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Swiss Transportation Safety Investigation Board STSB
Service suisse d'enquête de sécurité SESE
Servizio d'inchiesta svizzero sulla sicurezza SISI
Swiss Transportation Safety Investigation Board STSB

Summary Report

A summary investigation, in accordance with article 45 of the Ordinance on the Safety Investigation of Transport Incidents from 17th December 2014 (OSITI), as of 1st February 2015 *(SR 742.161)* was carried out with regards to the following serious incident. This report was prepared to ensure that lessons can be learned from the incident in question.

Aircraft	Textron Aviation 525, Cessna Citation M2		I-FVAB	
Operator	Italyfly Srl, Via Lidorno 3, I-38123 Trento, Italy			
Owner	Elimarca Srl, Via Castellana 90, I-31036 Ospedaletto di Istrana (Treviso), Italy			
Pilot	Italian citizen, born 1971			
Licence	EASA (European Aviation Safety Agency) Airline Transport Pilot Licence Aeroplane (ATPL(A)), issued by the Italian Civil Aviation Authority (*Ente Nationale per l'Aviazione Civile* – ENAC)			
Flight hours	**Total**	5,545 h	**During the last 90 days**	77 h
	On the incident type	350 h	**During the last 90 days**	77 h
Pilot	Italian citizen, born 1988			
Licence	EASA Commercial Pilot Licence Aeroplane (CPL(A)), issued by ENAC			
Flight hours	**Total**	1,546 h	**During the last 90 days**	73 h
	On the incident type	290 h	**During the last 90 days**	73 h
Location	Zurich Airport (LSZH)			
Coordinates	---		**Altitude**	---
Date and time	8th October 2017, 19:11 (LT = UTC + 2 h) All information in this report is given in local time			
Type of operation	Commercial			
Flight rules	Instrument flight rules (IFR)			
Flight phase	Take-off and climb			
Type of serious incident	Development of smoke in the aircraft			
Point of departure	Zurich Airport (LSZH)			
Destination	Venice Airport (LIPZ)			

Injuries to persons	**Crew**	**Passengers**	**Third parties**
Minor	0	0	0
None	2	0	-

Damage to aircraft	Not damaged
Third-party damage	None

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Course of events

Background

The business aircraft Cessna Citation M2, registered as I-FVAB, was maintained by the maintenance company Cessna Zurich Citation Service Center at Zurich Airport between 25th September 2017 and 6th October 2017. In the process, both engines underwent a compressor wash on 5th October 2017, during which the air intake duct and compressor were treated with a cleaning fluid. Both engines were then run in idle power for approx. 10 minutes to remove any residue of the cleaning fluid.

The next day, it was established that a bleed air valve in the windshield anti-ice system was not working properly. This valve was subsequently replaced, and a test was undertaken in which both engines were run at a power of 60-80% N1[1].

History of the flight

On the evening of the 8th October 2017, the flight crew accepted I-FVAB from the maintenance company with the intention of flying the aircraft to Venice Airport (LIPZ). As the crew was aware that maintenance work had been carried out on the aircraft, they performed a particularly thorough outside-check of the aircraft. No irregularities were detected during this check, nor when preparing the cockpit. Preparation with engines running also presented nothing out of the ordinary.

Subsequently, the flight crew began take-off from runway 28. Both crew members noticed an unusual, yet subtle smell during the take-off run. Shortly after the aircraft had taken off and the landing gear had been retracted, a significant amount of smoke developed inside the aircraft. The smoke was white in colour and the smell was unfamiliar to both crew members. It could not be attributed to burning oil, nor to overheated plastic. The pilot, who was the pilot flying (PF) at the time, told the co-pilot to put on his oxygen mask, then handed control of the aircraft over to him, so that she could put on her own oxygen mask and begin checking for faults. Neither pilot put on protective goggles because they did not perceive the smoke to be causing irritation to their eyes at the time. Both crew members were able to see everything in the cockpit and the smoke did not particularly restrict their activities. These initial steps correspond to the first points set out in the 'Environmental System Smoke or Odour' checklist from the emergency/abnormal procedures. The pilot began checking for faults using the checklist, not going through the checklist step by step. She decided to first of all set the air source selector to left (L), then right (R), then emergency (EMER) and finally to FRESH AIR. Switching the air source to FRESH AIR is listed as point 9 in the checklist (see ill. 1). This setting causes the pressure-regulating-shutoff valves to close and therefore no bleed air is supplied to the aircraft cabin. The cabin cannot be pressurised in this setting because the air is now supplied directly into the cabin from outside. This action prevented further smoke from entering the cabin. The pilot then notified air traffic control that there was smoke in the cockpit and that an immediate return to Zurich was necessary.

