HOW WE COULD REDUCE FATAL GLIDING ACCIDENTS BY ABOUT THE HALF

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OSTIV Training and Safety Panel, Oslo **1992**

INTRODUCTION

Collecting data from accidents and analysing them help to understand why and how accidents occur. Also, they help us to find methods and ways to avoid them in the future. We should concentrate ourselves mainly on fatal accidents and of course on those which occur most frequently. Then, the benefit for all of us would be the highest.

THE MAIN POSSIBILITIES TO AVOID ACCIDENTS

1) Training of the pilot:

The new gliders seem to be technically perfect, as they have to go through complicated and sophisiticated procedures until they get the certification by the authorities.

Therefore, you find the vast spread opinion that in 90% of all cases the pilot is the one to blame for the accident, especially if it is a fatal one.

So, it seems to be clear that everything has to be done to better the pilot. Emphasis is laid on special pilot-training by which the pilot learns all about the type of accident, how he can avoid faults that lead to that sort of accident and how he should handle the critical situation.

But as long as pilots have to practise and exercise to maintain a safe level of flying, it should be also clear that the making of faults and mistakes is an inherent feature of pilots.

We must accept therefore, that on the long term, just by the laws of probability, the pilots will never be able to exclude the making of faults by absolute certainty, even if it is a fatal one.

As a proof of this, I can name with ease 5 Austrian pilots who won the Austrian Nationals at least once, one of them even became World Champion, but who have lost their lives in gliding accidents, in spite of their extraordinary high flying hours and skills in competition and record flying.

So, we must invent other precautions which are able to transform the faults into harmless ones.

2) Alternative methods:

One alternative method is: to minimise the detrimental effect of the otherwise fatal accident.

Examples: Safety cockpits, foam seats, integrated parachutes to avoid the effect of a crash.

Another: to warn the pilot. Examples: stall-, landing gear -, collision warning instruments.

Stall Warning instrument (a comment of Wolfgang Meissner):

The next point is the pilot. To help him to keep the glider above the stalling speed a good functioning STALL WARNING INSTRUMENT would be the best. OSTIV has set out a prize for such an instrument, but unfortunately a completely satisfactory instrument has not been found yet, at least, as far as I know. (Remark: This relates to the situation in 1992. In the mean time OSTIV and others have found good solutions, but these are not well known - at least, the idea to use such stall warning instruments is not yet in the minds of the pilots).

see on page: http://www.dg-flugzeugbau.de/dsi.html

you will see this good instrument for any gliders !

3) The most effective method:

The most effective method is: to eliminate the cause of an accident completely.

If we want to find a remedy against serious accidents, we should always consider this method first.

Example: Accidents occur if adjacent mounted handles for the landing gear and the airbrakes are mistaken by the pilot in a landing approach. Pulling the wrong stick, the landing gear instead of the airbrakes, might cause the missing of the landing field with following crash and serious injuries. This cause of accident can be eliminated completely by mounting the operating handles of the airbrakes and of the landing gear on the opposite sides of the cockpit.

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THE MAIN CAUSES OF ACCIDENTS

Procedure of investigation:

To find out the main causes of gliding accidents, reports from Austria, Switzerland, Germany and England were studied.

To get an idea what would be the most severe and frequent problem in gliding the annual reports of "FUS" (Braunschweig, Germany) from 1980, 82, 83, 84 and 85 were used at last, as they were available and seemed practical for simple analysis.

In **fig.1** you see a typical page of such an annual report. All important data about an accident are set there in one line.

To simplify the analysis, discrimination between LAUNCH-, FLIGHT- and LANDING-accidents were made.

In the Launch Mode, the WINCH TOW and the AERO TOW were considered,

in the Flight Mode, MID AIR COLLISIONS and COLLISION WITH RIDGE (slope, trees, terrain etc.) were summed up extra.

As SPIN/STALL seems to be of major importance, in each mode - the LAUNCH , FLIGHT and LANDING MODE - the accidents with SPIN/STALL were sorted out.

Each accident was also classified whether the pilot got killed (F = fatal), injured (S = severe, serious) or not injured (N = non).

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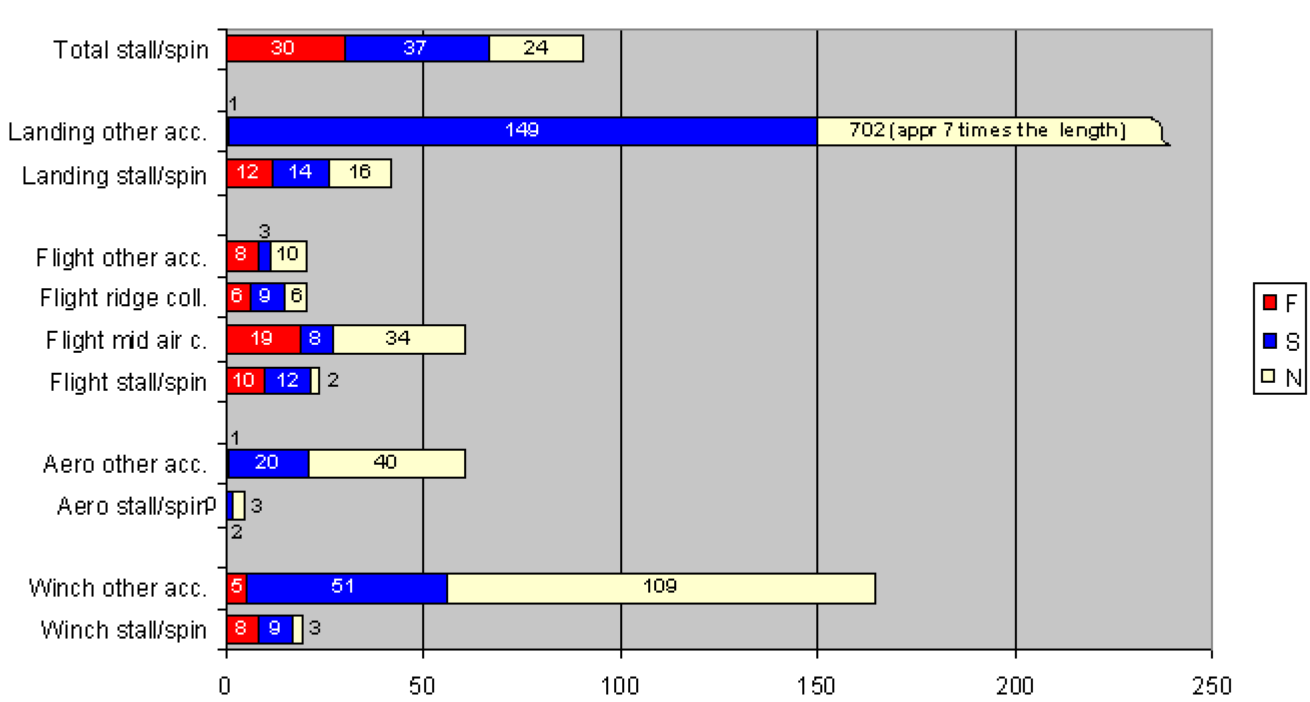
Results

Let's start with the results displayed in **fig. 2** .

