Statens haverikommission
Swedish Accident Investigation Authority

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Report RL 2012:14e

Aircraft accident to SE-FMU
at Kumla, Örebro county,
on 28 August 2011

Case L-92/11

The report is also available on our website: www.havkom.se

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Statens haverikommission
Swedish Accident Investigation Authority

The Swedish Transport Agency
Civil Aviation Department
601 73 NORRKÖPING

Report RL 2012:14e

The Swedish Accident Investigation Board (Statens haverikommission, SHK) has investigated an aircraft accident that occurred on 28 August 2011 at Kumla, Örebro county, involving an aircraft with registration SE-FMU

The Board hereby submits under the Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, a report on the investigation.

SHK respectfully requests to receive, by 29 April at the latest, information regarding measures taken in response to the recommendations included in this report.

On behalf of the SHK investigation team,

Jonas Bäckstrand   Sakari Havbrandt

General points of departure and limitations

The Swedish Accident Investigation Board (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 so far as possible to determine both the sequence of events and the cause of the events, along with the damage and effects in general. An investigation shall provide the basis for decisions which are aimed at preventing similar events from happening again, or to limit the effects of such an event. At the same time the investigation provides a basis for an assessment of the operations performed by the public emergency services in respect of the event and, if there is a need for them, improvements to the emergency services.

SHK accident investigations try to come to conclusions in respect of three questions: *What happened? Why did it happen? How can a similar event be avoided in future?*

SHK does not have any inspection remit, nor is it any part of its task to apportion blame or liability concerning damages. This means that issues concerning liability are neither investigated nor described in association with its investigations. Issues concerning blame, responsibility and damages are dealt with by the judicial system or, for example, by insurance companies.

The task of SHK does not either include as a side issue of the investigation that concerns emergency actions an investigation into how people transported to hospital have been treated there. Nor are included public actions in the form of social care or crisis management after the event.

The investigation of aviation incidents is regulated in the main by the 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 the Chicago Convention Annex 13.

The investigation

SHK was notified on 28 August 2011 that a Cessna U206E with registration SE-FMU had an accident on that day at Kumla, Örebro county.
The accident has been investigated by SHK represented by Mr Göran Rosvall, Chairperson until 25 January 2012, and thereafter Mr Jonas Bäckstrand, Chairperson, Mr Sakari Havbrandt, Investigator in Charge, Mr Kristoffer Danèl, Technical Investigator (aviation) and Mr Patrik Dahlberg, Investigator on Fire and Rescue Services.

The investigation was followed by Mr Sven Christiansson, Swedish Transport Agency.

Report RL 2012:14e

Aircraft; registration and type	SE-FMU, CESSNA U206E
Class/Airworthiness	Normal, valid Certificate of Airworthiness.
Owner	Täby Air Maintenance AB
Time of occurrence	28-08-2011, 1805 hrs in daylight Note: All times are given in Swedish daylight saving time (UTC + 2 hrs)
Place	Västra Åby at Kumla, Örebro county, (pos. 59° 07' N 015° 05' E, 46 m above sea level)
Type of flight	Private
Weather	According to SMHI's analysis, Wind: Roughly south-westerly, 10-15 kts, Visibility: >10 km with localized light showers in the area. No clouds below 2500 feet, temperature +17 degrees, dewpoint +11 degrees and QNH: 1007 hPa.
Persons on board;	1
crew members	0*
passengers	
Injuries to persons	Minor
Damage to aircraft	Substantially damaged
Other damage	None
Pilot:	
Age, licence	32, CPL[1](A)
Total flying time	404 Hours, of which 44 hours on type
Flying hours previous 90 days	47 hours, of which 44 hours on type
Number of landings previous 90 days	59, of which 58 on type

* Five parachutists left the aircraft prior to the accident.

Summary

The purpose of the flight was to drop parachutists. During the ascent, at an altitude of 1000 metres, the pilot heard a bang, the engine lost thrust and the rpm changed. Following the pilot's instruction, the parachutists jumped immediately. The pilot performed an emergency landing in a ploughed field. After a landing run of 30 metres, the aircraft nosed over. The pilot, who sustained minor injuries, was able to exit the aircraft unassisted.

The technical investigation revealed a large quantity of lead bromide, which is formed in the combustion of the fuel 100LL, in the oil system. This caused the oil suction screen to become ~~blocked~~ clogged, upon which the engine seized due to insufficient lubrication.

