



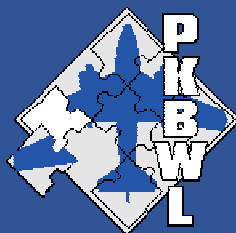
State Commission on Aircraft Accidents Investigation

# FINAL REPORT

**2022/5555**  
OCCURENCE NUMBER

## ACCIDENT

OTHR: Other



The sole purpose of the investigation and the Final Report is to prevent aviation accidents and incidents.

The Commission does not apportion blame or liability. The investigation is independent and distinct from any judicial or administrative proceedings.

Any use of this Report for any purpose other than air accidents and incidents prevention may lead to wrong conclusions and interpretations.

**Private, parachute jumps.  
2 Lightning 193 PS parachutes.  
Longinówka near EPPT,  
23 September 2022**

This Final Report was issued by the State Commission on Aircraft Accidents Investigation (PKBWL) on the basis of information available on the date of its publication.

This Report presents the circumstances of the aviation occurrence concerned, as well as its causes, contributing factors and safety recommendations.

This Report was drawn up in Polish.

Warsaw, 9 May 2024



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## TABLE OF CONTENTS

TABLE OF CONTENTS.....	3
INTRODUCTION .....	4
SYMBOLS, ACRONYMS AND ABBREVIATIONS .....	6
1. FACTUAL INFORMATION.....	7
1.1. History of the jump.....	7
1.2. Injuries to persons .....	9
1.3. Personnel information.....	9
1.4. Parachute information .....	10
1.5. Meteorological information .....	11
1.6. Place of occurrence information .....	11
1.7. Medical and pathological information .....	11
1.8. Survival aspects .....	12
1.9. Tests and research.....	12
1.10. Organisational and management information.....	12
1.11. Additional information .....	12
1.12. Useful and effective investigation techniques.....	14
2. ANALYSIS .....	15
3. CONCLUSIONS.....	17
3.1. FINDINGS.....	17
4. SAFETY RECOMMENDATIONS.....	17

## INTRODUCTION

### LEGAL GROUNDS

The State Commission on Aircraft Accidents Investigation (PKBWL) is a safety investigation authority referred to in Article 4(1) of Regulation (EU) No 996/2010 of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (Official Journal of the European Union L 295, 12.11.2010, p. 35, as amended).

The Commission conducts safety investigations pursuant to the provisions of the Aviation Law of 3 July 2002 (Journal of Laws No 130 of 2002, item 1112, as amended) and the European Union law on accidents and incidents in civil aviation, taking into account the standards and recommended practices laid down in Annex 13 to the Convention on International Civil Aviation made in Chicago on 7 December 1944 (Journal of Laws of 1959, item 212, as amended).

### KEY INFORMATION ON THE OCCURRENCE

Operator (user), flight number or type – Private, parachute jumps.

Manufacturer, type, model and registration marks of the aircraft – 2 Lightning 193 PS parachutes.

Place and date of occurrence Longinówka near EPPT aerodrome, 23 September 2022

### OCCURRENCE REPORT

The occurrence was reported to the PKBWL on 23 September 2022 under the mandatory occurrence reporting system by SMS EPPT and Skyvan Service Piotr Wojciech Jafernik Spółka Komandytowa.

The occurrence was assigned the reference number – 2022/5555.

Based on initial information, the occurrence was classified as an accident.

The classification was not changed in the course of the investigation.

### OCCURRENCE NOTIFICATION

The PKBWL notified the occurrence to:

- Romanian Safety Investigation and Analysis Authority (SIAA)
- Polish Civil Aviation Authority (ULC).

### ORGANISATION OF THE INVESTIGATION

The investigation was conducted by – PKBWL

Investigator-in-Charge (IIC) – Krzysztof Miłkowski.

Commission Member – Mieczysław Wyszogrodzki

Commission Member – Tomasz Pietrzak

Accredited Representatives (and their advisers) – none appointed

## RECOMMENDATIONS

Unless otherwise specified, the recommendations contained in this Report are addressed to the regulatory authorities of the State concerned. The decision on how to proceed is the responsibility of those authorities. Details are provided in Chapter 4 of this Report.

## TIME

All times in the Report are provided as UTC. LMT on the occurrence day = UTC+2.

## DATE

Where a date is provided in this Report in a digital format, the respective digits represent DD/MM/YYYY, where DD means day, MM means month, and YYYY means year.