(Fig. 2)



1) Total amount of accidents:

A total of 1272 accidents have been counted of which 70 were fatal, 277 with injured and 925 with non injured pilots.

2) Winch tows:

In WINCH TOWS we see that SPIN/STALL with 8 fatal accidents plays a dominant role.

It is also a severe problem, because the probability to survive in this case is not too high as can be seen on the relatively small columns of only 9 counted injured and 3 non injured pilots.

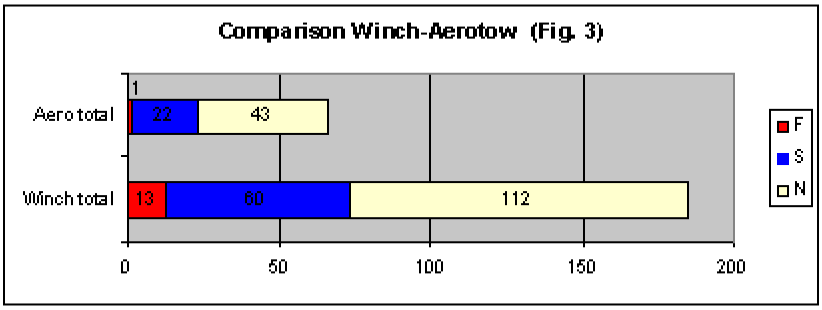
The rest of winch tow accidents show 5 fatal accidents which is still high.

3) Aero tows:

The aero tows display no fatal accidents due to spin/stall which seems plausible as the towing speed is well above the stalling speed.

4) Comparison between winch and aero tows (fig.3 and 4):

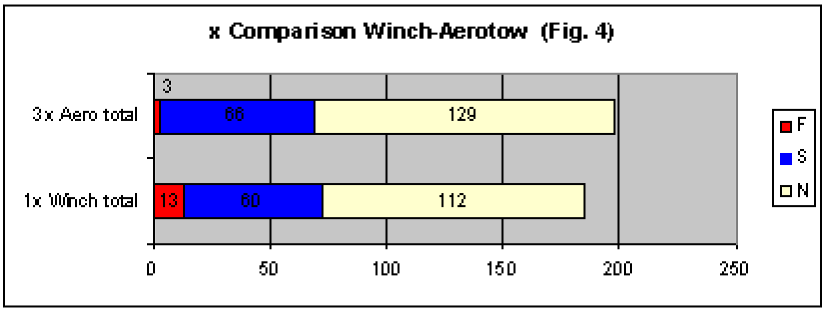
A comparison shows that the amount of accidents for winch tows are about one third higher than for aero tows. See **fig.3**.



This could be, because the amount of launches are three times as high.

If we assume that 75% of all tows are done by the winch and only 25% by the tug plane, then we are able to calculate and compare the accidents of both launching methods with the same amount of launches.

In **fig.4** we see the result. The total amount of accidents would be nearly equal for both, but the winch-fatal-accidents would be four times higher than for the aero tows. Therefore, winch towing seems to be much more dangerous than aero towing.



We might note here that this is partly due to the high rate of fatal stall/spin accidents in winch tows. If the gliders had a better stall/spin behaviour the rate of fatal accidents in winch towing would be less.

5) In Flight:

Going back to **fig.2** we are able to study now the accidents that occurred IN FLIGHT.

Here, the MID AIR COLLISIONS with 19 fatal accidents dominate the scene, followed by 10 fatal accidents due to STALL/SPIN.

6) Landing Mode:

The most interesting thing can be seen in the accident columns for the LANDING MODE:

STALL/SPIN cause again a high rate of fatal accidents with 12 accounts. If a glider gets into stall/spin, the probability to get killed or injured is rather high, since the 12 fatal and 14 severe accidents are relatively high in comparison to the only 16 registered accidents where the pilot was not injured.

The other accidents are with a total of 853 accounts very high. In spite of this, there is only one fatal accident recorded., which seems to be surprisingly low. So, if the pilot manages to avoid stall/spin during landing (or has a glider which is completely controllable in stall) , he seems to have a good chance to survive such an accident, probably because wing lift is still available and the pilot is able to steer the glider up to the end of the event.

Therefore, the avoidance of stall/spin in the landing phase (or a harmless, docile glider) seems to be most important.

7) <u>**Total amount of stall/spin accidents:**</u>

The last column in **<u>fig.2</u>** displays the TOTAL AMOUNT of accidents due to

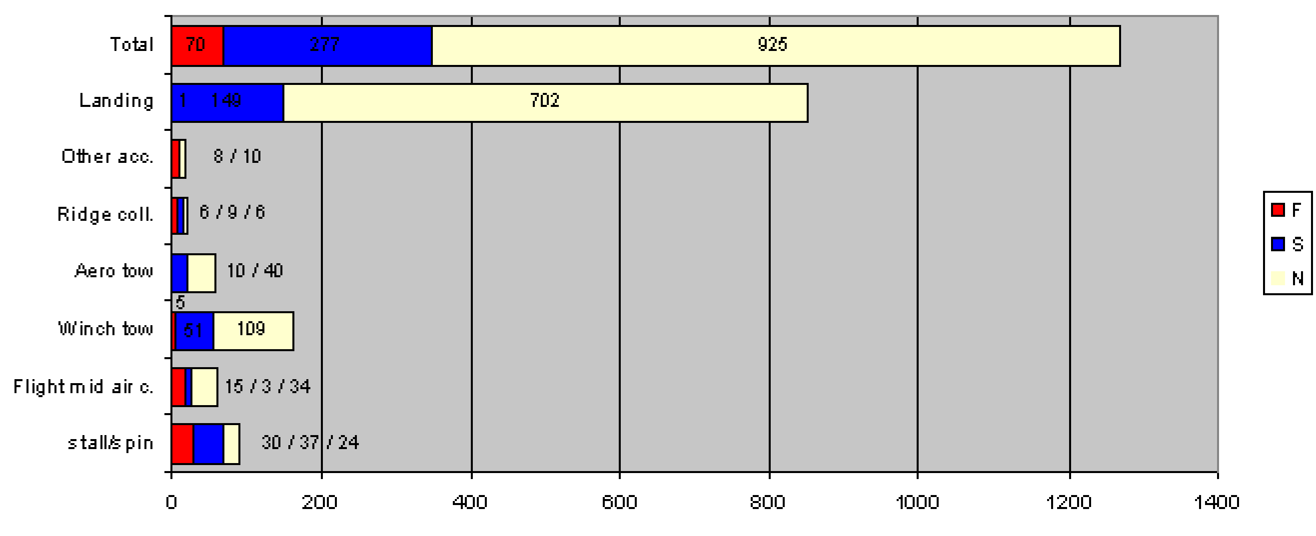
STALL/SPIN regardless whether this happened during the Launching, Flying or Landing Mode.

With 30 fatal accidents STALL/SPIN is clearly the leader in producing fatal accidents, followed by MID AIR COLLISIONS by 19.