The engine has been run on a fuel/air mixture which is richer than the recommendations in the flight manual. As a result, the engine was running too cold, thus facilitating the accumulation of lead bromide in the oil system.

[1] CPL – Commercial Pilot License.

The accident was caused by:

- The flight was performed with a fuel/air mixture richer than prescribed.
- The position of the oil drain plug contributed to the accumulation of lead bromide in the engine's oil sump.
- The position of the oil pump suction pipe, combined with the design of the oil pan, contributed to the lead bromide in the oil system stopping the oil supply.

Recommendations

The FAA is recommended to:

Act to change the maintenance programme for the engine type in question and other engines with similar fuel injection systems, such as Continental IO-520, so that an internal inspection of the oil pan is conducted in connection with oil changes, with the purpose of checking for the accumulation of waste products. (RL 2012: 14 R1)

EASA is recommended to:

Act to change the maintenance programme for the engine type in question and other engines with similar fuel injection systems, such as Continental IO-520, so that an internal inspection of the oil pan is conducted in connection with oil changes, with the purpose of checking for the accumulation of ~~waste products~~ deposits. (RL 2012:14 R2) EASA is also recommended to:

Issue an Airworthiness Directive to this effect, pending a change in the maintenance programme. (RL 2012:14 R3)

The Swedish Transport Agency is recommended to:

In an appropriate manner, inform the market in general about the importance of operating aircraft in accordance with the appropriate flight manual, particularly with regard to Continental's injection engines. (RL 2012:14 R4)

1. FACTUAL INFORMATION

1.1 History of the flight

The pilot was interviewed the day after the accident. The pilot was able to clearly depict the entire course of events.

The purpose of the flight was to drop parachutists from an altitude of 3000 metres.

The pilot had earlier that day flown five sorties during which he dropped parachutists.

The flight began at Örebro Airport at 1755 hrs. Six minutes later, during ascent, the pilot heard a bang, which he described as a knock and then as a decompression. Thereafter, the cabin filled with smoke, there was a loss of thrust in the engine and the rpm changed. The pilot then immediately moved the throttle to the idle position and instructed the parachutists to leave the plane. Following the pilot's instruction, the parachutists jumped immediately. When the aircraft's sliding door was opened, the smoke in the cabin cleared. The aircraft was then at an altitude of 1000 m and started to descend. During the evacuation, the pilot declared an emergency to air traffic control at Örebro Airport via radio.

Just before the incident, the pilot had inspected the instrument readings, all of which indicated normal values. Once the last parachutist had jumped, the pilot began looking for a suitable place to land. The pilot notified air traffic control that he planned to turn south, into the wind, in order to land in a suitable field.

The engine was running at idle until just before ground contact and was therefore not providing any thrust.

The pilot turned 180° in order to land to the south in headwind, selected a field and maintained the course towards it all the way down. The landing took place in a ploughed field. After a landing run of 30 metres, the aircraft nosed over. The pilot, who sustained minor injuries, was able to exit the aircraft unassisted.

Figure 1. The aircraft, seen from the first touchdown point after the emergency landing.

The accident occurred at pos. 59° 07' N 015° 5' E, 46m above sea level.

1.2 Injuries to persons

The pilot complained of neck pain.

	Crew members	Passengers	Total	Others
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	1	–	1	-
None	–	–	–	-
Total	1	–	1	–

1.3 Damage to the aircraft

The aircraft ended up on its back, resulting in damage to the nose gear, wings and fin, as well as to propeller and engine. Some of the damage can be seen in Figure 2.

Figure 2. The aircraft after the emergency landing.

1.4 Other damage

Some spillage of fuel and oil at the site of the accident.1.5 Personnel information

1.5.1 Pilot

The Pilot was 32 years old at the time and had a valid CPL.

Flying hours				
Latest	24 hours	7 days	90 days	Total
All types	4	21	47	404.6
This type	4	21	44	44

Number of landings this type previous 90 days: 58
Flight training on type concluded on 06-08-2011.

~~Skill test~~ Proficiency check for certificate (CPL) was performed 31-05-2011.

