Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

Air Accident Investigation Unit - (Belgium)
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Safety Investigation Report

ACCIDENT TO SOCATA MS880B AT EBUL ON 14 APRIL 2012

Ref. AAIU-2012-07
Issue date: 05 July 2013
Status: Final

FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident.

In accordance with Annex 13 of the Convention on International Civil Aviation and EU Regulation 996/2010, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and define recommendations in order to prevent future accidents and incidents.

In particular, Article 17-3 of the EU regulation EU 996/2010 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility in the accident.

Unless otherwise indicated, recommendations in this report are addressed to the Regulatory Authorities of the State having responsibility for the matters with which the recommendation is concerned. It is for those Authorities to decide what action is taken.

The investigation was conducted by Luc Blendeman, Sam Laureys and Henri Metillon

The report was compiled by Henri Metillon and was published under the authority of the Chief Investigator.

NOTES:

1. For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

2. ICAO document 9859 “Safety Management Manual” was used to identify the hazard and the consequences related to the accident.

SYNOPSIS

Date and hour of the accident:	14 April 2012 at 17:05 UTC
Aircraft:	SOCATA MS880B SN: 1796
Accident location:	On a field bordering EBUL Ursel Airfield N 51° 8' 23'' E 003° 28' 54''
Aircraft owner:	The pilot was the owner
Type of flight:	Training – Simulation of engine failure
Persons on board:	The pilot was alone on board

Abstract:
During a simulated forced landing at EBUL the pilot realized at 1000 ft AGL he had missed the approach and decided to go around. The engine did not respond to the throttle opening and the pilot had no other choice than performing a forced landing on a field bordering the airfield. Before touch down, the right wing collided with a tree.

Causes:
The accident was caused by an undetected engine failure during an exercise of engine failure simulation. The cause of the engine failure could not be determined with certainty. However, the simulated inoperative engine probably became inoperative due to fuel starvation, but the investigation could not exclude a carburettor icing phenomenon.

Hazard identified during the investigation[1]:
- Meteorological conditions conducive to carburettor icing.
- Selection of an almost empty fuel tank when flying at low altitude.
- Fuel starvation in turn when not properly coordinated (Slip or skid turns).
- Not adhering to the flight manual recommended procedures.

Consequence[2]:
Engine failure (SCF-PP) and collision with obstacle during landing (CTOL)

[1] Hazard – Condition or object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.
[2] Consequence – Potential outcome(s) of the hazard

1 Factual information.

1.1 History of flight.

After 5 months of not flying for medical reasons, the pilot restarted flying and made 6 flights between 16 March 2012 and 12 April 2012. On 14 April 2012, he took off, alone on board, from Runway 07 of EBUL airfield in order to perform simulated forced landings. The first exercises were performed using the R/H tank. For the last exercise of the day, the pilot climbed above the airfield up to 2500 ft and started the engine failure simulation by first reducing the throttle and thereafter setting ON the carburetor heater before describing large left hand circles in descent. The pilot left the electrical fuel pump in the OFF position and selected the left hand wing tank for this last exercise. At around 1000 ft AGL the pilot being approximately above the axis of final runway 07 realized he was too high and too close of the threshold and concluded he had missed the approach. He therefore decided to go-around, performed a right hand turn and thereafter a left hand turn in order to enter the circuit before opening the throttle. Unfortunately, the engine did not respond. The pilot tried unsuccessfully to restart the engine using the starter. When landing the airplane in a field bordering the airfield domain, the right wing collided with a tree just before touching down.

1.2 Injuries persons.

Injuries	Pilot	Passenger	Others	Total
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	1	0	0	1
None	0	0	0	0
Total	1	0	0	1

1.3 Damage to aircraft.

The airplane suffered significant structural damage to both wings, the fuselage and the nose landing gear, the most damaged part of the airplane being the right hand wing due to the collision with a tree.

1.4 Other damage.

A tree was damaged.