8) <u>**Comparison of the different types of accidents (fig.5):**</u>

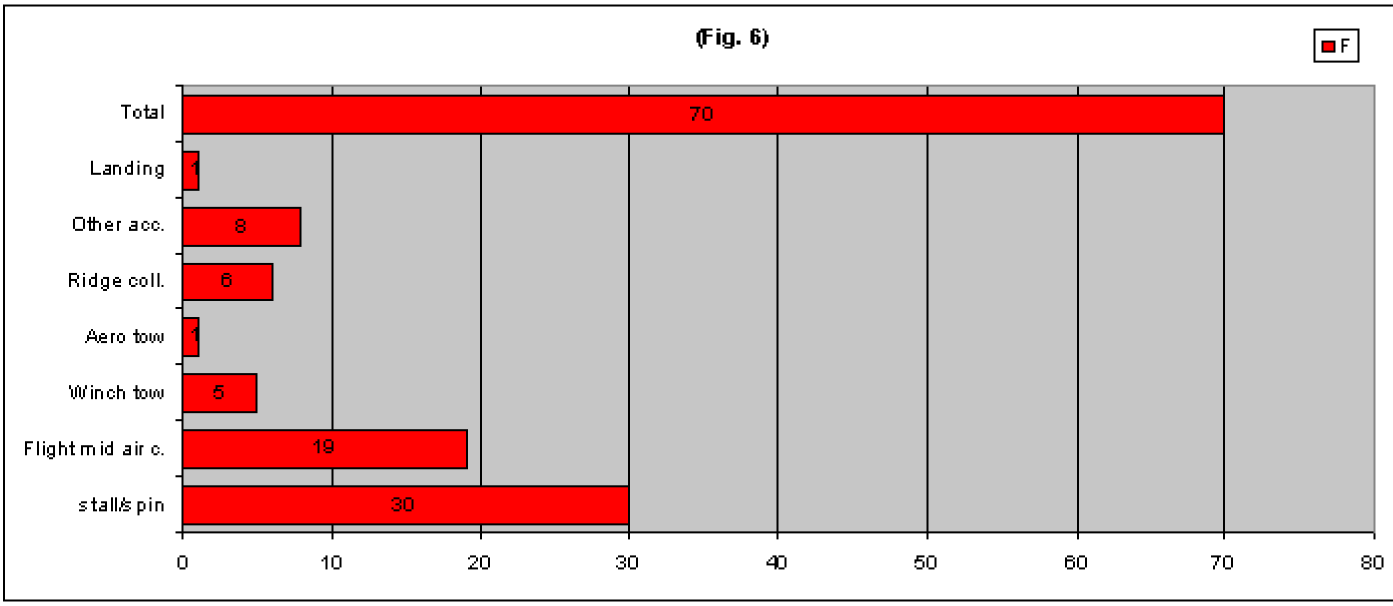
In **<u>fig.5</u>** the Stall/Spin accidents and Mid Air Collisions are compared with the other types of accidents. It is interesting to note that the probability to survive Stall/Spin , Mid Air Collision, Ridge Collision accidents is not very high due to the bad relation between Fatal/Serious/None, contrary to winch tow, aero tow and especially to the landing accidents, if stall/spin is excluded.

(Fig. 5)



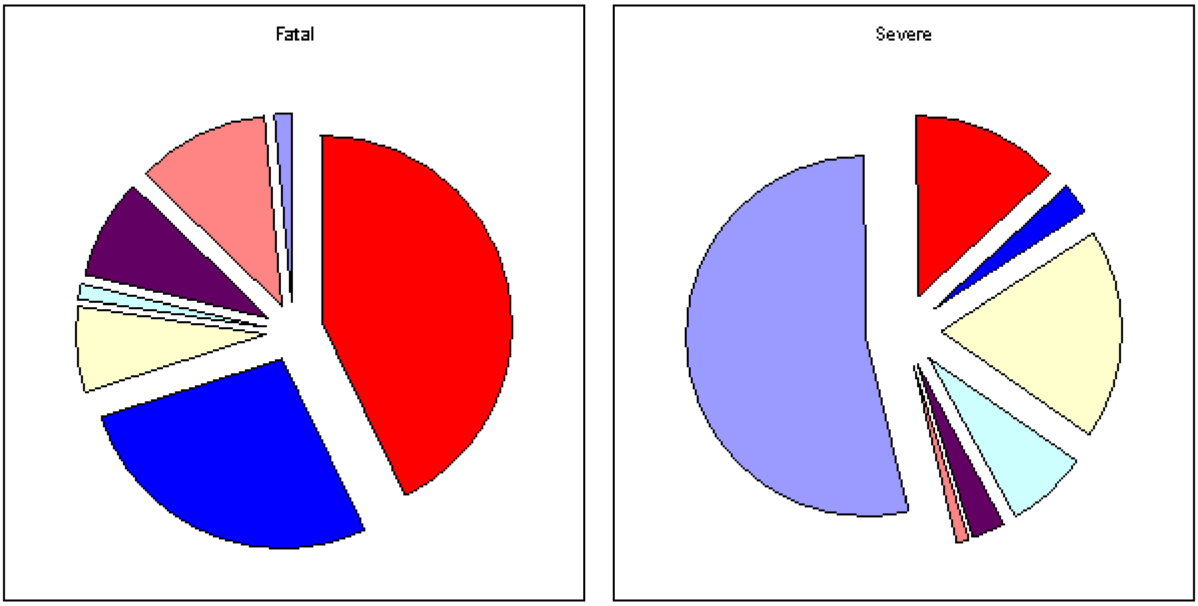
9) <u>**Fatal accidents (fig.6):**</u>

In **fig. 6** fatal accidents are considered only. Stall/Spin accidents, Mid Air Collisions and Winch Tow accidents (stall/spin being excluded here) make up nearly 80% of the total fatal accidents.



10) Distribution of accidents due to Fatal, Serious and Non injured pilots (tabl.1,2; fig.7):

Table 1 and 2 show the amount of accidents for the different types of causes and for fatal, severe and non injured pilots.



