THE REPUBLIC OF CROATIA

Air, Maritime and Railway Traffic Accident Investigation Agency

Air Traffic Accident Investigation Department

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F I N A L R E P O R T

ON ACCIDENT OF THE AIRCRAFT CESSNA 182 D, SKYLANE REGISTRATION HA-TUB 3 JUNE 2021,ON RPUS POREČ

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Investigations are independent and separate from court or administrative proceedings and should not prejudice determination of guilt or liability of individuals.

The final report cannot be used as evidence in court proceedings whose aim is determining civil or criminal liability of individuals.

CONTENT

OCCURENCE INFORMATION

Type of the occurrence:	Accident
Date:	3 June 2021
Local time:	15:15
Place:	On RPUS Poreč
Type of the aircraft:	Aeroplane
Manufacturer / model:	Cessna / C 182 D, Skylane
Registration:	HA-TUB
Owner:	Avia-Rent KFT
Operator:	Avia-Rent KFT
Number of persons on board:	One
Injuries:	No injuries
Damage to the aircraft:	Major material damage

INVESTIGATION

The Air, Maritime and Railway Traffic Accident Investigation Agency received information about the accident on the same day from the aeroclub Cumulus. The AIA investigators performed investigation at the accident site.

Upon completion of the investigation, the Air, Maritime and Railway Traffic Accident Investigation Agency issued this Final Report.

SUMMARY

On 3 June 2021, in the RPUS zone (Registered area for landing and take-off) Poreč, after the drop of four skydivers, the pilot noticed a malfunction of the engine during the descent. The pilot landed on the terrain before the threshold of the runway 01. No injuries occurred in the accident in question. Major material damage occurred to the aircraft.

The safety investigation determined that the accident most likely occurred due to carburettor icing during the descent of the aircraft.

In the investigation in question, AIN did not issue a Safety Recommendation.

1. FACTS AND INFORMATION

1.1. FLIGHT INFORMATION

On 3 June 2021 around 15:00 LT, pilot and four skydivers took off on the aircraft C182D, registration HA-TUB, to perform skydivers drop at an altitude of 3300 ft. Up to the planned altitude, the flight occurred without problems. After the skydivers drop, the pilot started descending, and at an altitude of 1300 ft he added engine power to plan the approach. The engine did not respond to adding the power. The pilot directed the aircraft towards the runway and checked the position of all controls to try to determine the cause of the engine malfunction. When it became clear to the pilot that he will

not reach the runway, he landed on the terrain before the threshold of the runway 01 where a rollover over the nose occurred, and the aircraft stopped on its back.

1.2. INJURIES

Injuries	Crew	Passengers	Others
fatal	0	0	0
serious	0	0	0
minor / none	1	0	0

1.3. DAMAGE TO THE AIRCRAFT

At RPUS Poreč, the aircraft was inspected at the accident site by AIA investigators. At the accident site, 230 meters before the threshold of the runway 01, the aircraft was found turned on its back. There was a smell of 100LL of gasoline around the aircraft. Damage to the aircraft fuselage skin and longerons were determined. Damage to the spar and the skin were found on the right wing. On the left wing, there was a rupture of the strut, which was completely bent, and the top of the wing was damaged. The front landing gear was found separated from the fuselage.

All determined aircraft damage corresponds to landing on uneven terrain and turning over the nose of the aircraft on its back. After the inspection at the accident site, the aircraft was turned to the upright position, and was moved in front of the hangar of the aeroclub, where a detailed inspection was performed.

Picture 1 – Aircraft HA-TUB at the accident site

1.4. OTHER DAMAGE

During the accident no other damages occurred, other than those to the aircraft in question.

1.5. PERSONAL INFORMATION

1.5.1. Pilot

Male person, Croatian citizen born in 1978. In the case of the accident in question, the person was the pilot of the aircraft and was sitting in the front left seat. He holds a valid CPL(A) pilot license with the authorizations SEP (land), MEP (land), IR/ME, A320, issued by the Slovenian aviation authorities in 2019. Until the accident in question, he had 656:46 flight hours, of which on the Cessna type 182 28:07, of which in the last 90 days 14:19. On similar types of aircraft Cessna 172 and 206, he had a total of 251:71 flight hours. He holds a valid Medical Certificate without restrictions issued on 06.11.2020.