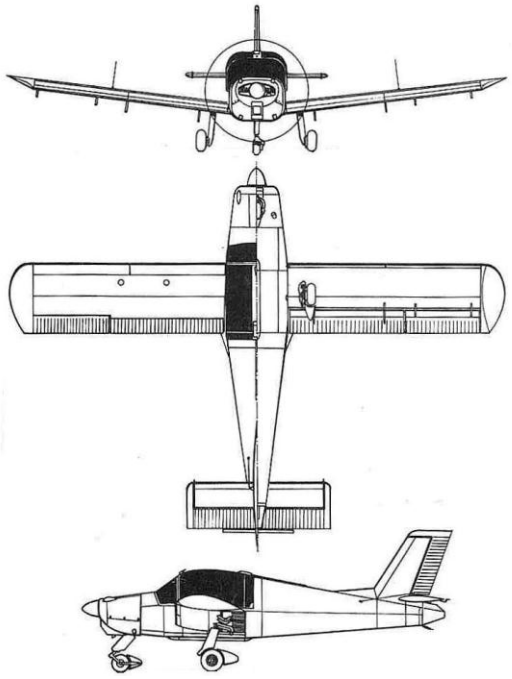
1.5 Personnel information.

Pilot: Male, 69 years old. Holder of a valid FAA Commercial Pilot License (Airplane Single engine land), first issued by FAA on 14 June 2003. Valid Medical Certificate Second Class (renewed in October 2011). Flight experience: Total Flight hours: 700FH, including 360FH as pilot in command of single engine piston airplane. 200 FH in double controls of SEP airplanes. Last biannual check performed on 29 January 2011. Pilot recent experience: the pilot flew 38 hours on N880V from May 2010 when he became the airplane

owner to the date of the accident. The pilot had stopped flying during 5 months, from 16 October 2011 to 13 March 2012 for health reasons. NB: The pilot held in the past a Belgian SEP (land) license delivered in June 1997 (no more valid since 31 August 2011).

1.6 Aircraft information.

The SOCATA "Rallye" is a single-engine, low-wing monoplane of all metal construction fitted with a fixed undercarriage. The MS880 is the original version produced and powered by a 100hp Continental (Rolls Royce) O-200-A engine. The airplane features slats normally open at low speed, and closing at a speed 30 – 40 km/h higher than the stall speed.
Other more powerful versions of the "Rallye" were developed and produced up to 1985. The first versions of the "Rallye" featured an interconnection between both fuel tanks and a fuel feeder tank located under the pilot seat and a ON/OFF fuel shut off valve. The later versions did not have a feeder tank and were provided with a LEFT/OFF/RIGHT fuel selector valve.
The MS880B SN: 1796 was provided with the last fuel system configuration, without feeder tank but including a three positions LEFT/OFF/RIGHT fuel selector valve.
Flight Manual: An extract of the Flight Manual Section 3 "Emergency Procedure" concerning engine failure in flight is reproduced at the end of this report. Although not required by regulation, a carburettor temperature indicator was installed to detect the presence of carburettor icing. However it was unserviceable.



General characteristics: Length: 7.25 m, Span: 9.74 m, Max. take-off weight: 770 kg, Power plant: Continental O-200-A piston engine, Fuel tank total capacity: 104 liters (52 liters in each wing).
Performance: Never exceed speed: 250 km/h, Cruise speed: 200 km/h, Speed range flaps down: 75 – 120 km/h, Speed range flaps up: 85 – 200 km/h, Best glide speed: 130 km/h with flaps and slats retracted, Lift to Drag ratio: more than 10.
Last maintenances: An FAA annual inspection was performed on 14 July 2010 as a preparation to get a FAA Airworthiness Certificate. The next FAA annual inspection, including a top overhaul of the engine, was performed on 22 September 2011.

1.7 Meteorological conditions.

Approximate meteorological conditions based on Brussels and Oostende airport METAR'S:
Temperature: 9°C, Dew point 3°, Wind: 10° 13 knots, Visibility +10 km and QNH: 1008 hPa.

