Final Report

SERIOUS INCIDENT/2021/5037

STATE COMMISSION ON AIRCRAFT ACCIDENT INVESTIGATION

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FINAL REPORT

from investigation of the aviation occurrence of the aircraft below 2250 kg MTOM

SERIOUS INCIDENT

OCCURRENCE NO. – 2021/5037

AIRCRAFT – Aeroprakt 22LS, SP-SENO

DATE AND PLACE OF OCCURRENCE – 21 December 2021, Szczodrkowice

The Report is a document presenting the position of the State Commission on Aircraft Accidents Investigation concerning circumstances of the air occurrence, its causes and safety recommendations. The Report was drawn up on the basis of information available on the date of its completion.

The investigation may be reopened if new information becomes available or new investigation techniques are applied, which may affect the wording related to the causes, circumstances and safety recommendations contained in the Report.

Investigation into the air occurrence was carried out in accordance with the applicable international, European Union and domestic legal provisions for prevention purposes only. The investigation was carried out without application of the legal evidential procedure, applicable for proceedings of other authorities required to take action in connection with an air occurrence.

The Commission does not apportion blame or liability.

In accordance with Article 5 paragraph 6 of the Regulation (EU) No 996/2010 of the European Parliament and of the Council on the investigation and prevention of accidents and incidents in civil aviation [...] and Article 134 of the Act – Aviation Law, the wording used in this Report may not be considered as an indication of the guilty or responsible for the occurrence.

For the above reasons, any use of this Report for any purpose other than air accidents and incidents prevention may lead to wrong conclusions and interpretations.

This Report was drawn up in the Polish language. Other language versions may be drawn up for information purposes only.

WARSAW 2022

Occurrence reference number	**2021/5037**			
Type of occurrence	SERIOUS INCIDENT			
Date of occurrence	21 December 2021			
Place of occurrence	Szczodrkowice			
Type and model of aircraft	Ultralight vehicle Cat. K4., UL-A. Aircraft, Aeroprakt 22LS			
Aircraft registration marks	SP-SENO			
Aircraft/User Operator	Private			
Pilot in Command	PPL(A) / UACP (Aviation Personnel Certificate of Qualifications)			
Number of victims/injuries	Fatal	Serious	Minor	None
	0	0	0	1
Domestic and international authorities informed about the occurrence	EASA, NBAAI[1], ULC[2]			
Investigator-in-Charge	Michał Ombach			
Investigating Authority	State Commission on Aircraft Accidents Investigation (PKBWL)			
Accredited Representatives and their advisers	None			
Document containing results	Final Report			
Safety recommendations	None			
Addressees of the recommendations	Not applicable			
Date of completion of the investigation	...			

1. Type of occurrence

Serious incident

2. Investigating authority

SCAAI (PKBWL)

3. Date and time of the occurrence

21 December 2021, 12:04[3] (11:04 UTC)

[1] NBAAI – National Bureau of Air Accidents Investigation of Ukraine
[2] Urząd lotnictwa Cywilnego – Civil Aviation Authority of Poland
[3] All times in Final Report are in UTC unless otherwise indicated, UTC=LMT-1hr

4. Place of the take off and unintended landing

Take-off from non-registered landing strip located south-west of Szczodrkowice village Skała commune (Fig.1).

Fig. 1. Place of take-off and unintended landing. Flight trajectory established based on coordinates recorded by the flight computer installed on SP-SENO a/c [source: GoogleMyMaps]

According to pilot's statement, he intended to fly to Zator (EPZT) landing field, about 40 km S-W (Fig. 2).