1.6. AIRCRAFT INFORMATION

Cessna 182 D

Manufacturer / model: Cessna Aircraft
MTOW: 1202 kg

The Cessna 182 D, Skylane, was manufactured by the American company Cessna Aircraft Company. It is a high wing aircraft, with four seats and non-retractable landing gear. The subject model D has been in production since 1960.This is multipurposed aircraft, therefore it is used for recreational purposes, taxi transport, panoramic flights, training of pilots, as well as for transport of skydivers. For the purpose of transporting skydivers, three seats are removed from the aircraft. This aircraft model is equipped with a carburetted TCM O-470-R engine with a 230 hp. This type of aircraft has a characteristic horizontal stabilizer that moves completely for trimming purposes. A variable pitch propeller is installed.

Cessna 182 D / Cessna Aircraft, registration HA-TUB

Registration:	HA-TUB
Year of manufacture:	1961
Aircraft serial number:	18253201
Engine type:	Teledyne Continental Motors O-470-R
Propeller type:	McCauley D3A32C411-C/82NDA-4
Total flight time:	1977.10 hours Tacho (Total 5386.66 hours)
Owner/Operator:	Avia Rent

Airworthiness certificate was issued on 09.03.2021 by the Hungarian CAMO organization. On 31.03.2021, a 100-hour inspection of the aircraft was performed by a certified mechanic at 1950.88 flight hours Tacho (Total 5360.44 hours).

1.7. METEOROLOGICAL DATA

Considering the nature of the accident, a meteorological report was prepared on the day of the accident for the altitudes of the flight in question over the area of RPUS Poreč. The numerical model WRF (Weather Research and Forecasting) was used to prepare this report. The results of the report confirm that at the time of the accident in the area of RPUS Poreč there was a probability of serious carburettor icing. The results of the report are shown in Tables 1, 2 and 3.

Altitude 2m			
Time	**Temperature**	**Dew point [˚C]**	**Probability of icing**
15:00	22	10	serious
15:30	23	10	serious

Table 1 – Temperature and dew point and probability of carburettor icing at an altitude of 2 m

Altitude 500 m			
Time	**Temperature**	**Dew point [˚C]**	**Probability of icing**
15:00	17	4	serious
15:30	18	5,6	serious

Table 2 - Temperature and dew point and probability of carburettor icing at an altitude of circa 500 m

Altitude 1000 m			
Time	**Temperature**	**Dew point [˚C]**	**Probability of icing**
15:00	14	7,7	serious
15:30	14	8,0	serious

Table 3 - Temperature and dew point and probability of carburettor icing at an altitude of circa 1000 m

1.8. COMMUNICATION

During the flight operations, the pilot communicated with the responsible person at RPUS Poreč via radio on the local frequency 123.50 Mhz.

1.9. AIRPORT INFORMATION

RPUS (Registered area for landing and take-off) Poreč is located 1.5 km southeast of the city of Poreč (Picture 2). The primary purpose of the RPUS is to use it for skydiving activities. The operator of RPUS is the aeroclub Cumulus.

Picture 2 – RPUS Poreč marked with orange arrow

1.10. FLIGHT DATA RECORDERS

The aircraft was not equipped with the flight data recorder or the cockpit voice recorder.

1.11. INFORMATION ON THE REMAINS AND THE ACCIDENT SITE

The aircraft landed 230 meters before the threshold of the runway 01 on grassy uneven terrain. Considering the pronounced unevenness of the terrain, the nose wheel was torn off and the aircraft turned over the nose on its back.

1.12. SEARCH AND RESCUE

Considering that the pilot landed the aircraft in the RPUS zone without injuries, there was no need for a search and rescue operation.

1.13. TESTING AND INSPECTION

1.13.1. Aircraft technical airworthiness

At RPUS Poreč, the technical airworthiness of the aircraft in question and the associated systems was inspected. The inspection was attended by the owner, airport operator representative, a certified mechanic for the type of aircraft in question hired by AIA for the purposes of the investigation and an AIA investigator. The aircraft was placed in the natural position, and a suitable mount was installed instead of the nose landing gear. The inspection of the fuel system did not reveal any defects that would cause the malfunction of the engine. A sufficient amount of fuel for the engine to work properly was found in the fuel system. The inspection of the oil system also did not reveal any technical deficiencies, and a sufficient amount of engine oil was present. The components of the ignition system, as well as the air intake and exhaust system also had no visible technical deficiencies. All engine controls had full deflection between the stops without resistance or jamming.

Due to the nature of the accident, the engine was started. The engine started from the first attempt without difficulty. During engine operation, magneto and carburettor heating check was performed. Both checks were performed successfully with values within the prescribed limit. The correct operation of the carburettor temperature indicator was also determined.

