RNSA

Rannsóknarnefnd samgönguslysa

Final report on aircraft serious incident

Case no.: **21-052F010**

Date: **1. June 2021**

Location: **Keflavik Airport (BIKF)**

Description: **Loss of power shortly after take-off**

1. FACTUAL INFORMATION

Location and time	
Location:	After take-off from RWY 19 at Keflavik Airport (BIKF)
Date:	1. June 2021
Time[1]:	06:26

Aircraft	
Type:	Thrush Aircraft S2R-H80
Register:	C-GWRJ
Year of manufacture:	2020
Serial number:	H80-235DC
CoA:	Valid
Engines:	One GE Aviation H80-100

Other information	
Type of flight:	Ferry flight
Persons on board:	1
Injury:	None
Damage:	Severely damaged
Short description:	Shortly after take-off from BIKF RWY 19, loss of engine power occurred resulting in an emergency landing

Pilot Flying	
Age:	61 years
Certificate:	FAA commercial pilot license
Ratings:	Airplane Single Engine Airplane Multi Engine Instrument Airplane
Medical Certificate:	Class 2, valid
Experience:	Total flight hours: 5000+ Total flight hours on type: 300+ Last 90 days on type: 19+ Last 24 hours on type: 0

[1] All times in the report are Icelandic local times (UTC+0), unless otherwise stated

Aircraft C-GWRJ was being ferry flown along with another aircraft of the same type from Kenya to Canada, during which multiple stops were made for rest and refueling.

Aircraft C-GWRJ is a single engine aircraft of the type S2R-H80, manufactured by Thrush Aircraft, equipped with a 510 USG Hopper tank normally used for storage of liquid used for agricultural spraying. Prior to the ferry flights the Hopper tank had been cleaned and connected to the aircraft fueling system, for the purpose of using it as a supplemental fuel tank for the ferry flight for increased range.

The two aircraft arrived at Keflavik Airport (BIKF) from Wick, Scotland (EGPC) on May 27th, 2021.

In the morning of June 1st, 2021, the two aircraft were refueled and prepared for departure for a flight from Keflavik to Goose Bay in Canada (BIKF - CYYR). The flight plan was for a 10.5 hour flight and the aircraft endurance was 12.5 hours.

Both aircraft were fueled to full capacity at Keflavik Airport by a fuel truck. First the accompanying aircraft was fueled and then aircraft C-GWRJ. The last prior fuel uplift for both aircraft had been in Wick, Scotland (EGPC).

The fuel uplift for aircraft C-GWRJ at Keflavik Airport was 391 USG, which brought the total fuel on board the aircraft to 740 USG[2]. According to the pilot, 95% of the fuel uplift went into the Hopper tank and about 5% to the wing tanks. Fuel from the wing tanks is used for take-off, climb and landings, while the fuel in the Hopper tank is only used during cruise. On a long flight, as planned this day to Goose Bay, fuel in the wings would be used during the cruise as well.

According to the pilot, when he sumped the fuel during the preflight check, there were some round droplets floating on the top of the fuel sample. The idea of water crossed the pilot's mind, but he knew that water does not float on top of fuel. So, the pilot's initial thought was whether it was possible that everything in the jug was water, as they had encountered a lot of rain. The pilot used his finger and poked the droplets and most of them disappeared. The pilot then smelled his finger, and it smelled of jet fuel. The pilot therefore concluded that it was pure fuel and poured the jug into the Hopper tank.

[2] Left wing tank 115 USG + Right wing tank 115 USG + Hopper tank 510 USG

At 06:13, after the preflight and the refueling, the pilot of aircraft C-GWRJ started the engine. The fuel selection valve in the cockpit was set to the fuel from the wing tanks.

The two aircraft requested a formation take-off. The formation take-off was approved by the ATCO in the Keflavik Tower and both aircraft were cleared for take-off from RWY 19 at 06:23.

Aircraft C-GWRJ was leading the formation take-off. Its pilot performed a shallow climb to keep up his speed, since he was leading the formation flight.

Everything was normal during the take-off. Shortly after the take-off, during the climb, the propeller speed was 2010 RPM, as the pilot had adjusted for climb power of 95-98 % torque. Shortly before reaching 500 feet the pilot adjusted the propeller speed again, now to 1950 RPM, and everything was normal.