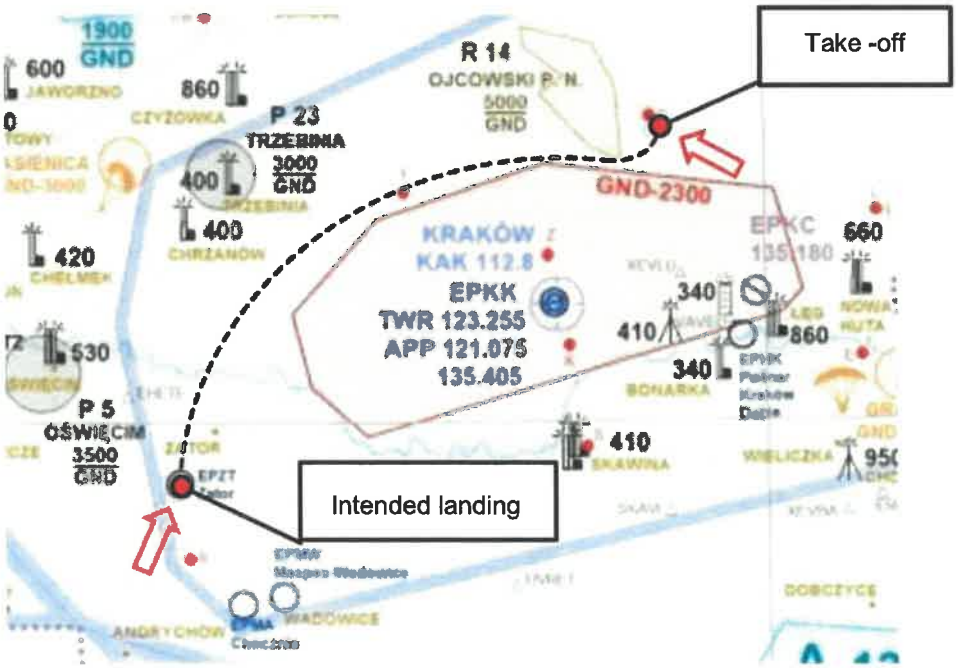


Fig. 2. Planned route to EPZT [source: PANSA][4]

[4] PANSA – Polish Air Navigation Services Agency

5. Place of occurrence information

Szczodrkowice area (Fig. 1)

6. Operation type

Private flight

7. Flight phase

Climbing after take-off

8. Flight conditions

Daylight, VMC

9. Meteorological information

Meteorological conditions had no impact on the accident.

According to pilot's statement, the N-W wind was below 5 kts, 2/8 scattered clouds with ceiling above 3000 ft. Ambient temperature minus 4°C.

10. Flight operator

Private

11. Personnel information (crew data)

Pilot – male, aged 46, valid PPL(A) and UACP with UAPL entry, Medical certificate class II/LAPL with no limitation.

Pilot declared his total flight time 1050 hrs, on Aeroprakt 32 & Aeroprakt 22 – 520 hrs, flown during last 12 months. This should be considered that the pilot was in current training.

12. Injuries to persons

None

13. Damage to aircraft

The perspex of side cabin doors were cracked/broken, the frame of the left door was twisted and the bottom fairing of left wing strut was broken (Fig. 3).

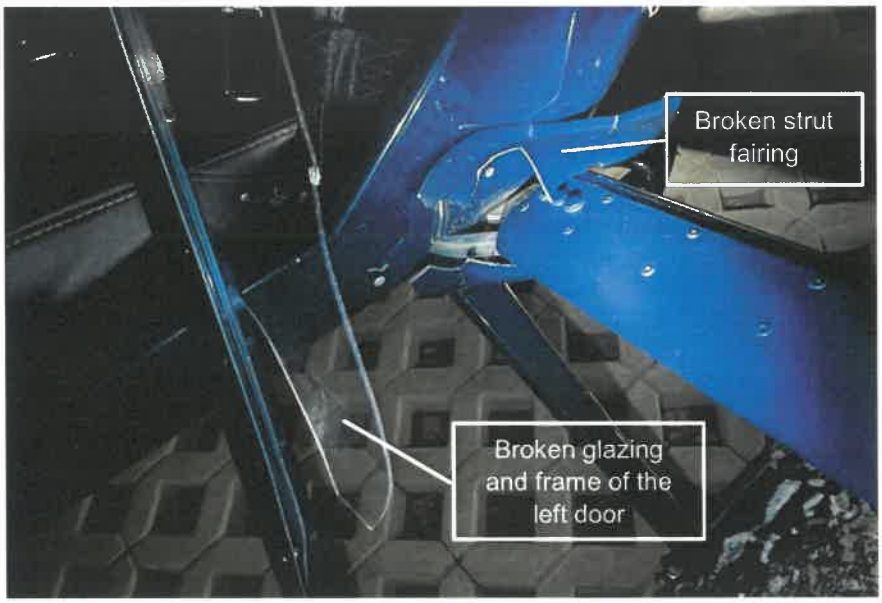


Fig. 3. Damage to the left cabin door and strut fairing [source: SCAAI]