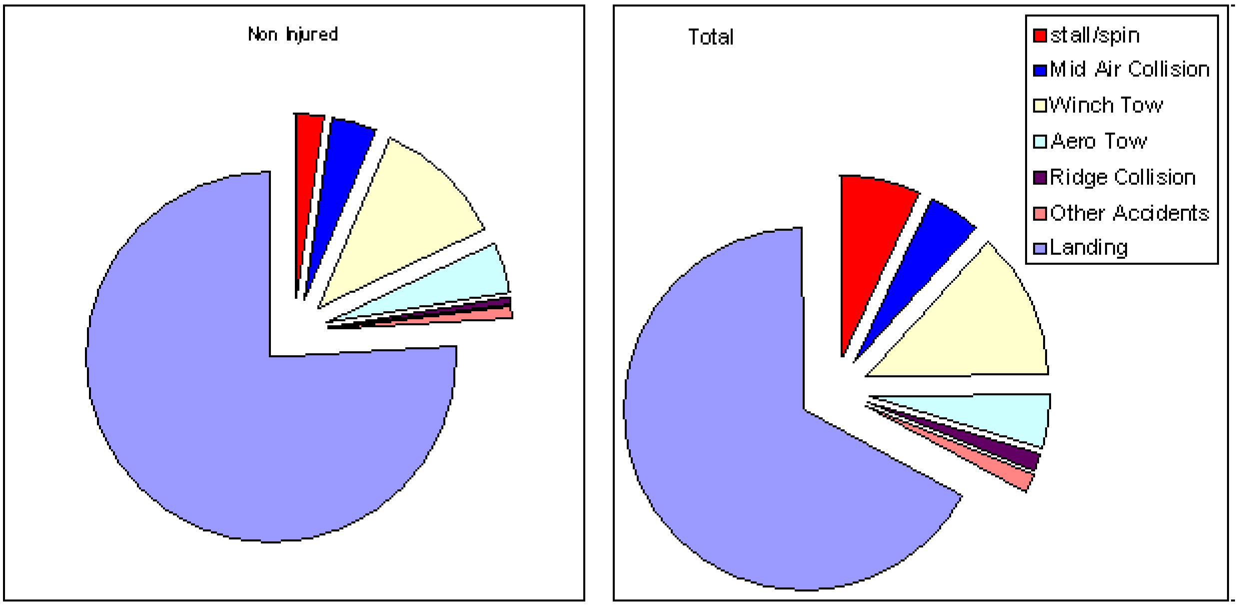


Fig.7 demonstrates those data graphically.

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By studying the distributions in fig.6 and fig.7 we see that we could avoid Stall/Spin (43%, British Gliding Association noted even 60% for the year 1986 in England), Mid Air Collisions (27%) and if we would use aero towing (1%) instead of winch towing (7%), we would be able to reduce the amount of fatal accidents by about 70 to 80%.

This is of course wish thinking, but we will see in the following that there are good chances to at least reduce fatal accidents by about half.

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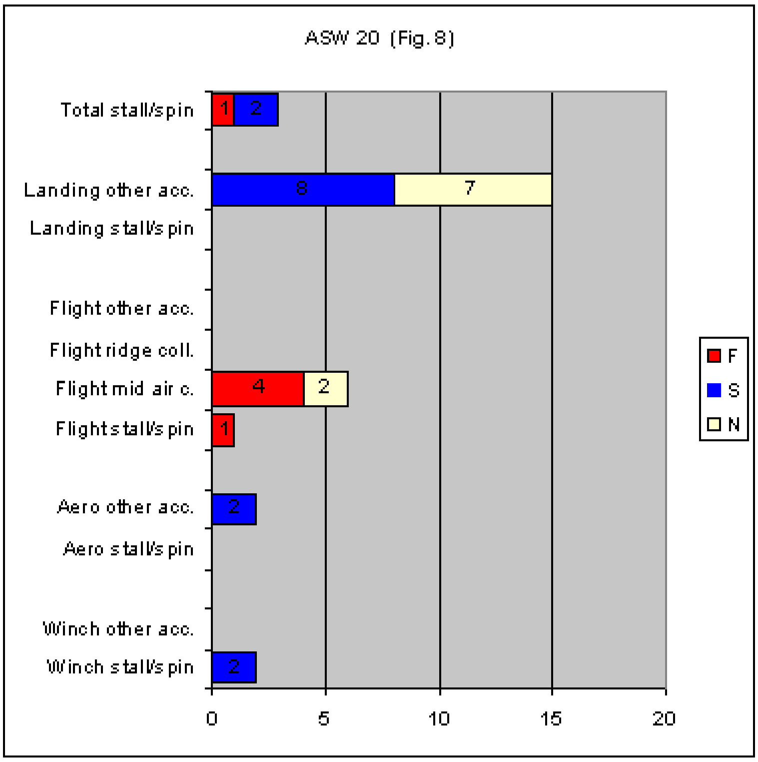
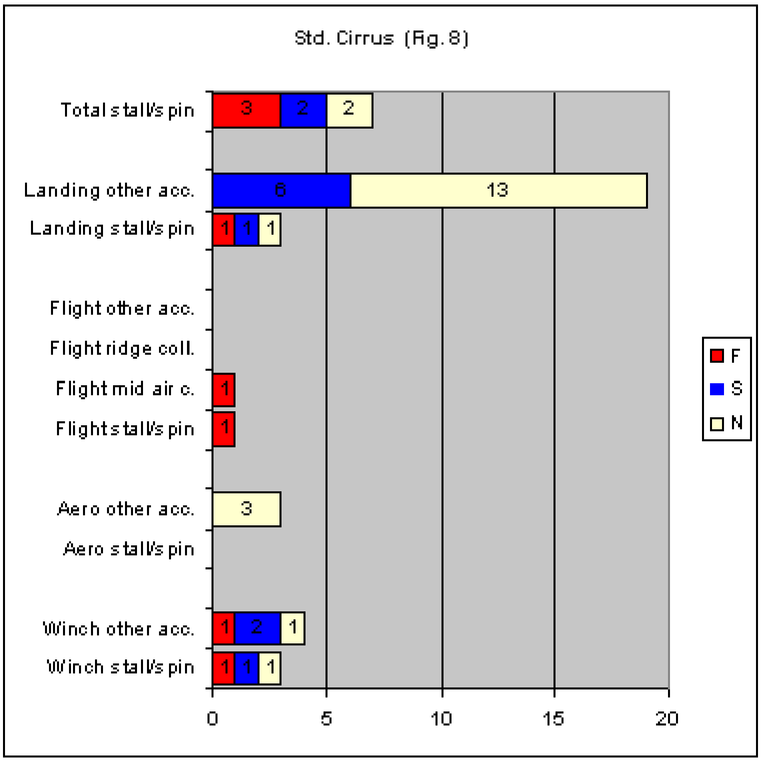
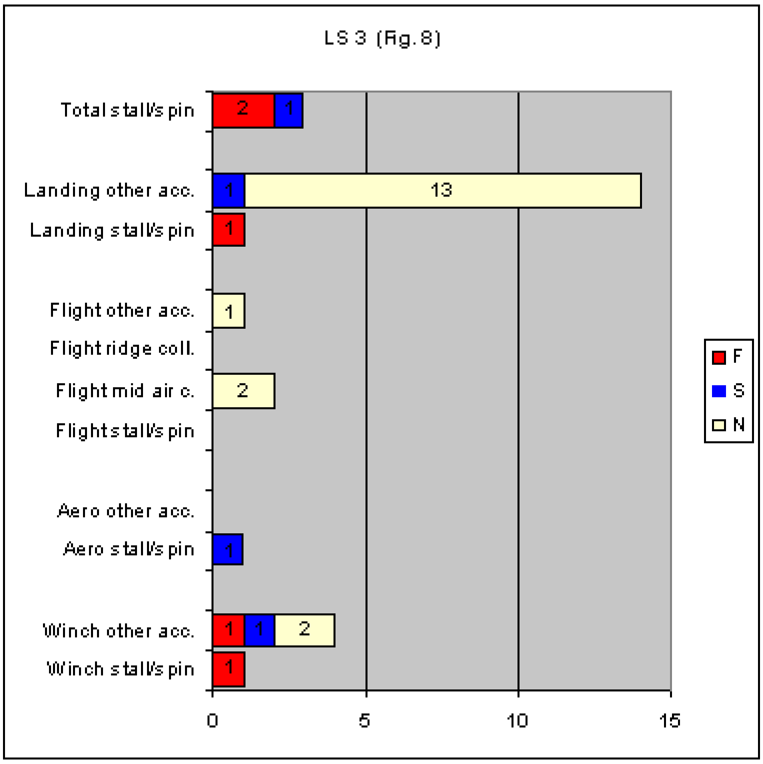
THE INFLUENCE OF THE TYPE OF GLIDER ON THE ACCIDENTS

