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Final report RL 2013:19e

**Accident involving the aircraft SE-MBC
on 28 February 2013 at Borlänge Airport,
county of Dalarna, Sweden**

Ref no L-20/13

12/19/2013

SHK investigates accidents and incidents from a safety perspective. Its investigations are aimed at preventing a similar event from occurring again, or limiting the effects of such an event. The investigations do not deal with issues of guilt, blame or liability for damages.

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The Swedish Transport Agency,
Civil Aviation and Maritime De-
partment

Final report RL 2013:19e

The Swedish Accident Investigation Authority (Statens haverikommission, SHK) has investigated an accident that occurred on 28 February 2013 at Borlänge Airport, county of Dalarna, involving an aircraft with the registration SE-MBC.

In accordance with Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, the SHK investigation team hereby submits a final report on the results of the investigation.

On behalf of the Swedish Accident Investigation Authority,

Jonas Bäckstrand

Sakari Havbrandt

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General observations

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is a state authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended to clarify, as far as possible, the sequence of events and their causes, as well as damages and other consequences. The results of an investigation shall provide the basis for decisions aiming at preventing a similar event from occurring again, or limiting the effects of such an event. The investigation shall also provide a basis for assessment of the performance of rescue services and, when appropriate, for improvements to these rescue services.

SHK accident investigations thus aim at answering three questions: *What happened? Why did it happen? How can a similar event be avoided in the future?*

SHK does not have any supervisory role and its investigations do not deal with issues of guilt, blame or liability for damages. Therefore, accidents and incidents are neither investigated nor described in the report from any such perspective. These issues are, when appropriate, dealt with by judicial authorities or e.g. by insurance companies. The task of SHK also does not include investigating how persons affected by an accident or incident have been cared for by hospital services, once an emergency operation has been concluded. Measures in support of such individuals by the social services, for example in the form of post crisis management, also are not the subject of the investigation.

Investigations of aviation incidents are governed mainly by Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation. The investigation is carried out in accordance with Annex 13 of the Chicago Convention.

The investigation

On 1 March 2013 SHK was informed that an accident involving an aircraft with the registration SE-MBC had occurred at Borlänge Airport, county of Dalarna on 28 February 2013 at 14.16 hrs.

The accident has been investigated by SHK represented by Mr Jonas Bäckstrand, Chairperson, Mr Sakari Havbrandt, Investigator in Charge, Mr Peter Swaffer, Operations Investigator, Mr Christer Jeleborg, Technical Investigator and Mr Urban Kjellberg, Investigator specialising in Fire and Rescue Services.

The investigation team of SHK was assisted by Mr Bernhard Kobylík as an accredited representative of the *Austrian Civil Aviation Safety Investigation Authority*, the Austrian equivalent to SHK

The investigation was followed by Mr Magnus Holmén of the Swedish Transport Agency.

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Aircraft; registration and type	SE-MBC, Diamond Aircraft DA 40D
Class/Airworthiness	Normal, Certificate of Airworthiness and Valid Airworthiness Review Certificate (ARC ¹)
Owner	Hässlö Flygförening
Time of occurrence	28/02/2013, 14.16 hrs in daylight Note: All times are given in Swedish standard time (UTC ² + 1 hr)
Place	Borlänge Airport, Dalarna county (pos. 6025N 01531E; 153 m above sea level), on runway 32 adjacent to the threshold
Type of flight	Private
Weather	According to the tower at take-off clearance: Wind 320 degrees 24 knots. According to Meteorological Aerodrome Report METAR at 13.20 hrs: CAVOK ³ temp./dp +5/0 °C, QNH ⁴ 1007 hPa
Persons on board:	1
crew member	1
Injuries to persons	None
Damage to aircraft	Substantially damaged
Other damage	None
Pilot:	
Age, licence	23 years, PPL ⁵
Total flying hours	125 hours, of which 72 hours on type
Flying hours last 90 days	8 hours, of which 3 hours on type
Number of landings last 90 days	9, of which 5 on type

Summary

The intention was to fly from Borlänge to Västerås. The aircraft was taxied on to the runway to line up for take-off.

The taxiing took five minutes and was just over 2 000 metres long, it was carried out in a tailwind of 21 knots.

During the taxiing, the pilot had difficulties in taxiing the aircraft in a straight line and had to use the right brake to a great extent and made several stops in order to maintain on the runway.