14. History of the flight and analysis

14.1. Description of occurrence

On 21 December 2022, the ultralight vehicle Aeroprakt 22LS, SP-SENO, took-off from landing strip nearby Szczodrkowice village. Immediately after take-off the pilot contacted Flight Information Service (Krakow Information) on radio frequency 119,275 MHz, reporting the flight to EPZT. One minute after, the cabin doors on left and right sides opened suddenly. The left door was also broken off from one of its hinges, it turned and rested on the wing strut impeding control of the aircraft. Pilot declared MAYDAY, turned back and landed on a ploughed field, near the departure site without further damage. The safe landing was reported by phone to FIS Kraków.

14.2. Analysis of occurrence

The occurrence has been consulted with Aeroprakt assembly plant. The pilot's and FIS reports as well as the records of flight data from *Dynon Avionics* installed on SP-SENO aircraft have been analysed.

14.2.1. Flight data analysis

The recorded data allowed to recreate the flight path from the take-off to landing as well as to determine the exact time of door opening. Several flight parameters have been recorded, based on sampling rate up to 16 times per second. To describe the occurrence some key parameters have been selected (see plots below).

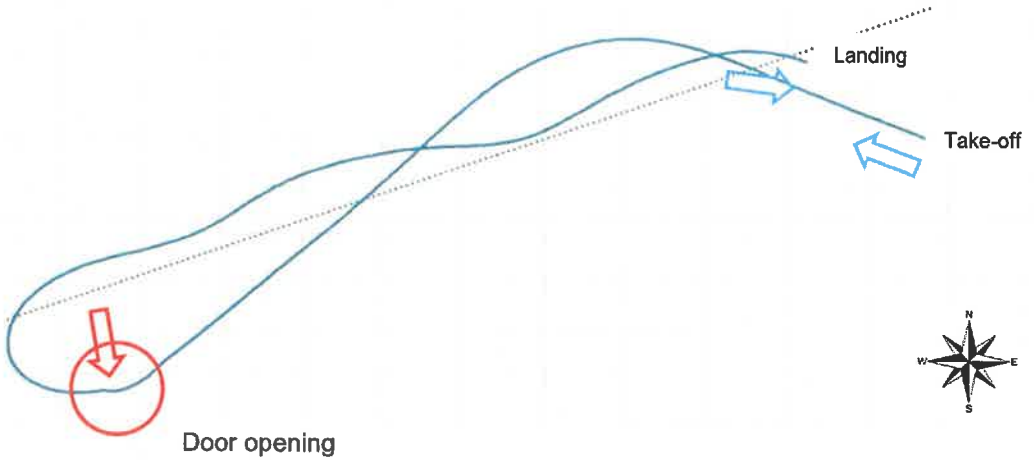


Fig. 4. Horizontal projection of the flight trajectory from take-off to landing, drawn based on flight data from *Dynon Avionics* (the scale preserved) [source: csv file]

Take-off time 11:03:00 hrs[5] (start of take-off run), heading 298 deg.

Landing time 11:05:12 hrs (end of landing roll), heading 95 deg.

Flight time (including the run and roll): **2 min. 12 sec.**

Autopilot was engaged at 11:03:18 hrs, i.e. 18 sec. after the beginning of the take-off run, 150 ft above the landing strip.

Autopilot disengaged at 11:03:53 hrs.

The following plots have been created as a function of time (Fig. 5)[6]:

a) barometric altitude and indicated airspeed (IAS[7]) / autopilot "on";
b) indicated airspeed and vertical and lateral accelerations;
c) RPM and vertical accelerations.

