

DATA SUMMARY
LOCATION

| | |
|---------------|--|
| Date and time | Friday, 20th June 2003; 18:00 hours |
| Site | Prox. of aerod. of Casarrubios del Monte (Toledo) |

AIRCRAFT

| | |
|----------------|----------------------------|
| Registration | EC-DRS |
| Type and model | SOCATA RALLYE 235-C |

Engines

| | |
|----------------|----------------------------|
| Type and model | LYCOMING O-540-B4B5 |
| Number | 1 |

CREW
Pilot in command

| | |
|--------------------------|---|
| Age | 52 years |
| Licence | Airline transport pilot (airplane) |
| Total flight hours | 20,000 hours |
| Flight hours on the type | 700 hours |

INJURIES

| | Fatal | Serious | Minor |
|---------------|-------|----------|----------|
| Crew | | 1 | 1 |
| Passengers | | | |
| Third persons | | | |

DAMAGES

| | |
|---------------|------------------|
| Aircraft | Important |
| Third parties | None |

FLIGHT DATA

| | |
|-----------------|-----------------------------------|
| Operation | General aviation – Private |
| Phase of flight | Take-off – Initial climb |

1. FACTUAL INFORMATION

1.1. History of the flight

The object of the flight in which the accident occurred was to familiarize a pilot in the handling of the aircraft.

This pilot, together with another pilot with extensive flying experience, took part in the flight for this purpose.

They took off from runway 08 of the aerodrome at Casarrubios del Monte, in the province of Toledo, with the pilot familiarizing himself acting as pilot flying, and then started to carry out landings and take-offs on that runway.

According to the crew's statements, after the third landing, they accelerated and initiated a new take-off. On starting to climb, they noticed a sort of «falter» in the engine, observing that the aircraft had difficulty in climbing and did not accelerate well, only achieving a speed of 70 kt. The vertical speed indicator showed between 200 and 300 feet/minute. They decided to extend the upwind leg until reaching a height of 2,350 feet, 300 feet above the aerodrome's elevation, and immediately afterwards started the turn into the downwind leg, maintaining a small bank angle of between 5° and 10°, at the end of which the aircraft had descended 50 feet, with its speed being maintained at about 70 kt.



Photo 1. Aircraft damage

At that moment the more experienced pilot took the controls, trying to increase the speed at the cost of losing height, for which he descended 100 feet and again levelled the aircraft. Immediately afterwards, the aircraft started to lose speed and height, until it crashed into the ground.

The pilot in command was blocked in his seat and had to be helped out of the aircraft by the other occupant.

Meanwhile, the grass covering the ground where they landed, which was dry, had caught fire and quickly extended to the aircraft, resulting in it being almost completely destroyed.

1.2. Injuries to persons

The pilot in command was taken to a hospital centre where he was diagnosed with a fractured vertebra, remaining in hospital for more than 48 hours.

The aircraft's other occupant was uninjured.

1.3. Meteorological information

Although no meteorological information for the aerodrome of Casarrubios del Monte is available, given its proximity to the Madrid/Cuatro Vientos airport, the latter's temperature and dew point data would have been very similar to those of Casarrubios.

The METAR of Cuatro Vientos at 18:00 local time indicates that the temperature was 36 °C, and the dew point 10 °C.

1.4. Personnel information

The pilot in command had an airline transport pilot's licence, with type ratings for DC9, MD88, MD90, instrument flight and flight instructor. He had more than 20,000 hours of flying experience, of which some 700 hours were in aircraft of the type that suffered the accident.

1.5. Pilot's statement

The pilot declared that throughout the flight the engine indicators did not show abnormal values as regards r.p.m, manifold pressure, etc.

He also indicated that he cut off the engine at the moment the aircraft made contact with the ground.