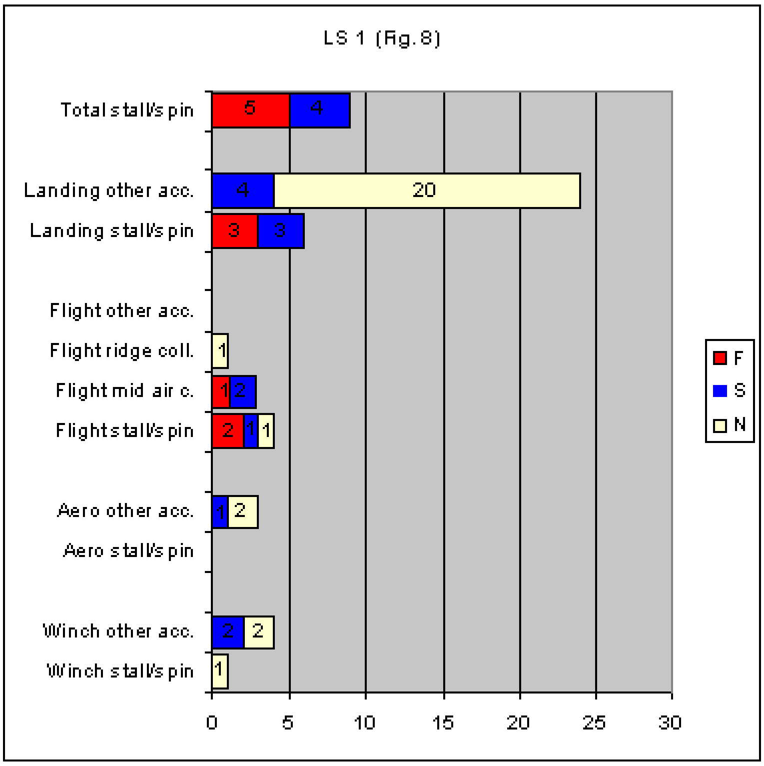
To study the influence of the glider on the accidents, the probability distribution was evaluated for each glider extra.

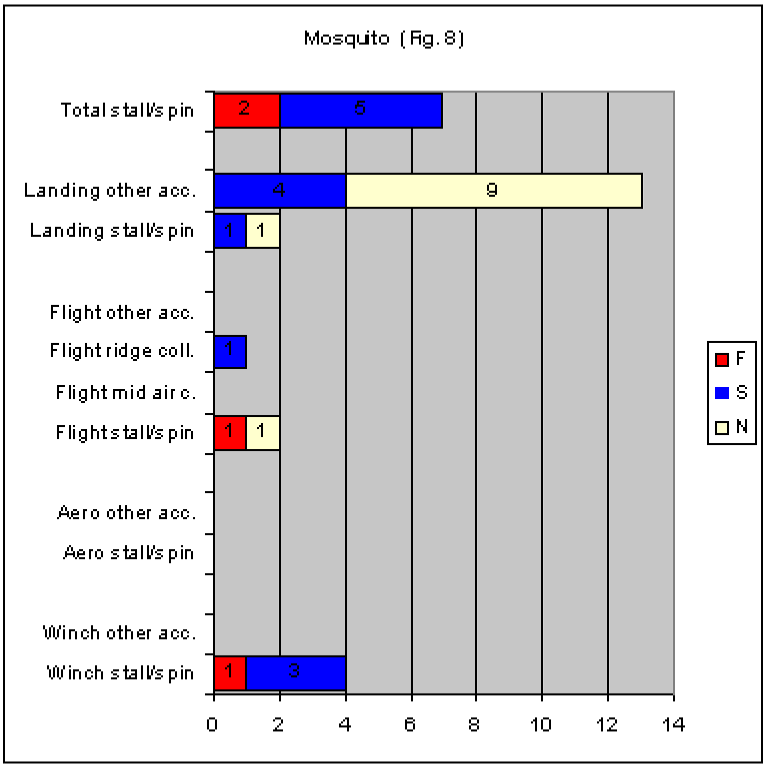
The results are seen in **Fig. 8-11**.

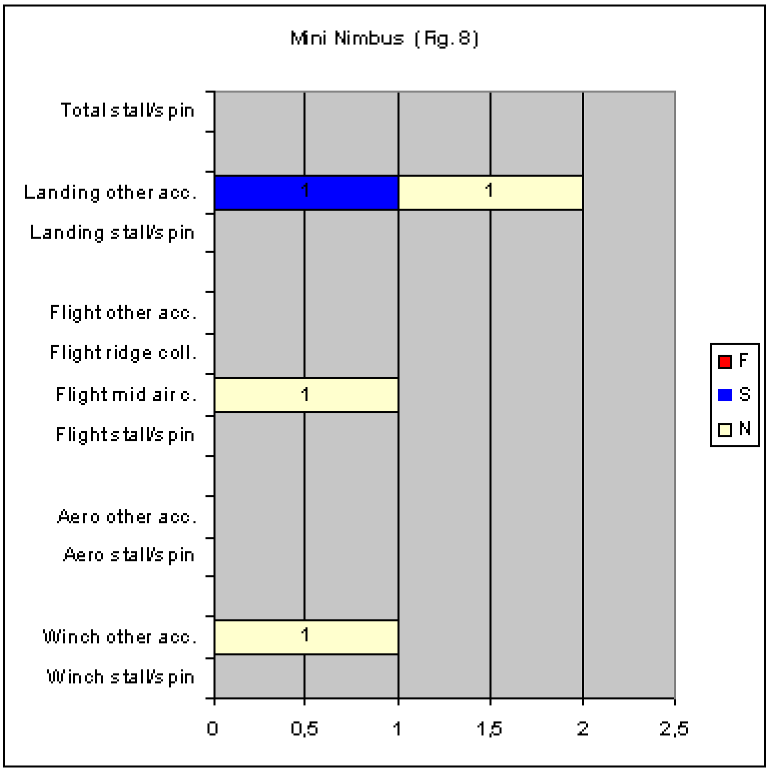

ASW 20 (Fig. 8)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
1
2
8
7
4
2
1
2
2
0
5
10
15
20
F
S
N