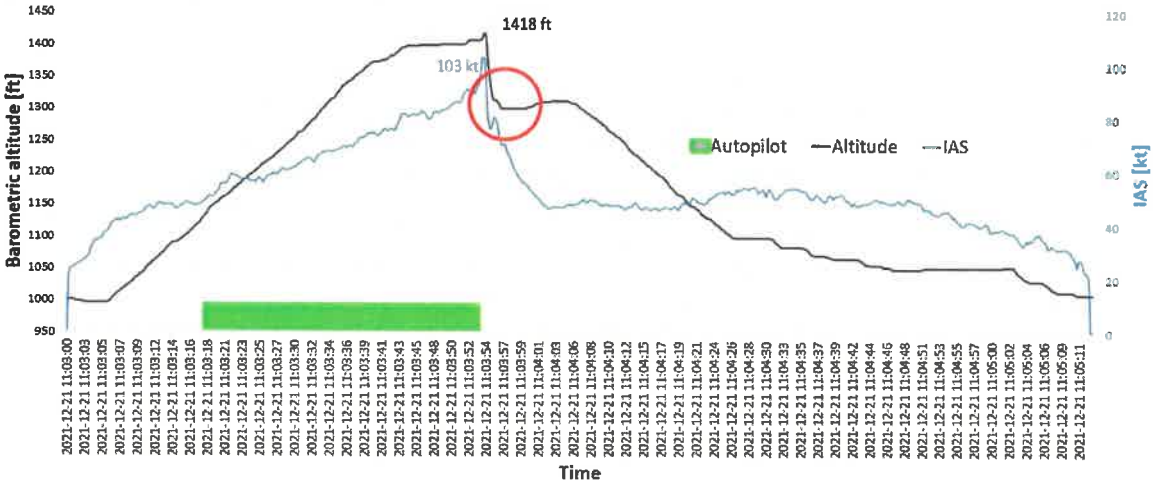


Fig. 5a. Barometric altitude and IAS. Autopilot engagement ("on") marked in green

[5] Times presented in UTC, as recorded
[6] Times on the plots Fig. 5a), b) i c) are given in UTC
[7] IAS – indicated airspeed

