CIAIAC
Comisión de Investigación
de Accidentes e Incidentes
de Aviación Civil

TECHNICAL REPORT
A-036/1999

Accident of the powered glider GLASER-DIRKS DG-600/18 M, registration D-KGLG, in Borja (Zaragoza) on 19 July 1999

MINISTERIO
DE FOMENTO

Technical report

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COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

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

NIPO: 161-03-011-0
Depósito legal: M. 23.129-2003
Imprime: Centro de Publicaciones

Diseño cubierta: Carmen G. Ayala

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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 in which happened the event being investigated, with its causes and its consequences.

In accordance with the provisions of Law 21/2003 and Annex 13 to the Convention on International Civil Aviation, the investigation has exclusively a technical nature, without having been targeted at the declaration or assignment of blame or liability. The investigation has been 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 has originally been issued in Spanish language. This English translation is provided for information purposes only.

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Abbreviations

00 °C	Grados centígrados
00° 00′ 00″	Grados, minutos y segundos
Ac	Altocumulus
ACC	Area Control Centre
ADF	Automatic Direction Finder
AIP	Aeronautical Information Publication
APP	Approach Control
ATC	Air Traffic Control
CAT I	Category I ICAO
Ci	Cirrus
CRM	Crew Resource Management
CTE	Commander
CTR	Control Area
Cu	Cumulus
CVR	Cockpit Voice Recorder
DH	Decision Height
DME	Distance Measuring Equipment
E	East
EPR	Engine Pressure Ratio
EM	Emitter
ETA	Estimated Time of Arrival
FAP	Final Approach Point
FDR	Flight Data Recorder
ft	Feet
g	Acceleration due to gravity
GPWS	Ground Proximity Warning System
h. min: seg	Hours, minutes and seconds
HP	Horsepower
hPa	Hecto-pascal
IAS	Indicated Air Speed
IFR	Instrumental Flight Rules
ILS	Instrumental Landing System
IMC	Instrumental Meteorological Conditions
INTA	National Institute of Aerospace Technology
Kms	Kilometres
Kts	Knots
Kw	Kilowatts
lbs	Pounds
m	Metres
MAC	Mean Aerodynamic Chord
mb	Milibars
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
METAR	Meteorological Actual Report
MHz	Megahertz
MM	Middle Marker
N	North
N/A	Not Applicable
NDB	Non Directional Beacon
MN	Nautical mile
OM	Outer Marker
P/N	Part Number
PF	Pilot Flying
PNF	Pilot Not Flying
QNH	Air pressure adjustment to make the altimeter mark the altitude of the airport above sea level during landing and take off

Abbreviations

RVR	Runway Visual Range
S/N	Serial Number
S	South
Sc	Stratocumulus
Shp	Shaft Horsepower
SVFR	Special Visual Flight Rules
TWR	Control Tower
U T C	Universal Coordinated Time
VIP	Very Important Passenger
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Radio-Range
W	West

1. FACTUAL INFORMATION

1.1. History of the flight

At approximately 13:00 local time[1] on 19-07-1999, the Glaser-Dirks DG-600/18 M powered glider, piloted by its owner, crashed into a hill near the Santuario de la Misericordia, in the municipality of Borja (Zaragoza), in a spot known as Fuente de la Gotera.

The aircraft had taken off from the aerodrome of Monflorite (Huesca) by its own means at 11:40 and had flown 110 kilometers when it reached the accident site. It was flying in the company of another DG-800 powered glider, the two pilots wanting to enjoy the sport of gliding. They had not decided on their landing site, having the possibility of either returning to the aerodrome where they had taken off, Monflorite, or continuing the flight to the Fuentemilanos aerodrome (Segovia), some 360 km from Monflorite, if the weather conditions throughout the day proved favorable.