1.14. ADDITIONAL INFORMATION

1.14.1. Pilot statement

In his statement, the pilot said that after reaching an altitude of 3300 ft and skydivers jumping, he started with the descent and preparing for landing on the runway direction 01. The aircraft was behaving manageable, and the engine worked without any problems. The initial course during and after the jumping of parachuters was west (towards the sea) after which it entered a slight turn of 270 degrees descending to a height of 1500 ft (preparation for entering the left downwind for the runway direction 01). During the descent, the pilot maintained the following parameters: IAS: 125-135 kt (indicated speed), VSI: 1000-2500 fpm (vertical speed), MAP: 16-17 in Hg (manifold pressure), RPM: 1800-1900 o/min (engine speed). The cooling vents were closed, and carburettor heating was turned on. The fuel supply valve was in the “BOTH” position. At an altitude of 2000-2100 ft, the pilot made a slight correction of the MAP (since it increased due to the descent, the pilot returned it to 16-17 in Hg), which the engine normally accepted.

At an altitude of 1300 ft the pilot started to increase the RPM and MAP of the engine, however the engine did not accept the change of command position. He checked the operation of the engine in various positions of the power control, but the engine did not react, and the MAP value was 16 in Hg all the time. The pilot stated that the engine was running all the time without vibrations or strange sounds. At an altitude of 1000 ft - 900 ft he directed the aircraft towards the runway and began to look for a reason the engine was not accepting commands, and did the following procedures:

- Switched the fuel valve to the left and then to the right tank.
- Checked the position of the magnet lock, switched to one and then to the other, then to both.
- Checked the position of the Primer pump - it was pressed and locked.
- Turned off and on the carburettor heating.

- Changed the position of the power lever.

The fuel mixture lever has not been moved since the take-off, so it was in the "RICH" position during the flight.

He repeated the said procedures about 7-8 times until the moment when he had to prepare for the field landing. The moment he realized that he would not reach the runway, the pilot chose the most suitable landing terrain, and announced on the airport frequency that he was going to land. Just before the touch down, he closed the fuel supply and turned off the MASTER switches. After touch down, overturning and stopping completely, he exited on the left door without injury.

1.14.2. TCM O-470-R engine

By the inspection of the aircraft, it was determined that a four-stroke petrol engine TCM O-470-R type, serial number: 811781-R, was installed in the aircraft in question. The engine has six air-cooled cylinders positioned opposite. It has a built-in carburettor under the crankcase, and because of this position of the carburettor in the aviation community it is known for its propensity to ice in all phases of flight.

The engine manufacturer states in the Engine Operation Manual that one of the reasons for the low MAP value during the flight may be carburettor icing.

1.14.3. Owner's Manual

A review of the contents of the aircraft Owner's Manual established that in section 2 "Checklist" on pages 2-5, procedures that a pilot must apply when lowering altitude and preparing for landing are listed.

Let-down

1. Set the mixture command to the "Rich" position
2. Reduce engine power to maintain horizontal flight speed
3. Apply sufficient carburettor heating to prevent icing if icing conditions are present

Before landing

1. Set fuel selector valve to "Both"
2. Recheck mixture - "Full rich" (full in)
3. Set the propeller command for at least 2450 RPM, so that high power will be available in the event of a go around
4. Check cowl flaps closed
5. Apply carburettor heat before closing throttle
6. Glide at 80-90 MPH with flaps up
7. Lower flaps as desired below 100 MPH
8. Maintain 70 to 80 MPH with flaps extended
9. Trim airplane adjustable stabilizer for glide

In addition, the manufacturer describes in the Owner's Manual the following, regarding maintaining of the engine temperature during descent. Operational details are described in Section 3, Chapter 7 of

the Owner's Manual. On page 3-3, the manufacturer states that the descent must be performed with the mixture control in the "Rich" position, and with enough engine power to keep it warm. It also states that in some cases, low MAP values can cause spark plugs fouling. At the end of the chapter, the manufacturer advises that when descending, the power should be added occasionally to increase the temperature of the cylinder.

1.14.4. Carburettor icing

Carburettor icing is a hazard which is possible during flight and has been recognized as a cause or a contributing factor in many safety-related events, including aviation accidents or serious incidents.