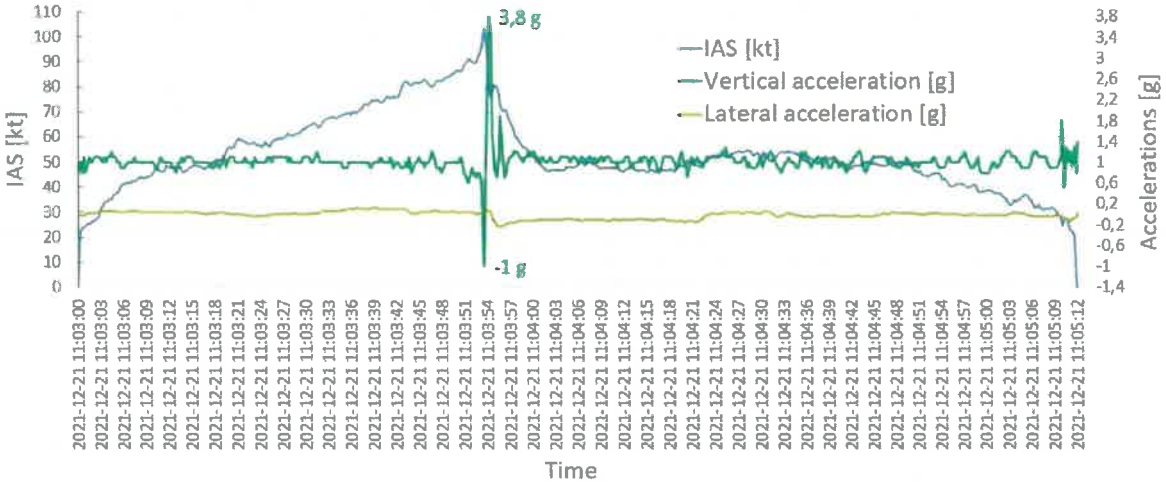


Fig. 5b. Accelerations and IAS

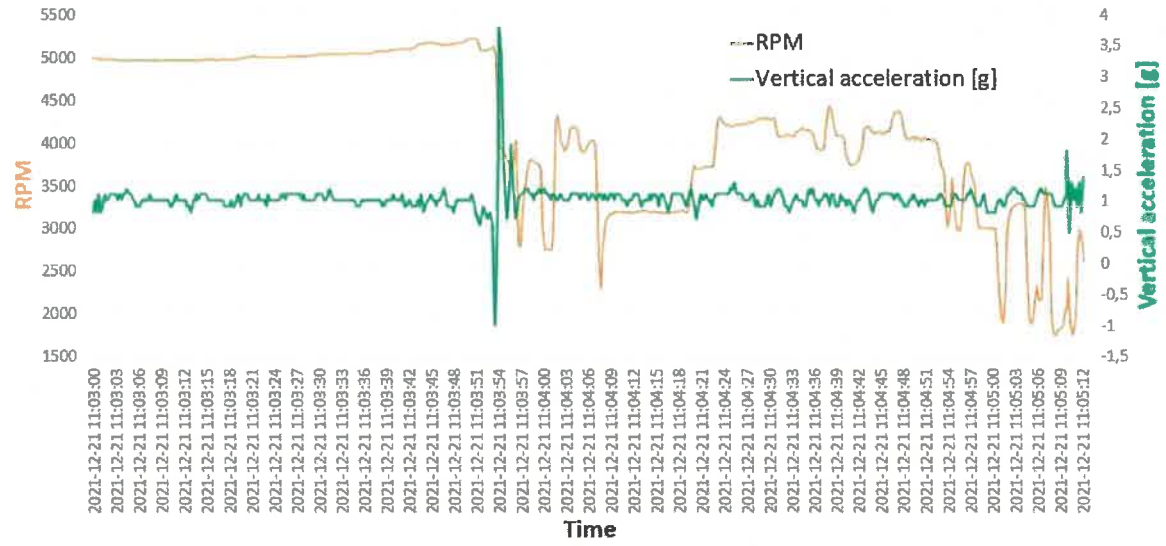


Fig. 5c. RPM and vertical acceleration

At the time of occurrence, at 11:03:54 hrs, the barometric altitude[8] was **1418 ft**, i.e. about 420 ft above the landing strip – see plot (Fig. 5a).

The pilot was increasing speed up to that height, with average climb rate of 2,3 m/sec. At 11:03:54 hrs the speed achieved **103 kts** (191 km/h) – see plot (Fig. 5b). All the time the full engine power (full throttle) was set, at max. RPM (Fig. 5c).

At 11:03:54 hrs the left and right doors, one by one, opened suddenly and the audible and visual warnings („GEES") of the *Dynon Avionics* system were activated signalling significant airframe load factor. The total value of vertical acceleration increase was 4,8 g (from -1g up to +3,8g), (Fig. 5b). That was combined with a relatively small lateral acceleration (acting perpendicularly to longitudinal axis of aircraft). Left door opening and its rotation (the door were suspended on one upper hinge only, rested on the wing

[8] Barometric altitude – the height as per altitude indicator where the reference pressure is set on standard, i.e. on the medium sea level, 1013,25 hPa

strut and acted like an airbrake) slowed down the a/c rapidly and pushed its nose about 30 deg. down, below the horizon. Pilot immediately pulled the yoke backward what caused the load factor of 3,8 g. The corresponding part of the flight path was marked with a red circle in (Fig. 5a). The disturbed flight trajectory can be also seen on its horizontal projection and has been marked by a red circle and an arrow in (Fig. 4).

14.2.2. Data analysis, visual inspection and functional tests

Detailed visual inspection of the locking mechanisms of SP-SENO a/c did not reveal the signs of deformations or damage on locks or corresponding metal fittings, horizontally riveted to the fuselage frame. Both mechanisms were working in the same mode and smoothly, and the forces to engage them were equal.

The door locking mechanism operation is based on a spring connected with a rotating handle, which is presented in Fig. 6. The spring moves the handle to the position „closed", turning it down parallelly to the bottom frame of the door.

The lock is not secured against unintentional unlocking, it works easily and smoothly. With regard to wide range of whole handle movement from horizontal to vertical (90 deg.), the lock releasing angle is relatively small (about 20 deg.).