1.6 Aircraft information

1.6.1 Airworthiness and maintenance

Aircraft	
TC-holder	Cessna Aircraft Company
Model	CESSNA-U206 E
Serial number	U20601478
Year of manufacture	1970
Gross mass	Max authorized start/landing mass 1633 kg, actual 1441 kg
Centre of gravity	Within the permitted range
Total flying time	8726 hours
Flying time since latest inspection	66 hours
Fuel loaded before event	Avgas 100 LL
Engine	
TC-holder	Teledyne Continental Motors
Model	IO-550-F
Number of engines	1
Serial number	284917-R
Total operating time, hrs	393
Operating time since overhaul	66
Propeller	
TC-holder/Manufacturer	
Propeller	Hartzell propeller Inc.
Model	HC-C3YF-1RF/F846A-8R

The aircraft had a Certificate of Airworthiness and a valid ARC[2].
Periodic inspection shall be carried out every 50 hours in accordance with the aircraft's maintenance programme.

[2] ARC - Airworthiness Review Certificate

Figure 3. The aircraft prior to the incident.

1.6.2 *Description of parts or systems related to the accident*

The injection system

The fuel is injected into the cylinders' inlet duct by means of Continental's own injection system. This consists of an engine-powered fuel pump which supplies fuel under pressure to a double regulating valve (Fuel Control Unit, FCU), one valve of which is connected to the choke in the inlet pipe and is actuated by the throttle at the pilot seat. The other regulating valve is connected to the mixture control.

The fuel system has no automatic regulation of the fuel flow. The fuel flow is a direct result of the pump pressure and the position of the throttle and the mixture control.

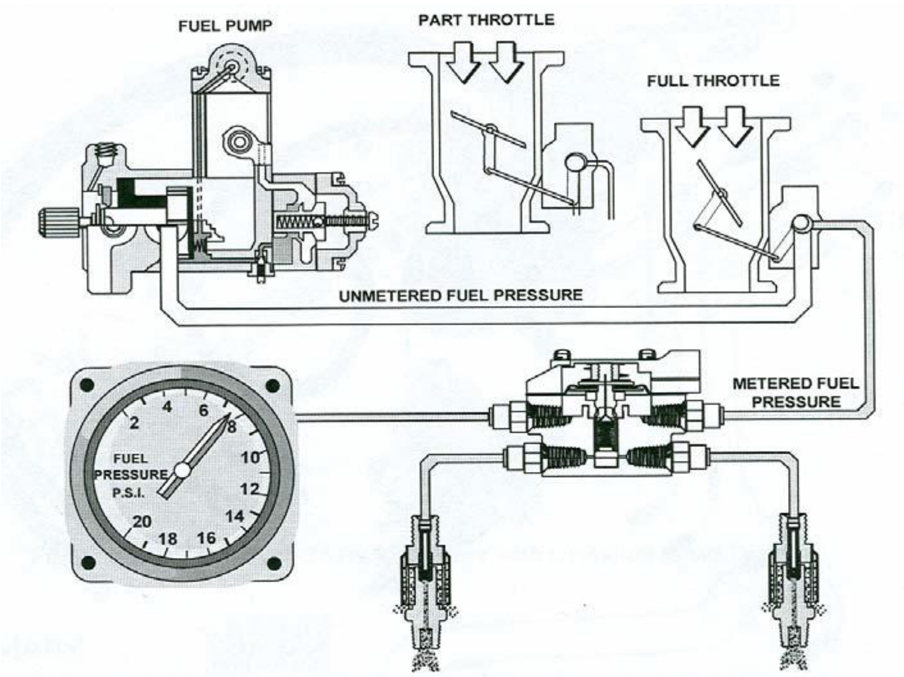

Figure 4. Diagram of the fuel system on SE-FMU. The gauge shows the fuel pressure. On SE-FMU, it is graduated to show the fuel flow instead and is combined with the manifold pressure gauge.

Operative information concerning the manifold pressure and fuel flow

The flight manual contains instructions pertaining to the fuel flow and manifold pressure values which must be maintained at different phases of the flight and at different altitudes. In accordance with STC SA2830SO, a ~~sign~~ placard with information on the maximum permitted manifold pressure, fuel flow and fuel flow settings at different altitudes during ascent must be affixed by the instrument that gives readings of manifold pressure and fuel flow. This ~~sign~~ placard was not found in SE-FMU. Figure 5 shows the ~~sign~~ placard as it is presented in the flight manual.

MAXIMUM POWER SETTINGS AND FUEL FLOWS (IO-550)

TAKE OFF: 2700 RPM
29.6 IN. MP., 27.4 GPH
OR FULL THROTTLE
MAXIMUM CONTINUOS POWER:
2700 RPM

PRESSURE ALTITUDE (FEET)	FUEL FLOW (GPH)
SL	27.4
2,000	24.0
4,000	22,5
6,000	21.0
8,000	20.0
10,000	18.5
12,000	17.5

Bonaire Aviation Company
P/N BN-PL303

Figure 5.

