 91 usable liters.

The aircraft requested to taxi at 11:54, took off at 12:01 and left the aerodrome's traffic circuit in keeping with established procedures.

Weather conditions at the Bilbao Airport were good for visual flight, but the weather information for the Vitoria Airport indicates that reduced visibility conditions prevailed at both the aerodrome and its vicinity. This could have been why the crew changed its intentions after informing LEVT TWR that they would do a visual flight around the Burgos area and requested to return to the Bilbao frequency and proceed to the area of Santander and subsequently to the Bilbao Airport.

2.2. Engine stoppage

The pilot reported at 12:37 that the engine had failed.

Thirty-six minutes of flight time elapsed from the time the aircraft took off until the engine failure was reported. It is very likely that the failure report was made immediately after the engine failed.

According to the Flight Manual, at cruising power fuel is consumed at a rate of 20 l per hour, meaning that in 36 minutes of flight, the engine consumed approximately 12 l. It is not known how much time elapsed between when the pilot started the engine and arrived at the runway hold point and requested takeoff, but based on the distance from the refueling station and on the length of the engine checklist before takeoff, this duration can be estimated at 10 minutes (about 2 l). This means that there should have been about 77 l in the engine after the accident.

No fuel was found in the engine, the fuel system, the tank or a fuel spill at the site after the accident. This could be attributed to the break in the tank due to the impact causing the fuel to spill at the crash site, but had there been fuel in the tank, a check revealed that 10 l would have remained in the tank. Since no fuel was found inside the tank, the 77 l that should have been in the aircraft obviously must have been lost somehow.

Based on the investigation conducted on the ground after the accident, it was noted that with the aircraft on the ground, between 1.0 and 1.2 l of fuel could be lost per minute through the maintenance drain on the return line. The amount lost in flight could not be checked, but the Venturi effect would have made this rate higher.

From the time they requested to taxi after refueling until the engine stoppage, 43 minutes elapsed. At the rate observed, this would mean 52 liters were lost through the drain. In the five minutes the engine might have been running while the crew completed its checks before requesting to taxi to the runway, this would add another 6 l for a total of 58 l lost through the drain.

The remaining total up to 77 l could be explained by the increased loss as a result of the Venturi effect in flight.

Even though the pilot was rated as a flight instructor on the aircraft type in question, based on his students' statements he may not have been fully aware of the consequences of leaving the maintenance drain on the return line open. The Flight Manual also does not clearly state what might happen if said drain were to be left open.

The student was in a course to obtain his commercial helicopter pilot license. The aircraft they were using for the flight was not the one he typically used, meaning he most likely was not very familiar with the various points checked in the pre-flight inspection.

Although there is a warning label next to the drain stating that the drain is for maintenance use, the label is only visible from underneath the airplane and this drain is equal to that used in other aircraft of the same type as the rugged and the drainer kept onboard is designed for opening this type of drain, they may have believed that using it on the drain in question was an appropriate part of the fuel draining procedure that is required prior to each flight.

Under these circumstances, with the engine stopped, they would not have noticed that they had left the drain open as no fuel would have issued from this drain, since it is on the return line and the engine was stopped. Once they started the engine, fuel would have started flowing out the drain, though this would not have been noticeable from the cockpit. No one saw them taxiing with the drain open either, as happened with another crew from the same operator that was warned before they could take off, allowing them to close the drain.

Even though the drain was found in the closed position after the impact, it may have closed as a consequence of the impact given its violent nature, or been closed by emergency personnel during the rescue operations.

A mechanical fault in the engine can be ruled out since it was shown to be working properly after the accident.

2.3. Emergency landing

According to eyewitness statements, at first the aircraft glided smoothly without sharp turns. This indicates that the impact took place under controlled conditions and that perhaps the pilot did not properly estimate the slope of the terrain.

At the school, precautionary landings were practiced on an air field, both at the Bilbao and the Sabadell bases, though in the former said landings were practiced only at the Bilbao Airport. The skill required to satisfactorily execute this maneuver at various fields of small size, such as those used at the base in Sabadell, would be greater than that required to do it on a runway, especially a large runway such as the one in Bilbao. This indicates that the pilot performed the maneuver correctly to the practiced altitude (500 ft) but the landing, which he had not practiced sufficiently, the pilot was not able to handle, resulting in the impact with the ground.

The terrain chosen for the emergency landing was suitable. The terrain was clear, without obstacles, and hard, with a positive slope that would have helped stop the airplane in a shorter distance than flat terrain. But the pilot was unable to transition from the glide to the flare and ended up striking the ground with the nose of the aircraft.

Possibly because of the stress of the situation the pilot did not complete the Flight Manual procedure for an engine failure, since after the impact the magnetos and the master were both on, though the fuel shutoff valve was closed.

3. CONCLUSION

3.1. Findings

- The instructor had a valid license and was properly rated to fly on this type of aircraft.
- All of the aircraft's documentation was in order.
- On the day of the accident, the crew was conducting a visual flight scheduled to last about two hours.
- Before the flight the crew fully refueled the airplane.
- An inspection of the fuel lines did not reveal any anomalies.
- After the accident the maintenance drain was found closed.
- No traces of fuel were found in the tank, engine or fuel system during the post-accident inspection. There was also no fuel spilled in the vicinity of the aircraft.
- The propeller did not show signs of having impacted the ground under power.
- After the accident it was shown that the engine did not have any mechanical problems.
- The field chosen by the pilot for the emergency landing was suitable.
- At the base where the pilot was trained (Bilbao), it was not customary practice precautionary landing; it was mostly practiced landing maneuver without power.
- The glide maneuver to the chosen field was executed properly, but the transition between the glide and the pre-landing flare was not.
- The pilot did not complete the engine failure procedure.

3.2. Causes

The engine stopped due to fuel exhaustion.

Although the cause for the loss of fuel during the flight could not be reliably determined, the investigation found that inadvertently leaving the drain on the fuel return line open is compatible with the accident scenario in terms of the initial amount of fuel and the time elapsed between the refueling, takeoff and engine stoppage.

The pilot's gliding of the airplane and selection of the field for the emergency landing maneuver were correct, but he was unable to adapt the landing to the slope of the field chosen, resulting in the airplane's nose impacting the ground.

4. RECOMMENDATIONS

The type of drainage used for the fuel return line, and labeled as maintenance drainage, is considered a potentially aircraft unsafe condition both for its location and its design, as it is very similar to the standard fuel drainage system for the pilots. As a result:

REC 25/13. It is recommended that the manufacturer, DIAMOND AIRCRAFT INDUSTRIES INC., revise and modify the design and location of the maintenance drainage systems, replacing them by new ones that cannot be manipulated with the standard drainer normally used by the crews.

In the event of an engine failure, the pilot, in addition to choosing a suitable landing site, should also be familiar with how the airplane handles without power control throughout the entire approach phase, including the final flare maneuver, until the landing is assured. When training precautionary landings, the descent can be continued below 500 ft, accepted as the minimum for maneuvers of a general nature, though always in compliance with regulations and over surfaces authorized for landings and, if necessary, the subsequent takeoff.

REC 26/13. It is recommended that the operator, Aerolink, ensure that training on precautionary landings include the last phase of the approach to the final flare, and that this training be conducted in different settings so as to familiarize its pilots, especially its instructors, with the complete emergency landing maneuver should such a maneuver be necessary in the event of an engine failure.