DATA SUMMARY

LOCATION

Date and time	**24 june 2002; 17:45**
Site	**Ocaña airfield (Toledo)**

AIRCRAFT

Registration	**PH-1204**
Type and model	**SCHLEICHER Ka 6 BR**

Engines

Type and model	
Number	**0**

CREW

Pilot in command

Age	**31 years**
Licence	**Pilot of sailplanes**
Total flight hours	**143 hours**
Flight hours on the type	**35 hours**

INJURIES

	Fatal	Serious	Minor
Crew		**1**	
Passengers			
Third persons			

DAMAGES

Aircraft	**Destroyed**
Third parties	**Tow cable broken**

FLIGHT DATA

Operation	**General aviation – Non commercial – Pleasure**
Phase of flight	**Take off – Initial climb**

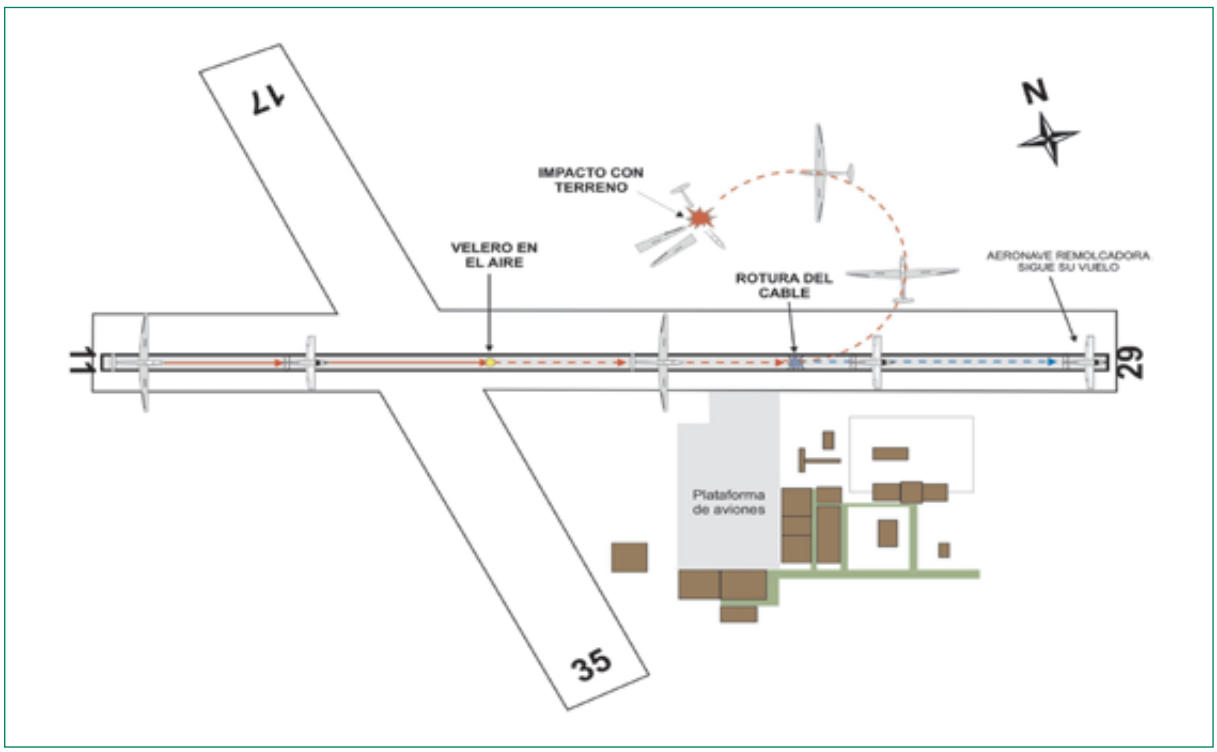
1. FACTUAL INFORMATION

1.1. History of the flight

At approximately 17:43, local time, a Robin DR-400-180R aircraft, registration EC-BTN, began to tow a Schleicher Ka 6 BR glider, registration PH-1204, on runway 11 of the Ocaña aerodrome. The take off was carried out in a normal way, the glider lifted off first followed by the towing aircraft shortly afterwards. Seconds later, when both aircraft had travelled about three fourths of the 1200 metre-long runway (see diagram), the tow cable broke.