When the aircraft reached 500 feet, close to the end of the runway, the pilot initiated a right turn at an air speed of 110-120 mph.

Then, shortly after initiating the right turn and with no prior indication, there was a loss of engine power.

The pilot noticed a lot of gray smoke coming out of the engine. He immediately considered a restart and turned the emergency fuel pump ON. The pilot then noticed that the engine's N1 was 12% and he knew a restart would not be possible, due to low altitude and low RPM.

Due to his low altitude and as the aircraft was losing altitude very quickly, the pilot knew he would not be able to make it back to the runway. He therefore shifted his focus to prepare for an emergency landing.

At 06:26 the pilot of aircraft C-GWRJ called on the Keflavik Tower frequency:

"I got an engine failure."

The pilot dumped the fuel from the 510 USG Hopper tank and searched for a suitable landing site. The pilot noticed some structures to his left, at his 11 o´clock, and steered

right of those to an open space. According to the pilot, he did not have time to shut OFF his fuel, using the fuel shut shutoff valve, before the emergency landing.

The pilot landed the aircraft in an open area and according to his information the speed of the aircraft was slightly over stall speed as he felt one buffet shortly before the emergency landing.

Figure 1: Take-off at Keflavik Airport (BIKF) and the emergency landing site

2. ANALYSIS AND CONCLUSION

Measurements at the emergency landing site revealed that the aircraft had skidded around 280 meters on a westerly heading, while turning on its vertical axis to the left during the skidding, breaking off the tail wheel, collapsing the main landing gears and coming to rest on a TRUE heading of 155°.

The pilot was uninjured after the emergency landing and was able to exit the aircraft unassisted. He tried to call Keflavik Tower but was unable to reach the tower. He therefore contacted his colleague in the accompanying aircraft who relayed the message to Keflavik Tower, as well as circling over the emergency site until the emergency vehicles arrived.

SIA-Iceland dispatched an investigator to the accident site. The on-site investigation suggested that this could be a fuel related accident, so SIA-Iceland impounded the fuel truck that had been used to fill the aircraft with fuel and arranged for fuel sample to be taken and sent for analysis. The analysis of the fuel sample from the fuel truck confirmed that it met the specification of Jet A-1 fuel and subsequently the impounded fuel truck was released.

Figure 2: C-GWRJ at the accident site

The aircraft was equipped with MVP50 engine monitor. SIA-Iceland accessed the data from the MVP50 for analysis. The analysis of the MVP50 data showed:

- During the take-off, there was no delay between the fuel flow measurements and the Ng speed on the engine
- There was a fluctuation in the fuel flow (item 1 in Figure 3)
- The fuel pressure was slowly decreasing (item 2 in Figure 3)
- There was a significant fuel flow drop without fuel pressure change and Ng speed slowly decelerated for about 5 seconds (see item 3 in Figure 3)
    - During standard operation when the fuel flow decreases, the fuel pressure increases
    - The data however shows a slow decrease in fuel pressure (item 2 in Figure 3) and no reaction to a significant drop in fuel flow
- The engine decelerated about 5 seconds after the drop in fuel flow
- The engine power dropped below idle, followed by doubling of fuel pressure when the 2nd (emergency) aircraft electric pump was activated (item 4 in Figure 3)

Figure 3: MVP50 analysis

The fuel flow fluctuation and the immediate drop in fuel flow suggested:

- Air or water contamination in the fuel line, or
- Fuel leak upstream of the aircraft fuel flow meter, or
- Aircraft main fuel boost pump malfunction

SIA-Iceland performed an inspection of the aircraft fuel system. The inspection revealed:

- Both the primary and the emergency electric fuel pumps were found to be operational
- There was no fuel leak located in the aircraft fuel supply system to the engine, having disregarded damage to the Header tank in the aircraft lower fuselage caused by the crash
- Water contamination was found in the fuel system
    - Corrosion was noted on bolts and nuts in the engine fuel filter, indicating water contamination (see Figure 4)
    - Water contamination was confirmed in a fuel sample collected in the engine fuel filter (see Figure 4 and Figure 6 left)
    - Water contamination was confirmed in a fuel sample collected in the aircraft fuel filter drain (see Figure 5 and Figure 6 right)