## FIGURES AND TABLES

Unless otherwise specified in this Report, the PKBWL is the source.

## SYNOPSIS

On 23 September 2022, a group of 16 skydivers and a camera operator performed a jump from a height of 4,000 m to build a canopy formation (CF). The exit from the aeroplane and deployment of the parachutes were normal. Two of the skydivers became entangled while building the planned formation. Skydiver no. 1 became entangled in the canopy of skydiver no. 2. The canopy of skydiver no. 1 remained open but started to rotate, resulting in both two skydivers collided with the ground in that configuration. Skydiver no. 1 sustained serious injuries, whereas skydiver no. 2 died on the spot.

The place of the occurrence was near the town of Longinówka, some 3 kilometres from the Piotrków Trybunalski aerodrome.

## SYMBOLS, ACRONYMS AND ABBREVIATIONS

### SYMBOLS

° degree e.g. °C (temperature) and 1° (angle)

### ABBREVIATIONS

C	degree Celsius
CF	Canopy Formation
E	East / eastern longitude
g	standard acceleration of gravity
h	hour(s)
IIC	Investigator-in-Charge
kg	kilogram(s)
km/h	kilometres per hour
m	metre(s)
min	minute(s)
s	second(s)
UTC	Coordinated Universal Time
WL	wing load

## 1. FACTUAL INFORMATION

### 1.1. History of the jump

On 23 September 2022, a formation of 16 skydivers and a camera operator performed a jump from a height of approximately 4,000 m maintaining the sequence as planned for the intended formation (Fig. 1). In the initial phase of the formation build-up, there occurred difficulties with stabilising the positions in respective rows. Skydiver no. 1 had been assigned the second position from the right in the fourth row, whereas skydiver no. 2 the extreme right position in the third row.

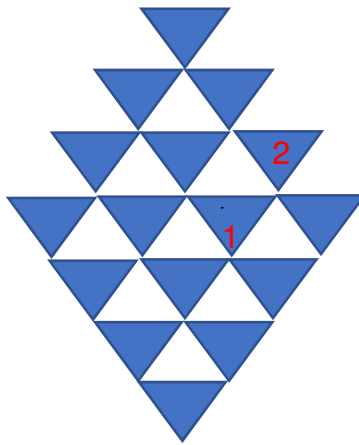


Fig. 1. A formation of 16 skydivers with marked positions of skydivers no. 1 and 2.  
[Source: PKBWL]

While skydiver no. 2 was taking his position, the formation experienced a wave causing the canopy cells of skydiver no. 2 to close. As a result, the pressure in the canopy decreased, which caused a drop in the forward velocity and a rise in the vertical velocity. The canopy of skydiver no. 2 started moving backwards relative to the formation, heading directly towards skydiver no. 1, who was in the correct spot and preparing to enter the formation. The canopy of skydiver no. 2 started moving backwards relative to the formation, and skydiver no. 1 did not manage to avoid collision with the oncoming canopy.



Fig. 2. The moment of the collision of skydivers no. 1 and 2  
[Source: the organiser]

The canopy of skydiver no. 2 flew into the front right lines of the canopy of skydiver no. 1 causing the canopy to dive and the body of skydiver no. 1 to be hoisted up (Fig. 2). The body of skydiver no. 1 was wrapped from head to waist in the canopy of skydiver no. 2 (Fig. 3). The deformed canopy of skydiver no. 1 and the partially working canopy of skydiver no. 2 entered into fast rotation with a significant loss of height. Until the moment of impact to the ground, neither skydiver performed an effective emergency procedure prescribed for such a situation. As a result of impact to the ground at a speed in the range of 70-80 km/h, resulting in serious injuries to skydiver no. 1 and the death of skydiver No. 2 at the scene.