The towing aircraft continued on its route and the glider began a very shallow turn to the left, almost without banking, as if trying to return to the threshold from where it had departed. When it had turned more than 90° it increased the bank, and instants later the left wing descended abruptly and the aircraft began to descend quickly, until it crashed into the terrain.

As a result, the pilot was seriously injured and the aircraft was destroyed.

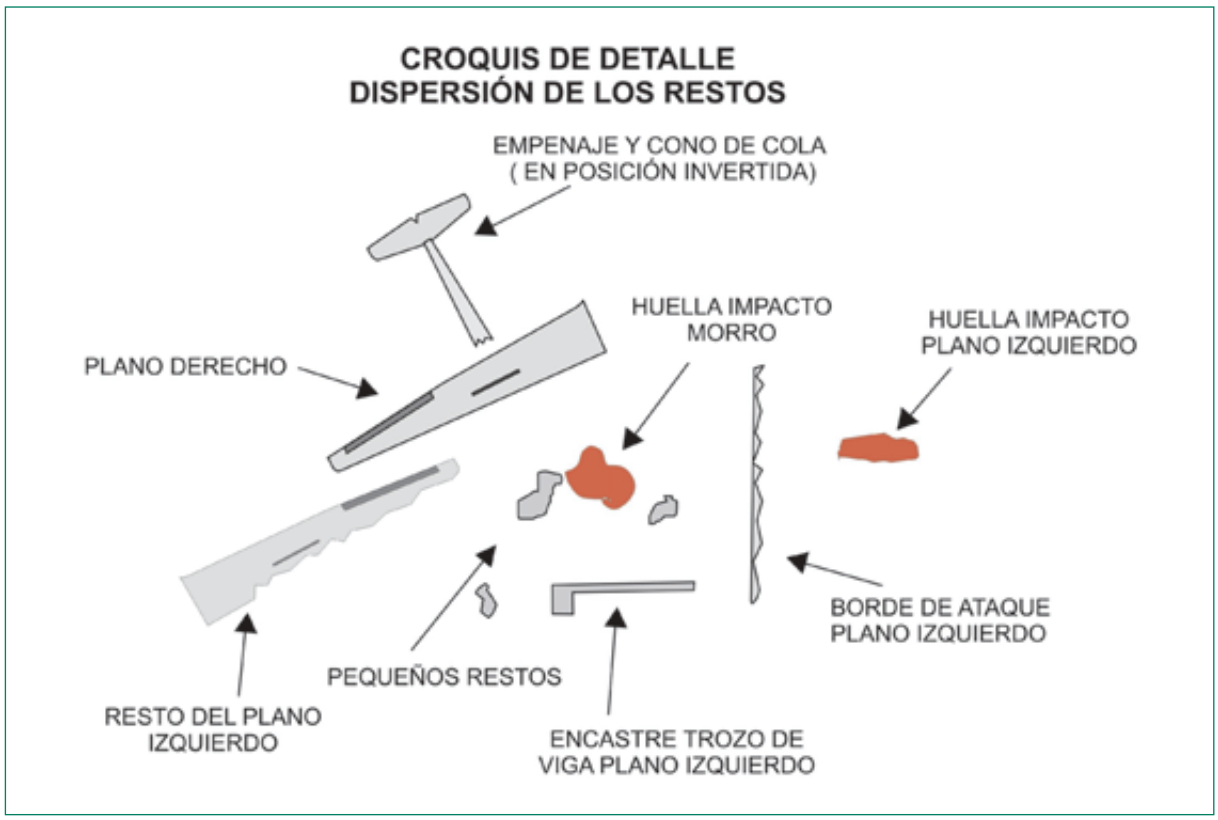


1.2. Meteorological information

According to the information provided by the personnel of the Ocaña aerodrome, the meteorological conditions were CAVOK, a South-Southwest wind was blowing with a speed between 12 and 14 knots, and the temperature was 32 °C at the time the accident happened.

1.3. Marks left by impact against terrain and wreckage distribution

The aircraft wreckage was concentrated in a very small area around the spot where it impacted against terrain.



An impact mark was found on the ground, produced by the leading edge of the left wing, and to its left, the impact mark of the aircraft nose was noticed.

The left wing was broken in three parts: the leading edge, located very close to the spot where the wing impacted, a beam fragment and the wing root area, located near the spot where the nose impacted, and the wing tip, located farther to the left.