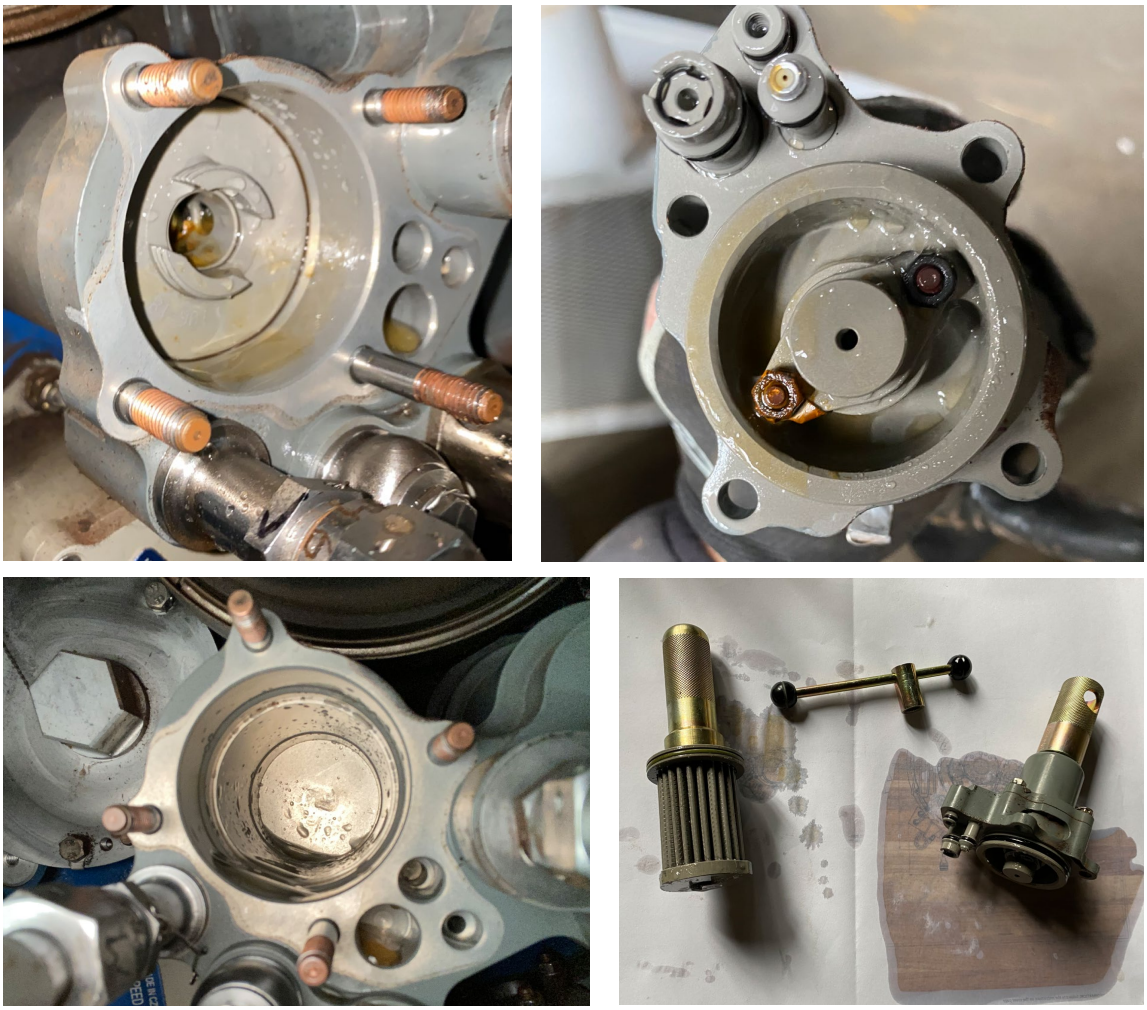

Figure 4: Engine fuel filter (located on accessory gearbox on the engine)