Atmospheric conditions

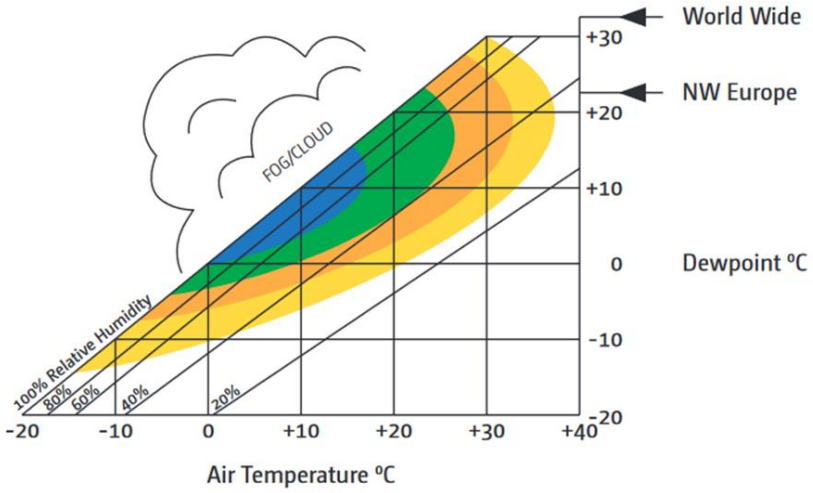
The three main atmospheric factors that affect carburettor icing are air temperature, dew point, and air humidity percentage.

Possible atmospheric conditions in which carburettor icing can occur are:

- In an atmosphere with clean air without visual signs of possible icing.
- In a cloud (mass of condensed watery vapour), and below or above clouds.
- In the atmosphere just after the clouds break.
- If the surface of the ground over which it is flown is wet or just moist.

Atmospheric conditions of possible carburettor icing are shown in Picture 7. Aeronautical meteorological reports usually do not contain specific meteorological warnings of possible icing; therefore, pilots' knowledge and transfer of experience is very important. The reason for the lack of possible warnings about the conditions of possible icing is that in many cases it is impossible to measure individual values, such as humidity at certain flight altitudes, and it is very likely that these values significantly differ from those measured at the airport or at other measuring station on the ground.

In the past, testing have shown that sometimes carburettor icing can occur during cruising if the air temperature is 20 ^{0}C and humidity 60%, or during descent if the air temperature is 25 ^{0}C and humidity 30%.



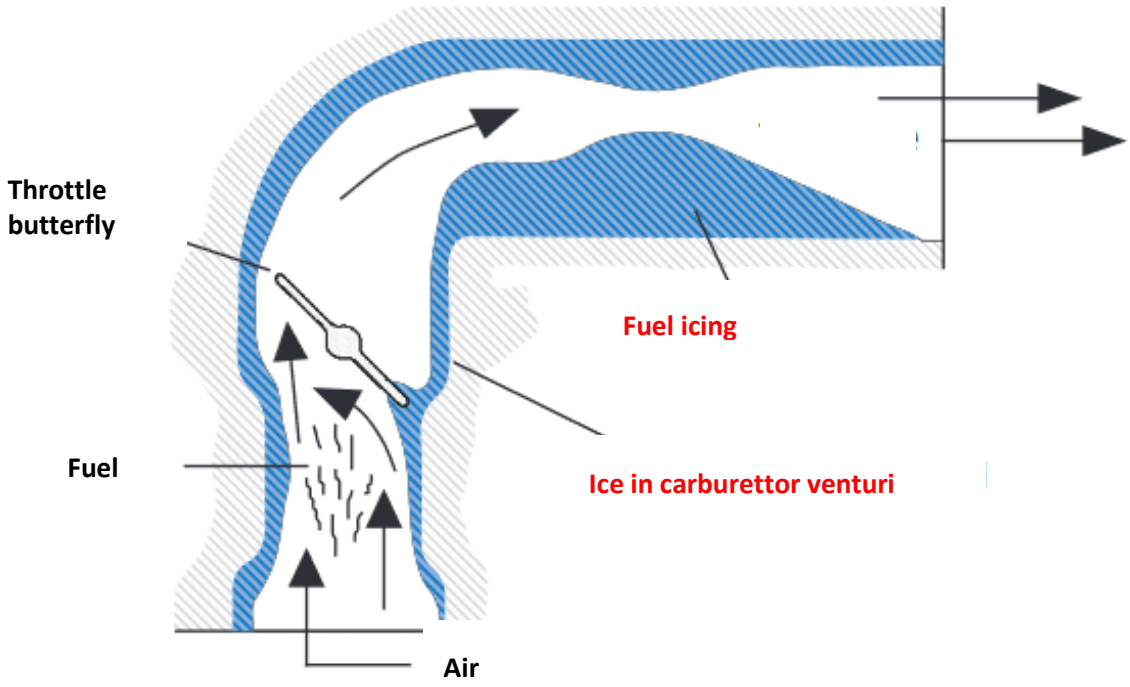
Picture 7 – Chart of atmospheric conditions for carburettor icing

Engine factors

When certain atmospheric conditions are met, carburettor icing can occur when, during engine operation, the air temperature in the carburettor drops in one of two cycles, as follows:

- When fuel evaporates in the air which used for combustion.
- After the mixture has passed through the venturi, when the air pressure drops.