1.6. Aircraft information

1.6.1. General

Aircraft identification

- Manufacturer: Socata
- Model: Rallye 235-C
- Serial number: 13317
- Year of manufacture: 1979
- Hours: 3003:45

Engine

- Manufacturer: Lycoming
- Model: O-540-B4B5
- Serial number: RL-19507-40A
- Hours: 1082:20

Propeller

- Manufacturer: Hartzell
- Part number: HC-C2YK-1-BF
- Serial number: CH 21769

Governor

- Manufacturer: Woodward
- Part number: 2106RL
- Serial number: 1445194V

1.6.2. Airworthiness certificate

| | |
|-----------------------|---|
| Class | Normal |
| Category | Aerial work |
| Technical performance | Normal |
| | Aircraft authorized for any environmental condition |
| Validity periods | Issued: 14 March 1995 |
| | Renewed: 27 May 2003 |
| | Expiry: 30 April 2004 |

1.6.2. Aircraft maintenance

The aircraft's Maintenance Manual indicates that inspections should be made every 25, 50 and 100 hours. In connection with the engine, it specifies that Lycoming, the engine's manufacturer, recommends inspections every 50 and 100 hours.

1.7. Wreckage and impact information

The first mark found on the ground, some 5 metres long, was probably made by the right leg of the main landing gear.

Another mark, 3.60 metres long, was found parallel to the first one, starting some 1.80 metres after the first. There was a separation between both marks of 1.80 metres, which is the approximate width of the aircraft's main undercarriage.

Then there was a section of some 8 metres with no marks at all, and then two more marks, similar to those described above, but at an angle of 15° with respect to the first marks.

The aircraft was found at the end of these marks, turned at an angle of 45° with respect to the first marks.

The fire had burnt both wings and the whole fuselage, with the exception of the tail part.

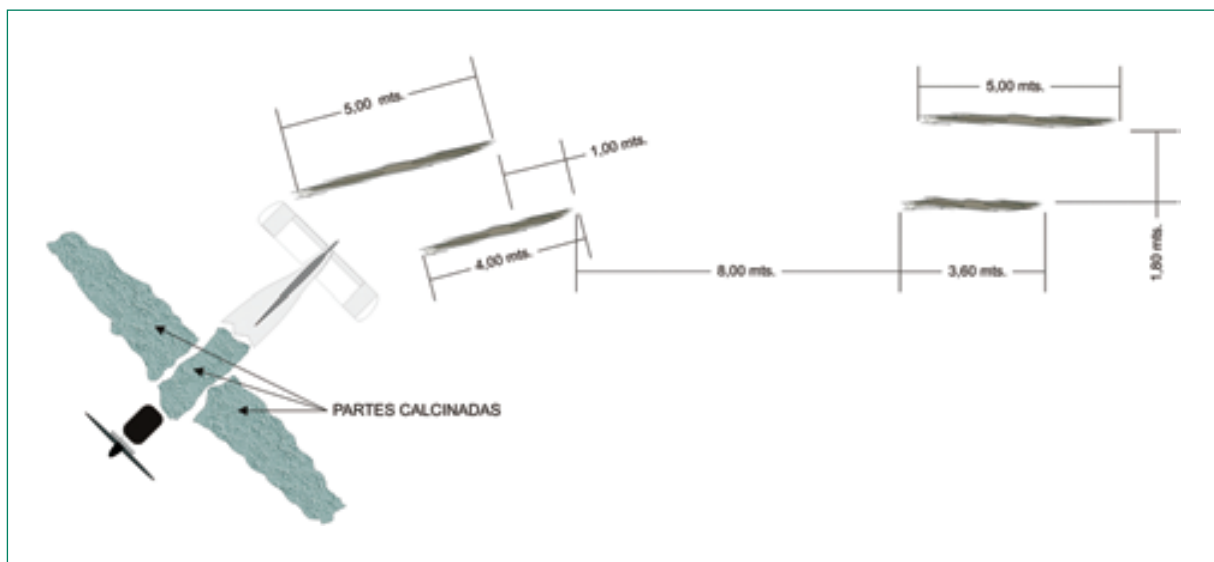


Figure 1. Diagram of ground marks and wreckage layout

The only damage to the horizontal stabilizer and vertical tail fin was that the paintwork was affected by the effect of the heat.

Although the engine showed signs of having been affected by the fire, no serious damage appeared to have been caused to it. Only some of the elements in the rear part of the engine, such as the magnetos, had been affected by the heat.

