MINISTRY OF INFRASTRUCTURE

SAFETY INVESTIGATION AUTHORITY

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FINAL REPORT

ON THE ACCIDENT INVESTIGATION OF

TL-2000 STING S4

S5-PGC

5. 7. 2020 near the village of Spodnja Gorica

Republic of Slovenia

»2020«

CONTENTS

INTRODUCTION

Final report on aircraft accident investigation contains facts, analyses, causes and safety recommendations of the Committee for investigation of aircraft accident, taking into account the circumstances in which the accident took place.

In accordance with point 3.1 of Chapter 3 of Annex 13 to the Convention on International Civil Aviation (11th edition, July 2016), Article 1 of Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 concerning investigations and the prevention of accidents and incidents in civil aviation, Article 137 (4) of the Aviation Act list of the Republic of Slovenia and Article 2 of the Decree on the Investigation of Air Accidents, Serious Incidents and Incidents.

The sole objective of the investigation is the prevention of future accidents and incidents. It is not the purpose of the final report to apportion blame or liability. Using this report in any other intent may lead to wrong interpretation.

This document is the translation of Slovenian version of the Final report.
Although efforts have been made to translate it as accurately as possible, discrepancies may occur.
In this case, the Slovenian version is the authentic, official version.

COMPOSITION OF THE INVESTIGATION COMMISSION

The Head of Safety Investigation Authority of Slovenia on the basis of Article 5 of Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on civil aviation accident and incident investigation and prevention, Article 138 (3) of the Aviation Act list of the Republic of Slovenia and Article 7 of the Decree on Investigation of Air Accidents, Serious Incidents and Incidents on 6 July 2020, appointed an Accident Investigation Commission to investigate the circumstances in which the accident occurred, to identify the causes of the accident and to prepare safety recommendations for preventing such accidents in the future.

Composition of the commission:

1. **Toni STOJČEVSKI – Investigator in Charge,** Head of SIA, and
2. **Urban ODLAZEK – Member of the Commission**, Aviation accident and incident investigator of the Ministry of Infrastructure

1. SUMMARY

1. Date and time of the accident: 5 July 2020 at 15:15 UTC[1]
2. Aircraft: TL-2000 Sting S4, Serial no. 17ST456, Registration mark S5-PGC[2]
3. Manufacturer: TL Ultralight, Hradec Karlove (Czech Republic)
4. Location: Wheat field near the village of Spodnja Gorica, N 46˚ 24' 45" E 015˚ 40' 11", Republic of Slovenia
5. Type of Flight: Private VFR flight in VMC conditions
6. Owner / user: Letalski center Maribor, Slovenia
7. Consequences: Major damage to the aircraft during an emergency landing with a use of a balistic parachute

1.1. Injury to persons:

Injuries	***Crew***	***Passengers***	***Other***
Fatal	**-**	**-**	**-**
Serious	**-**	**-**	**-**
Minor / None	**0/2**	**-**	

1.2. Damage to the aircraft

Damage to the fuselage, engine and propeller.

1.3. Damage to the equipment

Usage of a balistic parachute – BRS Ballistic Recovery System.

[1] This report uses the Coordinated Universal Time (UTC). On the day of the accident, two hours (UTC + 2) must be added for local time.
[2] The aircraft involved in the event falls under the category of microlite aircraft, which requires a national Permit to fly rather than an Airworthiness Review Certificate, to meet the requirements for airworthiness.

2. GENERAL

At 15:00 UTC the crew composed of a student and a flight instructor took off from Maribor Airport (LJMB), for the purpose of conducting a training flight in the local zone. According to the crew statements, after the aircraft arrived in the practice zone, student began to perform climbing and descending turns, followed by the flight instructor's demonstration of powerless approach to stall in flaps UP configuration.

No abnormalities were observed during the first approach to stall demonstration at 3.000 feet AMSL. During the second demonstration at 10 knots lower speed (around 34 knots) loss of control occured. The plane entered an unintentional spin with several rotations and the crew was unable to gain control of the aircraft. The flight instructor also tried to add full power while attempting to recover from a spin, to increase the airflow around the tail control surfaces. The action was ineffective, that is why he shut down the engine and activated the BRS (Balistic Recovery System). The plane stabilized and landed with a rescue parachute in a wheat field about 5 kilometers south of Maribor airport. The aircraft structure suffered significant damage (particularly in the nose section) when it landed at a high vertical speed. The crew evacuated the aircraft on their own, with no injuries.

Figure 1: Aircraft position at the scene

The flight instructor immediately called the Information Center and also informed the manager of the Maribor Aviation Center, who forwarded the information to the Maribor ATC. SIA Slovenia investigators and the Police arrived to the scene and photographed the position and condition of the aircraft, as well as obtained appropriate pilot and aircraft documentation from the crew.

The plane was transported to the Maribor Aviation Center's hangar, after being inspected by the investigation commission and Police representatives, by the owner – Maribor Aviation Center. The commission interviewed the flight instructor and the student pilot before continuing to gather information from the aircraft's owner and operator, the Maribor Aviation Center. The plane was also equipped with a GPS logger, the readings of which were seized by the commission during the investigation.

2.1. Weather report for the 5th of July 2020 in the area of Maribor airport

METAR:

LJMB 051500Z VRB02KT CAVOK 29/13 Q1016=
LJMB 051530Z 08003KT CAVOK 29/12 Q1015=
LJMB 051600Z 20001KT CAVOK 28/11 Q1015=

At the time of the event a weak wind was blowing from different directions. Visibility was greater than 10 km, there were no significant clouds, air temperature was 29°C, dew point 12°C and QNH 1015 mbar.