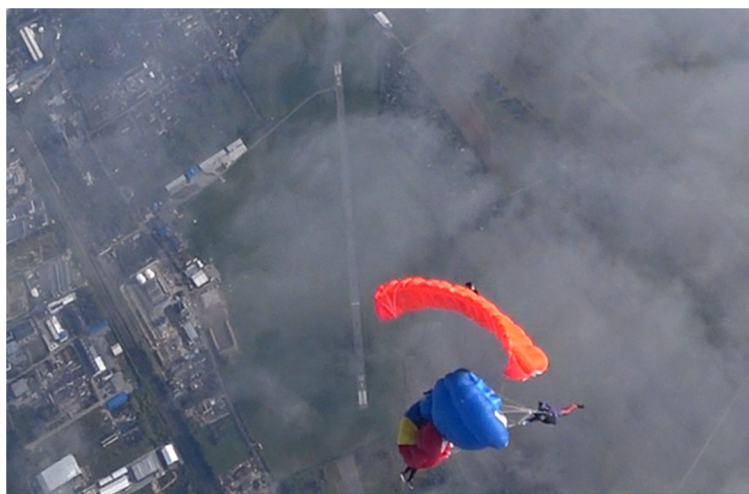


Fig. 3. Entanglement of the parachutes and uncontrolled descent of skydivers no. 1 and 2.  
[Source: the organiser]



## 1.2. Injuries to persons

Table 1. General – summary of the number of injuries to the skydivers involved.

Injuries	Crew	Skydivers	Total in the aircraft	Others
Fatal	0	1	1	0
Serious	0	1	1	0
Minor	0	0	0	0
None	1	15	16	n/a
<b>TOTAL</b>	1	17	18	n/a

Table 2. Injuries by nationality

Country/ nationality	Injuries to skydivers	
	Fatal	Serious
Poland	0	1
Romania	1	0

## 1.3. Personnel information

### 1.3.1. Skydiver no. 1

Citizen of Poland, male, aged 49.

Qualification certificate: PJ (C) – Parachute Jumper Licence, Category C, valid until 9 July 2023.

Total number of jumps – 808.

Number of jumps in 2022 – 25.

### 1.3.2. Skydiver no. 2.

Citizen of Romania, male, aged 49.

Parachute Jumper Licence, Category D – valid until 15 October 2022.

Ins SL rating – valid until 15 October 2022.

Ins Tower rating – valid until 15 October 2022.

Technical acceptance – valid until 15 October 2022.

Test Parachutist – valid until 15 October 2022.

Total number of jumps – 3,700.

Number of jumps in 2022 – 150.

#### **1.4. Parachute information**

##### 1.4.1. Skydiver no. 1:

Model of the main parachute: Lightning 193 PS.

Serial number: 023005.

Year of manufacture: 2017 r.

Model of the reserve parachute: r-MAX (b) 188.

Serial number: 60854540

Year of manufacture: 2018.

Automatic Activation Device: Vigil Cuatro.

Serial number: 57096

Year of manufacture: 2018

Date of the last maintenance: 1 May 2022.

##### 1.4.2. Skydiver no. 2:

Model of the main parachute: Lightning 193 PS.

Serial number: 0222590.

Year of manufacture: 2014

Model of the reserve parachute: Fury Reserve

Serial number: F-5443-R

Year of manufacture: 2004

Automatic Activation Device: none

Date of the last maintenance: 29 March 2022

### 1.5. Meteorological information

Cloud cover: none

Cloud base: none

Visibility: 2 km

Temperature at ground level: 9°C

Pressure QNH: 1020 hPa

Wind in the descent zone: direction 340°, speed 5.5 m/s

Wind at ground level: direction 290°, speed 3 m/s

### 1.6. Place of occurrence information

The skydivers collided with the ground in an arable field in the town of Longinówka, some 2.6 km south of the EPPT aerodrome and some 4 km away from the centre of the city of Piotrków Trybunalski.



Fig. 4. Topography of the EPPT aerodrome. Situation layout: the direction of the aeroplane's run, the drop points of the first and last skydivers, the planned place of landing.

[Source: the organiser]

### 1.7. Medical and pathological information

As a result of collision with the ground, skydiver no. 1 sustained serious injuries and skydiver no. 2 died on the spot. No evidence was found to show that the skydivers' actions were affected by any disease, incapacity or physiological factors. The

skydivers were not under the influence of alcohol or other substances impairing their actions.

### **1.8. Survival aspects**

The skydivers had reserve parachutes which were not used. The two skydivers collided with the surface of the ground at a speed in the range of 70-80 km/h. Skydiver no. 2 hit a hard and rough part of the arable field, which caused instantaneous death, whereas skydiver no. 1 hit a soft and ploughed part of the field, which led to serious injuries.

### **1.9. Tests and research**

The parachute rigs of both skydivers were examined and it was found that all components had been in a technically serviceable condition and functioned cooperatively as outlined in the user manuals. Furthermore, video footage recorded by another skydiver was analysed.