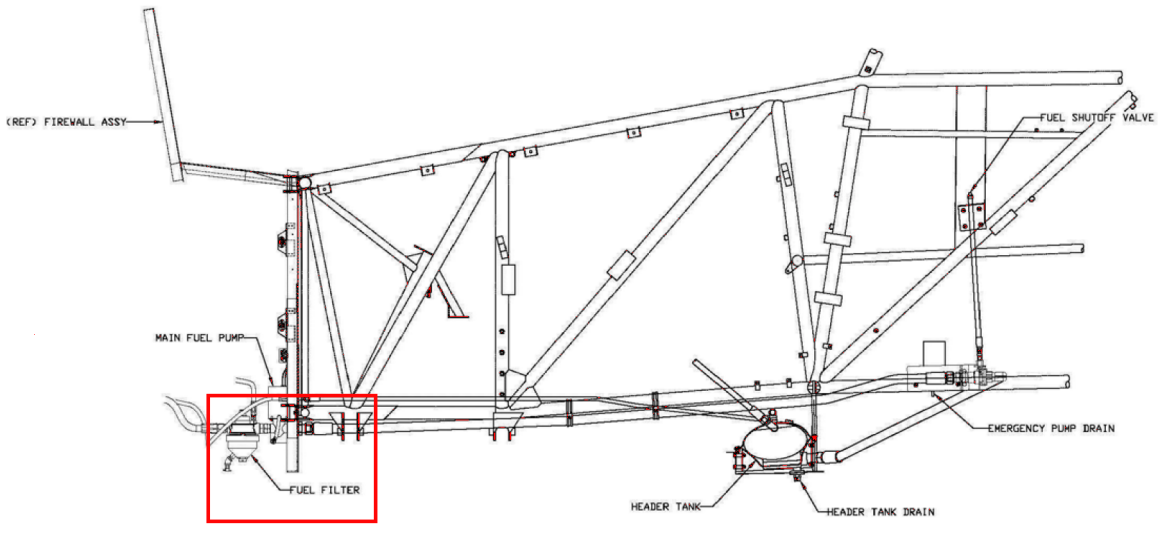

Figure 5: Aircraft fuel filter drain (located at the left lower fuselage, forward of wing)

Figure 6: Fuel found contaminated with water
Left: From engine fuel filter / Right: From aircraft fuel filter drain

As fuel from the wing tanks was mostly used for take-off, climb and landing, but fuel from the Hopper tank was used for cruise during the ferry flights from Kenya in Africa, most of the fuel in the wing tanks had been uplifted in Kenya.

All aviation fuels dissolve water in varying amounts depending upon the fuel composition and temperature. Dissolved water in the fuel is similar to the humidity in the air[3].

Dissolved water is not a problem for aircraft operation, as long as it remains in solution. Lowering fuel temperature will however cause dissolved water to come out of solution as free water, and the free water can affect the engine operation.

[3] FAA AC 20-125 Water in Aviation Fuels

In Kenya the temperature and the humidity are much higher than in Iceland. The aircraft landed at Keflavik Airport in Iceland on May 27th and was parked there for five days before the accident flight on June 1st.

SIA-Iceland concluded that this allowed for dissolved water to come out of solution with the fuel in the wing tanks and to accumulate at the bottom of the wing tanks.

SIA-Iceland also concluded that the pilot's initial thought that everything in the jug of the sumped fuel during the preflight was possibly water, was most likely a correct assumption and the poked droplets were most likely small contents of fuel on top of the water.

SIA-Iceland therefore concluded that the loss of engine power was caused by water contamination in the fuel.

When the pilot turned on the emergency fuel pump and attempted to restart the engine, it was already operating below idle, and the water contamination in the fuel prevented a relight.

3. SAFETY RECOMMENDATIONS

None.

Safety Action:

SIA-Iceland reminds pilots of the importance of vigilance during fuel sump.

The following board members approved the report:

- Geirþrúður Alfreðsdóttir, chairman
- Bryndís Lára Torfadóttir, board member
- Gestur Gunnarsson, board member
- Hörður Arilíusson, deputy board member
- Tómas Davíð Þorsteinsson, deputy board member

Reykjavík, 10. November 2022

On behalf of SIA-Iceland

Ragnar Guðmundsson
Investigator-In-Charge