1.8 Aids to navigation.

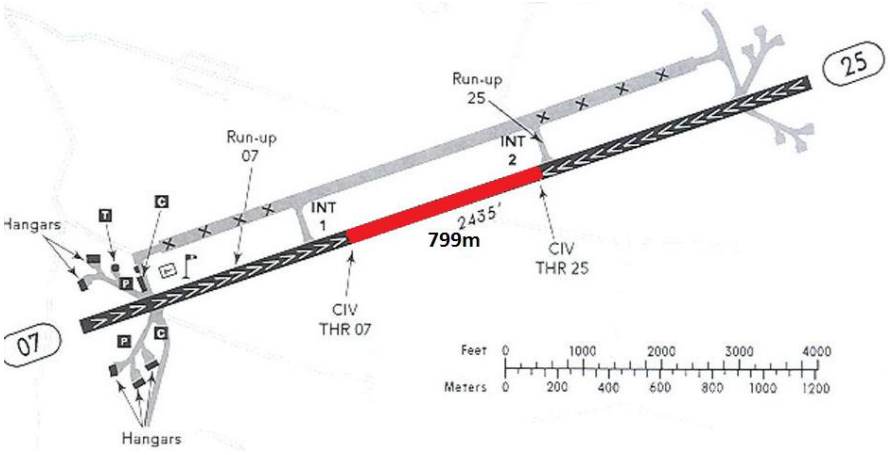
Not applicable

1.9 Communication.

Not applicable

1.10 Aerodrome information.

The EBUL Ursel airfield is a former NATO reserve base that is now categorized as a reserve airfield of the Belgian Defence - Air Component. The airfield is located between the cities of Gent and Brugge. It is equipped with a 2980 m long – 45 m wide bi-directional concrete runway oriented 070° / 250°. Elevation of the airfield is 95 ft. The length of the runway is limited to 799 m for civil use. The circuits are left hand for both runways (07 and 25) at an altitude of 1200 ft. On the day of the accident the runway in use was 07.



Flight path and crash site

The flight path was reconstructed based on the declaration of the pilot.
Considering he had missed the approach, the pilot decided to stop the exercise when he was flying at around 1000 ft above the threshold of the Air Defence runway.
The airplane made a right hand turn followed by a left turn. The exact position of the airplane when the pilot realized the engine was no more operating is unknown.
The crash site is located at around 650 meters from the axis of the runway.

1.11 Flight recorders.

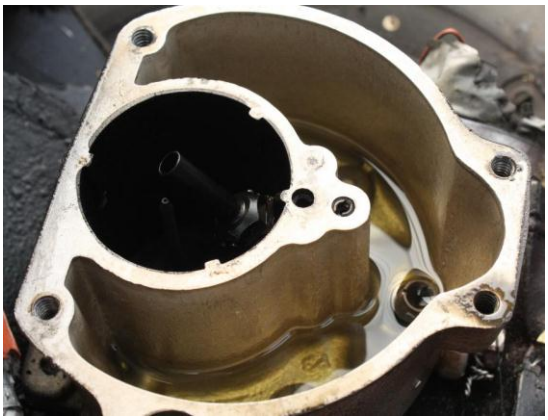
Not applicable

1.12 Wreckage and impact information.

Before touching down, the right wing collided with a tree and the airplane went nose first into the ground.
An external inspection of the airplane, including the position recording of the different engine controls was performed the day of the accident on the crash site. Thereafter, the airplane was transported to the airfield and stored in a closed hangar. The airplane was thoroughly inspected by investigators 6 days after the accident, on 20 May 2012.
As it was clear the engine failed to respond to the opening of the engine throttle, the inspection focused on the cause of the engine failure.

- As already seen on the crash site, all the engine controls were found in the OFF position which means throttle set on idle, mixture on cut off, carburettor heat OFF, fuel selector valve on the close position, electrical fuel pump OFF, magneto switches OFF and master switch OFF. The battery was also disconnected. All these controls had been set OFF after the accident.

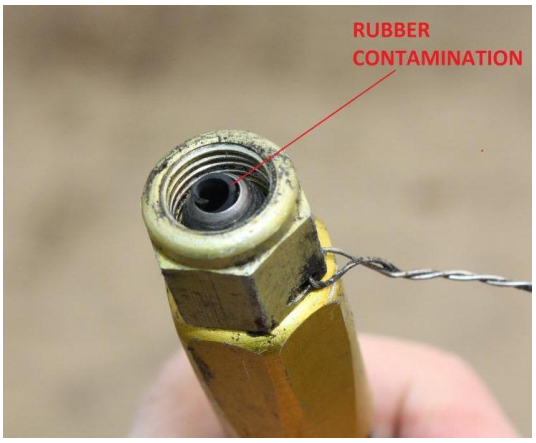
- Both wing fuel tanks as well as the entire fuel system up to the firewall were determined to be fuel tight after the accident. No fuel leak or fuel odour was noticed by the investigator on the crash site.
- The left fuel tank was found almost empty while the right one was filled more than one half.
- Both fuel tanks were filled with automotive fuel.
- The ignition system was tested: both magneto's were tested by turning the crankshaft. They were found operative as well as the spark plugs.
- The mechanical integrity of the engine was verified: the crankshaft, the camshaft, the intake and exhaust valves and the accessories were turning and/or moving as they should. There was normal compression at each cylinder assembly.
- The fuel tank ventilation and the fuel system located in front of the firewall was inspected: the fuel gascolator/filters, the fuel lines, the mechanical fuel pump were controlled. No anomaly was found. The carburettor fuel intake finger screen was found in good condition and clean. Some lines were damaged but no pre impact anomaly was found except that one end of a flexible fuel line was partially clogged by a rubber shaving. However this contamination was not recent and the remaining free section had proved to be sufficient to properly feed the carburettor at full power.
- Finally, the carburettor was removed from the engine taking special care to avoid spillage of the fuel remaining in the float chamber. Thereafter the carburettor bowl and the throttle body were carefully disassembled showing that the fuel level and quantity remaining in the carburettor bowl was insufficient to feed the main nozzle.