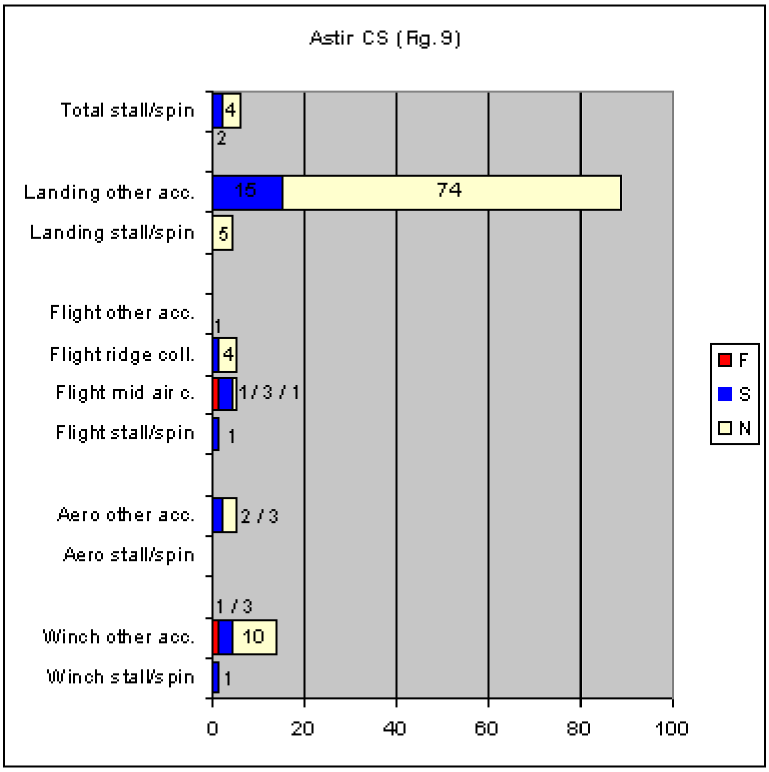

Std. Cirrus (Fig. 8)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
3
2
2
6
13
1
1
1
1
1
3
1
2
1
1
1
1
0
5
10
15
20
F
S
N

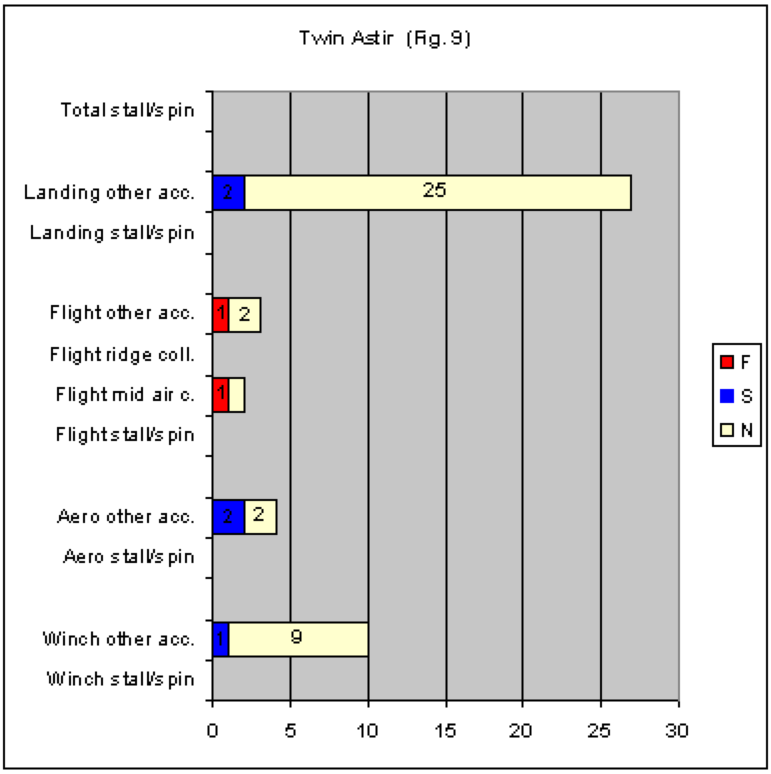

LS 3 (Fig. 8)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
2
1
1
13
1
1
2
1
1
1
2
1
0
5
10
15
F
S
N

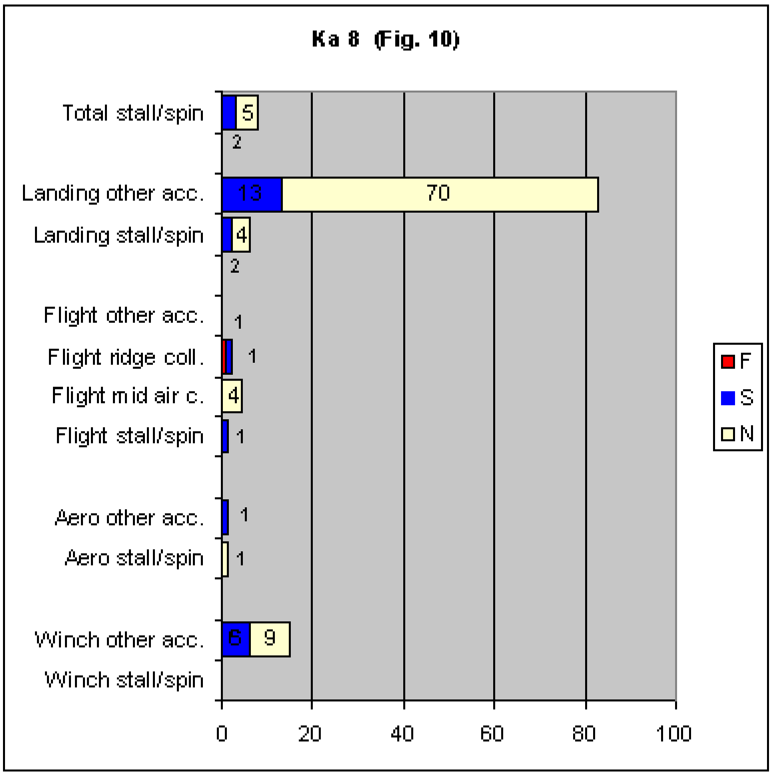

LS 1 (Fig. 8)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
5
4
4
20
3
3
1
1
2
2
1
1
1
2
2
2
1
0
5
10
15
20
25
30
F
S
N

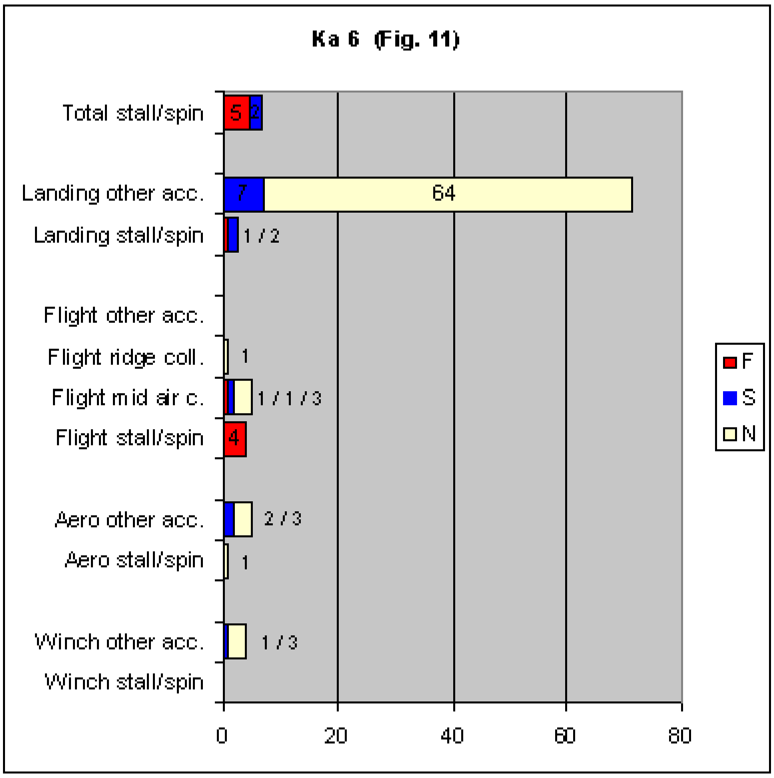

Mosquito (Fig. 8)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
2
5
4
9
1
1
1
1
1
1
3
0
2
4
6
8
10
12
14
F
S
N