Figure 2: Maribor airport at the time of the event

2.2. Pilot and flight instructor experience information

On 17June 2012 the flight instructor was accepted into the AC Maribor Aviation School. On 18 January 2012 he obtained instructor rating for microlite pilot license.

Data from the licence:

TYPE OF LICENCE:	MICROLITE PILOT
Country of issue of the licence:	REPUBLIC OF SLOVENIA
Licensing Office:	CAA Slovenia
Special endorsments:	CVFR dated 25 October 2011
Date of issue of the licence and validity:	Valid from 18 October 2005 till 18 October 2021
Microlite type:	Airplane

2.3. Details on pilot medical certificate

Medical certificate type:	CLASS 2
Issuing State:	REPUBLIC OF SLOVENIA
Validity of a medical certificate:	20 May 2021

- Total flight time:
  - The pilot's total flight time up to the date of the accident was 290 hours and 33 minutes.
  - The pilot flew 11 hours 54 minutes in the previous three months.
  - The pilot did not fly in the previous 24 hours.

According to the data presented above, the pilot had sufficient experience as a flight instructor and maintained his flight qualifications for flying with microlite airplanes without major interruptions.

3. ANALYSIS

3.1. Pitot static system inspection

The aircraft was inspected in the hangar of Maribor Aviation Center, where it was adequately secured in accordance with the investigation commission's instruction, until the arrival of the expert commission for the inspection and analysis of the pitot static system. Due to transportation from the crash site requirements, the wings were removed and transported to the hangar alongside the fuselage. Testing and inspection was performed by connecting the measuring equipment to the pitot static system ports. An attempt to test the system's operation was unsuccessful due to excessive leakage in the system. As a result, testing of the condition and calibration of the instruments was not possible. The static channel of the barometric indication system had excessive leakage, resulting in incorrect operation of the barometric mechanical and electronic indicators of altitude, speed and vertical speed.

An examination of the PVC connections revealed a leak that was not caused by the accident. The leak in the static system installation was found on the »T« connector which connects the Air Data Computer, the Static Ports and the line leading to the cockpit instrument panel. The »T« connector is located behind the cockipt on the inside of the right side of the fuselage. The »T« connector's drilled hole was approximately 1.5 mm in diameter. Over the drilled hole, insulating tape was wraped.

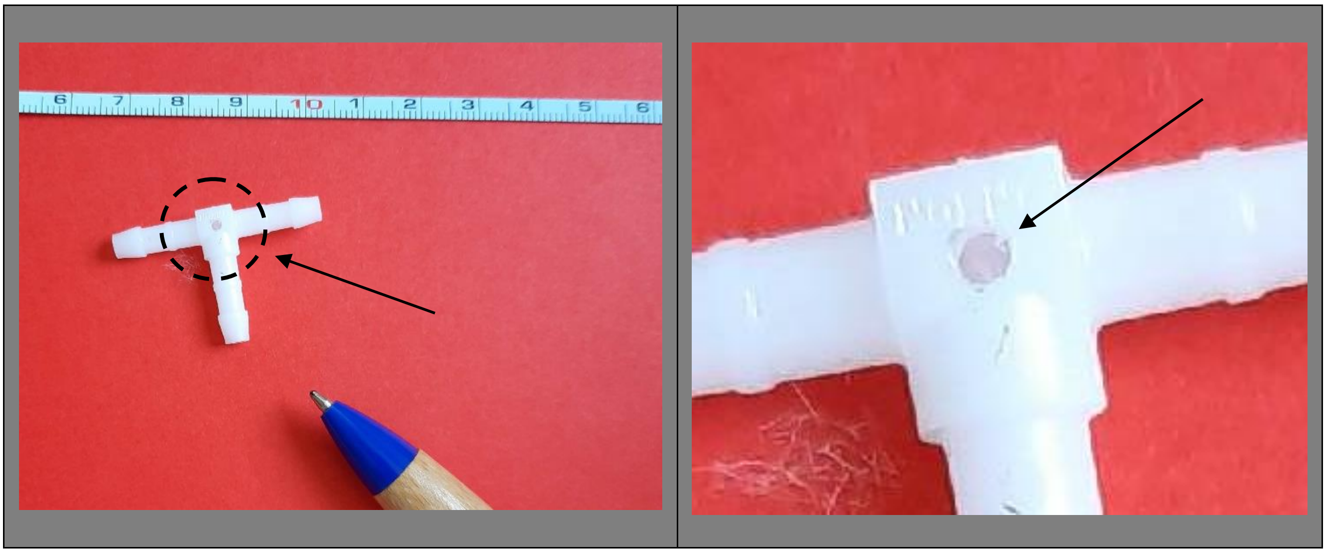


Figure 3: Leakage location at the "T" connector

3.2. Pitot static system leakege removal and calibration

Following the removal of the leak source, a re-test of the aircraft's pitot static system tightness was carried out. Following a successful leak test, barometric instruments and electronic multifunction devices were tested and calibrated. The test was completed successfully. The instruments resumed normal operation after the static line leak issue was resolved. The installation of both pneumatic channels was adequate in terms of tightness. The test results are included in Final report Appendices.

Following the inspection and calibration of the pitot static system, the commission requested responses from the aircraft manufacturer regarding the findings of the pitot static system inspection test.