In the final minutes prior to the accident, the aircraft, in unpowered free flight, was flying at an altitude similar to the height of the nearby hills, some 730 m above sea level, and some 700 m to the south of those hills. To the west and in the surrounding valleys, there were fields which were ideal for a landing, and the pilot also had the possibility of starting the engine to continue in flight. However, the aircraft was attempting to gain height, turning in a spiral in the thermal upcurrent rising from the slopes of the hillsides, caused by a mild southerly wind. In this situation, the wind pushed the glider towards the summit of the hill of 529 m height, over which it flew at a height of some 150 m, and there it suddenly lost control and plunged to the ground, crashing to leeward into the northern slope with great violence and at a steep dive angle.

It is estimated that the loss of control occurred when the pilot was flying with an insufficient speed margin to prevent stalling, on making a brusque maneuver to avoid crashing into the ground at the summit of the hill, or on being caught off guard by an adverse gust of wind. The pilot was killed instantly.

1.2. Injuries to persons

Injuries	Fatal	Serious	Minor/none
Crew	1		
Passengers			
Others			

[1] UTC time is two hours less than local time.

1.3. Damage to aircraft

The aircraft was completely destroyed as a result of the impact with the ground.

1.4. Other damage

There was no other damage.

1.5. Personnel information

1.5.1. *Pilot in command*

Age/Sex:	62 years old/Male
Nationality:	Austrian
License:	Glider Pilot, number 8137

Qualifications:

— Single/dual control
— Towing by automobile, aircraft and winch, and flight in powered glider
— Powered glider abroad
— Radio station operator

Pilot's license:

— First issued:	16-09-1975
— Renewal date:	29-07-1998
— Expiry date:	30-08-2000
— Total flying hours:	4000 hrs (In all aircraft, with or without engine)*
— Hours in last 90 days:	100 hrs*
— Hours in aircraft type:	68 hrs*

1.6. Aircraft information

TThe DG-600 aircraft family consists of several models: a pure glider of the Standard class of 15 m wingspan, developed in 1987, a glider with removable wingtips which lengthen the wingspan to 17 m, and several powered glider versions. The powered glider with 18 m wingspan with «winglets» was created in 1992, with a small 25 HP Rotax engine and propeller which retract into a compartment in the upper part of the rear fuselage. This fuselage is very slim at the end.

* The information on the pilot's flying hours in command is taken from the statement of his flying companion.

The wings are the same in all models, apart from the tip extensions installed in the 17 and 18 m wingspan models. They are made of high-resistance carbon fiber which allows for very low relative thickness.

The DG-600M is equipped with a stall warning system with aural and visual warnings. The system is set to provide a warning when the airspeed is 5 km/h above the stall speed.

The aircraft has flaps to reduce the stalling speed in slow flight and on landing, or to provide high gliding coefficients at high speeds using negative flap positions. It is also equipped with water tanks in the wings which can carry up to 120 liters as ballast to increase the gliding speed at the optimum point of its polar curve. This water can be jettisoned during flight.

A total of some 112 DG-600 aircraft were built, but construction was stopped because of a fire which destroyed the production plant, warehouses and molds of the model in 1992.

1.6.1. *Aircraft data*

Make:	GLASER-DIRKS
Model:	DG-600/18 M
Serial number:	6-111M52
Year of manufacture:	1997
Registration number:	D-KGLG
M.T.O.W.:	480 kg
M.T.O.W. self-propelled:	440 kg
Owner:	The pilot

It should be noted that the aircraft was registered in Germany even though the pilot was Austrian.

1.6.2. *Airworthiness certificate*

Number:	L 20742
Type:	Powered glider
Date of issue:	21-05-1997
Expiration date:	March 2000

1.6.3. *Maintenance log*

Total flight hours:	Unknown
Las annual inspection:	10-03-1999
Hours since last annual inspection:	483

The inspection report of the last renewal of the Certificate of Airworthiness indicates that the altimeter was faulty. According to this report it was not repaired.