### **1.10. Organisational and management information**

An international group of skydivers planned CF jumps for 19-24 September 2022 at the EPPT aerodrome as part of practice for breaking the European record in a formation of 36 jumpers (Euro Challenge 2022 in Piotrków Trybunalski).

### **1.11. Additional information**

Beginning on 19 September 2022, as part of practice sessions, the skydivers performed jumps in smaller formations, ranging from groups of several to over a dozen skydivers. The target formation was intended to have the shape of a diamond (Fig. 1). Respective skydivers were to join the ones already in formation so that the latter could hook their feet around the outermost front line without changing their positions – one skydiver from the left, and one from the right. The record breaking formation was planned to include persons with relevant skills confirmed by previous participation in formations of several dozen jumpers, many years of experience and significant number of jumps (several hundred or several thousand each). Apart from skydivers practising for the record, there were also persons with less experience who were learning formation building techniques and jumping in small groups of only several skydivers.

Normally, CF jumps are performed from 4,000 m with immediate deployment of the canopy, and once fully inflated, they start their flight approximately 100 m below the aeroplane. The direction of the flight during formation building and flight is set by the first skydiver from the top, the so-called "pilot". A flight in formation and/or formation building is continued down to the height of no less than 1,500 m (the lower limit is increased in the case of strong "thermals", or rising air columns, felt as turbulences),

thus ensuring sufficient time and height for skydiver separation. Below that height, it is allowed to build small and simple formations of 2-4 skydivers. To ensure even flight of the formation, all persons involved have the same model of the main canopy, i.e. Lightning manufactured by Performance Designs, with the size adapted to the weight of the skydiver so that the canopy wing load could range between 1.25 and 1.4. Formations are designed in such a manner that larger canopies are higher in the formation and smaller canopies are lower and to the outside. The purpose of such care for detail is to ensure similar flight characteristics of all canopies in the formation, which makes it easier to maintain the stability of the formation. Building such a formation is a challenging task, for performing manoeuvres while approaching the formation by nature requires the skydiver to turn, decelerate, and accelerate, which causes the canopy to tip. When a canopy is being "added" to the formation, it needs a calm, smooth and level flight. To ensure smooth cooperation in formation building, proper verbal and non-verbal communication is used to adjust the flight of respective canopies in the formation.

The intended formation is discussed before each jump. "Dry" practice is carried out on the ground, i.e. all participants in a given formation simulate formation building taking into account the order of approaching the formation, and communication within the formation at the phase of building and breaking up.

Such actions mitigate the risk of formation instability and possible entanglement of the skydivers, which improves the jump safety.

CF jumps are associated with an increased risk of entanglement. When skydivers become entangled, the canopies normally disentangle on their own. If this does not occur within the first few seconds, an emergency procedure must be initiated, which is taught already during basic parachute training (before the first training jump). When an entanglement occurs, one or both canopies become deformed, resulting in a rotating movement and g-loads, which, after a few rotations can make the emergency procedure more difficult to carry out. When a skydiver remains in fast rotations for longer than several seconds, problems with perception can be compounded even by loss of consciousness. Moreover, with such a fast rotating movement and canopy deformation, the rate of descent grows several times above the one safe for landing. According to the standard emergency procedure, a skydiver whose canopy wraps around the body of another skydiver can effectively rectify the situation by releasing the main canopy (with the right handle) and deploying the reserve parachute. After releasing the main canopy, any tension in the canopy and lines are relieved and the skydiver wrapped in another skydiver's canopy has a chance to slide it off their body and then proceed adequately to the condition of their own canopy (the emergency procedure must be carried out if required). Where the main canopy cannot be released, it is required to use a knife, which is mandatory equipment of every skydiver. In CF jumps, the knife is much larger than in any other jumps, and it often happens that two knives are carried.

Since the rig of a skydiver wrapped in a canopy is blocked, it is unreasonable for them to deploy the reserve parachute.

### **1.12. Useful and effective investigation techniques**

Standard investigation techniques were applied, and the video footage and photographic documentation recorded during the jump were analysed. Calculations were carried out to establish angular velocity and g-load acting on the skydivers during the descent.

## 2. ANALYSIS

On 19-24 September 2022, CF parachute jumps were performed at the EPPT aerodrome. A practice session for a group of 16 skydivers had been planned for 23 September 2022.



