The "Definition" of the Motorsegler

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Zusammenfassung

Der Motorsegler hat in verschiedenen Ländern und verschiedenen Organisationen oft ganz verschiedene Namen, aus denen manchmal Definition und Anwendungsbereich hervorgehen sollen. Die neue Kategorie Motorsegler muss aber eine deutliche Abgrenzung zu den leichten Motorflugzeugen, jedoch auch eine enge Verbindung zu den Segelflugzeugen haben. Sehr oft werden Forderungen nach einer bestimmten Gleitzahl oder Sinkgeschwindigkeit oder auch nach anderen Leistungswerten aufgestellt, die nur durch eine Reihe von Versuchsflügen und vielen Flugmessungen nachgewiesen werden können. Doch die Zulassungsbehörden sollten schon zu Beginn der Musterprüfung erkennen, ob es sich um einen Motorsegler handelt oder nicht. Rechenwerte sind oft zu optimistisch.

Die wesentlichen Kennwerte eines Segelflugzeuges und eines Motorseglers sind vor allem

hohe Flügelstreckung $\frac{b^2}{S}$

niedrige Flächenbelastung $\frac{W}{S}$

von denen Gleitzahl E und Sinkgeschwindigkeit W_s abhängen.

Wenn wir sagen

$$\frac{W}{S} \cdot \frac{S}{b^2} = \frac{W}{b^2}$$

dann haben wir darin einen Wert, der für Motorsegler nicht grösser als 3 kg/m² sein sollte. Dadurch hat man zu den Leichtflugzeugen einen genügend grossen Abstand, da diese erst bei 4 kg/m² beginnen. Trägt man einmal die Gewichte W und Spannweiten b von Segelflugzeugen, Motorseglern und Leichtflugzeugen auf (Fig. 1 bis 3), dann erkennt man die nahe Verwandtschaft der ersten beiden Kategorien.

Natürlich müssen für Motorsegler (wie auch für Leichtflugzeuge) weitere Forderungen aufgestellt werden (z. B. für Steuerbarkeit, Startstrecken, Brandschutz usw.), doch können diese den Motorsegler nicht «definieren».

Es wird vorgeschlagen, das Wort «Motorsegler» international zu benützen und ihn mit $\frac{W}{b^2} \leqq 3$ kg/m² zu definieren.

Introduction

The Motorsegler – in Germany a well known, accepted, and certificated category – has in different countries and organisations several names such as

powered, auxiliary powered, self launching, motorised, motor — glider or sailplane

Some other names are motosoarer, motoplaneur, avion-planeur, motoaliante, motorzwever, etc. The trouble is that in many cases the name has to "define" the motorsegler or has to include some of its limitations (e. g. self launching sailplane SLS).

My first proposal: let us say all over the world "motorsegler" or "moto(r)soarer" (MS)

Technically, the motorsegler seems to be difficult to define: there must be a separation from the light aeroplane and there should be a good connection with the sailplane. Many definitions include recommendations or requirements for a certain glide ratio L/D, a minimum sinking speed W_s, or some other performance values which can only be known accurately after a series of flight tests and careful measurements (because the calculated performances are often very optimistic) (1), (2), (3). But even measurements in a so-called smooth atmosphere can suffer from