Mini Nimbus (Fig. 8)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
1
1
1
1
0
0,5
1
1,5
2
2,5
F
S
N


Astir CS (Fig. 9)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
4
2
15
74
5
1
4
1 / 3 / 1
1
2 / 3
1 / 3
10
1
0
20
40
60
80
100
F
S
N


Twin Astir (Fig. 9)
Total stall/spin
Landing other acc.
Landing stall/spin
Flight other acc.
Flight ridge coll.
Flight mid air c.
Flight stall/spin
Aero other acc.
Aero stall/spin
Winch other acc.
Winch stall/spin
2
25
1
2
1
2
2
1
9
0
5
10
15
20
25
30
F
S
N





Although the absolute number of launches, performed by each glider was not known, we nevertheless get a picture which is of course clearer the more total numbers of accidents are registered. Some show a poor statistic (low number of accidents) which probably means that this type of glider has not been flown very much.

The column TOTAL STALL/SPIN is of big interest, as the counted accidents there give more insight into the stalling characteristics.

A comparison of gliders of fig.8 and 11 with the gliders of fig.9 and 10 with respect to this column show that there are two different types of gliders:

TYPE A : show FATAL accidents due to STALL/SPIN, even if there is poor statistic (low amount of total accidents)

TYPE B : show NO FATAL accidents due to STALL/SPIN, even if there is good statistic (high amount of registered accidents).

We conclude from this that it is possible to make gliders which are hard to get into spin and which are completely controllable in stalled configuration by the steering elements e.g. by ailerons or rudders or both.

Such glider contribute NO fatal accidents caused by stall/spin to the whole amount of accidents recorded.

Since stall/spin is with 43% in the above performed evaluation the most frequent cause of fatal accidents - in other countries, as mentioned above, this can even go up to 60% - we should think about whether it is really worth while to have gliders which are able to spin, pitch down inadvertently, flick etc. or NOT.......!!!

In the above performed evaluation we should not forget that from 70 persons 30 got killed due to stall/spin in only 5 seasons in Germany !!

Because of the high amount of fatal accidents, we should really do something about this sort of accident.

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MEANS AGAINST STALL/SPIN ACCIDENTS

1) Safer Gliders:

According to the above mentioned possibilities, we should first investigate, whether it is possible to eliminate spin/stall from the gliders completely.

If this were possible then we would be able to reduce the fatal accidents by about the half !!!

The solution would be:

The glider must be totally controllable by the ailerons and rudder, when stalled. Inadvertend pitch down, flick or even spin against the will of the pilot should not be possible.

This seems to be hard to fulfil, but statistic shows that there are those two types of gliders, one of which (TYPE B) does not produce any fatal accidents when stalled.

Twin Astir, Std. Astir are examples for type B. But, of course, other gliders could be named as well, for example Pik 20 D : by transition into stall with normal procedure you get no flick or pitch down movement. The sink rate increases, but the glider remains controllable. The monoeuvrability is even better than in normal flight. By using ailerons you can change 45° to 45° banking within 2-3 sec. Just as fast you can do this by using rudders only. Inadvertent spin with this glider seems to be impossible.

Due to this fact, we can conclude that it is really possible to make gliders that are completely controllable in stalled configuration, and by flying only such gliders we would be able to reduce the fatal accidents by about 40 to 60 %.

Knowledge about stall/spin has in the mean time increased, better profiles have been developed, so that the new gliders, even those which are very successful in championships are supposed to be gliders of TYPE B .

<u>Accordingly, they should cause NO fatal accidents any more due to stall/spin in the future !!</u>

This would be really good work done by the constructors and producers, and would safe a lot of lives !!

Nevertheless, to support those, who have spared no expense to make the glider "safe" the AIR WORTHY REQUIREMENTS of OSTI V and JAR 22 should be revised and adapted to the new situation. This would prevent new gliders coming on the market which are critical, because performance has been squeezed out of the aerodynamics at the cost of good stall characteristics and which compete now the "safer" ones.

Of course, many of the gliders which have caused a lot of fatal accidents and <u>which will still cause further ones</u> are plastic gliders of the first generations.

These gliders could be made safer by modifying them, probably at the cost of some performance. But, if we think of the high rate of fatal accidents it is perhaps worth while to do so.

2) <u>Stall Warning instrument:</u>

The next point is the pilot. To help him to keep the glider above the stalling speed a good functioning STALL WARNING INSTRUMENT would be the best. OSTIV has set out a prize for such an instrument, but unfortunately a completely satisfactory instrument has not been found yet, at least, as far as I know. (Remark: This relates to the situation in 1992. In the mean time OSTIV and others have found good solutions, but these are not well known - at least, the idea to use such stall warning instruments is not yet in the minds of the pilots).

3) <u>Know how:</u>

The other thing is that there is a great lack of information about spin/stall. Nearly nobody seems to know that this is the main cause of fatal accidents, what really happens in stall/spin and how the pilot can avoid this by proper flying techniques.

A book or paper that would cover the whole subject in a complete, thorough but nevertheless popular way would be appreciated.

(Remark: a lot of research work has been put into safety cockpits, rescue systems etc., but not any as it seems into the development of stall/spin–safer gliders !!)

4) risk management:

Since fatal launching accidents occur due to stall/spin only in winch-, but not in aero towing, the pilot should calculate his/her risks and avoid winch towing if he/she, for instance, flies a glider with critical stall characteristics.

So, evaluating the risks for different actions e.g. proper risk management will also help to reduce accidents.

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MID AIR COLLISONS

The next high amount of fatal accidents go back to mid air collisions which has again become a sad actuality by the recent (+1992) death of Helmut Reichmann.

There are a lot of possibilities to reduce this sort of accident, but a complete elimination of this cause is at the moment not in sight. (Remark: as anti collision colour markings and strobe lights are not able to prevent collisions in all situations, the development of anti collision instruments seem to be necessary. The new ADS-B system combined with flight recorders and proper display might be a solution).

But, to deal with this subject would go beyond the scope of this paper.

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SUMMARY

A simple analysis of annual gliding accident reports, as they were published by the German FUS, has been performed.

The evaluation of the frequency of accidents show that STALL/SPIN is by distance the main cause of fatal accidents.