Shortly afterwards, the smoke lessened and the pilot therefore decided to stop going through the checklist and to focus on landing the aircraft at Zurich Airport. Air traffic control then directed the aircraft towards runway 14 using radar vectors. The crew ensured that it was not passing through any clouds so that, should the situation worsen, it would still be possible to execute a visual approach approach at any time.

The aircraft finally flew at an altitude of 5000 ft AMSL[2] and was directed to the instrument landing system of runway 14 via a right downwind approach. Approx. 8 minutes after take-off,

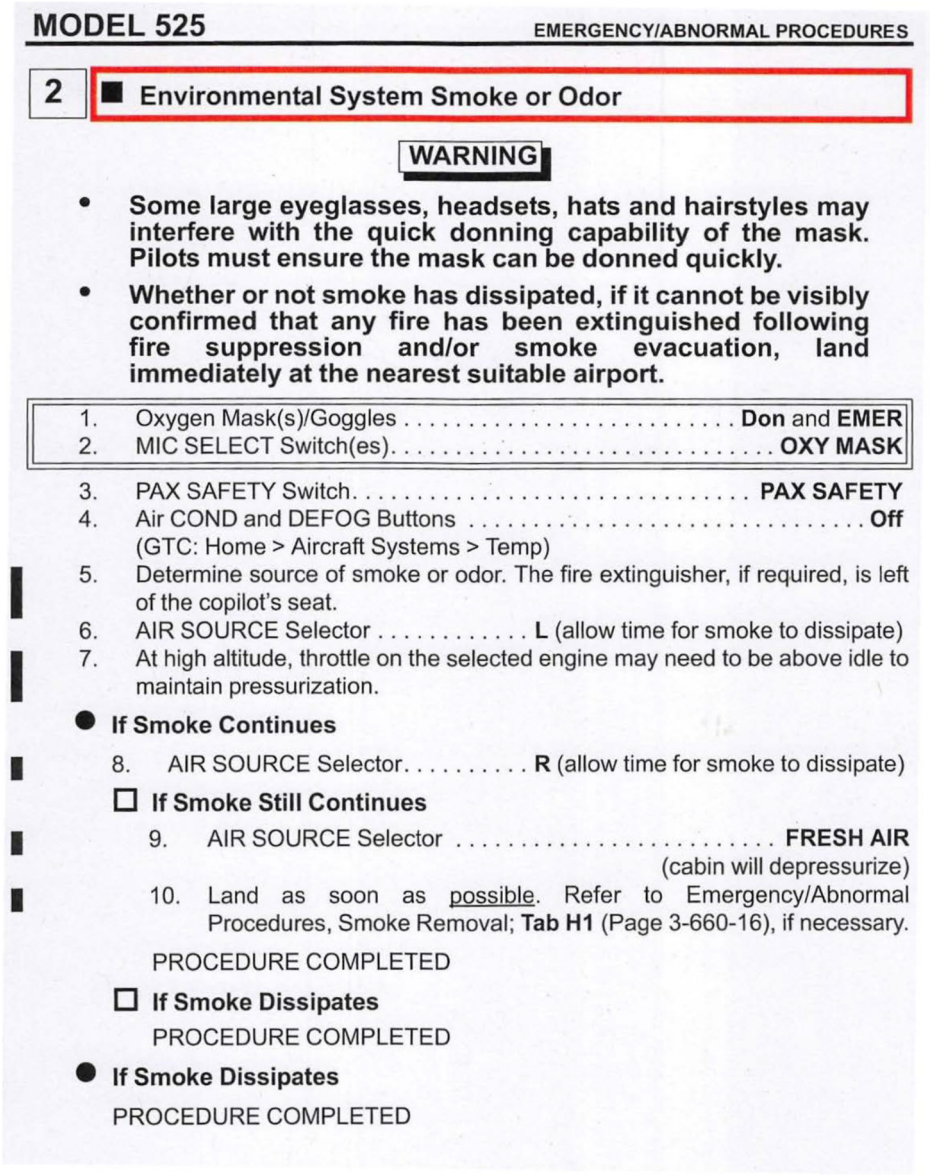
[1] N1: rpm speed of the low-pressure section of a two-shaft turbojet engine in percent of revolutions per minute

[2] AMSL: above mean sea level

I-FVAB landed on runway 14 and taxied to its parking position without any further incident.