1.6.4. *Engine*

Make:	ROTAX
Model:	Rotax 275
Power:	25 hp
Serial number:	3840626
Hours since last inspection:	49
Date of last inspection:	10-03-1999

1.7. Meteorological information

The weather situation over the Iberian Peninsula on 19-07-1999 was characterized by a depression of thermal origin with entry of warm air from Africa. Meanwhile, a pocket of cold air over the northwest of the Peninsula, combined with the humidity in the area, maintained certain instability.

There are no records of precipitations or electrical discharges in the western area of Saragossa and the Moncayo.

For reference, the following are the METAR reports of the airport of Saragossa, which is located some 60 km to the southeast of the accident site.

METAR of the airport of Saragossa on 19-07-99

— 11:00 UTC: Wind: 110°/03 Kt
Visibility: 10 km or more.
Cloudiness: 3 to 4 oktas at 1,900 feet (580 m).
Temperature: 25 °C.
Dew point: 15 °C.
Pressure at sea level: 1017 mb

— 12:00 UTC: Wind: 090°/05 Kt
Visibility: 9000 m.
Cloudiness: 1 to 2 oktas at 2,000 feet (610 m).
Temperature: 26 °C.
Dew point: 15 °C.
Pressure at sea level: 1016 mb

— 13:00 UTC: Wind: 060°/06 Kt
Visibility: 9000 m.
Cloudiness: 1 to 2 oktas at 2,000 feet (610 m).
Temperature: 27 °C.
Dew point: 15 °C.
Pressure at sea level: 1016 mb

The statement of the companion on the expedition who was flying ahead of the lost aircraft, who flew over the site after the accident, gives a southerly direction for the wind with an intensity of 10 to 15 km/h. The GPS equipment in his aircraft provided exact information on the wind.

1.8. Aids to navigation

No navigational aids were used.

1.9. Communications

The aircraft had a radio transmitter which was used to maintain contact with the pilot of the other DG-800. This companion received no alert calls immediately prior to the accident.

1.10. Information on aerodromes in the area

The departure aerodrome, Monflorite (Huesca), is some 110 km east of the accident site and therefore had no relationship with the accident.

— *Monflorite:*
Reference point coordinates: N 42° 5,417′ W 0° 17,750′
Altitude: 540 m
Runway: 13-31 of 600 × 12 m tarmac on a broad platform of grass.

In the final stage of the flight, the glider was some 25 km from the summit of the Moncayo, which is 2,226 m in height and some 2 km from the aerodrome of Ablitas.

— *Ablitas:*
Reference point coordinates: N 42° 0,500' W 1° 37,267'
Altitude: 324 m
Runway: 31-13

As a glider, the aircraft was capable of landing in fields not specially prepared for the purpose, a field or piece of fallow land of little over a hundred meters in length being sufficient for landing.

1.11. Flight recorders

According to witnesses, the aircraft was equipped with an FAI/IGC sports flight recorder, commonly called a GPS LOGGER, of the LX 20 type, by Filser Electronics. This recorder stores various parameters of geographical position and geometric and barometric height, as well as engine use during the flight; however, it has not been possible to analyze it during the investigation.

1.12. Wreckage and impact information

Following the indications provided by the flying companion to Saragossa control, the wreckage of the aircraft were located in an area called the Fuente de la Gotera, to the north of the town of Borja, in a smoothly sloping meadow at 500 m altitude, at the top of a hill and to leeward on the northern side of the hill.

The hill where the Santuario de la Misericordia is located has an altitude of some 750 m and is some 2 km from the Fuente de la Gotera. To the north of the Fuente de la Gotera there is another hill of 729 m in altitude. The hill on which the Fuente de la Gotera is found has summits of 529, 517 and 513 m (See Map 1 in Appendix B).

The town of Borja is approximately 60 km NW of Saragossa and 110 km SW of Monflorite.

The meadow where the glider crashed is a rustic area with bush, holm trees and a few rocks, surrounded by larger trees and pines in the highest area.