According to the flight manual, the following values must be maintained during the various phases of flight:

Take-off
- Max throttle
- Fuel/air mixture according to the signs in the aircraft.

Ascent
- Manifold pressure 24.5 inches Hg
- Rpm 2500 revolutions/min
- Fuel flow: 16.5 gallons per hour.

Level flight in an altitude range of 2500-15000 feet and normal~~ly~~ lean fuel/air mixture[3].
- Rpm range 2200-2500 revolutions per minute.
- Manifold pressure between 15 and 25 inches Hg.
- Fuel flow between 9.4 and 18.2 gallons per hour.

Letdown
- Manifold pressure and rpm corresponding to the desired engine power.
- During letdown with engine power: lean fuel/air mixture.
- During letdown with the engine at idle: max rich fuel/air mixture.

3 Mixture obtained when the cylinder head temperature is 25°F below peak temperature.

The engine's lubricating system

Apart from lubrication, the purpose of the lubricating oil is to dissipate heat from bearing surfaces and other warm parts of the engine. It is also intended to carry ~~off impurities~~ away contaminations to the oil filter, and act as a pressure fluid in the propeller adjustment mechanism.
A diagram of the lubricating system in SE-FMU's engine IO-550-F is shown in Figure 6

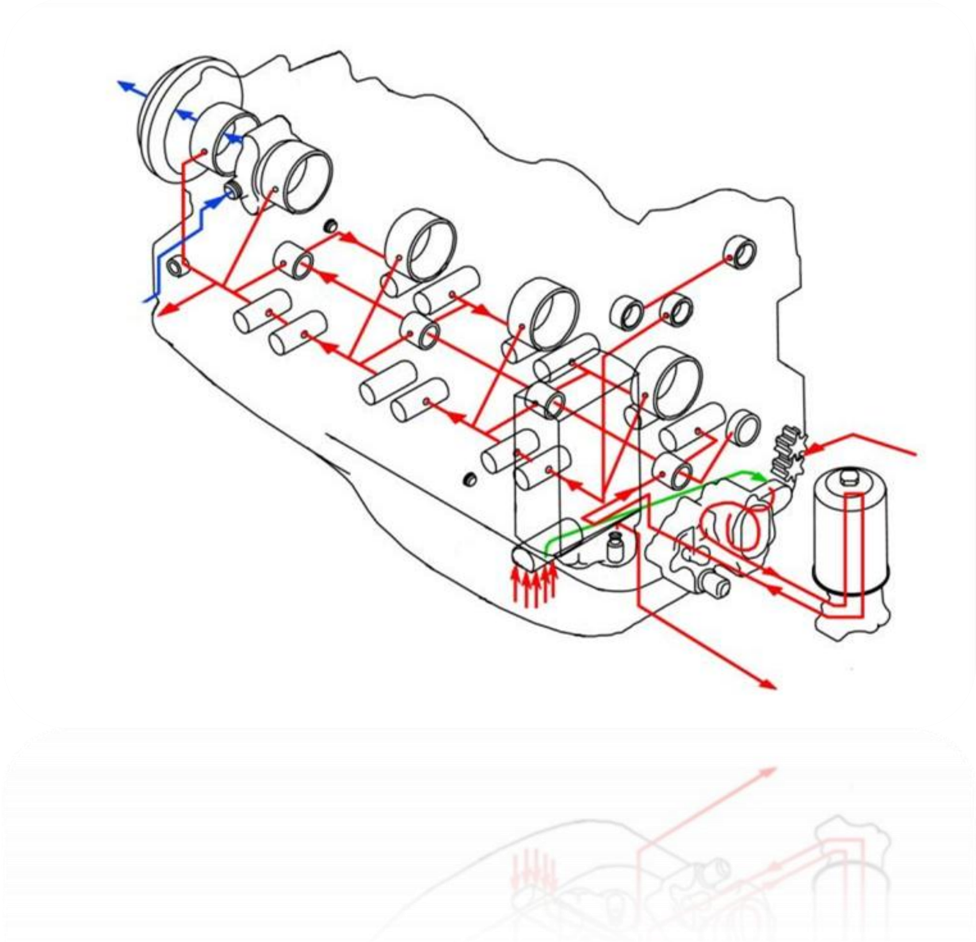

Figure 6. The lubricating system. Green marks the suction side, red and blue mark the pressure side, blue shows the oil to the propeller adjustment mechanism.

