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Accident Rate of Different Types of Gliders in the Czech Republic

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Abstract

This article deals with the accident rate of gliders during the last decade in the Czech Republic. Gliding has a solid base in the Czech Republic and an analysis of their accident rate according to the glider type may benefit future research in this area. The first part of the paper explains the data sources of the accident rate calculations and their evaluation. It describes the different glider types that were analysed and provides a list of their most common use. The next part of the article is about a calculation of the accident rate for each glider type and their evaluation. The last section of this article presents a summary of the findings and the main conclusions from the data analysis.
KEY WORDS: *air accident, accident rate, glider, glider accidents, gliders in the Czech Republic, air accidents in the Czech Republic*

1. Introduction

At the end of the last decade, research about an aviation accident simulation was taken place at the University of Pardubice, at the University of Košice and other partner organisations. Statistics of small aircraft accidents in the Czech Republic were compiled within the project. [1] Only a small part of the statistics was used. So, the authors of this article decided to use the statistics and the data obtained from it and to process them scientifically.

The accident statistics included groups of small aircraft – namely aeroplanes, gliders, and helicopters. For each aircraft type (or group of similar aircraft types), the statistics contain data about the number of accidents in the Czech Republic between years 2006 and 2017, the number of registered aircraft in the Czech Republic to the year 2017, what the aircraft type is used for, and technical data such as the number of crew seats, type of construction, whether they are equipped with oxygen, etc. [1]

2. Types of gliders and their usage

First, it was necessary to select the group of aircraft to be further processed. The authors decided to select gliders due to the volume of the data and authors' relation to unpowered flying. The table 1 shows the types of gliders or groups of similar gliders and their usage.

Table 1

Types of gliders and their usage [1]

Types	Usage
L13/A/AC, L23	training, recreation
VSO-10 Gradient	recreation, sport
VT-16, 116	recreation, veteran
Cirrus/Discus/Ventus	recreation, sport
ASW-15a/b/19/20/24/27	recreation, sport
Schleicher K 7/ASK-13	training, recreation, veteran
Grob - G103 Twin Astir	training, recreation, limited sport

Looking at the Table 1, it is obvious that the processing the gliders as a whole group is an underutilization of the potential of the collected data. Therefore, it was decided to add two subgroups to the overall data to be processed separately. These groups are:

- gliders used for training
- gliders used for sport

It is not necessary to process the gliders used for recreation, as essentially all types of gliders are used for recreational flying. The processing of this subgroup is therefore included in the overall processing of the gliders.

3. Accident rate and it´s evaluation

The accident rate is expressed as the ratio of the number of accidents to the number of registered gliders in this case. The accident rate is expressed as a percentage [%]. The formula (1) for the calculation of the accident rate is given below.

$$N = \frac{n}{l} \cdot 100 \qquad (1)$$

where N [%] is the accident rate of a given type or group of gliders, n [-] is the number of accidents between years 2006 and 2017 and l [-] is the number of registered aircraft in the Czech Republic in the year 2017.

Each table also shows the average accident rate of the given group of gliders divided by use (all gliders or recreation, training, sport). The average accident rate was calculated according to the well-known formula for calculating the average (2).

$$N_p = \frac{1}{m} \sum_{i=1}^{m} n_i \qquad (2)$$

where N_p [%] is the average accident rate of the given glider group, m [-] is the number of glider types that are in the given group and n_i [%] is the accident rate of the given glider type.