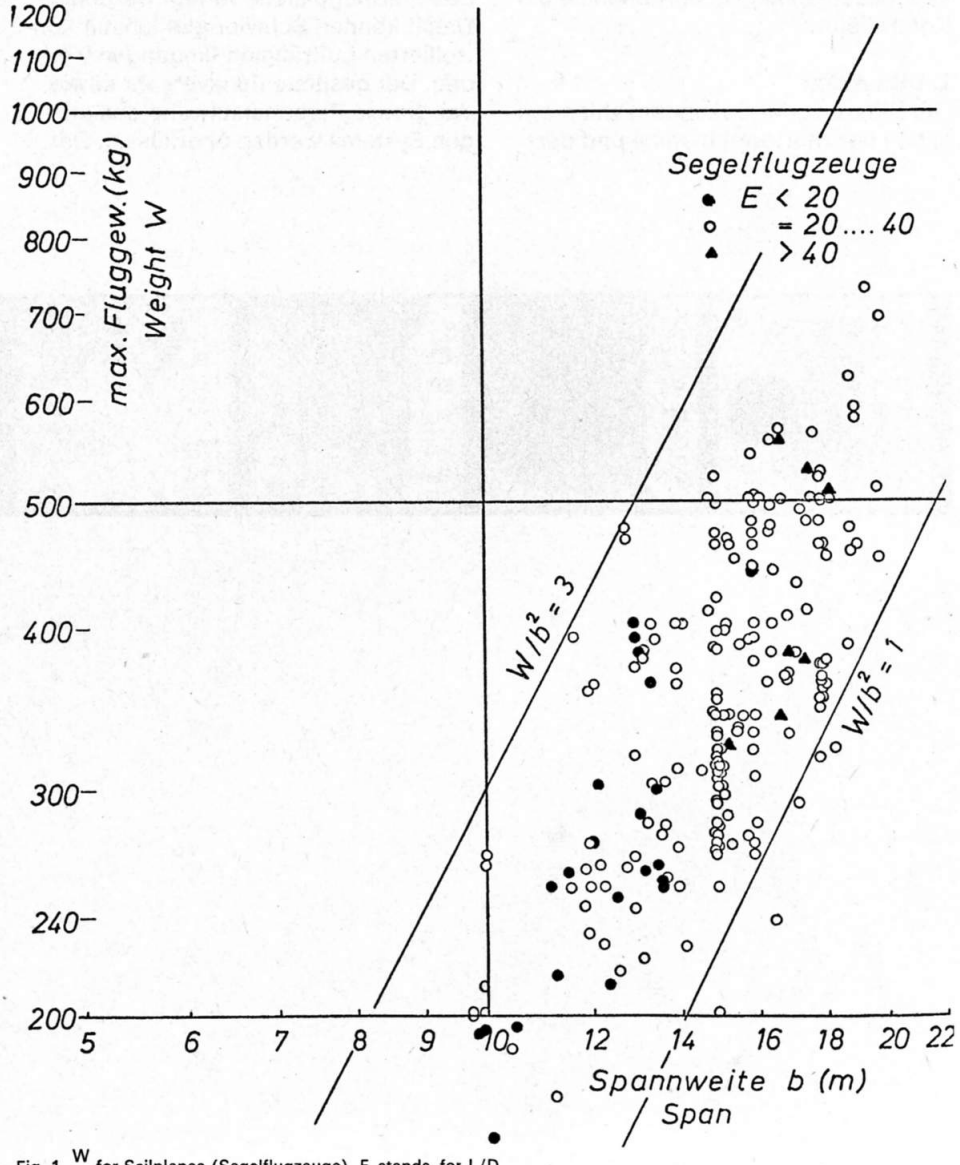

Fig. 1. $\frac{W}{b^2}$ for Sailplanes (Segelflugzeuge). E stands for L/D

a lot of scatter (4) which makes it difficult to say with certainty: this is a motorsegler.
It would be helpful for the aviation authority as well as for the designer to know the correct category of the aircraft before the beginning of the certification. Also, the jury of a motorsegler competition needs a definition or a formula for the class or handicap evaluation which is simple to understand and easy to calculate.

Theoretical considerations

The determining characteristics of a sailplane and also of a motorsegler are, above all, in my opinion

the high aspect ratio $\frac{b^2}{S}$

the low wing loading $\frac{W}{S}$

upon which the special performance qualities (high L/D and low W_s, respectively) depend.

If we say

$$\frac{W}{S} \cdot \frac{S}{b^2} = \boxed{\frac{W}{b^2}}$$

then we have a value which could be limited as we explain in the following paragraph.