1.8. Aircraft inspection

1.8.1. *Field inspection*

The aircraft's condition only permitted a visual inspection of the engine, propeller, wings, elevator and rudder and stabilizers.

The engine did not appear to have suffered serious damage, either from the impact into the ground or the fire that broke out subsequently.

Both propeller blades were bent backwards, although this was more serious in one than the other. Neither of them showed signs of impacts on their leading and trailing edges,



Photo 2. Marks in one of the blades

only showing longitudinal marks, which must have occurred during their contact with the ground, indicating that, when this occurred, the propeller was not rotating.

The wings were seriously affected by the fire, which melted some of their parts. Even so, the left-hand wing tank was approximately 50% full of fuel.

The horizontal stabilizer and elevator control column were damaged at their right-hand end by the effects of the fire, with no abnormalities being seen in their fastenings. The continuity of the controls could not be checked because the cables had been destroyed.

The vertical tail fin and rudder bar were virtually undamaged, with only part of the paintwork being affected. Nor could the continuity of the controls be checked because the cables had been destroyed.

The rest of the aircraft was completely destroyed.

1.8.2. *Workshop inspection*

The engine and propeller assembly were taken to a workshop to be subjected to a more detailed inspection.

Once mounted on a bench, the propeller was rotated, noting that it was not possible to rotate it more than a 1/4 of a turn.

Then work commenced on stripping the engine, starting with the oil filter, which was fairly clean. The oil suction filter was removed and also found to be free from particles. The oil was drawn off from the crankcase and measured, the volume of which was about 12 litres, which is the quantity it normally contains. The oil's appearance was normal and did not appear to contain particles. Nevertheless it was filtered, with nothing abnormal appearing.

The governor was removed and found to contain oil.

The sparkplugs were removed and were found to be in good condition. The magnetos were removed but could not be given a more thorough examination because they were completely blocked due to the effect of the temperature to which they had been subjected.

The rocker box covers were removed, noting that the valve springs of cylinders 5 and 6 had lost «strength» and could not be compressed by hand. This loss of characteristics was possibly due to the effect of the heat to which they were subjected during the fire.

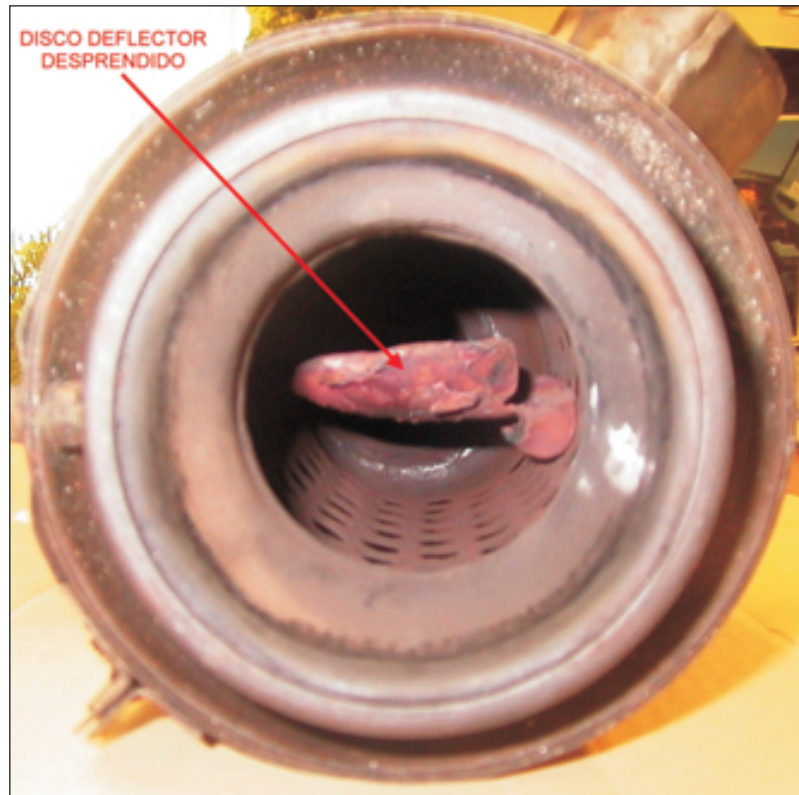


Photo 3. Loose baffler inside the muffler

Then the cylinders were stripped, with numbers 1, 2, 3 and 4 being found in good condition, whilst numbers 5 and 6 showed clear signs of oxidation and cylinder 6 was blocked, due to the seizing of the oil regulating piston ring. The cylinders' oxidation was probably caused by the water used to put out the fire entering the engine. After stripping cylinder 6, the crankshaft rotated freely.