The nose of the aircraft was completely destroyed up to the wing root. Its fragments were scattered about the area where the impact took place.

The right wing suffered little damage. Its location is indicated on the diagram.

Of the two pieces the cable split into after it broke, only the one hooked on to the towing aircraft was found. The other one, coupled to the glider hook, could not be located. It can be deduced that the glider pilot, before impacting with terrain, voluntarily used the cable-release mechanism.

On the other hand, taking into account the length of the cable fragment that was recovered, it can be concluded that the breakage took place at a point very near to the end hooked to the glider.

1.4. Statements of witnesses

The pilot of the towing aircraft stated that after lifting off the runway, when both aircraft were climbing, he observed that the glider was very low from the normal position it should have taken, and, in addition, was swaying from left to right. Faced to this situation, he communicated by radio with the pilot of the glider in order to ask him to climb. He immediately felt a strong pull. When he looked in the rear-view mirror, he saw that the glider was turning to the left and was surprised that it wasn't heading straightforward.

On the other hand, the statements taken from a group of pilots that were in the swimming pool of the aerodrome, who had seen practically the whole manoeuvre, matched those of the towing aircraft pilot. In this sense, they stated that the glider was always below or at the same height as the towing aircraft, and also that about halfway down the runway its wings began to roll. They also stated that at the moment the tow cable broke, the glider was lower than the towing aircraft. Afterwards, the glider began to turn towards the left.

It was not possible to interview the pilot at the first moments after the accident because he was hospitalised due to the serious nature of his wounds and he was transferred, later on, to a hospital in his country. Although some communications were held later on, the pilot could not remember any detail of the operation. It was the first time that he visited Ocaña Aerodrome y within a week he had carried out 4 towed flights from that aerodrome. The pilot commented that he had not been informed on the procedure to be applied in the event of breakage of the tow cable.

2. ANALYSIS

2.1. Breakage of the tow cable

During the tow phase the glider must be slightly above the towing aircraft, because otherwise it could be affected by the propeller stream. When this happens, the drag of the glider increases and this produces a sudden increase of the tension acting over the cable.

In the present case, the witnesses stated that the glider was never above the towing aircraft, but always at the same level or below it. This fact probably produced changes in the tension of the cable, with sudden decreases and increases. In some of those cycles the ultimate load of the cable was exceeded and it broke.

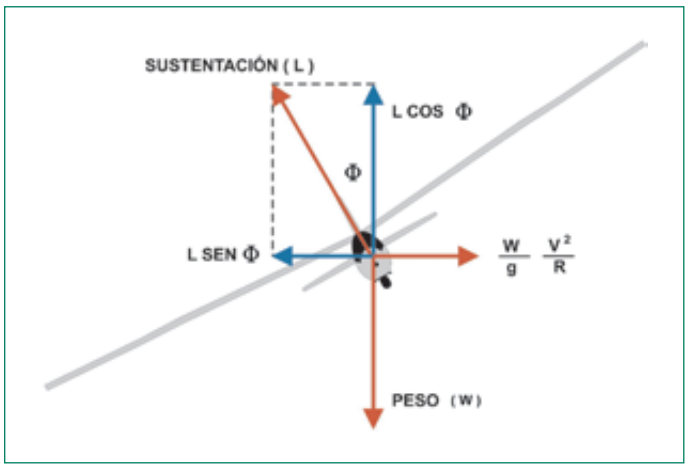
Breakage of the tow cable is not abnormal, but rather something foreseen and, to a certain extent, desirable, since this is a way to avoid strong pulls during the towing process that could seriously endanger both aircraft. So, the link between the towing aircraft and the glider should have an ultimate strength that can be obtained through a fuse or directly through the capability of the cable.

2.2. Manoeuvres

In the specific case of the Ocaña aerodrome, the Flight Operations Department has designed a procedure plan listing the actions to follow in case the tow cable would break. These actions depend on the moment at which the breakage occurs. Specifically, the procedure plan states that, if the tow cable breaks during the flight phase in which the present one occurred, the glider should continue the flight with the same heading and land immediately on the runway, in case there is enough length for it, or land on the ground area located beyond the end of the runway. There is no evidence that the pilot was familiar with this specific procedure of the aerodrome, although the instructions contained in the procedure in the event of breakage of the cable must be considered common practice of the pilots to achieve the best possible safety conditions in those circumstances.