Evaluations

Applicable checklist



MODEL 525 EMERGENCY/ABNORMAL PROCEDURES

2 ■ Environmental System Smoke or Odor

WARNING

- **Some large eyeglasses, headsets, hats and hairstyles may interfere with the quick donning capability of the mask. Pilots must ensure the mask can be donned quickly.**
- **Whether or not smoke has dissipated, if it cannot be visibly confirmed that any fire has been extinguished following fire suppression and/or smoke evacuation, land immediately at the nearest suitable airport.**

1. Oxygen Mask(s)/Goggles . . . . . **Don** and **EMER**
2. MIC SELECT Switch(es). . . . . **OXY MASK**
3. PAX SAFETY Switch. . . . . **PAX SAFETY**
4. Air COND and DEFOG Buttons . . . . . **Off**
   (GTC: Home > Aircraft Systems > Temp)
5. Determine source of smoke or odor. The fire extinguisher, if required, is left of the copilot's seat.
6. AIR SOURCE Selector . . . . . **L** (allow time for smoke to dissipate)
7. At high altitude, throttle on the selected engine may need to be above idle to maintain pressurization.

● **If Smoke Continues**

8. AIR SOURCE Selector. . . . . **R** (allow time for smoke to dissipate)

☐ **If Smoke Still Continues**

9. AIR SOURCE Selector . . . . . **FRESH AIR**
   (cabin will depressurize)
10. Land as soon as possible. Refer to Emergency/Abnormal Procedures, Smoke Removal; **Tab H1** (Page 3-660-16), if necessary.

PROCEDURE COMPLETED

☐ **If Smoke Dissipates**

PROCEDURE COMPLETED

● **If Smoke Dissipates**

PROCEDURE COMPLETED

Illustration 1: 'Environmental System Smoke or Odour' checklist from the emergency/abnormal procedures

Medical examination

After landing, the pilots complained of burning eyes and a sore throat. They did not feel dizzy. The medical examination carried out on the same evening did not diagnose any poisoning.

Technical investigation

On 9th October 2017, a ground run of both engines was executed under the supervision of the STSB. During this, both engines were operated at take-off power for 3 minutes each. Engine 2 developed an easily detectable odour in the cockpit, which was characteristic of the cleaning fluid used in the compressor wash.

Conclusions

The engine manufacturer stipulates that the engines run in idle power for at least 2 minutes following a compressor wash. The maintenance company had run the engines in idle after the compressor wash, initially for around 10 minutes, and for a few minutes the next day at a power of 60-80% N1, which significantly exceeded the manufacturer's specification. Despite this, smoke developed shortly after take-off due to cleaning fluid residue in the engine. This shows that the manufacturer's procedure for the engine test following a compressor wash is not always sufficient to prevent smoke from developing at take-off power or full throttle.

The pilot decided not to go through the 'Environmental System Smoke or Odour' checklist step by step, but instead set the air source selector to FRESH AIR. This setting effects that no engine air is supplied to the cabin and, because the smoke originated from the engines, this also prevented further smoke from entering the cabin. This setting also prevents the cabin from being pressurised. However, this did not affect the safe control of the aircraft, because the maximum flying altitude was only 5000 ft AMSL. The pilot's decision not to go through the checklist step by step and to directly switch the cabin's air supply from the engines to a fresh air supply from outside was appropriate and quickly defused the situation.

In this case, the crew did not feel any immediate irritation in their eyes and therefore did not use protective goggles. After landing however, the pilots experienced burning eyes, which shows that the smoke was not harmless. The lesson to be learned from this is that, in the event of a suspected danger, protection must be used immediately and consistently – not only when harm or an impairment is experienced.

Based on these findings, the Swiss Transportation Safety Investigation Board concludes that, with regards to the serious incident under investigation, no other findings are expected which would need to be addressed to prevent such an incident. Therefore, based on article 45 of the OSITI, the STSB will not investigate further and concludes the investigation with this summary report.

Berne, 11th December 2017 Swiss Transportation Safety Investigation Board