The fuel filter was found to be clean. The carburettor was damaged due to its impact against the ground. It was opened and pieces of plastic were found in the bowl, which proved to be the remains of the float, which had melted in the heat from the fire. Otherwise, the carburettor's appearance was normal and nothing unusual was seen.

The next step was to strip the two exhaust pipes mounted on this type of aircraft, which had previously been released from the engine. Both manifolds and exhausts were in good condition and without obstructions. However, the two mufflers were cracked and on moving them something sounded in their interior. In both cases the noise was caused by a baffler (an air deflector disc), which was loose. The bafflers condition indicated that they had worked loose prior to the accident.

In summary, with the exception of the loosening of the muffler deflector discs, all the damage found in the engine-propeller assembly and its accessories was caused

either by the impact or subsequently by the fire or the water used to put the fire out.

1.9. Additional information

1.9.1. Information on the exhaust system

This aircraft's engine has six opposite cylinders arranged three to the left of the engine's longitudinal axis and three to the right. There is an exhaust pipe on each side to collect the gases from the three cylinders on that side.

Each exhaust pipe has three main parts: manifold, muffler and exhaust.

The manifold collects the gases from the three cylinders on its side and takes them to the muffler.

As can be seen from the longitudinal section in Figure 2, the muffler has two cavities separated by a wall (intermediate). The exhaust gases circulate through the inner cavity, which also has a perforated wall. In the base of this cavity there is a baffle or deflector