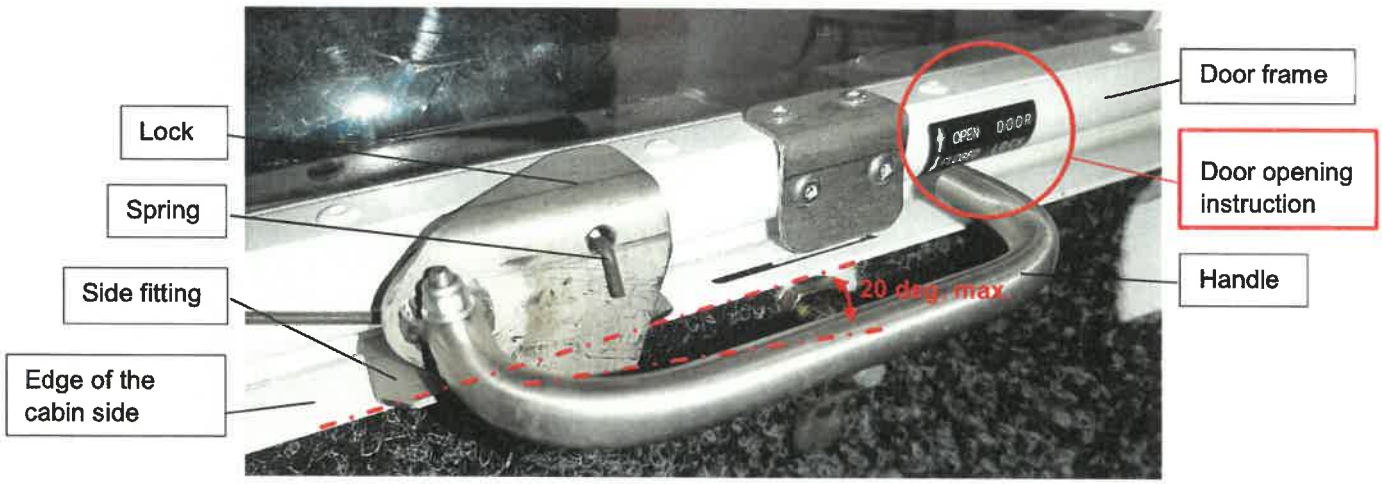


Fig. 6. Door locking mechanism (left door) with hadle in closed setting. Also shown the range of engagement of locking mechanism [source: SCAAI]

For comparison purposes the inspections of intact doors were also done on three different Aeroprakt 22 aircraft. It has been found that:

- for each aircraft, the locking mechanisms were working in a similar mode: smoothly and springy, the releasing forces (to unlock the handle) were low and the releasing angles were the same (up to 20 deg.). The springs caused that each mechanism turned back to its „closed" position;
- the design provides for significant asymmetry between the hinges located on the upper frame of the door and the position of the locking mechanism on the bottom (Fig. 7.). This causes uneven distribution of forces around the door frame in case when an opening force is applied – particularly in the front part (see Fig. 8);

Fig. 7. Location of hinges and the locking mechanism on the door

Fig. 8. The force above 40N applied to the door in its front area and a visible gap between the door and fuselage frame

- high force applied did not unlock nor open the door;
- in case of insufficient door frame stiffness caused by a mechanical damage, the lock will not work properly and the door will open;

- the function of the gas spring installed in the rear part of the door is to keep the door „closed" or „opened" on the ground only, this spring is not sufficient to secure the door fully open or closed in flight;
- the side windows have been made from a thin PET[9] – flexible and not susceptible for cracking, even when deformed or damaged. Potential stress inside a thin and flexible PET, resulting from heat deformation, will not cause any deformation of frame – the glazing does not affect the overall stiffness and the shape of the door – this is the role of the frame;
- pulling the door out of the fuselage, perpendicularly to the aircraft longitudinal axis (see Fig. 8), when the force was applied to the forward part of the door, revealed their insufficient stiffness. The formed gap was about 10 mm when the force applied was 30 N and was increasing up to 40÷50 mm with the force of 45 N. The applied forces were relatively low and corresponding to aerodynamic forces in flight. This was consistent with observations of some Aeroprakt 22LS users about gaps in the area of the front parts of the doors during flights with high speeds.

The temperature effect (thermal deformation of the door) was excluded as a cause of the door opening. There are approx. 1100 aircraft of "22" series operated in a more severe climate than in Poland (northern Russia). No occurrences have been reported due to temperature effect.

The visual check as well as simulations made did not confirm the possibility of spontaneous inflight door opening, as long as its frame (particularly the bottom edge) has been deformed.

The most probable cause of the left door opening was a coincidence of several factors: insufficient door frame stiffness, high airspeed and possible unintentional touch of the handle by the pilot. The last assumption may be supported by the sequence of actions of the pilot, who just after engaging autopilot moved his legs back from the rudder pedals. It should be noted, that the door locking mechanism does not have any latch position which could keep it in closed position. Therefore, the pilot simply could not feel the touching and moving the handle by his leg or shoe. Additionally, during take-off the pilot probably kept his hand on the throttle lever, which is situated just behind the door handle. Having in mind the small angle of door lock releasing (less than 20 deg.), it was quite easy and undetectable to touch it. The airspeed was high, much more than V_A[10].