STALL/SPIN accidents play a dominant role in winch tows, in flight near ground (mountains, alps) and in landing procedures. In the latter case, although the accidental rate there is the highest, to some surprise, nearly all fatal accidents are because of STALL/SPIN and not of other causes.

Further analysis shows that there are two types of gliders. One type (TYPE A) is critical in stalled configuration and the other type (TYPE B) is harmless below the stalling speed.

By flying only gliders of TYPE B we would be able to reduce fatal accidents by about the half.

All new glider types, even the best in competition flying, seem to be, thanks to the effort and good work of the constructors, producers and authorities, of the safer TYPE B. So, they should show up NO fatal accidents in the future due to stall/spin - I hope so at least !! (Remark: I guess, I was a little bit too optimistic.)

Nevertheless, to avoid competition of "unsafer" gliders with "safe" ones and to support the "safer" ones, the airworthy requirements of OSTIV and JAR 22 should be revised and defined new.

The next high amount of fatal accidents go back to mid air collisions, but dealing with this subject would go beyond this paper.

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ACKNOWLEDGEMENTS

The author wants to thank Ing. Raicher and Ing. Veit of the ministery of transport, Ing. Rüdiger Kunz (constructor of Std. Austria), Ing. Baha, Ing. Dundler and the Austrian Aero Club for their great help.

LINKS

http://www.dg-flugzeugbau.de/unfallakte.html
BFU 1999 Segelflugzeuge

Nr.	Discription	Reports by	Date
84451	Flugunfall mit dem Segelflugzeug der Type DG 303 Club Acro, Kennzeichen XXXXXX, am 01. August 1998 um 13:15 Uhr UTC am Plischer Kogel, Gemeinde Turnau, Bezirk Bruck an der Mur, Steiermark		1998-08-01
84446	Zusammenstoß des Segelflugzeuges Type Discus CS, Kennzeichen XXXXX, und des Paragleiters Type Voyager 12, Werknr. ZZZZZZ, am 10. Mai 1998 um ca. 12:30 Uhr UTC*) über dem Großen Solstein, Gemeinde Zirl, Tirol		1998-05-10
84443	Flugunfall mit dem Segelflugzeug Type DG 500 "Elan Trainer", Kennzeichen XXXXX, am 20. Mai 1998 um ca. 12.50 Uhr UTC*) bei Mandorf, Gemeinde Kötschach-Mauthen, Bezirk Hermagor, Kärnten.		1998-05-20
84440	Flugunfall mit dem Segelflugzeug Type DG 300 Club Elan Acro, Kennzeichen XXXXXX am 29. März 1998, um ca. 12:15 Uhr UTC*) am Hechenberg westlich von Innsbruck, Tirol.		1998-03-29
84422	Flugunfall mit dem Segelflugzeug der Type Cirrus, Kennzeichen XXXXXXX, am 23. Februar 1997 zwischen 14:00 und 14:30 Uhr UTC*) am Nordhang des Wagenbänkberges, Gemeinde Trieben, Steiermark.		1997-02-23
84417	Flugunfall mit dem Segelflugzeug Type PZL Swidnik PW5, Kennzeichen XXXXX, am 20. Juli 1996 um ca. 09.45 Uhr UTC*) auf dem Flughafen Innsbruck, Tirol.		1996-07-20
84415	Flugunfall mit dem Segelflugzeug Type DG 300 Elan, Kennzeichen OE-XXX, am 11. Juni 1996 um ca. 12:50 Uhr UTC *) bei St. Lorenzen im Lesachtal, Kärnten.		1996-06-11
84390	Zusammenstoß zwischen den beiden Segelflugzeugen der Type Grob G102 Club-Astir IIIb, und dem Segelflugzeug der Type Standard Austria S1, am 3. Mai 1995 um ca. 10:12 Uhr UTC*) Galsterbergalm, Gemeinde Pruggern, Bez. Liezen, Stmk.		1995-05-03
84383	Flugunfall mit dem Segelflugzeug Type LS-7WL, Kennzeichen XXXXX, am 1. August 1994 um ca. 09:55 Uhr UTC *) etwa 1 km südöstlich des Flugplatzes Reutte-Höfen, Tirol		1994-08-01
84369	Flugunfall mit dem Segelflugzeug der Type Ka 8 B, Kennzeichen XXXXX, am 18. Juli 1993 um 13:48 Uhr UTC*) am Flugplatz Wiener Neustadt Ost, Niederösterreich.		1997-07-18
84368	Flugunfall mit dem Segelflugzeug Type K8b, Kennzeichen OE - XXXX, am 8. Juli 1993 um ca. 10:25 Uhr UTC *) östlich des Flugplatzes Friesach/Hirt, Kärnten.		1993-07-08
84367	Flugunfall mit dem Segelflugzeug der Type SZD 50/3, Kennzeichen XXXXXXX, am 10. Juli 1993 um14:54 Uhr UTC beim Flugplatz Schärding Suben, Oberösterreich.		1993-06-10
84347	Flugunfall mit dem Segelflugzeug Type Mini Nimbus HS7, Kennzeichen XXXXX, am 24. Juni 1992 um ca. 11:44 Uhr UTC *) an der Südflanke des Jaukenmassives, Gemeinde Dellach im Gailtal, Bezirk Hermagor, Kärnten.		1992-06-24
84170	Flugunfall mit dem Segelflugzeug Type Kestrel, Kennzeichen OE-XXX, am 2. Juni 1985 um		1985-06-02

	ca. 13:45 Uhr UTC *) am Flugplatz Mauterndorf, Salzburg.	
74393	Flugunfall mit dem Segelflugzeug Type Nimbus 2b, Kennzeichen D-1112XXX, am 26. Mai 1995 um 11:10 Uhr UTC *) im Stausee Klaus, Gemeinde Klaus a.d. Pyhrnbahn, Bezirk Kirchdorf a.d. Krems, Oberösterreich.	1995-05-26
74392	Flugunfall mit dem Segelflugzeug Type PZL-Swidnik PW5, Kennzeichen OE-XXX, am 23. Mai 1995 um ca. 17:45 Uhr UTC *) beim Flughafen Innsbruck, Tirol.	1995-05-23
74386	Flugunfall mit dem Segelflugzeug Type Cirrus 75, Kennzeichen OE-XXX, am 2. Juli 1994 um ca. 15:50 Uhr UTC *) in Rattenberg bei Fohnsdorf, Steiermark.	1994-07-02
74384	Flugunfall mit dem Segelflugzeug Type DG 300 Elan, Kennzeichen OE-XXX, am 16. Oktober 1994 nach 13:14 Uhr UTC*) im Bereich der Materialseilbahn zur Wangenitzseehütte, Gemeinde Nußdorf, Bezirk Lienz, Tirol (Osttirol).	1994-10-16
74361	Zusammenstoß der Motorsegler Type Stemme S10, Kennzeichen OE-XXX, und Ventus cT, Kennzeichen D-XXX, am 17. Mai 1993 um ca. 13:00 Uhr UTC *) ca. 1,5 km südlich des Kreuzjochs, Gemeinde Gerlosberg, Tirol.	1993-05-17