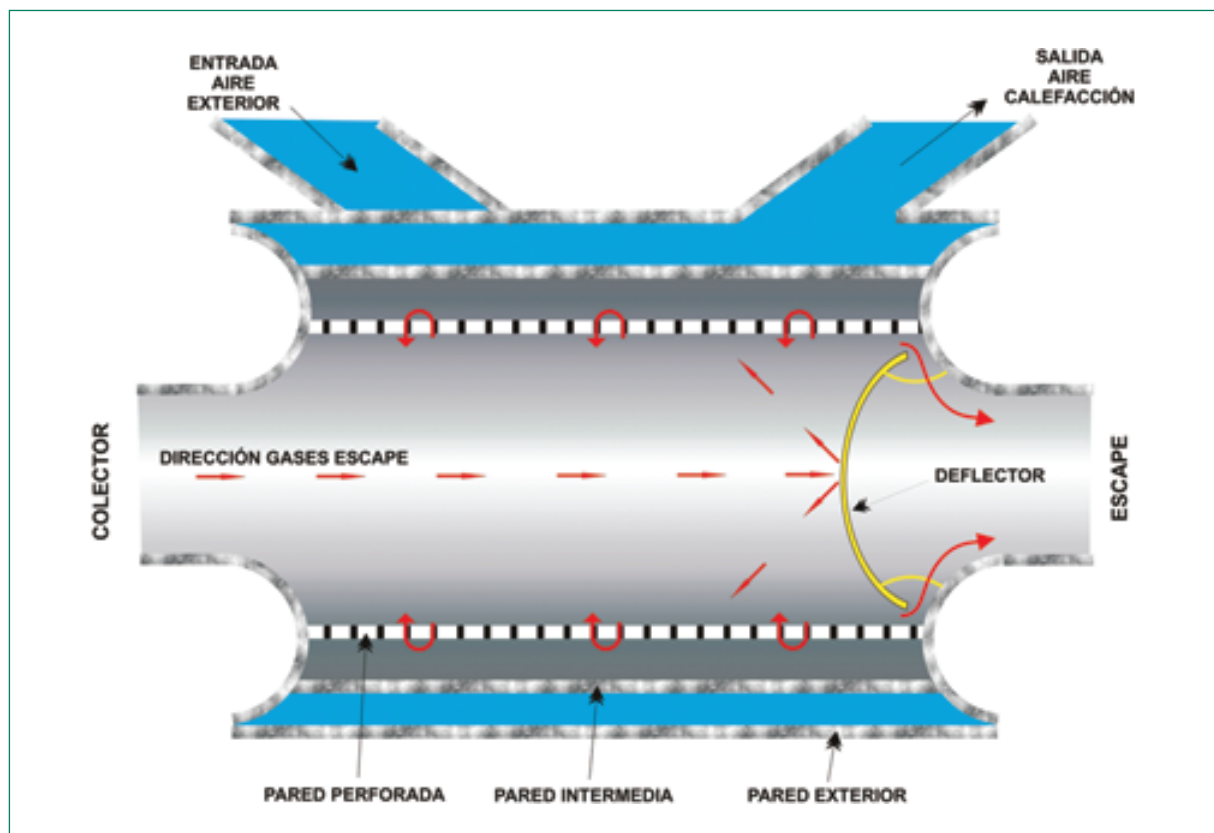


Figure 2. Schematics of the muffler

disc, secured by three pins, which are welded to the inner walls of the muffler. Outside air circulates through the most external of the cavities, is warmed up in contact with the intermediate wall, and then leaves the muffler and is carried to the cabin for heating purposes.

The exhaust gases enter the muffler and sink to the bottom, where they come up against the deflector disc, which directs them to the muffler's sides, so that they flow through the perforated wall, which reduces their noise. The gases then leave the muffler through the space that is left between its base and the deflector disc and enter the exhaust, which is a cylindrical pipe some 50 cm long, and are finally exhausted into the atmosphere through its end.

The aircraft's manufacturer informed that the aircraft's maintenance schedule establishes that a visual inspection of the exhaust system must be carried out every 100 hours, in order to detect the presence of cracks, burnt areas, etc., as well as to check the correct state of the joints of the various elements of which it is comprised. There are no indications in respect of the need to inspect the fastenings of the mufflers' internal deflectors.

1.9.2. *Service experience of the exhaust system*

The BEA informed that no reports of similar failures of the exhaust system of this manufacturer was available in 19 years of production during which a lot of flight hours have been flown.

2. ANALYSIS AND CONCLUSIONS

The marks and bending on the propeller blades indicate that when they made contact with the ground the engine was hardly rotating.

The meteorological conditions that existed at the moment of the engine failure were not conducive to the formation of ice in the carburettor.

No abnormalities were found in the engine and its systems to justify the loss of power, with the exception of the loosening of the deflectors of both mufflers.

The loose deflectors were caught inside the mufflers, where they were able to move freely. In this situation, it is possible that at a given moment they were positioned in such a way that they partially obstructed the exhaust gas outlet, which would result in a loss of power.

If this situation had occurred in just one of the exhausts, only three of the cylinders that take up the gases would have been affected, in which case the engine would have suf-

ferred strong vibrations, which would have been picked up by the pilot. In this respect, it must be considered that, according to the pilot's statement, at no time did abnormal vibrations occur.

On the other hand, if the partial obstruction of the exhaust gas outlet had occurred in both mufflers almost simultaneously, no vibrations would have been produced in the engine but there would have been a considerable loss of power, as a result of which the engine would have been incapable of maintaining its rotation rate. This reduction in power would be detected by the governor, which would intervene by reducing the propeller blade angle, in order to reduce the power required by the propeller, so that, even though the engine was supplying less power, it would be capable of maintaining the rotation rate. On reducing the propeller blade angle, there is a reduction in its thrust. This situation is similar to what was described by the pilot in his statement.

Although the only hypothesis that could be argued, according to the statements and information gathered, to explain the engine failure would be the partial obstruction of exhaust gases in both mufflers simultaneously, it is considered that the likelihood of this fact is extremely limited. Therefore, it has not been possible to determine the probable cause of this accident.