Improper controls coordination could have been one more cause of the occurrence. Twelve seconds after rotation, the pilot engaged the autopilot. The system keeps and changes the yaw using the ailerons only. Making a proper coordinated turn (the trajectory shows that the aircraft began turn – Fig. 4), required additional applying the rudder. The disproportionate deflection of the rudder relative to deflection of ailerons, leads to downslide or outward side slip and generates asymmetrical airflow on the

[9] PET Poli (terephthalic ethylene) – is a light, strong and easy for treatment polymer
[10] V_A – the highest speed for an aircraft at which full deflection of the controls does not cause overloading of the airframe

fuselage that can suck and pull the doors out of the fuselage resulting in its deformation and detachment.

Once the left door was detached and rested on the wing strut, the airflow in the cockpit rapidly changed, and the right-hand door was also deformed and opened.

Disturbed airflow on the airframe caused by opened and deformed doors, affected the aircraft control, making it difficult. The pilot turned right approx. 180 deg and decided to make emergency landing at the departure site.

SCAAI analysed the door locking mechanism of Aeroprakt 22 aircraft. The design provides for locking and securing the door as „closed" in one place only, on the bottom part of the frame. Some operational experience shows a weakness of such solution, particularly when the door frame becomes deformed as a result of sideslips, high airspeed and/or in severe turbulence.

The side window with a convex profile creates aerodynamic force pulling the door away from the fuselage.

The gas spring role is just to keep the door fully closed or open. The force produced by the spring is not enough to keep the door closed in flight.

The cockpit ergonomy, location and design of door lock do not exclude unintentional, accidental loosening or even opening of door by a pilot (or passenger) in flight. Such a risk increases particularly during cold part of the year when the locks may work easier and a crew – due to warm clothes – have limited space in the cockpit. Thick clothing in combination with handle location make the handle invisible to pilot or passenger and easy to displace.

14.3. Commissions findings

1. The pilot had a valid ratings to perform the flight.
2. The aircraft airworthiness was properly documented.
3. The mechanical condition of the doors and door locks were as per the design.
4. The autopilot was engaged just after lift-off.
5. Starting from the take-off and also during the climb, the pilot was continuously increasing the airspeed up to above V_A, with autopilot engaged.
6. Pieces of broken side windows detached form the aircraft in flight.
7. Problems with the aircraft control resulted in a forced landing.
8. The pilot did not suffer any injuries in the cause of the occurrence.

15. Cause of the occurrence

The most probable cause of the occurrence was an insufficient stiffness of the left cabin door, which could have been combined with an unintentional touching of the door handle, and resulted in releasing the lock during flight with a high airspeed. The opening of the right cabin door was a consequence of its prior deformation under the sudden air blow which resulted from the left door opening.

16. Factors contributing to the occurrence

- engaging the autopilot immediately after take-off and close to the ground, too early retraction of the legs from rudder pedals and acceleration with full throttle of the engine;
- improper coordination of the rudder and ailerons deflection while initiating a turn;
- door locking mechanism not corresponding with insufficiently stiff cabin door.

17. Safety recommendations

PKBWL has not proposed any safety recommendations.

18. Proposed systemic changes and/or other comments

SCAAI recommends to apply the best practices when operating non-certified aircraft. Engaging autopilot just after take-off as well as acceleration close to the ground, particularly when autopilot is engaged, cannot be recognized as a good practice. The limitations as per applicable Flight Manual (Pilot's Operating Handbook) must be followed.

It was established that some unintentional inflight door openings occurred in the past, which resulted from crack/damage to windshield (e.g. after a bird strike. Following that, the airflow through the cockpit was causing the door frame deformation and disengagement of lock.

The investigation showed, that when the shape of the door is deformed and the lock handle is slightly turned (about 20 deg. up), the lock releases and the door opens. It leads the conclusion, that the door stiffness is too low and that on the front edge of the door an additional lock should be installed.

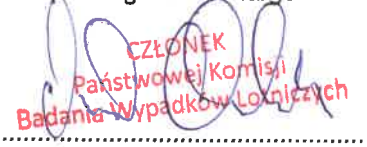
The Commission recommends that the aircraft manufacturer considers some changes in the design of the door locking system, to prevent unintentional, accidental or spontaneous door opening in flight.

19. Annexes

None

END

Investigator-in-charge



Michał Ombach