The aicraft is also equiped with Dynon MFD electronic flight instruments, which in addition to the attitude indicator and heading indicator, functions as an electronic altimeter, vertical speed indicator and an airspeed indicator. During the test, the indications of these indicators were consistent with the indications of other pneumatic instruments.

In order to continue the investigation, the commission examined documentation on regular inspections of same type of aircraft registered in the Slovenian Aircraft Register governed by the Civil Aviation Agency - CAA. It has beed established that also other Sting aircraft had the same deviation or technical error due to »IAS instrumental error compensation«. The Commission had not received any additional explanations (except for the comments on the draft report given in Annex No. 2) from the aircraft manufacturer regarding its inability to verify the operation of the aircraft's pitostatics on the ground before the release of the Final report. The manufacturer's instructions in the Aircraft Maintenance Manual (AMM) at Point 3.10.3 Pitot–static system, specify a method for checking the static tightness of the system, but this could not be performed in practice due to air leakage in the pitot static system.

3.3. Mass and balance

The maximum take-off mass of the airplane has been specified by the airplane manufacturer in the Pilot Operating Handbook (POH), with a warning that the maximum take-off mass must not be exceeded. The aircraft manufacturer specified that the maximum take-off mass of the airplane equipped with the parachute rescue system was 472.5 kg, noting that the aircraft mass limit values should be calculated and the center of gravity determinated prior to flight and both must be within predetermined limits (Center of gravity permitted range is: 24.53% and 30.89% (% MAC)

On 16 May 2017 the aircraft manufacturer determined the aircraft's mass and center of gravity position.

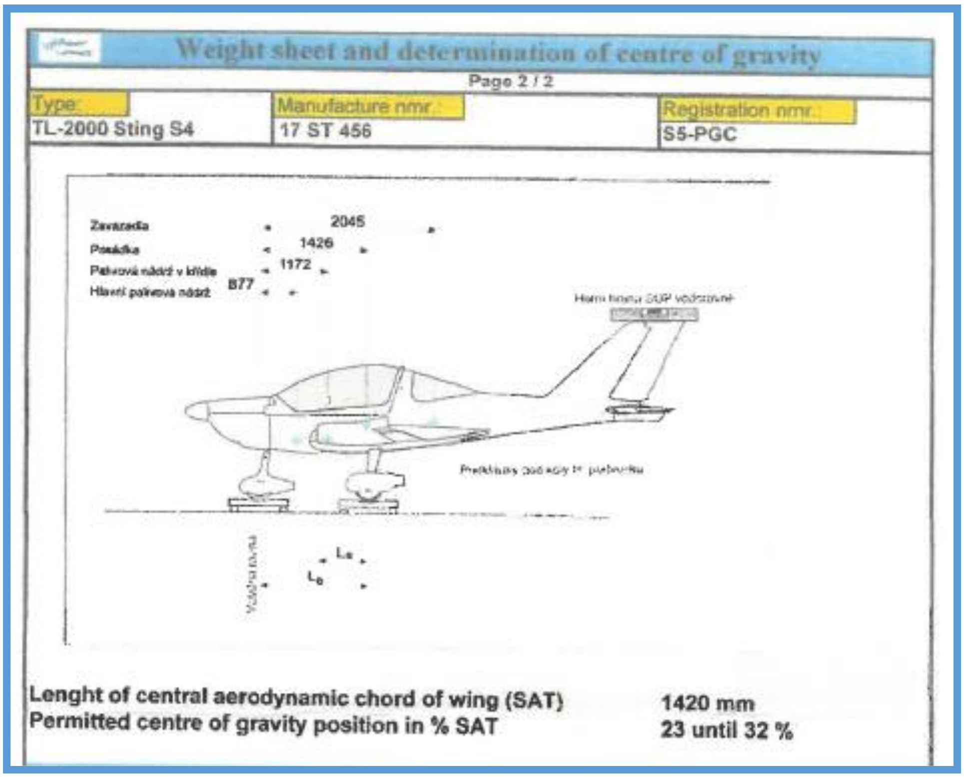
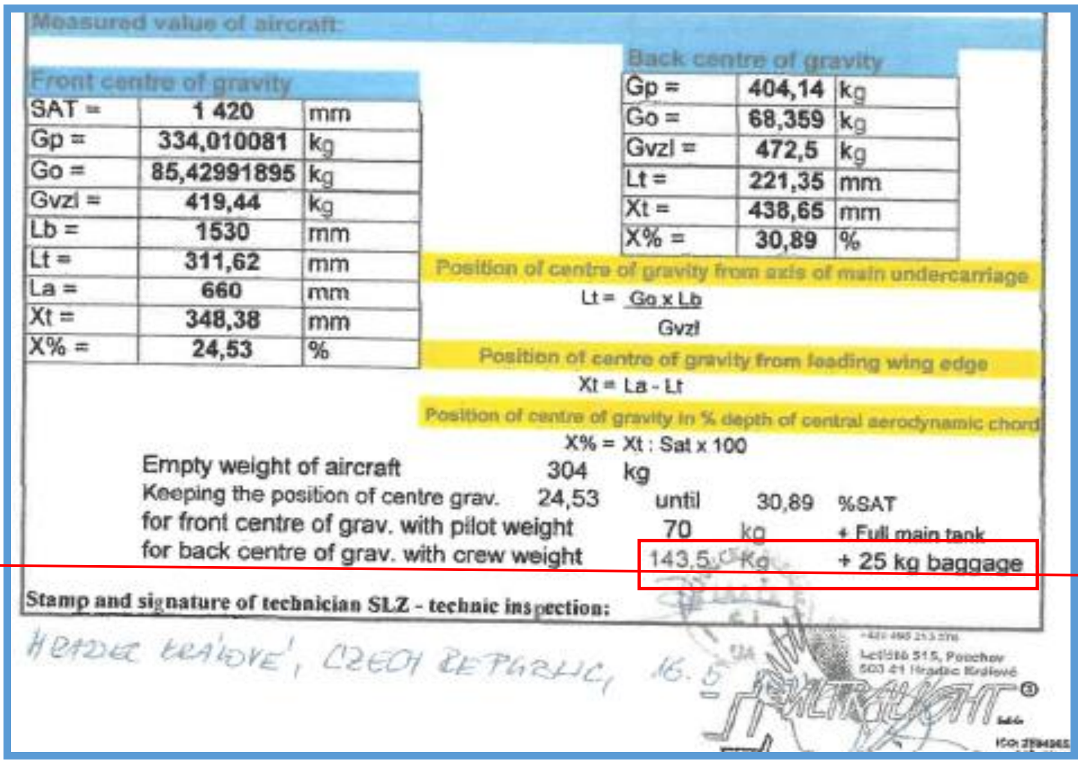