Inspection of the accident site revealed several traces aligned in a northerly direction. The first mark on the hillside was a small hole about 15 cm in diameter and 6 cm deep, caused by the initial impact of the left wingtip. The tip extension of the left wing, separated from the wing assembly, was lying 2 m away in a horizontal position, with its bottom surface upwards (See distribution of wreckage in photos 2, 3 and 7).

A short distance away there was a larger hole in which there were scattered control instruments, small methacrylic fragments of the cockpit canopy and remains of encephalic mass. There are marks of impact with stones, rocks and bush.

Some twelve meters away from this latter hole and 20 m away from the initial impact of the left wing, the main bulk of the wreckage was found. The left and right wings, in a single piece, were standing in a plane close to the vertical. The wings were resting on their trailing edge; the leading edge, along its full span, was bent towards the upper surface.

The entire front fuselage was crushed, and among its wreckage the lifeless body of the pilot was found, fastened into his harness in a prone position (face down).

The rear fuselage was resting in an inverted position, ahead of the wing, having bent around the lateral axis of the aircraft at the support point of the pilot's seat, thrust forward by the weight of the engine and all of the rear fuselage and tail.

The rear fuselage was also fractured at its narrow end point, ahead of the tail unit. This tail unit was not in an inverted position like the fuselage; instead, it was in the normal flight position, leaning slightly to the left and joined to the fuselage only by the rudder and elevator control cables.

1.13. Medical and pathological information

The deceased pilot was approximately 168 cm in height and of heavy build. After the accident, he had open fractures in the cranium and internal fractures in both jaws and the frontal bones of the face and the thorax. The left arm had been severed at shoulder level and was found several meters away from the body, under the left wing of the aircraft; the lower limbs were bent at unnatural angles.

The forensic examination determined violent death by multiple injuries, the immediate cause being traumatic hemorrhagic shock.

1.14. Fire

The wreckage of the aircraft did not catch fire; the fuel tank remained intact and airtight (Photo).

1.15. Survival

There was no chance of surviving the accident, owing to the violence of the frontal crash into the ground.

1.16. Test and research

1.16.1. *Trajectory of the aircraft*

The trajectory of the aircraft from its takeoff in Monflorite to the place where the accident occurred is unknown. However, it can be stated that the accident site is on a direct route from Monflorite to Fuentemilanos.

The deceased pilot's companion stated that they left Monflorite at 11:40, local time, and that he was flying in front. Prior to the accident, his friend was flying a little low and nearby, some 750 m from a south-facing slope in the vicinity of Borja, at 700 m height. He was in a phase of circular flight, turning in a thermal and attempting to gain height.

The accident occurred at 12:20 according to the companion's statement. The alarm call to the SAR (Search and Rescue Service) was not made until 13:50.

The tracks of the aircraft along the ground indicate a diving attitude in a northerly direction prior to impact, which was of great violence, the aircraft coming to a stop after 20 m.

1.16.2. *Study of the wreckage*

Flight configuration

Based on the position of the wreckage, it can be said that the aircraft was flying with the landing gear retracted and the engine and propeller also retracted. It has not been determined whether it was flying with water ballast. The fuel tank was three quarters full (See photo). The position of the flaps was neutral or slightly negative, but their position may have been altered by the impact.

Instruments

The altimeter recovered from the wreckage was set at 950 mb and showed a reading of –65 m in height. Bearing in mind that the METAR of Saragossa on the day and time of the accident gave a QNH of 1016 mb and that each millibar represents some 8.5 m, the altimeter reading allows us to estimate that the altitude of the point where the accident occurred was 500 m.

The anemometer was found set, showing a reading of 202 km/h.

Wings

The wing assembly is composed of four elements: the left wing and right wing (joined together by two bolts in the joint area behind the cockpit), and two wingtip extensions fitted to the ends of the main wings.

The initial impact of the end of the left wing separated the left wingtip extension, breaking its normal fixings, without absorbing a large amount of energy. The wingtip extension was found lying in a horizontal position with its bottom surface upwards, and otherwise undamaged.