The oil is sucked up via a screen from the rear of the oil pan. The filter is positioned low (just 3.5 mm) over the bottom of the pan - see Fig.

Figure 7. Position of the oil filter. Note that the oil drain is positioned at the side, roughly 15 mm above the bottom of the pan. The drill bit in the image serves as a dimension reference and has a diameter of 3.5 mm.

~~From the screen~~, ~~t~~ The oil is drawn from the screen and channelled ~~through ducts~~ to the oil pump. The oil pump, which is gear-driven, is what produces the oil flow and oil pressure. After the pump, the oil goes through an oil filter. A thermostat then sends the oil on to an oil cooler, if it needs to be cooled, before reaching the points requiring lubrication via ducts. Main bearings and crankshaft bearings are lubricated via direct, serial pressure lubrication, in which the lubricating oil is drawn through ducts inside the crank case and crankshaft respectively.

The oil to the propeller adjustment system is led via a collar into a cylindrical cavity in the front section of the crankshaft to the propeller adjustment system. As the crankshaft rotates, its front section will act as a centrifugal separator, in which substances with a higher density will be flung out against the crankshaft's interior wall.

The cylinder barrel is lubricated by a dense oil mist which forms when connecting rods and crank webs break down oil coming from nozzles in the connecting rod and tramp oil from the existing surfaces. The oil scraper ring, which is the lowest of the piston rings on each piston, scrapes oil from the cylinder barrels down into the oil pan.
The oil is drained off via an opening in the side of the oil pan. The bottom edge of the opening is positioned roughly 15 mm above the bottom of the pan.

1.7 Meteorological information

The weather, according to SMHI's analysis:
Wind: south-westerly, 10-15 kts, visibility greater than 10 km, no cloud below 2500 feet, temp/dewpoint +17/+11 °C. QNH 1007 hPa.

1.8 Aids to navigation

Not applicable.

1.9 Radio communications

The pilot had radio contact with Örebro Airport's air traffic control.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

The pilot had a GPS device which recorded the flight. The recording verifies the pilot's account.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

Emergency landing took place in a ploughed field. There were roads, power lines and cowsheds adjacent to the field.

The nose wheel lay severed just before the point the aircraft began to overturn.

Figure 8. Picture taken facing the opposite direction of the flight path, showing,among other things, the cowshed that the aircraft flew over.

1.12.2 Aircraft wreckage

The aircraft was turned upright and taken to a parking place alongside the field where a preliminary investigation was carried out. This ~~reveals~~ revealed, among other things, cracks in the crankcase and that the engine supplied low power upon ground contact. The wings were removed and the wreckage was transported to a hangar where the engine would be dismantled.

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

There was no fire.

1.15 Survival aspects

1.15.1 Rescue and medical intervention

Conditions

According to the Accident Prevention Act (2003:778), rescue services are the rescue interventions for which the state or municipalities are responsible in the event of accidents and imminent danger of accidents in order to prevent and limit injury to persons and damage to property and the environment. Nerike Fire Department was responsible for the municipal rescue service and forces were alerted from the SOS centre in Örebro.

Alert and rescue services

The air traffic controller at Örebro Airport alerted the SOS centre of the impending accident while the aircraft was still in the air. At 1802 hrs Nerike Fire Department was alerted. The information provided was that an aircraft had engine problems and needed to perform an emergency landing. Initially, the pilot intended to land on E20, but then further confirmation was received that the pilot was looking for a potential field to land in after passing over Kumla Prison. While the rescue services were on their way, confirmation was received that the pilot had performed an emergency landing near Åbytorp. The first unit from the rescue services arrived at the site at 1815 hrs together with an ambulance and police.

At the site of the accident, the power to the plane was disconnected and the Emergency Locator Transmitter (ELT) was located and deactivated. The healthcare services' medical officer took charge of the pilot, who was examined at the site. He did not wish to be taken to hospital. Other medical personnel saw to the parachutists that had jumped out prior to the emergency landing.

The area around the aircraft was cordoned off and the rescue intervention ended at 1900 hrs.

1.15.2 The pilot's position and injuries

The pilot sat in the left-hand seat and made use of the safety belt. After the accident, the pilot was hanging upside-down and fell from the seat when the safety belt was undone. The pilot complained of neck pain, which he understood to have come from the fall.