Statistical diagrams

In the figures 1, 2 and 3 are plotted (without any manipulation) the weights and spans of sailplanes (5), light aeroplanes (6), and motorseglers (7). We find that the field of sailplanes is limited by $W/b^2 = 3$ and 1 kg/m² with a modern trend to $W/b^2 = 1$ due to glass fibre (GRP, or in German GFK) surfaces. The light aeroplanes lie in the region $W/b^2 \geq 4$ kg/m², being mostly well beyond that value. Nearly all motorseglers have the same limits as the sailplanes. The very few exceptions slightly above 3 kg/m² are early designs having more the qualities of "high performance aeroplanes" like the RF3, RF4 and RF5. The well known RF5 is in our consideration a good example for the trend of the development: it has been observed that the original RF5 had insufficient "soaring performance" (L/D, W_s). The demand for an improvement arose and the designer developed the RF5B which is generally acknowledged to be a real motorsegler; it lies well in our field between 1 and 3 (in fig. 3 the dotted line a). Also one of the best training motorseglers, the two seater SF25B Falke (side-by-side) has in its tandem version SF28 a somewhat lower W/b^2 (in figure 3 the dotted line b). Walter Stender (8) made the attempt to categorize motorseglers and to include also these RF-types into the aera of motorseglers, establishing a more complicated formula (illustrated by the chain-dotted boundary in Fig. 3) and perhaps a better limitation. But I think W/b^2 is a good and sufficient single quantity which can be measured by a balance and a tape-measure and so easily determined before the first flight for certification or, on the other hand, for handicaps in competitions etc. In table 2 are shown those motorseglers which have been tested and measured in flight by the DFVLR. The represented data confirm our considerations.