The impact of the leading edge of the wing against stones and bush and the ground itself produced cracks and local damage seen in photos 2, 4 and 7. In addition, there was a uniform bending of the leading edge along its entire span towards the bottom surface, clearly seen in photos 4 and 6. Also, the effect of this impact distributed along the leading edge made the wing rotate leading edge up from the dive position to its final resting position close to the vertical plane, resting on its trailing edge. However, the wing spar withstood the impact, and the wing as a whole remained intact.

The wings came to rest with their span in an east-west direction, as can be observed from the angle of the shadows of the sun in the photos taken on the day of the accident, when the sun was at around 40°, and it was therefore approximately 18:00 local time, and its azimuth was approximately 270°.

Fuselage and tail unit

The front fuselage received the full force of the impact and was crushed against the ground by its own inertia and that transmitted by the wings. The wing spars crushed the base and canopy of the cockpit.

The entire rear fuselage, from the support point of the pilot's seat, flipped over the wings, with the landing gear, engine, propeller and fuel tank, and came to rest in an inverted position. The end of the rear fuselage shows a fracture in the narrow section at the root of the tail unit. The tail unit was not inverted like the rest of the fuselage; it remained in one piece and was in a normal flight position, leaning slightly to the left and joined to the fuselage only by the rudder and elevator control cables.

1.17. Organizational and management information

This is not considered relevant for this investigation.

1.18. Additional information

1.18.1. *Estimation of the operating weight of the aircraft*

The police information states that the pilot was carrying on board his light baggage, consisting of a folder with the aircraft documentation, a mobile telephone, credit cards, cash, a personal hygiene bag, several pieces of clothing, slippers, etc.

Adding the weight of this baggage to the empty weight of the glider (approximately 315 kg), the weight of the pilot himself, who was of heavy build, and the parachute, fuel, etc., we can estimate that the flight weight would come very close to the maximum allowed weight of 440 kg for self-propelled take-off. Under these conditions, the aircraft would not have been carrying water as ballast in the wings.

1.18.2. *Intentions and flight plan*

Prior to take-off, the head of the Sports Aviation Center of Monflorite informed the pilots of the necessity of making a flight plan if their destination was Fuentemilanos, to which the pilots replied that they would inform Saragossa control on 119.30 Hz once they had decided on their destination.

1.18.3. *The sport of gliding*

Those who enjoy the wonderful sport of gliding seek firstly to remain in the air by searching for upcurrents to gain height, which is then lost in downward gliding. When flying in the vicinity of an aerodrome, the possibility of not finding upcurrents leads simply to the ending of the flight with a landing at «home» following the normal procedures that have been learned and practiced.

A more daring phase of this adventure sport is to undertake long-distance flights. The height gained in an upcurrent allows for level gliding in which a certain distance is covered, and before reaching the ground another upcurrent must be found in order to repeat the cycle. In this way it is possible, and quite common, to cover long distances of hundreds of kilometers. Knowledge of meteorology and the performance of the glider itself, and the choice of the route that provides the best upcurrents, all influence the success of the endeavor. Normally, failure simply consists in losing all height and having to land anywhere possible. As these aircraft have a low approach speed, landing on farm fields that have not been specially prepared does not constitute a very high risk (though there may always be surprises and obstacles that are impossible to see from the air). After landing, the pilot faces another awkward situation in which he depends greatly on his recovery team, who must locate him and help him to return home. The glider is disassembled, packed into a trailer and towed away by an automobile. The ground support team is crucial in this sport.

Compared to pure gliders, powered gliders have a small engine for taking off and also for returning «home» with greater autonomy when there are no upcurrents: in flight, the engine is started before all height is lost, and the flight continues in self-propelled mode until all of the available fuel is consumed.

The special problem for powered gliders is that, if they fly very low, there may be insufficient height off the ground to start up a cold engine, bearing in mind that the greater increase in aerodynamic resistance in the engine and propeller configuration deployed will accelerate the loss of altitude. The imminent landing would be precarious and unstable. If a powered glider is in this low-flying situation, the pilot must act as if it were a simple glider.