1.15.3 Evacuation

The pilot managed to exit the aircraft unassisted.

1.16 Tests and research

1.16.1 Engine inspection

The engine was transported to a workshop where it was dismantled and inspected by SHK.

The engine oil was sent to a laboratory for analysis.

Metal particles were found in the oil filter. The filter was also sent for laboratory analysis.

The analysis of the oil sample, oil filter and the viscous substance from the pan revealed that:

- The oil was of type AeroShell Oil W 15W-50.
- The sample contained large quantities of wear particles and wear fragments.

The particles consisted of the following, in descending order of mass concentration:

- Lead or lead compound
- Iron
- Copper
- Chrome
- Aluminium
- Nickel
- Tin
- Zinc

The substances listed above are found in the engine's mechanical systems such as the crankshaft and its bearings.
Once the oil pan had been removed, loose engine parts such as the valve lifter and broken parts of connecting rod caps were found - see Figure 10. There was also a viscous substance containing metal fragments, among other things. The substance was sent for analysis. The analysis revealed that the sample consisted of the same particles as the oil sample but with a higher concentration of lead or lead compound.

The oil screen was partially clogged.

The largest concentration of the substance was found in the area of the oil pan under the screen. Here, the substance had a firmer consistency and contained a larger concentration of solid metal particles.

Figure 9. Deposits and remnants of engine parts in the oil pan.

Large quantities of the viscous substance were found in the crankshaft with a moderately high density - see Figure 11. The substance was sent to the laboratory for analysis, where it was established that the substance consisted primarily of lead bromide.

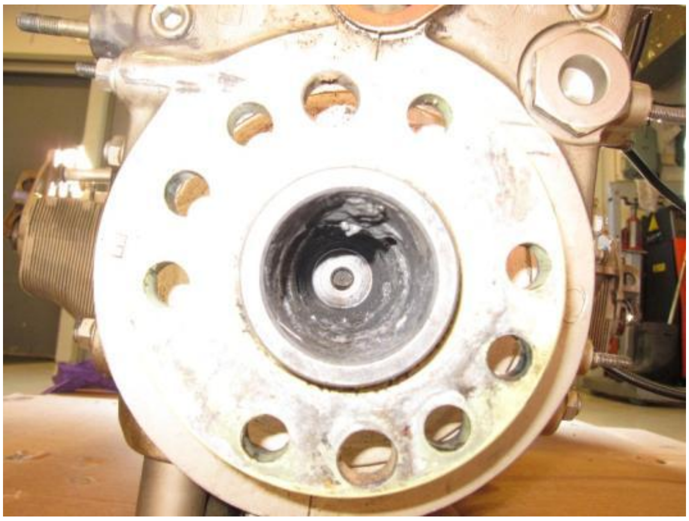
Figure 10. Image showing remnants inside the front end of the crankshaft.
The image was taken after some of the deposits had been removed.

The crankcase was cracked in several places. At the cracks, the material bulged outwards from within. Connecting rod 1 had a fracture at the base. Impact mark from connecting rod 1 in the crankcase and cracks alongside the markings could be noted - see Figure 11. Connecting rod 2 was somewhat bent while the other connecting rods were apparently undamaged.

Crankshaft bearing 1 and the axial bearing were cut and the corresponding contact surfaces on the crankshaft were affected by heat. Other crankshaft bearings and main bearings were scratched, had signs of wear and in many cases remnants of bearing material. The bearings were correctly in place. The oil ducts in the crankcase and crankshaft were not blocked. The oil pump did not appear to have any defects.