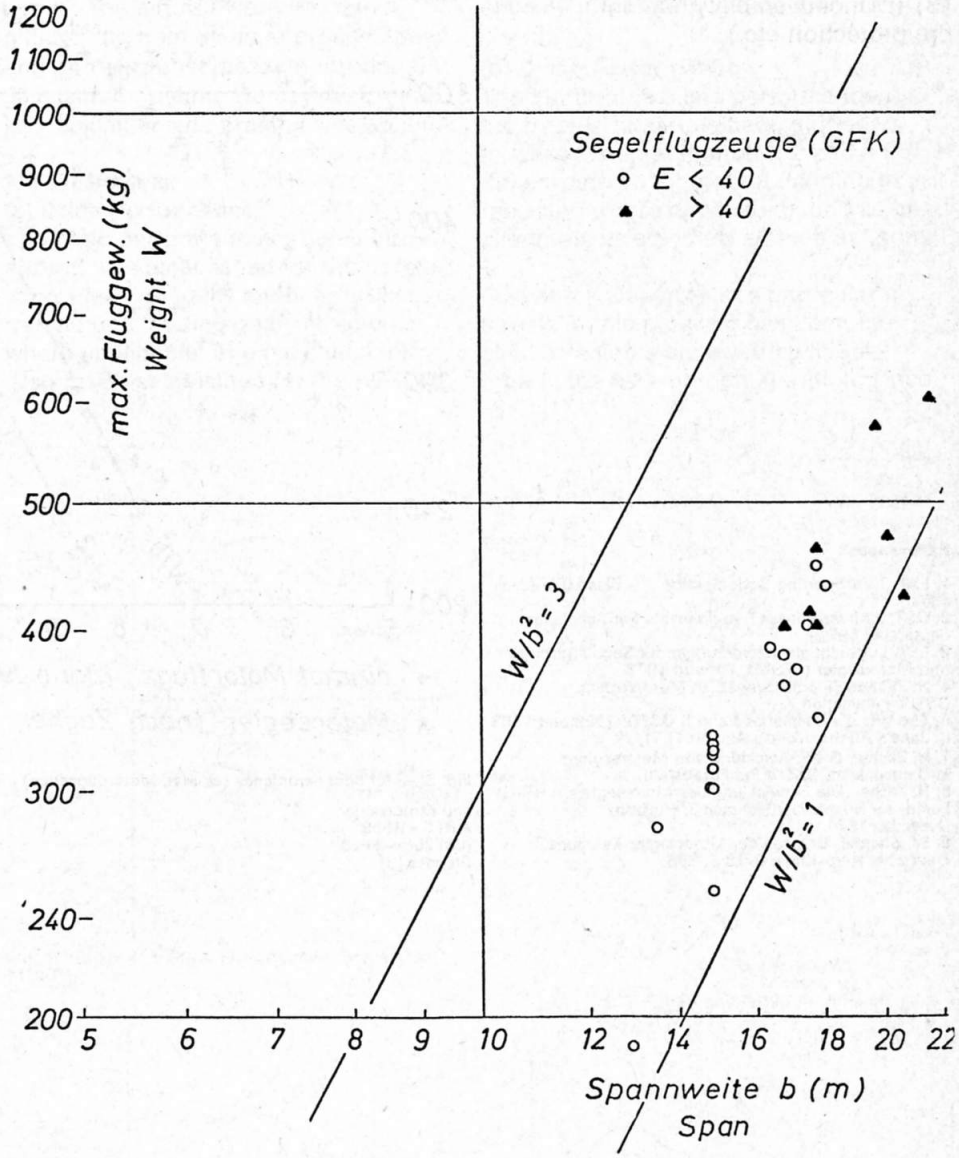

Fig. 2. $\frac{W}{b^2}$ for glass fibre sailplanes (GFK-Segelflugzeuge)

Table 1

"Definitions"
of the FAI-CIVV Sporting Code Sect. 3 Class D 1971
OSTIV Airworthiness Requirements for Sailplanes 1971
LBA Lufttüchtigkeitsforderungen für Segelflugzeuge und Motorsegler, Entwurf 1973

Max. all-up weight	W	≦ 750 kg
Max. take-off distance to 15 m	s_{15}	≦ 600 m
Min. rate of climb	r/c	≧ 300 m in 4 min (≧ 1.25 m/s)
Max. stall speed	V_{so}	≦ 75 km/h
Min. normal glide ratio with engine off	L/D	≧ 20[1]
Max. sinking speed single seater	w_s	≦ 1.0 m/s[2]
two seater		1.2
Glide ratio airbrakes open	L/D	≦ 7 at 1.3 V_s

[1] FAI and OSTIV only [1], [2], [3]
[2] LBA only

Table 2

Some performance-measured motorseglers

Type	Span [m]	Weight [kg]	W/b² [kg/m²]	V_{so} [km/h]	W_{smin} [m/s]	L/D [–]	Remarks
RF3	11,2	370	2,95	71,3	1,49	16,1	
RF5	13,7	650	3,45	86	1,52	18,0	
K8B–KM48	15,0	321	1,45	≈60	1,10	16,5	[1]
SF25B	15,3	540	2,30	67,2	1,02	21,1	
SF28	16,3	583	2,20	≈65	0,96	23,5	
SF27M	15,0	370	1,65	75	0,77	31	
fs26	12,6	333	2,10	75	1,00	24	
Mü23	20,0	660	1,65	≈70	0,96	21,5	
AK1	14,9	392	1,78	≈70	0,80	30,5	
D37	18,0	374	1,15	<70	0,60	37,9	[1]

[1] non selflaunching

My second proposal: the "motorsegler" is "defined" by a W/b^2 not more than 3 kg/m²

Requirements for motorseglers

It is obvious that motorseglers must have some additional requirements as in the case of other aircraft (e.g. take-off run, climbing speed or angle, stalling speed, weight limit, number of seats etc.).
However, these do not "define" the motorsegler. They are simply there to provide for safety, like all other airworthiness requirements (2), (3) (manoeuverability, strength, fire protection etc.).