Figure 4: Data from measurements performed by the manufacturer



Measured value of aircraft:

Front centre of gravity

SAT =	1 420	mm
Gp =	334,010081	kg
Go =	85,42991895	kg
Gvzl =	419,44	kg
Lb =	1530	mm
Lt =	311,62	mm
La =	660	mm
Xt =	348,38	mm
X% =	24,53	%

Back centre of gravity

Gp =	404,14	kg
Go =	68,359	kg
Gvzl =	472,5	kg
Lt =	221,35	mm
Xt =	438,65	mm
X% =	30,89	%

Position of centre of gravity from axis of main undercarriage

Lt = Go x Lb / Gvzl

Position of centre of gravity from leading wing edge

Xt = La - Lt

Position of centre of gravity in % depth of central aerodynamic chord

X% = Xt : Sat x 100

Empty weight of aircraft	304	kg		
Keeping the position of centre grav.	24,53	until	30,89	%SAT
for front centre of grav. with pilot weight		70	kg	+ Full main tank
for back centre of grav. with crew weight		143,5	Kg	+ 25 kg baggage

Stamp and signature of technician SLZ - technic inspection:

HRADEC KRÁLOVÉ, CZECH REPUBLIC, 16. 5

Letiště 515, Pouchov 503 41 Hradec Králové

Figure 5: Data from the manufacturer's report on the performed weight measurement

The manufacturer's documentation of the airplane mass measurement, as well as documentation obtained from the airplane's owner, show that the airplane mass and center of gravity limits were clearly defined:

- **The airplane's maximum take-off mass is 472.5 kg,**
- **Empty mass is 304 kg,**
- The maximum crew mass (pilot and passenger) is 151 kg,
- The minimum crew mass (pilot without passenger) is 70 kg,
- The airplane's center of gravity must be located between the forward point 24,53% MAC and the aft point at 30,89% MAC,
- The Mean Areodynamic Cord (MAC) measures 1420 mm in lenght.

The position of the center of gravity of an empty aircraft can be calculated based on the weighing of the empty aircraft and the documents issued. The center of gravity is obtained at 28% MAC.

The examination of the POH and AMM established that the manufacturer had prescribed the aircraft weighing procedures and the determination of the position of the center of gravity in the aeroplane POH (mainly intended for pilots) while the instructions for the day-to-day determination of the airplane mass and balance were likely to be (by error) placed in the Aircraft Maintenance Manual (intended for personnel, who maintains the aircraft and not for pilots who operate it).

3.4. Theoretical calculation of the take-off mass

Adding 77 liters of fuel (information obtained from the Airplane Technical Log) to the fuel tank, increases the aircraft's weight by 55.5 kg (at a fuel density of 0.72 kg/l for 95 octane unleaded fuel). There were two avarage weight pilots onboard the aircraft, each weighing about 75 kg, so the crew weighed around 150 kg. **In this case, the total take-off mass was 509.5 kg, which is 37 kg more than the maximum take-off mass**.

The aircraft consumes approximately 16 liters per hour, resulting in a weight reduction of 11.5 kg per hour of flight.

As only 20 minutes elapsed between take-off and the accident, it is assumed that the amount of fuel consumed was aroud 5 kg, so it can be concluded that the mass of fuel consumed between take-off and the event had no significant effect on the change in total mass.

The maximum crew weight of 143.5 kg and 25 kg of baggage determine the aft limit position of the center of gravity (as specified by the manufacturer in the weighing report – Figure 5). The given report makes it difficult to conclude whether fuel is already included in this mass, because adding all the masses reluts in a mass greather than 472.5 kg, i.e. greater than the maximum allowed.

Following the manufacturer's instructions, the following calculation is made: We get a total mass of 528 kg by adding 143.5 kg (crew weight) + 55.5 kg (fuel in the main tank) + 25 kg (baggage) + 304 kg (empty aircraft mass).

When we subtract the fuel, we get exactly 472.5 kg. As a result, we can conclude that the mass of fuel is included in the total given mass. When we subtract 25 kg (baggage), we get 118,5 kg, and when we add an empty mass of 304 kg, we get 422.5 kg. This demonstrates that we have space for 50 kg of fuel, or 69.5 liters of fuel (so by no means a full main tank). As a result, if the crew can weigh 118.5 kg, each pilot can weigh 59.25 kg. The crew involved in the accident was not so light and the plane did not have only 50 kg of fuel, so the commission concludes that the actual center of gravity was at the aft limit.