Table 2

Table of statistics for all analysed gliders [2, 3]

Types	**Number of accidents**	**Number of registered aircraft**	**Accident rate [%]**
L13/A/AC, L23	**27**	255	10.6
VSO-10 Gradient	**10**	135	7.4
VT-16, 116	**4**	58	6.9
Cirrus/Discus/Ventus	**8**	158	5.1
ASW-15a/b/19/20/24/27	**4**	109	3.7
Schleicher K 7/ASK-13	**4**	16	25.0
Grob - G103 Twin Astir	**3**	17	17.6
		Average accident rate:	**10.9**

The Table 2 contains the data and their processing for all glider types that were included in the collected data. *Schleicher* type gliders have the highest accident rate of the whole group (accident rate 25 %), followed by *Grob - G103 Twin Astir* type gliders (accident rate 17.6 %). [4] However, it cannot be clearly stated that these types have a high accident rate. The accident rate is influenced by many factors such as usage, type of construction, ergonomics, pilot experience, etc. In these two cases, the resulting accident rate is influenced both by the small number of registered aircraft and by the fact that both types are used for training. It can be assumed that the likelihood of accident of these two types during the training or recreational activities is higher. Comparatively, for the same usage (training and recreational flying), the glider type *L13A/L23* has been used in the Czech Republic for many years. The lower accident of this type rate can be explained by the fact that the most of the glider pilots in the Czech Republic have undergone basic training on this type of aircraft and thus a greater knowledge of the behaviour and limits of this aircraft can be assumed. The knowledge is higher than the glider types *G103* and *ASK 7/13*. These two (*G103* and *ASK 7/13*) types have become more common in the Czech Republic since about year 2007. Another factor may be the relatively higher weight of the *G103* structure, which is approximately 150 kg more than the *L13A*, *L23*. This requires slightly different habits in piloting technique and estimation, especially in thermal stream alignment and approach to landing and landing itself.

The gliders with the lowest accident rate are the *ASW* type (accident rate 3.7 %) and the *Cirrus/Discus/Ventus* gliders (accident rate 5.1 %). [4] It is obvious that the results are not influenced by the small number of registered gliders. The data gives the information that these types are safe. The result is also affected by the fact that both types are used for recreation and sport. So, it can be assumed that the pilots are already experienced, and it differs from gliders used for training.

The last comparison worth mentioning is the comparison of the average accident rate of gliders against powered airplanes, helicopters and against all aircraft that had been researched. The following list shows the average accident rate for each type of aircraft:

- all aircraft researched: 8,8 %.
- airplanes: 8,0 %
- helicopters: 9,4 %

If we compare these numbers with the average accident rate of the gliders (10.9 %), we find that unpowered flying is slightly more dangerous, according to these results. [4] These results may be due to many factors, such as the high volume of pilots flying and learning the gliding. Minor accidents caused by off-airport landings due to lack of propulsion, and others. Certainly, a not negligible difference between powered and unpowered flying is the fact that errors are much better corrected in powered flying than in unpowered flying, such as the possibility of "go around" when landing. However, the differences in average accident rate are not significant and it cannot be concluded that unpowered flying is more dangerous than powered flying.

Table 3

Table of statistics for gliders used for training

Types	**Number of accidents**	**Number of registered aircraft**	**Accident rate [%]**
L13/A/AC, L23	**27**	255	10.6
Schleicher K 7/ASK-13	**4**	16	25.0
Grob - G103 Twin Astir	**3**	17	17.6
		Average accident rate:	**17.7**

The Table 3 shows the data of the gliders used for training. Compared to the data listed in the Table 2, it is obvious that the accident rate of each type and the average accident rate are higher. As already mentioned, this is also due to the higher probability of accidents during the training. The accident rate for the second and third types are also slightly distorted by the small number of registered aircraft. Nevertheless, it can be concluded that the safest type of glider for training is the *L13* and *L23* type (accident rate 10.6 %). This is confirmed by the fact that it is the most used type for glider training in the Czech Republic.