At the end of the runway, the pilot called the tower as smoke had begun emanating from the right side. The tower was informed of this and that the probable source of the smoke was the brake.

¹ ARC - Airworthiness Review Certificate.

² UTC - Universal Time Coordinated - Is a reference for time.

³ CAVOK - Ceiling And Visibility OK - Aviation meteorological term for cloud base above 5 000 feet, visibility greater than 10 km and no significant weather.

⁴ QNH - Indicates barometric pressure adjusted to sea level.

⁵ PPL - Private Pilot Licence.

The pilot had exited due to the fire. A technician attempted to extinguish the fire with a hand-held fire extinguisher, but without success. The airport fire brigade later came to extinguish the fire with foam.

The combined result of the inverse effect that the rudder had on the heading in tailwind, the turning moment of the propeller and the required engine power output led to the extended use of the right brake, causing it to overheat.

The type certificate holder has responded to the accident and has introduced a warning in the aircraft flight manual. The warning elucidates the importance of avoiding prolonged use of the brakes when taxiing due to the risk of overheating, with reduced braking action as a consequence.

The accident was caused as the risk of the brakes overheating on the aircraft type was not evaluated in an appropriate manner. This resulted in the fire.

Recommendations

None.

1. FACTUAL INFORMATION

1.1 History of the flight

The intention was to fly from Borlänge to Västerås. Runway 32 in Borlänge was in use. The aircraft (Fig. 1) was taxied from the parking place in front of the tower out on to the runway to line up for take-off.



Fig. 1. DA-40D SE-MBC during salvage. Photo: Borlänge Rescue Services.

The total taxiing took five minutes and was 2 100 metres long, just over 2 000 metres of which was taxied in a tailwind of 21 knots. The taxi route has been drawn by the pilot during the interview and may be seen in Figure 2.

During the taxiing on the runway, the pilot stated that there had been difficulties in taxiing the aircraft in a straight line and it was necessary to use the right brake to a great extent. The taxiing was commenced along the left side of the runway and continued on that side with a number of stops, marked in yellow in Figure 2.

At the end of the runway, the pilot called the tower as smoke had begun emanating from the right side. The tower was informed of this and that the probable source of the smoke was the brake. The tower offered to have a technician sent out to the location, which the pilot accepted.

After just over a minute, the tower called the aircraft but received no answer as the pilot had exited due to fire. During this time, the technician had arrived at the aircraft, upon which he called the tower and informed it of the fire. The tower alerted the rescue services. The technician attempted to extinguish the fire with a hand-held fire extinguisher, without success.



Fig. 2. Borlänge Airport. Taxi route according the pilot. Photo: Google Earth, © Lantmäteriet Dnr 2013/0375

Location: at the threshold to runway 32, position 6025N 01531E; 153 m above sea level.

1.2 Injuries to persons

	Crew mem- bers	Passengers	Total	Others
Fatal	0	—	0	—
Serious	0	—	0	—
Minor	0	—	0	—
None	1	—	1	—
Total	1	—	1	—

1.3 Damage to the aircraft

The damage was substantial. The right brake, wheel with tyre and fairing, as well as landing gear and the inner part of the right wing and its flap, were ravaged by fire (Fig. 3).



Fig. 3. Damage to wheel, wing and flap. Photo: Borlänge Rescue Services.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Pilot

The pilot was 23 years old at the time and had a valid PPL.

Flying hours				
Latest	24 hours	7 days	90 days	Total
All types	–	–	8	125
This type	–	–	3	72

Number of landings this type previous 90 days: 5.

Type rating concluded on the 26th of July 2011.

Latest PC⁶ carried out on 26 July 2011 on a DA 40.

1.6 Aircraft information

1.6.1 Airworthiness and maintenance

Aircraft

TC-holder	Diamond Aircraft Industries GmbH
Model	DA 40D
Serial number	D4.330

⁶ PC - Proficiency Check.

Gross mass	Max authorised start/landing mass 1150/1150 kg, actual 979 kg
Centre of gravity	2.45, within permitted limits

The aircraft had a Certificate of Airworthiness and a valid Airworthiness Review Certificate.

1.6.2 Description of parts or systems related to the accident

1.6.2.1 Steering

The nose wheel on the aircraft was free-castering and had no direct link to the pedals. Manoeuvring on the ground is normally achieved via manipulation of the rudder, but also by applying differential brake pressure where the rudder effect is not sufficient. The pedal is hinged and has two functions. The upper part on the pedal is linked to the brakes. The lower part of the pedals is only linked to the rudder.