Immediately after the tow cable broke, the pilot, instead of continuing on in the heading he had followed, began a turn to the left. At that moment the aircraft was at about 40 metres of height above the runway and its speed could have been around 70 or 80 km/h.

To facilitate the aircraft turning, it is necessary to bank it towards the desired side. In that position the lift forms an angle with the vertical, so that its horizontal component «pulls» the aircraft, causing it to turn. The weight of the aircraft must be balanced by the vertical component of the lift (L), whose value is equal to the lift multiplied by the



cosine of the angle formed with the vertical (ϕ), that is to say $L \cdot \cos \phi$. Since this value is smaller than L, in order to keep the aircraft from descending, the lift should be increased by increasing the angle of attack. This causes an increase in the induced drag and in the stall speed, i.e. that an aircraft stalls at a higher speed if it is turning than if it were in a straight and level flight.

In the present case, taking into account the large span of this kind of aircraft, the low speed, low height turn initiated by the glider made the left wing tip to descend and to lose speed until stall occurred on that side of the wing, and eventually produced the fall of the glider and the impact into the ground.

2.3. Impact sequence

The remains of the aircraft were concentrated in a very small area around the point where it impacted against the ground, indicating that this impact had a big vertical component.

On the other hand, in view of the damages suffered by the aircraft and the marks it left on the ground, it is assumed that the left wing made contact first, as the aircraft was in a banked attitude toward the left. Immediately afterwards the impact with the nose occurred.

2.4. Evaluation of tow cable properties

In light of the fact that the tow cable breakage occurred during the tow phase it was decided to carry out a set of tests to obtain the mechanical strength properties of the cable.

2.4.1. *Technical specifications applicable to tow cables*

The Joint Aviation Regulations (JAR) in JAR-22.581 state that the ultimate load of the tow cables or of the fuse, if installed, should not be less than 1.3 times the maximum weight of the glider to be towed and may not in any case be less than 5000 N.

The glider involved un the present accident has a maximum weight of 300 kg equivalent to about 2940 N. If this value is multiplied by 1.3 we obtain a total of 3822 N. Given that this amount is less than 5000 N and according to what is established in the aforementioned regulations, the ultimate load of the cable should not be less than 5000 N.

2.4.2. *Visual Inspection of the tow cable*

The tow cable is composed of four rope strands, having a total diameter of approximately 9 mm. It could be observed that one of its ends was broken. With regards to its appearance, it was noted that the external surface showed signs of severe wearing caused by being repeatedly dragged across the ground during the glider towing process.

2.4.3. *Testing*

A tensile test was carried out on the tow cable. Samples with a measured length of 400 mm were used, as specified in UNE-EN-919 standard, which were cut long enough so as to let them to be joined to the testing clamps. Six test samples were made.

These were subject to a tensile test, joining them directly to the mechanical clamps of the machine. The trials began using clamps suitable for the testing of metallic wires, but as it was noted that the cable always broke at the clamp end, other clamps were used, specifically designed for testing of ropes. In spite of this, the breakage continued to occur at the clamp end.

The following are the values for ultimate load obtained before the test samples broke:

Test sample	Type of clamp used	Ultimate load
1	Wire	6256.6 N
2	Wire	6462.6 N
3	Rope	6306.6 N
4	Rope	5306.4 N
5	Rope	5237.7 N
6	Rope	4873.9 N

Each test sample was taken from an area successively closer to the end where the cable broke. Thus, test sample 1 was the farthest from the end where breakage occurred, while test sample 6 was the nearest to it. The values obtained show that the piece of cable end tested and the ultimate load are related in such a way that the closer the test sample is to the end where breakage occurred, the lesser is the ultimate load.

All the values obtained are above the minimum value set by the aforementioned standard, 5000 N, except for test sample number 6 whose ultimate load was 4873.9 N, that is only 2.5% lower.

3. CONCLUSIONS

It is considered that the breakage of the tow cable was the beginning of the sequence that led the accident. This breakage was produced by the sudden increase of tension of the cable, probably due to the fact that the glider was affected by the propeller stream of the towing aeroplane at some point during the initial climb. However, the breakage of the cable alone cannot be considered enough to cause the accident, because other circumstances were present like the turn initiated by the pilot when the aircraft did not have enough speed and/or height and that made the aircraft to stall and to crash into the ground.