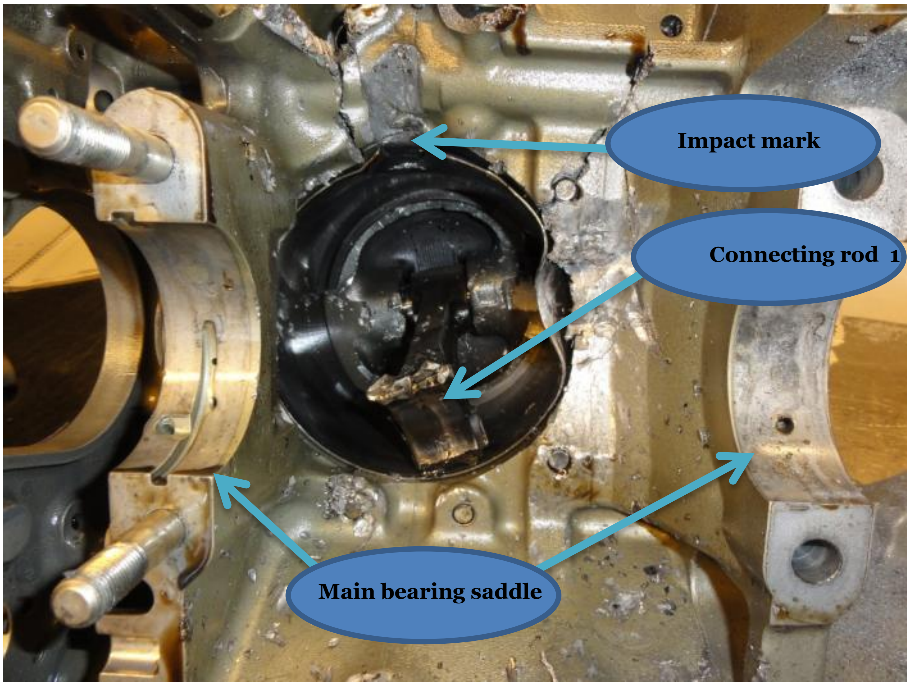

Figure 12. Image showing damage to the engine

Experiment: accumulation of lead bromide in oil

A laboratory experiment was carried out to see whether it is possible for lead from Avgas 100LL to accumulate as lead bromide in the oil. This experiment would emulate fuel leaking into the lubricating system. The temperatures covered the interval of the engine's operating conditions. The result was that lead bromide did not form and accumulate in the oil.

1.17 Organization and management of the parachute club

In the parachute club, there are no formal instructions with regard to power settings, flight speeds, etc. beyond those in the aircraft's flight manual. It is however normal for instructions and procedures to be mediated in an informal way between pilots.

1.18 Additional information

1.18.1 Gender equality issues

Not applicable.

1.18.2 Environmental aspects

Approximately 20 litres of aircraft fuel ran out onto the ground underneath the aircraft. At the Environmental Office in Kumla, the decision was made that the polluted soil would be dug up and decontaminated.

1.18.3 Operation of the plane when dropping parachutists

In order to obtain more information concerning the operation of the aircraft when dropping parachutists, two additional pilots were interviewed. The information was very concordant.

A normal ascent to 3000 m is summarized below.

TAKE-OFF
- Max rpm (2700).
- Max throttle.
- Max rich fuel/air mixture.
- Cowl flap open.

CLIMB
- Rpm 2500.
- Throttle corresponding to 25 inches Hg manifold pressure.
- Up to approximately 2000 m max rich fuel/air mixture; thereafter lean to peak value in exhaust temperature.
- Speed approximately 90 mph.

When dropping parachutists
- Rpm 1800.
- Throttle corresponding to 15 inches Hg manifold pressure.
- Max rich fuel/air mixture.

LETDOWN
- Rpm 1800.
- Throttle corresponding to 15 inches Hg manifold pressure.
- Max rich fuel/air mixture.
- Speed approximately 140 mph

1.18.4 Fuel

For SE-FMU, the fuel Avgas 100LL was used. According to the applicable fuel specification, the fuel contained, inter alia, max 0.56 g/l lead and bromine. The lead acts as an octane enhancer and the bromine suppresses the formation of lead deposits in the combustion space. As a result, lead bromide is formed during combustion. Lead bromide gasifies at approximately 220°C and is intended to exit with the exhaust gases.

1.18.5 Comparison with other common general aviation aircraft

The fuel injection system of this aircraft differs considerably from those of the most common general aviation aircraft such as PIPER PA 28 or CESSNA 172. On these aircraft types, the mixture control is used primarily to save fuel or when flying at high altitude. The mixture is often set to full rich for entire flights.

SHK has previously discussed, in the reports RL 2006:12 and RL 2011:04, the problems of differences in emergency procedures between this particular type of fuel injection system and those found in other common types of aircraft.

1.19 Special or effective methods of investigation

None.

2. ANALYSIS

2.1 Engine failure

The analysis of the wear particles found in the oil indicates that these were generated as a result of surface fatigue under unusually high temperatures. This means that the lubrication did not function satisfactorily. The large quantities of lead bromide sediment found in the engine, including in the partially clogged screen, limited the oil flow. From this, it can be concluded that the engine seized as a result of an oil deficiency.