Table 4

Table of statistics for gliders used for sport flying

Types	**Number of accidents**	**Number of registered aircraft**	**Accident rate [%]**
VSO-10 Gradient	**10**	135	7.4
Cirrus/Discus/Ventus	**8**	158	5.1
ASW-15a/b/19/20/24/27	**4**	109	3.7
Grob - G103 Twin Astir	**3**	17	17.6
		Average accident rate:	**8.4**

The Table 4 shows the data of the gliders used for sport flying. As can be seen, their accident rate is lower compared to all gliders that were analysed. The only type that stands out above the others due to its higher accident rate is the *Grob - G103 Twin Astir* type (accident rate 17.6 %). [4] However, as already mentioned, this accident rate is influenced by the fact that the type is also used for training and, in addition, there are only a few registered gliders. However, it can be stated in general that all other types are safe. This is also because the fact that sport flying is performed by pilots who are experienced, and the reliable gliders are used for sport flying.

As already written, the data obtained from the statistics are up to year 2017. Therefore, the authors decided to update the number of accidents that occurred between years 2018 and 2021. The Table 5 contains this extended data. Unfortunately, the authors were not able to obtain the actual number of registered aircraft up to year 2020 or 2021. However, updating the accidents is sufficient to verify the older data. It can be assumed that the fluctuation in the number of registered aircraft is small. It is obvious from the Table 5 that although the accident rate has slightly increased due to the above mentioned, the data processed in this paper can be considered as well telling.

Table 5

Table of statistics for all analysed gliders extended with accidents from year 2018 to year 2021 [2, 3]

Types	Number of accidents (2006 - 2017)	Number of accidents (2018 - 2021)	Number of accidents total	Number of aircraft	Accident rate [%]	Accident rate Actual [%]	Difference in accident rate [%]
L13/A/AC, L23	27	7	**34**	255	10.6	13.3	2.7
VSO-10 Gradient	10	3	**13**	135	7.4	9.6	2.2
VT-16, 116	4	2	**6**	58	6.9	10.3	3.4
Cirrus/Discus/Ventus	8	6	**14**	158	5.1	8.9	3.8
ASW-15a/b/19/20/24/27	4	4	**8**	109	3.7	7.3	3.7
Schleicher K 7/ASK-13	4	0	**4**	16	25.0	25.0	0.0
Grob - G103 Twin Astir	3	1	**4**	17	17.6	23.5	5.9
					Average accident rate:	**14.0**	

4. Discussion

The data sources in this article are validated by state institutions of the Czech Republic. The numbers of registered types are verified from the Czech Aviation Register maintained by the Civil Aviation Authority Czech Republic and are valid for the year period 2006 – 2017. The numbers of aircraft accidents are validated by the Air Accidents Investigation Institute.

The results and conclusions of this article were also consulted and validated by the Air Accidents Investigation Institute. However, as mentioned above, the obtained results have some error rate and cannot be considered as unequivocally correct. A major contribution to this study would be to determine the accident rate not on the number of aircraft registered but on the total flight hours or cycles of the analysed aircraft types. However, these data are almost impossible to obtain. Another interesting factor for this study would be, for example, an analysis and categorisation by types of construction and equipment. For example, the effect of the auxiliary tandem nose wheel, the weight of the glider, whether the glider was water filled at the time of the accident, whether it has an auxiliary engine, etc.

Finally, it would be useful to create a categorisation of the conditions under which the accident occurred. Respectively the influence of the meteorological situation or the situation at the accident place. As an example, the influence of turbulence and other airflow, or the organization and situation during operation. For example, in a group landing of several gliders at the same time, which can be at sailing competitions, etc.

Of course, to include these mentioned factors in this study, we would have to use a larger statistical scope, for example by changing the period or by extending the scope to other countries outside the Czech Republic. On the other hand, in such a case, the number of influences such as the heterogeneity of the training of pilots at different countries or the influence of the approach to training, which was also different before 30 years ad in these days, would be extended.

5. Conclusions

In this article, accident rate has been calculated for selected types of gliders registered in the Czech Republic. Both the accident rate of different types and the accident rate of only specific groups were analysed. These groups were gliders used for the training and gliders used for the sport flying. The results show which types have low accident rate and are safe and which have the accident rate higher. However, it must be considered that the results are influenced by many positive and negative factors and cannot be taken as a dogma. The results point to possible risks and may serve as a basis for further, more detailed research.

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