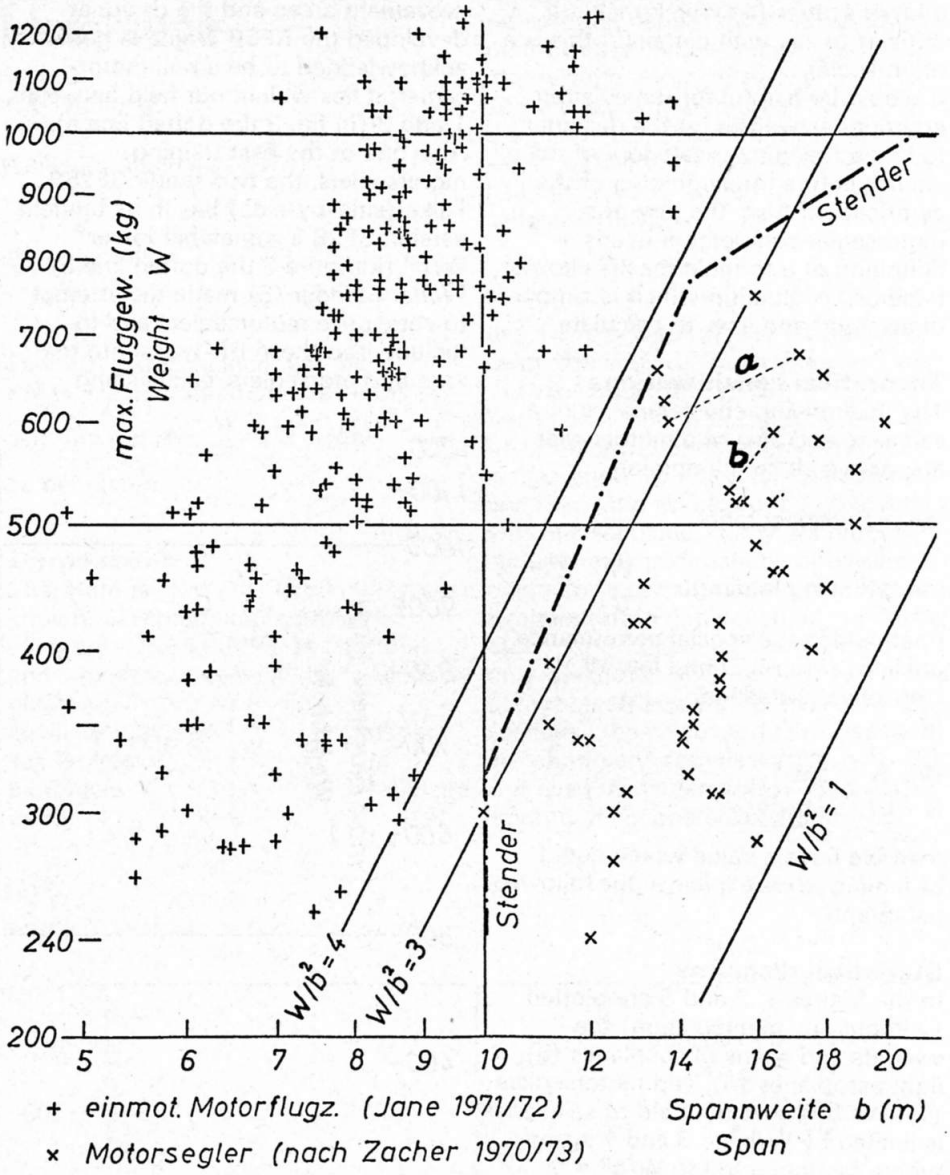

Fig. 3. $\frac{W}{b^2}$ for light aeroplanes (einmot. Motorflugzeuge) and Motorsegler.
a RF5→RF5B
b SF25B→SF28
Stender [8]

References

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