Not having a reliable recovery team may increase the pilot's feeling of tension and desire to remain in flight beyond prudent limits. Flying at a low altitude, struggling with unpredictable upcurrents, turning very tightly and with high bank angle in order to remain within a narrow thermal, in turbulence and under stress, can lead to a loss of coordination of turns and a loss of concentration, resulting in possible inadvertent stalling.

1.19. Useful or effective investigation techniques

Not used.

2. ANALYSIS

2.1. Flight preparation

According to witnesses, the DG-600 powered gliders, registration numbers D-KGLG and DG-800, departed from Monflorite at 11:40 local time, without a definite flight plan. There was an implicit intention to reach Fuentemilanos, 360 km. away, but the weather was not the best and the cloud cover was low, although it might improve as the day wore on. Visibility, however, was suitable for VFR flying.

The decision on whether to return to Monflorite or to continue to Fuentemilanos would most likely have been postponed until the pilots had crossed the Iberian System mountain range on the other side of the Moncayo. The two companions departed without a preconceived idea of where they would spend the night, and that is why they were carrying their light baggage on board. They were certain, in any event, that their engines would enable them to reach any destination they were to decide upon later.

Moreover, they had no trailers for the land transport of their aircraft, nor does it appear that they had made any arrangements for a hypothetical recovery.

2.2. Flight

After takeoff, the two gliders followed a route of approximately 248º, leading to Fuentemilanos, and they reached Borja, some 110 km away, at roughly 12:20 according to the second pilot's statement. This would have meant a speed on this leg of the flight of more than 160 km/h, which does not seem plausible if the weather that day was not very good. Therefore, it should be estimated that the two aircraft flew over Borja at around 13:00.

Upon reaching this town, the altitude of the accident aircraft, which was following the other glider, was quite low. The winds, which in Saragossa and the Ebro Valley were easterly, were southerly here, probably because of the influence of the Iberian Mountains. Some 25 km from the Moncayo, the foothills of the Iberian range provided a certain topographic support and the possibility of mild thermals up the slopes. The pilots had only been flying for an hour and should not have been experiencing particular fatigue, but we can assume a certain tension on the part of the pilot who was flying low: not having a ground support team meant having to remain in flight at all costs. The pilot's goal would have been to locate the center of an upcurrent and achieve a minimum descent speed in order then to gain height within the thermal. The low flying conditions could have been maintained for several minutes.

2.3. Hypothesis of accident

It is considered that the fracture of the rear fuselage at the point next to the tail unit occurred when the tail was still in the air. As the fuselage was tipping over, the tail reac-

ted like a weather vane and leveled out, now attached only by the flight control cables, and hit the ground when it had already attained a normal position. This would also explain the lesser damage found in the structure of the tail. This leads us to consider material failure as an initial hypothesis.

2.3.1. *Hypothesis of material failure*

The fracture of the fuselage at the point next to the tail unit, which occurred when the tail was in the air, suggests the possibility that this was the cause of the accident. With the fuselage broken at this point, the aircraft would lose control and plummet to the ground.

Inspection of this break could not clarify the cause of it. Nevertheless, we believe that the very slim fuselage could not split without extremely high maneuvering loads or gusts of wind, which were not probable on that day and at that altitude.

Other circumstances which may have led to the break of the fuselage, such as the presence of prior incipient fractures caused in previous hard landings, are also considered improbable, as the owner himself was the habitual pilot of the aircraft in its short operational life.

2.3.2. *Inadvertent stalling*

With the pilot's ample experience of 4000 hrs (although only 68 of these hours were with the type of aircraft involved in the accident), it does not seem plausible that he should inadvertently find himself stalling. Nevertheless, it can be stated that in the last few minutes before the accident, the aircraft was in unpowered free flight and not prepared for an imminent landing. The flight altitude was similar to that of the nearby summits, some 730 m above sea level, and some 700 m south of the hillsides. To the west and in the nearby valleys there were ideal fields for making a forced landing, with the option also of starting up the engine to remain in flight. However, the pilot tried to gain altitude by spiraling up the thermal upcurrent rising from the hillside, caused by a slight southerly wind. In the last four or five minutes, in which the glider may have made ten or so complete 360° turns, the wind moved the aircraft towards the summit of the hill at 529 m altitude. There, it suddenly lost control and plunged to earth, crashing to leeward into the northern slope with great violence and at a steep dive angle.