2.1.1 Supply of lead bromide in the oil system

Lead bromide is formed in the combustion of Avgas 100LL. The majority of the lead bromide formed during the combustion of Avgas 100LL would under normal operating conditions exit along with the exhaust gases.
Most sorties were largely flown with a fuel/air mixture richer than prescribed. When the engine is run with a rich mixture, not all fuel is burned. The unburned fuel is vaporized and the heat of vaporization will lower the temperature in the combustion space. If the temperature is lowered by a sufficient amount, some areas of the combustion space will have a lower temperature than the vaporizing temperature of lead bromide, whereby the latter will condense. This is likely to occur in the cylinder barrel, where the piston's oil scraper ring draws the lead bromide into the engine's lubricating system.

2.1.2 Accumulation of lead bromide and blockage of the lubricating system

The lead bromide, which was mixed with the oil, was suspended in the oil, though some also ended up in the bottom of the oil pan due to its higher density.

In the cylindrical cavity in the front part of the crankshaft, the separation of lead bromide was even more pronounced. Here, a viscous mass of lead bromide and oil was formed. Some of this may have been carried further and ended up in the bottom of the oil pan.

In addition, the position of the oil drain plug resulted in a quantity of pure oil also remaining, which meant that a large amount of the lead bromide was not flushed out when draining the oil.

Once enough lead bromide had accumulated in the oil pan, the suction screen became blocked, whereby the oil flow ceased, which in turn led to the engine seizing.

2.1.3 The impact of a missed inspection

In the factual information, it is reported that the inspection interval had been exceeded by 16 hours. This has probably not affected the fact that the engine seized, but may have brought forward the time of the incident.

2.1.4 Lack of information signs

The lack of information signs with instructions pertaining to the fuel flow and manifold pressure values which must be maintained at different phases of the flight probably contributed to the pilots flying with a richer fuel/air mixture than prescribed.

2.2 The flight

The aircraft was operated in accordance with the informal instructions which existed within the organization - see 1.18.3. These differed from the instructions found in the flight manual in terms of the adjustment of the fuel/air mixture. The reason for this may be that the fuel system in the engine of this particular aircraft is designed in a manner which requires that the fuel/air mixture is actively regulated by the pilot in nearly all phases of the flight, whereas other common aircraft types can be flown with no problems on a full rich mixture.

As the flight altitude was sufficiently high when the engine failed, it was good that the parachutists left the aircraft. This meant that the aircraft became lighter and thereby easier to manoeuvre during the emergency landing. The risk of injury to persons was also reduced, especially in consideration of the fact that the parachutists are not strapped in inside the aircraft.

The approach and landing were problem-free until the aircraft had rolled around 30 metres along the ploughed field. The cause of the aircraft nosing over was probably the nose wheel fork snapping due to the heavy load in the soft ground, resulting in the aircraft's nose being pushed into the ground.

3 CONCLUSIONS

3.1 Findings

a) The pilot was qualified to perform the flight.
b) The aircraft had a Certificate of Airworthiness and valid ARC.
c) The engine had seized as a result of a deficient lubricating function.
d) Abnormal quantities of lead bromide were found in the engine's lubricating system.
e) There was no ~~sign~~ placard in the aircraft with information concerning limitations of the fuel flow and power setting.
f) The pilots' understanding of the engine parameters which were to be maintained differed from those prescribed in the flight manual.
g) The engine had exceeded the inspection interval by 16 hours.

3.2 Causes

- ~~The flight was performed~~ The aircraft was operated with a fuel/air mixture richer than prescribed.
- The position of the oil drain plug contributed to the possibility of accumulation of lead bromide in the engine's oil sump.
- The position of the oil pump suction pipe, combined with the design of the oil pan, contributed to the lead bromide in the oil system stopping the oil supply.

4. RECOMMENDATIONS

The FAA is recommended to:

Act to change the maintenance programme for the engine type in question and other engines with similar fuel injection systems, such as Continental IO-520, so that an internal inspection of the oil pan is conducted in connection with oil changes, with the purpose of checking for the accumulation of ~~waste products~~ deposits~~.~~ (RL 2012:14 R1)

EASA is recommended to:

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Issue an Airworthiness Directive to this effect, pending a change in the maintenance programme. (RL 2012:14 R3)

The Swedish Transport Agency is recommended to:

In an appropriate manner, inform the market in general about the importance of operating aircraft in accordance with the appropriate flight manual, particularly with regard to Continental's injection engines. (RL 2012:14 R4)