1.6.2.2 Propeller

The aircraft is equipped with one clockwise-rotating propeller, from the pilot's view, which produces a moment which forces the aircraft to the left.

1.6.2.3 AFM, Aircraft Flight Manual⁷

At the time of the accident the aircraft flight manual contained no instructions or warnings concerning necessary handling when taxiing the aircraft or during prolonged use of the brakes.

1.7 Meteorological information

According to the tower at take-off clearance: Wind 320 degrees 24 knots. According to Meteorological Aerodrome Report (METAR) at 13.20 hrs: CAVOK temp./dp +5/0°C, QNH 1007 hPa.

1.8 Aids to navigation

Not applicable.

1.9 Communications

SHK has examined the radio communication in connection with the event.

1.10 Aerodrome information

The airport had operational status in accordance with the Swedish AIP⁸.

1.11 Flight recorders

A GPS of the model Garmin 1000 was installed. It was not possible to obtain any information from this.

⁷ AFM - Aircraft Flight Manual - published by the manufacturer.

⁸ AIP - Aeronautical Information Publication – Contains information on airports, airspace and national rules. The Swedish Transport Agency is responsible for the published information.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

The accident site was on runway 32, just within the threshold.

1.12.2 Aircraft wreckage

The aircraft was parked at the accident site during the fire and was salvaged after the rescue operation was concluded.

1.13 Medical information

Nothing indicates that the mental and physical condition of the pilot were impaired before or during the flight.

1.14 Fire

A fire started at the right wheel. The fire spread to the inner and rear part of the right wing and its flap (Fig. 3). A portable fire extinguisher was on board but was not used.

1.15 Survival aspects

1.15.1 The rescue operation

After completed taxiing, the pilot notified the tower that smoke was coming from the aircraft. The air traffic controller in the tower proposed that a technician be sent out to assist. When the technician arrived at the aircraft, the controller was informed that there was fire in one tyre and that no person remained in the aircraft. The tower alerted the airport's rescue services, first via radio, and subsequently a warning alarm, an accident risk, was triggered which automatically resulted in SOS Alarm being alerted at 14.16 hrs. SOS Alarm alerted the municipal rescue services and an ambulance and the police.

The fire that had started at the right wheel had spread to the right wing when the airport's rescue services performed fire extinction with foam. When the municipal rescue services arrived at the site, the fire was extinguished. Checks were made to ensure there was no fuel leakage from the fire-damaged wing. No further measures by the rescue services were needed.

1.15.2 Evacuation

The pilot exited the aircraft, via the canopy and to the left, in connection with the fire starting.

1.16 Tests and research

According to an interview with the manager of the school that type rated the pilot, there is no documented training material about taxiing the aircraft type. However, the school manager stated that extra time is given to teaching the pupils about what applies for taxiing the type with respect to the free-castering nose wheel.

At the interview, it was said that they “*stress to the pupils the importance of bringing down the feet from the pedal's upper part in order to avoid riding on the brakes when taxiing*”. It was furthermore mentioned that the school is

aware of the general risk of overheating that exists upon extended brake application and that this is emphasised to the pupils during the initial phase of training.

The school manager also stated that in crosswind they “*must brake the entire time - yet continuous braking is to be avoided. The pupil shall instead let the aircraft build speed and be held up by the rudder if possible, to then be braked - the procedure is to be repeated in order to execute correct taxiing*”.

1.17 Organisational and management information

Not applicable.

1.18 Additional information

1.18.1 Gender equality issues

Not applicable.

1.18.2 Environmental aspects

The aircraft was to some extent built from composite materials. There were combustion gases and residues as a result of the fire that arose in the composites. However, the accident has not entailed any other environmental impact.

1.18.3 Measures taken

The type certificate holder has responded to the accident and has introduced a warning in the AFM (revision 6). The warning elucidates the importance of avoiding prolonged use of the brakes when taxiing due to the risk of overheating, with reduced braking action as a consequence.

1.19 Special or effective methods of investigation

None.

2. ANALYSIS

2.1 The taxiing

2.1.1 Nose wheel and brakes

Since the taxiing distance was long and the taxiing was executed in a strong tailwind and with extensive use of the right brake, the latter's temperature was building up.

Over time, the overheated brake resulted in a reduction of the braking capacity in the right brake.