Fig. 5. The skydivers taking their positions in the formation rows.  
[Source: the organiser]

The jumpers and a camera operator exited the aeroplane at approximately 4,000 m in the sequence appropriate for the intended formation. Skydiver no. 1 had been assigned the position in the fourth row, second from the right. Skydiver no. 2 had been assigned the extreme right position in the third row. The task of skydiver no. 2 was to join the formation by "fixing" his canopy to the formation and preventing its turn towards the centre of the formation, in particular until the skydiver from the fourth row (the position assigned to skydiver no. 1) joined to stabilise the setup. Skydiver no. 2 prevented his canopy from turning, but at a moment of stronger work on the canopy the formation waved in such a manner that the canopy cells became closed and the pressure in the canopy dropped. This resulted in a decrease of forward velocity and an increase of vertical velocity, causing the canopy of Skydiver No. 2 to move backward relative to the formation, heading straight towards skydiver no. 1, who was in the right position preparing to join the formation. The unexpected backward direction of flight of the canopy of skydiver no. 2 surprised skydiver no. 1, who was unable to react and avoid the collision. The canopy of skydiver no. 2 collided with the front right lines of the canopy of skydiver no. 1, causing the canopy to dive and the body of skydiver no. 1 to be hoisted up, and eventually wrapping around the body of skydiver no. 1 from head to waist. The deformed canopy of skydiver no. 1 and the partially working canopy of skydiver no. 2 entered into fast rotation generating loads of 3-5 g with a significant loss of height. The descent in entanglement lasted more than 2 minutes, with the rotational speed reaching 39 rotations per minute.

It is highly likely that, despite the tightly fitted vest and harness of skydiver no. 2, the harness shifted up and to the right together with the vest as a result of the dynamic rotation generated after the skydivers became entangled. At a certain (undetermined) moment, the vest shifted also relative to the harness and the main canopy release

handle on the right, making it difficult for Skydiver No. 2 to find the handle. Based on an analysis of the video and photo footage, it was established that skydiver no. 2 had been unsuccessfully searching for the right handle to release the main canopy for at least 22 seconds after the entanglement, as the handle remained intact in its pouch until the skydiver no. 2 touched down. The vest might have been damaged during the search for the right main canopy release handle. During the descent in entanglement, as a result of very fast rotation generating significant g-loads, there might have occurred problems with perception, awareness and loss of consciousness, which could explain why the knife was not used. The photographic documentation indicates the vest of skydiver no. 2 was ripped along the right side stitch, i.e. on the side where the main canopy release handle is located.

Skydiver no. 2 did not carry out an effective emergency procedure until the very moment of impact to the ground. He did not release or cut away the main canopy. Skydiver no. 1 did not take any actions either, although it is unlikely that he could successfully use his knife to cut away the canopy that had wrapped around his body. Skydiver no. 1 touched down on a soft, freshly ploughed field, whereas skydiver no. 2 landed on a grassy, but much harder part of the field. As a result of landing at a speed in the range of 70-80 km/h, skydiver no. 2 died on the spot and skydiver no. 1 sustained serious injuries and survived the accident.



### 3. CONCLUSIONS

#### 3.1. Findings

- 3.1.1. Skydivers no. 1 and 2 held appropriate ratings and qualifications to perform jumps in accordance with applicable regulations.
- 3.1.2. The jumps were performed in accordance with applicable procedures and the CF jump plan.
- 3.1.3. All components of both parachute rigs were in a technically serviceable condition and cooperated with one another normally; both rigs were used in accordance with their intended purpose and user manuals.
- 3.1.4. No evidence was found to show that the behaviour of the skydivers was affected by any physiological factors.
- 3.1.5. Toxicological tests for the presence of alcohol were negative.
- 3.1.6. A hypothesis has been assumed that a shift of the vest prevented skydiver no. 2 from carrying out the emergency procedure.

#### 3.2. Causes and contributing factors

**The cause of the accident** was the unsuccessful attempt to carry out the emergency procedure by skydiver no. 2 following entanglement of his canopy with skydiver no. 1.

**The contributing factor** was that skydivers no. 1 and 2 were joining the formation as the group was stabilising their positions and rows, which caused an uncontrolled change in the direction of flight of skydiver no. 2 towards the position of skydiver no. 1.

### 4. SAFETY RECOMMENDATIONS

PKBWL has not formulated any safety recommendations.