It is considered that control may have been lost when the pilot was flying with an insufficient speed margin to prevent stalling, on making a brusque maneuver to avoid crashing into the summit of the hill, on being caught off guard by an adverse gust of wind, or by turning too tightly with a high bank rate.

With its operating loads, the aircraft was already carrying a lot of weight, leading us to assume that it did not carry water ballast in the wings; as for the flaps, it is not known whether the pilot had selected high flap positions.

The flying height at the moment of stalling was some 150 m, which was necessary for the glider to accelerate from the approximately 80 km/h airspeed in a stall situation to the 202 km/h indicated by the set anemometer found after the crash.

As for the probable cause of stalling, this aircraft type's negative record and recognized tendencies toward sudden stalling must be borne in mind.

2.4. Dynamics of impact

Following the stall, the falling aircraft accelerated to 202 km/h and crashed first with the tip of the left wing, which flew off when its normal fixings broke. The next impact of the aircraft was fully in the nose, which was crushed until the entire leading edge of the wing reached the ground. The spar behind the pilot's head struck the cockpit with its full inertia and smashed it. The impact of the wing on the ground lifted and bent its leading edge, leaving the entire wing in an almost vertical plane.

When the nose and wings struck the ground, the tail was in the air due to the steep dive angle. The fuselage flipped over the wings due to the inertia of the whole assembly, which included the engine, and came to rest in an inverted position. The tipping speed of the fuselage was accentuated by the impact. The inertia loads and aerodynamics of the tail fractured the narrow fuselage at its rear point. The aerodynamic loads leveled out the tail, now attached to the fuselage only by the flight control cables, and it fell to earth in its normal position.

It should be noted how the movements of the fuselage and the wings differed in the accident: the wing assembly moved as a single piece, taking on a positive spin which tipped it over, while the rear fuselage and tail turned in a negative direction, tipping over the wings.

3. CONCLUSIONS

3.1. Findings

— The pilot was qualified for the flight and had a valid license.
— The meteorological conditions were suitable for a visual flight. Winds were mild, from the south and east.
— The pilot was flying in a thermal at low altitude in the minutes prior to the accident.
— The aircraft was in flight configuration, with its landing gear and engine retracted.
— The aircraft plunged to the ground in hilly terrain, out of control in a steep dive, causing the death of the occupant.

3.2. Causes

It is considered that the accident occurred because of an inadvertent stall when spiraling within a thermal at low altitude, with an insufficient airspeed margin for the foreseeable conditions of maneuvering loads and turbulence.

4. SAFETY RECOMMENDATIONS

None.

APPENDICES

APPENDIX A
Photographs

Photo 1. *Aircraft of the type involved in the accident*

Photo 2. *The wreckage, viewed in the direction of the impact. In the foreground, the trace and hole of the impact of the front fuselage can be seen*

Photo 3. *Final position of the fuselage and tail. Inverted fuselage. Fracture of fuselage at tail joint*

Photo 4. *Bottom surface of left wing*

Photo 5. *Left wing tip*

Photo 6. *Complete wreckage, looking south*

Photo 7. *Complete wreckage, looking north. Hills in background of 730 m height. Let wing tip separated from its wing*