The position of the aircraft's center of gravity at or beyond the aft limit affects maneuverability as well as the characteristics of the aircraft in unintentional spin. In this accident there was a tendency of a flat spin (according to interviews) and an inability to establish control over the aircraft.

Flying inside the center of gravity limits allows for meneuverability. Any deviation from the limits of the center of gravity, reduces the aircraft's maneuverability and the enables inability to generate sufficent aerodynamic forces to change the angle of attack by elevator deflections (especially at low speed). This decrease in aircraft maneuverability is primarly due to the shorter elevator control force levers, as well as the lower lift force generated on the control surfaces with disturbed flow due to the high angle of attack of the wing.

3.5. The aerodynamic effects of the left aileron deflection when the control stick is in the neutral position

The commission established that the left aileron of the Sting aircraft is deflected downward by approximately 15 degrees, while the right aileron is aligned with the wing surface (based on analyzing the aircraft involved in the accident, an external inspection, and witness statements). During the inspection of another aircraft of the same type and manufacturer registered in Slovenia, a similar deficiency has been found.

The aileron deflection existance reason is not known to the Comission, but could origin from the airplane production, or aileron rigging in airplane maintenance. As rigging is controled after the airplane production, it is possible that condition of aileron deflection from neutral occured in later time. One aileron deflection, can induce problems when flying at low speeds, that is high angles of attack.

The angle of attack is defined as the angle between the direction of incoming air and the Mean aerodynamic cord and increases as the aileron deflects downwards due to cord angle change. Asymmetric loss of lift can occur if the aircraft is located near a critical angle of attack with such anomaly. However, before the stall, lift difference forms on the left and right wing. As a result of this (when the control is in the neutral position and the speed is reduced – witness statement), the plane begins to bank to the right. Because the flight is asymmetric, the stall, which occurs earlier on the left wing due to a greater angle of attack, makes the aircraft enter the left spin. If the aircraft's center of gravity is in the rear position, the tendency of lifting the nose worsens the situation to the point where it can lead to the danger of the aircraft entering the undesired aircraft state where the flat spin develops.

Unintentional entry into the spin is a shock for the pilot because he did not use the usual flight control inputs for controlled entry into the spin maneuver (namely the full deflection of the rudder at a large angle of attack). The Comission believes the unbalanced flight was caused by torque aroud the vertical axes caused by a deflected left aileron combined with aircraft position corrections using a rudder to correct the bank at high angles of attack (near the stall speed).

The Commission discovered traces of the rudder sliding against vertical stabilizer, while inspecting the control surfaces and their operation. Traces of sliding were found in the first third of the vertical stabilizer, viewed from the horizontal stabilizer upwards. When moving the rudder from the cockpit (deflection of the rudder to the right), an area of increased resistance was felt when passing over the slipped part. The user and the owner of the aircraft did not detect these traces pror to the event. Also, these traces were not found on the other two aircraft of the same type registered in the Slovenian Aircraft Register. The Commission cannot confirm with certainty that this anomaly was induced during airplane crash when the BRS was activated. Therefore, the Commission warns that the transition of the rudder sliding along the vertical stabilizer (if existing before) may give the pilot a false impression that he has reached the maximum rudder deflection (which is crucial for a successful recovery from a spin).

The following factors are important when recovering from a spin: power idle, appropriate configuration (flaps retracted, trim correctly set for the prescribed speed, ailerons in neutral position – aligned with the wing), and center of gravity position within limits (which must be checked before take-off).

The pilot attempted to follow the aircraft manufacturer's prescribed procedures in accordance with the checklist, but encountered following factors unknown to him at the time:

- Limitations of rudder deflection (possible)
- Left aileron deflected down during contol stick in neutral position
- The center of gravity positioned at aft limit

3.2.10 Inadvertent spin

WARNING

Intentional spins in this airplane are prohibited!

Should an inadvertent spin occur in this airplane, the following recovery procedure should be used:

1. Throttle...IDLE
2. Ailerons...NEUTRALIZE
3. Rudder...........APPLY FULL (in opposite direction of rotation)
4. Elevator..FORWARD (to break stall)
5. Rudder...NEUTRALIZE
6. Elevator.....................................RECOVER SMOOTHLY FROM NOSE-LOW ATTITUDE

CAUTION

Close the throttle to prevent an unnecessary increase in airspeed. During a spin, one wing is in a stalled condition resulting in ineffective aileron inputs to control the rotation. Neutralize the ailerons, and apply full rudder in the opposite direction of rotation. Because an airfoil can stall at any airspeed and in any relation to the horizon, push forward on the stick to break the stall.

Figure 6: Instructions for the recovery from unintentional spin

The sequence of flight control inputs for the recovery from a spin is crucial. It is first necessary to stop rotation around the vertical axis, ensure smaller angles of attack to establish normal airflow over a wing to regain lift and stabilize the aircraft from a steep dive, without overloading the structure, exceeding maximum speed or inducing secondary stall below the Va speed.

According to the pilot's testimony, he tried to add full power to achieve airflow, but this caused an additional torque upwards around the lateral axis, worsening the conditions and making the spin flatter. As the aircraft began to lose altitude, the pilot shut down the engine and activated the rescue parachute system. The throttle remained in the fully open position untill the impact.