The carburettor was carefully inspected in order to find the reason of the low quantity of fuel found in the bowl.
The "Nose down" position of the airframe after the accident could not explain such a significant loss of fuel.
The float and the float valve and seat did not show any anomaly. The fuel inlet strainer was clean.

The fuel found inside the tanks and in the carburettor was a "yellow/green" coloured automotive fuel.

No STC authorizing the use of automotive fuel was found to be applied to the airplane.
The mechanical fuel pump was tested and found serviceable.



The contaminated flexible line was inspected again and it was determined unlikely that the rubber shaving contamination could have moved and fully obstructed the fuel flow.

Additionally, fuel flow had been proven to be sufficient to feed the engine when full engine power (and consumption) was applied.

1.13 Medical and pathological information.

The pilot remained conscious after the crash while being shocked. He was taken to hospital for detailed medical examination. He was superficially hurt on the head and got also a backache.

1.14 Fire.

There was no fire

1.15 Survival aspects.

Obviously the crash was survivable.

1.16 Tests and research.

Not applicable

1.17 Organizational and management information.

Not applicable

1.18 Additional information.

Not applicable

1.19 Useful or effective investigation techniques.

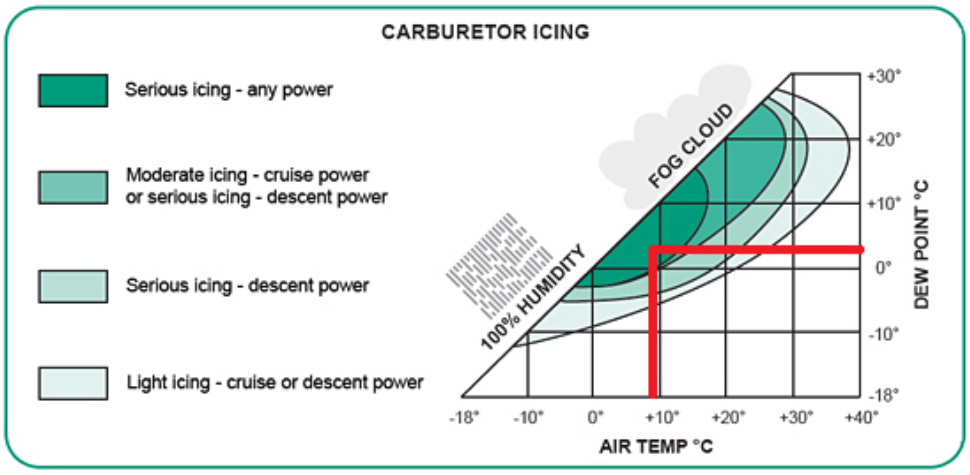
Not applicable

2 Analysis.

Engine failure

The meteorological condition and the interview of the pilot showed the following interesting points:

- As seen on the hereunder graph, the meteorological condition were such that carburettor icing was likely to occur.



- The pilot set the carburettor heater ON after the throttle reduction to idle while it is recommended to use the heater a few seconds before setting the throttle to idle.
- The carburettor temperature indicator was unserviceable.
- The pilot did not check if the engine remained operative during the engine failure simulation.
- Automotive fuel was used, which is known to make the carburettor more sensitive to icing.

Therefore, a carburettor icing was considered as a potential cause of the engine failure during the first step of the investigation. However, this hypothesis could not be demonstrated as the signs of carburettor icing rapidly disappear.