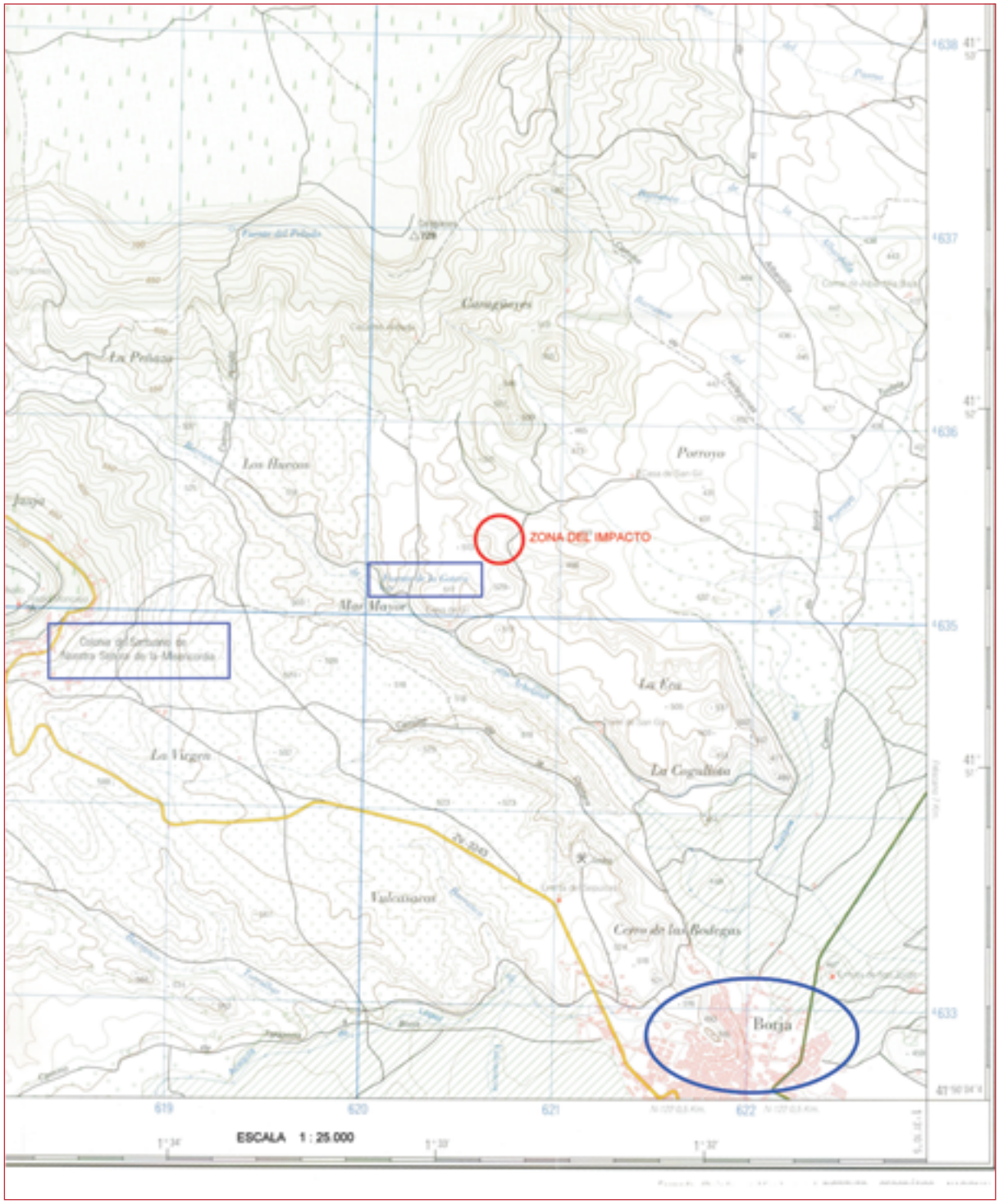
Photo 8. *Engine and propeller ejected from their compartment*

Photo 9. *Wreckage of front fuselage and detail of fuel tank*

Photo 10. *Altimeter set at 950 mb, reading –65m. General view and detail*

Photo 11. *Anemometer reading 202 km/h*

APPENDIX B
Topographic map of accident site



Map 1. *Topographic map of accident site (grid 1 km²)*