2.1.2 Rudder effect

When taxiing in the wind conditions that prevailed, a strong tail wind, the rudder deflection gave an inverse effect on the aircraft's desired direction.

When the pilot steered to the right, the rudder acted so as to catch the wind (Fig. 4). The rudder lost its normal and desired steering function since a surface was created upon which the wind acted. This resulted in a moment that swung the aircraft to the left.

The pilot had experience of other aircraft where the same effect had been achieved when taxiing in tailwind, but in those cases, the pedals were also linked to the nose wheel, which provided authority when steering.

The conditions demanded a handling that, due to the rudder's inverse effect, differed from normal taxiing practices.

The reasoning that the rudder acts to catch the wind with a counteracting moment and effect on the desired direction only applies to taxiing in a strong tailwind.

2.1.3 *The propeller's moment*

The clockwise-rotating propeller produced a moment that forced the aircraft to the left (Fig. 4). This moment was strengthened in line with the engine's rpm. The short moment arm that exists between the propeller's thrust and the right brake meant that it was necessary to use both a great engine output and braking effect in order to counteract the moment and thereby maintain the heading.

2.1.4 *Forces and moments acting on the aircraft*

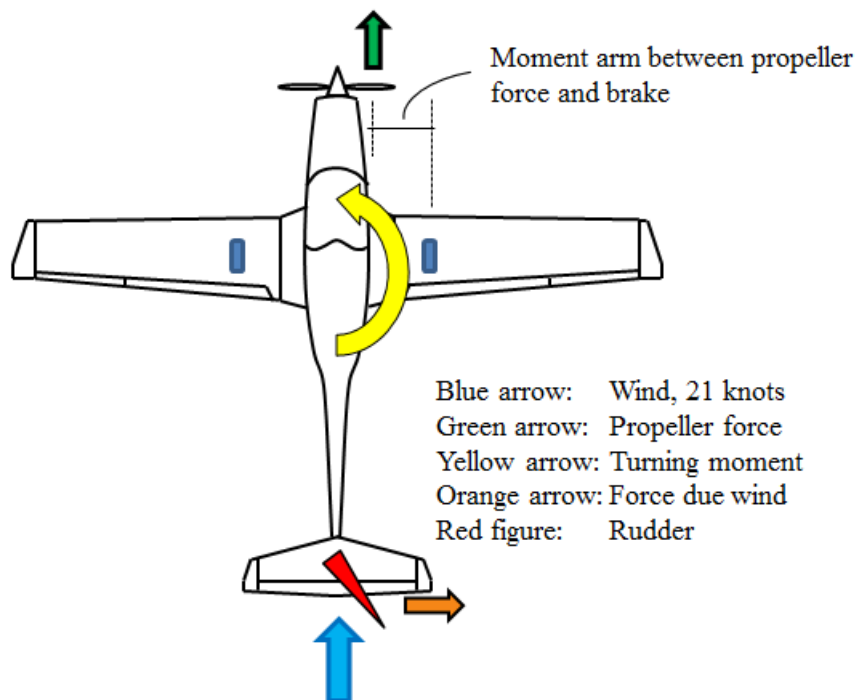


Fig. 4. Forces and moments at the time of the accident.

2.2 **Overheating of the brakes and fire development**

Given the short moment arm between the right wheel and the propeller's thrust, it is likely that a great engine output was used. The energy from the engine output was thereby transferred to the brake, which came to be overheated.

The aircraft was equipped with wheel fairings of composite material, which contributed to the confinement of the heat that arose as a consequence of the overheated brake. This contributed to the occurrence of a fire.

It is not possible to establish whether it was the right tyre or fairing that ignited first. The fire spread to the inner and rear part of the right wing and its flap (Fig. 3).

3 CONCLUSIONS

3.1 Findings

- a)* The pilot was qualified to perform the flight.
- b)* The aircraft had a valid Airworthiness Review Certificate.
- c)* Steering was executed with extensive use of the right brake.
- d)* There was a tailwind of 21 knots.
- e)* The taxiing distance was 2100 metres and the taxiing lasted for 5 minutes.
- f)* The right brake overheated, upon which a fire arose.
- g)* The fire resulted in substantial damage on the aircraft.
- h)* The AFM lacked instructions or warnings about handling the aircraft in situations such as that which arose at the time of the accident.

3.2 Causes

The risk of the brakes overheating on the aircraft type was not evaluated in an appropriate manner.

4. RECOMMENDATIONS

None.