The Commission studied the CAA's Ultralight Aircraft Training Program, which is used by aviation schools for the purpose of training students to obtain a microlite pilot's license in accordance with the Rules on Ultralite Aircraft, Official Gazette of the RS, No. 49/16, 52/16, 32/18, 10/19 and 75/19). The practical exercises specified in the program include practical training in the zone (pilot zone-exercise No. 4, a total of 180 minutes), which includes sharp turns, flight at minimum speed, and avoidance of a spin-approach to stall. Also from the training program, the listed elements in the practical training are performed by the student in the part of the solo flights that is determined in exercise no. 11 (S) (total 120min). Among the elements of the exercise in the flight school manuals, it is stated that in the part of the practical training in the zone, the approach to stall is carried out at minimum speed with flaps and without. The Commission evaluates that in the manuals of the aviation schools, such practical training exercises in the zone and independent flights in the zone where the approach to stall takes place do not contain a detailed explanation and objectives of performing an approach to stall with the microlite type. This raises the question of determining the limits or critical values of the minimum speed of the aircraft when performing an approach to stall and what signs and moments should be considered when performing an approach to stall to prevent an unintentional response of the aircraft to an unusual attitude or spin.

It is also necessary to emphasize the fact that the possible exceedence of the minimum speed limits of the aircraft can quickly lead to a stall and, consequently, to a spin that poses a fatal danger. The instructions given by microlite aircraft manufacturers to stop the spin and establish a controlled flight do not guarantee that the attempt to recover from an upset will be successful, despite the sufficient altitude at which such GA exercises are normally performed.

The general instructions for conducting approach to stall exercises outlined in the box below for training students on GA aircraft must be adapted for each type of microlite aircraft in accordance with the instructions and capabilities of the ultralight aircraft.

There are, of course, prescribed configurations for each approach to stall exercise (take-off, landing and horizontal flight). A take-off configuration (take-off flaps) is typically used for take-off approach to stall exercise, which is determined by the climb angle, and the deceleration is simulated by pitching up at fixed power. The horizontal flight approach to stall is intended in flaps retracted configuration, full or cruise power and the stall is induced by increasing the angle of climb.

Full flaps, throttle near idle and landing speed trim must be used when performing landing approach to stall exercise. As we keep the minimum vertical speed in the descent, the stall occurs and the stall recovery is made by increasing engine power and slightly lowering the nose (without loosing altitude).

Except in the case of specific flight instructor training on aircraft whose characteristics permit, the recovery from approach to stall demonstration begins at the first signs of stall and is **not demonstrated to full stall**.

The aircraft involved in an accident was conducting approach to stall exercise with the flaps retracted and engine power at idle. Due to the low altitude of the zone, aircraft aileron anomaly and flying at stall speed beyond the first signs of a stall, the pilot lost control of the aircraft, which he was unable to regain within available altitude. Recovery from a stall with the given parameters was not possible. The pilot's actions while performing a stall worsened the situation, however, the correct decision to shut down the engine and activate the rescue parachute ensured the crew's survival and damage to the aircraft only.

The crew's chances of survival would be nil, if the aircraft was not equipped with a rescue parachute. In this case, the BRS system fully justified its purpose.

4. CONCLUSIONS

In accordance with the investigation's objectives of improving civil aviation safety and preventing similar accidents and incidents in the future, the findings in this report do not constitute a finding of blame of liability. The use of this report for purposes other than improving aviation safety may result in misinterpretation.

4.1. Findings

1. The pilot in the role of flight instructor held a valid license – the licence of a microlite aircraft pilot with a flight instructor rating and a valid medical certificate Class 2;

2. The pilot has sufficient experience and maintained his flight qualifications and currency. He did not have major interuptions in flying on the type of aircraft involved in the accident in the last 12 months;

3. A valid Permit to fly has been issued to the aircraft by the Slovenian CAA;

4. At the time of the event Flight school possesed a valid operating license issued by the Slovenian CAA, including following approved training programs:

   Microlite – airplanes

   - Controlled VFR (CVFR) endorsment training
   - Microlite flight instructor course

5. The meteorological conditions on the day of the event were favorable for flying. The weather had no effect on the event;

6. A pitot static system inspection revealed a deficiency in the form of excessive leakage in the static line of the barometric indication system, resulting in the barometric mechanical and electronic altitude, speed, and vertical speed indicators error. The leak in the static system installation was found on the »T« connector that connects the Air Data Computer, the static ports and the line leading to the instrument panel;

7. Traces of rudder sliding along the vertical stabilizer were discovered during the inspection of the control surfaces and their operation. The Commission does not rule out the possibility that the traces of sliding occurred due to the collision of the aircraft with the ground or when BRS was activated;

8. A check of the aircraft at the accident site revealed that the throttle lever was full forward. Resistance was felt on the pedals due to damage to the aircraft's nose gear, caused by collision with the ground. The aircraft was adequately secured by the crew during the emergency landing Crew was evacuated safely and all checklists prescribed by the aircraft manufacturer in the aircraft manual were completed;

9. A review of the Pilot operating handbook revealed that the aircraft manufacturer had specified the checklists for action in the event of unintentional spin, as well as the conditions for using the BRS rescue system;

10. A review of the aircraft documentation revealed that the manufacturer of the TL Ultralight aircraft had provided appropriate checklists. The checklists for unintentional spin are described in Chapter 3 of the Pilot operating handbook;

11. It has been established that the flight instructor, while demonstrating approach to stall without flaps and with idle engine power, flew at a speed below the prescribed minimum flight speed – Vso;