Consequently, other possible causes of engine failure had to be checked by a close examination of both the entire engine and the aircraft fuel system.

Examination of the carburettor was performed 6 days after the accident allowing it to be seen that the fuel level in the bowl was too low to properly feed the main nozzle. No indication was found that a leak occurred after the crash or during the transportation of the wreckage to the hangar.

The pilot declared he made the first exercises of the day using the right tank while he had switched the fuel tank selector to the left tank before the last exercise.

The pilot tried to restart the engine using the engine starter meaning that the engine was completely or almost stopped at the end of the exercise.
In summary:

- The left hand tank, being almost empty, was selected.
- The airplane was not provided with a feeder tank located under the pilot seat to help avoiding fuel starvation, while earlier built “Rallye” airplane do have such equipment.
- The electrical fuel pump was OFF during the entire engine failure simulation.
- Taking into account that no pertinent anomaly was detected in the fuel system, the following hypothesis could explain the low fuel quantity found in the carburettor:
    - The engine failure simulation involved large circles above the airfield. These circles were possibly not properly coordinated. Slip or skid turns cause the fuel to move inside the fuel tanks both towards the wing tip or wing root. In case of left hand slip turn, the fuel inside the left hand tank will move toward the wing tip causing the mechanical fuel pump to suck air instead of fuel and causing therefore fuel starvation.
    - Carburettor fuel vaporization and fuel consumption did not stop as long as the engine is turning, both by wind milling or by its own energy.
    - The engine failure exercise duration was estimated to be around 1,5 to 2 minutes of descent from 2500 ft to 1000 ft which is sufficient to empty a not properly fed carburettor.
    - When the pilot decided to interrupt the exercise the airplane was flying at a very low speed having as consequence that the engine had stopped turning by wind milling. Therefore the mechanical fuel pump was no more operating. Feeding of the carburettor was thus impossible except if the electrical fuel pump had been switched ON.

Flight Manual guidance

The procedure of the flight manual in case of engine failure in flight is reproduced at the end of this report. Obviously, the actions recommended by the flight manual about fuel tank selection, electrical fuel pump and check of the fuel level indicator were not adhered to during the exercise while the simulation of an engine failure should normally be as close as possible to an actual engine failure.
It is likely that the pilot did not review the procedure before the flight.

Pilot proficiency.

The pilot restarted flying on 16 March 2012 after more than 90 days not flying. He reported he performed 6 flights alone on board to regain experience as prescribed by CFR 14 § 61.57 “Recent flight experience” (no pilot may act as a pilot in command of an aircraft carrying passengers unless that person has made at least three takeoff and three landings within the preceding 90 days).

3 Conclusions.

3.1 Findings.

- The pilot license was valid.
- The airplane was in airworthy condition.
- No pre-impact anomaly that could have caused an engine failure was found in the wreckage.
- The pilot had not flown between 16 October 2011 and 16 March 2012 due to medical reasons.
- Automotive fuel was found in the fuel tanks while no STC was found to be applied to this airplane to allow the use of this type of fuel.

3.2 Causes.

The accident was caused by an undetected engine failure during an exercise of engine failure simulation.
The cause of the engine failure could not be determined with certainty.
However, the simulated inoperative engine probably became really inoperative due to fuel starvation, but the investigation could not exclude that carburettor icing had occurred.

Contributing factors:

- The lack of speed up action on the throttle during the engine failure simulation prevented the pilot realizing the engine had actually failed.
- The electrical fuel pump was not set to ON.
- An almost empty fuel tank was selected.
- The late use of the carburettor heat system, after setting the throttle control to idle.
- The carburettor temperature indicator installed in the airplane was unserviceable.
- The use of automotive fuel making the carburettor more sensitive to icing.

4 Safety recommendations.

AAIU(Be) has no recommendation.

5 Enclosure

5.1 Extract of MS880B Flight Manual Emergency Procedures.

3.3 Engine failure in flight

CHECK
- *Fuel pressure. Switch on the booster pump*
- *Fuel level indicator*
- *Fuel cock open on the tank with the highest level*
- *Mixture on full rich (pushed)*

Fly the aircraft to the best lift-to-drag ratio speed 140 km/h – 76 kt - 87 mph with retracted flaps. The aircraft flies over 10 times approx. its altitude (with no wind).

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