If the air temperature inside the carburettor drops below the dew point, moisture condenses and ice accumulates on the inner walls of the carburettor or on the throttle butterfly, which directly regulates the engine power (Picture 8). Accumulations of ice inside the carburettor block the air flow, thus changing the ratio of air and fuel in the mixture, which can result in constant, equal loss of engine power, rough engine operation, and ultimately engine failure.



Picture 8 – Carburettor cross-section with possible icing points

Engine factors that can increase the possibility of icing are:

- Use of MOGAS fuel.
- Use of reduced engine power during flight, especially at cruising altitude or in descent.
- Rough surface of the venturi on which ice accumulates more easily.
- Carburettor position in relation to the engine.
-

Procedures in case of suspicion of carburettor icing during flight

The procedures which the pilot needs to follow in case of suspicion of carburettor icing during the flight depend on the aircraft model and the engine model, i.e. the procedures prescribed by the aircraft manufacturer and described in the Pilot operating handbook (POH) or its equivalent; Aircraft flight manual (AFM) or Owner's manual (OM).

Regardless of the specifics of each aircraft, the standard procedures described in a number of issued documents of aviation organizations, such as the FAA (Federal Aviation Administration) or EASA (European Aviation Safety Agency), can generally be applied.

Accordingly, on 17 July 1996 the FAA issued an advisory document AC 91-51A, which describes the hazards of carburettor icing, how to detect such hazards timely, and how to act in such case. As a background to the issuance of this document, it was stated that the analysis of accidents and serious incidents established that the pilots were not fully aware of the effects of icing on aircraft control.

On 13 October 2010, EASA issued a Safety Information Bulletin, SIB 2010-03, in which it also describes the hazards of carburettor icing in aircrafts, referring to the previously issued document AC 91-51A by the FAA.

In a leaflet for promotion of safety, "Piston engine icing" issued by EGAST (European General Aviation Safety Team), the hazard of carburettor icing, its causes, recognition, general practices as well as pilot procedures are described in detail.

1.15. ANALYSIS OF THE COURSE OF EVENTS

In his statement, the pilot stated that during the descent he kept the MAP value at 16-17 in Hg, which belongs to the lower values of the charge pressure. The pilot further stated that during the descent at one point he could not achieve a MAP value above 16-17 inHg. One of the reasons for this phenomenon stated by the engine manufacturer in the engine Operation Manual may be carburettor icing.

The aircraft manufacturer advises in the Owner's Manual that power should be added occasionally during descent to increase the temperature of the cylinder and consequently the entire engine.

1.16. ANALYSIS OF TECHNICAL AIRWORTHINESS

After the performed analysis of the technical inspection of the aircraft, we can conclude the following with great certainty. Defects or irregularities have not been identified in the aircraft and associated components that could cause the malfunction of the engine, failure to respond to commands, or completely engine stop. After the visual inspection, the engine started without any problems, and no malfunction was noticed.

2. CONCLUSION

2.1. FINDINGS

- The flight pilot possesses a valid Commercial pilot licence and Medical Certificate without restrictions.
- A valid Return to Service Certificate and Airworthiness Certificate have been issued for the aircraft.
- During the technical airworthiness check, no technical deficiencies were identified that would affect the correct operation of the engine.
- On the day of the accident at the altitudes of the flight in question above the area of RPUS Poreč, there was a serious possibility of icing of the carburettor.

2.2. IMMEDIATE CAUSE

After conducting a safety investigation, we can conclude that it is very likely that the engine malfunctions during the flight occurred due to icing of the carburettor. Although due to the very nature of the event, such phenomenon cannot be confirmed with certainty on the ground, based on the collected information, other possible causes of engine malfunction have been excluded.

3. SAFETY RECOMMENDATIONS

Considering that all measures to avoid this accident, i.e. the way of operating the aircraft, operating procedures, are generally well known, in this matter the Air, Maritime and Railway Traffic Accident Investigation Agency has no safety recommendation.

Investigator in Charge

Dejan Ćurik