12. In the Pilot operating handbook footnotes, the manufacturer spcifically states that flying below the minimum speed is prohibited. The exact explanations, expectations, or consequences of flying below the minimum speed are not provided in the manual. The areodynamic impact analysis shows that recovering an aircraft from the undesired aircraft state (UAS) caused by flying at minimum speed is nearly impossible. According to the Commission, in such a situation, the only way to survive is to deploy the BRS rescue system;

13. There were no deviations or deficiencies identified in the section relating to the analysis of the emergency response and procedures of the airport services related to the event, as well as the decisions made in coordination with the competent air traffic control services. Response

procedures, emergency services, and air traffic control measures were all implemented on time and correctly. The ELT did not activate during the forced landing;

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14. Prior to landing, the pilot did not make a distress call to the appropriate air traffic control. As a matter of priority, he attempted to safeguard the aircraft and crew;

15. Rescue and air traffic control personnel responded to the accident in a timely and correct manner, making decisions consistent with their responsibilities;

16. According to the Pilot operating handbook, the aircraft is expected to be damaged during landing impact, when the rescue system is used, but the crew will survive.

4.2. Causes

Direct cause

During an emergency landing, a plane impacted the ground with a rescue parachute deployed.

Indirect cause

Unintentional spin and loss of control during training flight.

5. SAFETY RECOMMENDATIONS

Based on the results of the analysis, the Commission believes it is necessary to issue several safety recommendations. The SIA Slovenia has already warned Slovenian users of the same type of aircraft (or variants of the same type of aircraft) of deviations from standards and recommended practices. Some deviations necessitate harmonization among EU NAAs, which issue Permits to fly in national airspace and with mutual Permit to fly recognition, give permission for the aircraft to fly in other EU countries. Deviations should be exchanged during Safety conferences, as this helps improving flight safety.

SI-SR001-2022

The aircraft manufacturer (TL Ultralight) should review Aircraft Maintenance Manual pitot static testing procedure on ground.

SI-SR002-2022

The aircraft manufacturer (TL Ultralight) should prescribe detailed aileron rigging procedure in the Aircraft Maintenance Manual, which would prescribe aileron deflections and neutral postion in relation to defined reference line.

SI-SR003-2022

CAA Slovenia should include the final report as one of the topics covered by the Safety Conference to be titled »Approach to stall exercises and related danger of unintentional spin entry«. Presentation of instructions for the correct use of flight controls at low speed.

SI-SR004-2022

CAA Slovenia should check the actual condition of the aircraft during the procedures for issuing Permit to fly for TL-2000 Sting S4 aircraft and based on the findings, prescribe appropriate procedures for eliminating errors and deviations that owners of aircraft registered in Slovenia must comply with.

SI-SR005-2022

CAA Slovenia should again issue a Safety notice to the professional public (Microlite airplane pilots) to remind them of the limits of maximum aircraft mass and center of gravity limits, as well as the regular control of mass and balance in clubs and flight schools, which should be conducted before each flight.

SI-SR006-2022

CAA Slovenia should request that training organizations provide a clear definition of approach to stall exercise flow in the Training Manuals (aircraft configuration and how far the stall is demonstrated should be stated).

APPENDICES

APPENDIX 1: Report on inspection of pitot static system

AIR SPEED INDICATOR TEST

	MODEL	P/N	S/N
IAS #1	BARO		X
IAS #2	DYMOND		

IAS #1 RANGE	180	KTS	(Km/h)
IAS #2 RANGE	180	KTS	(Km/h)

REF.SPEED	IAS #1	IAS #2	TOLERANCE
40	-6	+ 1	1,5
50	-5	+ 1	1,5
60	-4	+ 0,5	1,8
70	-3	+ 0,5	2,1
80	- 2	+ 0,5	2,4
90	- 1,5	+ 0,5	2,7
100	- 1	+ 0,5	3,0
120	- 2	+ 0,5	3,6
140	- 5	+ 0,5	4,2
160	- 10	+ 0,5	4,8
180	- 18	+ 0,5	5,4
200	X	X	6,0
220	X	X	6,6
240	X	X	7,2
260	X	X	7,8
280	X	X	8,4
300	X	X	9,0
320	X	X	9,6
340	X	X	10,2
360	X	X	10,8
380	X	X	11,4
400	X	X	12,0

MAX FRICTION	≤ 1	0
HYSTERESIS	≤ 1	0

NOTE: Baro Altimeter STOPED prematurely at 162 KTS

ALTIMETER TEST

	MODEL	P/N	S/N
ALT #1	BARO		
ALT #2	DYMOND		

MAX. ALTITUDE	20.000	FEET	METER

ALTITUDE ft (mx0,1)	ERROR (ft) LH	ERROR (ft) RH	TOL. (feet)
-1.000	+ 60	+ 10	20
0	+ 50	0	20
500	+ 50	+ 5	20
1.000	+ 50	0	20
1.500	+ 60	0	25
2.000	+ 60	0	30
3.000	+ 70	+ 10	30
4.000	+ 60	+ 10	35
6.000	+ 70	+ 10	40
8.000	+ 90	+ 10	60
10.000	+ 90	+ 10	80
12.000	+ 100	+ 15	90
14.000	+ 130	+ 25	100
16.000	+ 130	+ 25	110
18.000	+ 120	+ 30	120
20.000	X	X	130
22.000	X	X	140
25.000	X	X	155
30.000	+ 60	+ 10	180

MAX FRICTION	≤ 90	0
HYSTERESIS	50	10

VERTICAL SPEED INDICATOR TEST

	MODEL	P/N	S/N
VSI #1			
VSI #2			

VSI #1 max RANGE	X	Ft/min	(m/s)
VSI #2 max RANGE	X	Ft/min	(m/s)

VSI Indicator #1

RNG LH	ALT. DIF. (ft)	TOLERANCE ft/min - sec		UP	DN
0.500	20002500	100	48..72	X	X
1.000	2000..3000	200	48..72	X	X
2.000	2000..4000	300	51..69	X	X
3.000	2000..5000	300	54..66	X	X
4.000	2000..6000	400	54..66	X	X
5.000	2000..7000	500	54..66	X	X
6.000	2000..8000	600	54..66	X	X

VSI Indicator #2 (EFIS)

RNG RH	ALT. DIF. (ft)	TOLERANCE ft/min - sec		UP	DN
0.500	20002500	100	48..72	0	0
1.000	2000..3000	200	48..72	0	0
2.000	2000..4000	300	51..69	0	0
3.000	2000..5000	300	54..66	-	-
4.000	2000..6000	400	54..66	-	-
5.000	2000..7000	500	54..66	-	-
6.000	2000..8000	600	54..66	-	-

ALTITUDE ENCODER TEST

	MODEL	P/N	S/N
ENCODER	xxx		

ENC. RANGE	xxx	FEET

ALTIMETER setting to standard atmosphere. (1013,2 mb)

ALTITUDE [ft]	DECODED ALTITUDE [FL]	MAX DIFF. [feet]
-1.000	Not testad	X
0	Not testad	X
1.000	Not testad	X
2.000	Not testad	X
4.000	Not testad	X
6.000	Not testad	X
8.000	Not testad	X
10.000	Not testad	X
12.000	Not testad	X
14.000	Not testad	X
16.000	Not testad	X
18.000	Not testad	X
20.000	Not testad	X
25.000	Not testad	X
30.000	Not testad	X

Test results of second attemp to perform the aircraft pitot-static system Leak Test.

TEST FIELD CONDITIONS					
AMBIENT TEMPERATURE:	25 °	Deg.C	ATM.PRESSURE	1016	mbar
			PRESSURE ALTITUDE	787	ft
TEST FIELD LOCATION	LJMB		TEST FIELD ELEVATION	876	ft

PITOT SYSTEM LEAK TEST	LH		RH	
IAS AT BEGINING OF TEST	100	kt	N/A	kt
IAS LEAK RATE	- 0,4	kt / min	N/A	kt / min

FOUND CONDITION	PASS	FAIL	PASS	FAIL
	PASS		N/A	

STATIC SYSTEM LEAK TEST	LH		RH	
INDICATED ALTITUDE AT BEGINING OF TEST	10.000	feet	N/A	feet
INDICATED ALTITUDE LEAK RATE	- 19	feet / min	N/A	feet / min

FOUND CONDITION	PASS	FAIL	PASS	FAIL
	PASS		N/A	

APPENDIX 2: Summary of the manufacturer's comments on the draft final report

The manufacturer's representative commented on the draft final report through an accredited representative of the investigating body (the text is attached in its entirety in the original).

I refer to your transmittal letter, dated 29. 7. 2021, with enclosed the draft final report concerning the accident occurred on July 5, 2020 to aircraft TL-2000 Sting S4, registration S5-PGC, at LJMB.

Please, consider that the Air Accidents Investigation Institute of the Czech Republic as the State of Design and Manufacture reviewed the Draft Final Report an consulted the conclusions with the TL ULTRALIGHT s.r.o. We provided the following significant comments on the draft report:

1) Ad chapter 5. Safety recommendations – SI-SR003-2021 descriped in the Draft report:

   TL-ultralight insists on its statement provided in the document „Manufacturer statement from 27.11.2020", in particular part:

   The hole with diameter 1,5 mm is standardly the part of pitot-static system of aircraft type TL 2000 Sting S4 (UL versions). Such system has been made in this aircraft 17 ST 456 too. Whole pitot-static assembly of the aircraft is based on the flight test and it is adjusted in order to inform the flight crew with minimum of differences. Flight measurements were performed for the aircraft airspeed indication system, on the basis of which IAS and CAS differences were determined. The results of the measurement is written in POH manual (airspeed indication system error correction). The determination of the error of the airspeed indication system by means of ground tests is inaccurate and it does not include the effects of air flow on the sensors, etc.

   We do not agree to remove the hole for pitot-static system because it could be very dangerous for aircraft operation. Of course we refuse the resposibility for this modification.

2) Ad 3.5 The aerodynamic effects of the left aileron deflection …(Page 14).

   To 15 degrees left aileron deflection, while the right aileron is aligned with the wing surface:

   After the aircraft production, leveling was performed (including aircraft control) from which the record is made. A copy of this record is transmitted with the aircraft. The document shows the leveling results and no anomaly described is mentioned (nor can it be, because the setting would be completely outside the permissible limits).

3) Ad 4.1 Findings poit 7 (Page 19)

   To to traces of the rudder sliding against vertical stabilizer:

1

Is it clear when the touch occured? Have control pedals been at its stops? The stops are located on the pedal assembly.

In accordance with ICAO Annex 13 Article 6.4, we look forward to receiving a copy of your Final Report on this occurrence.

Sincerely,

[redacted]

Air, Maritime and Railway Accident and Incident Investigation Unit
Langusova 4, 1535 Ljubljana
Republic of Slovenia
By e-mail