Small competition sailplanes

By B. J. Cijan and B. S. Shenstone

For the purposes of avoiding extreme designs in International Contests, "classes" are introduced so that normal sailplanes can be competitive. The root of the idea of classification is, however, the cost factor. It was this that caused the Standard Class to be devised after twenty-odd years of fumbling and guessing whether a span-limited class would be worth-while. The last few World Contests showed that excessively large-span sailplanes were only just a little more successful than others and as a result are being built in fewer numbers. On the other hand, Standard Class machines, since they are cheaper and can also be club machines, are widely produced and have had an unexpected success in contests. Numbers of sailplane types plotted against span show a concentration in the neighbourhood of 12 to 15 m. Designers interpret the Standard Class as having a span of exactly 15 m and not as the FAI Specification states "equal to or less than 15 m". This definition makes it clear that the Standard Class is wide open below 15 m span. In Junin (1963) there was only one really small machine, the Australian ES 59 Arrow of 13,24 m span.

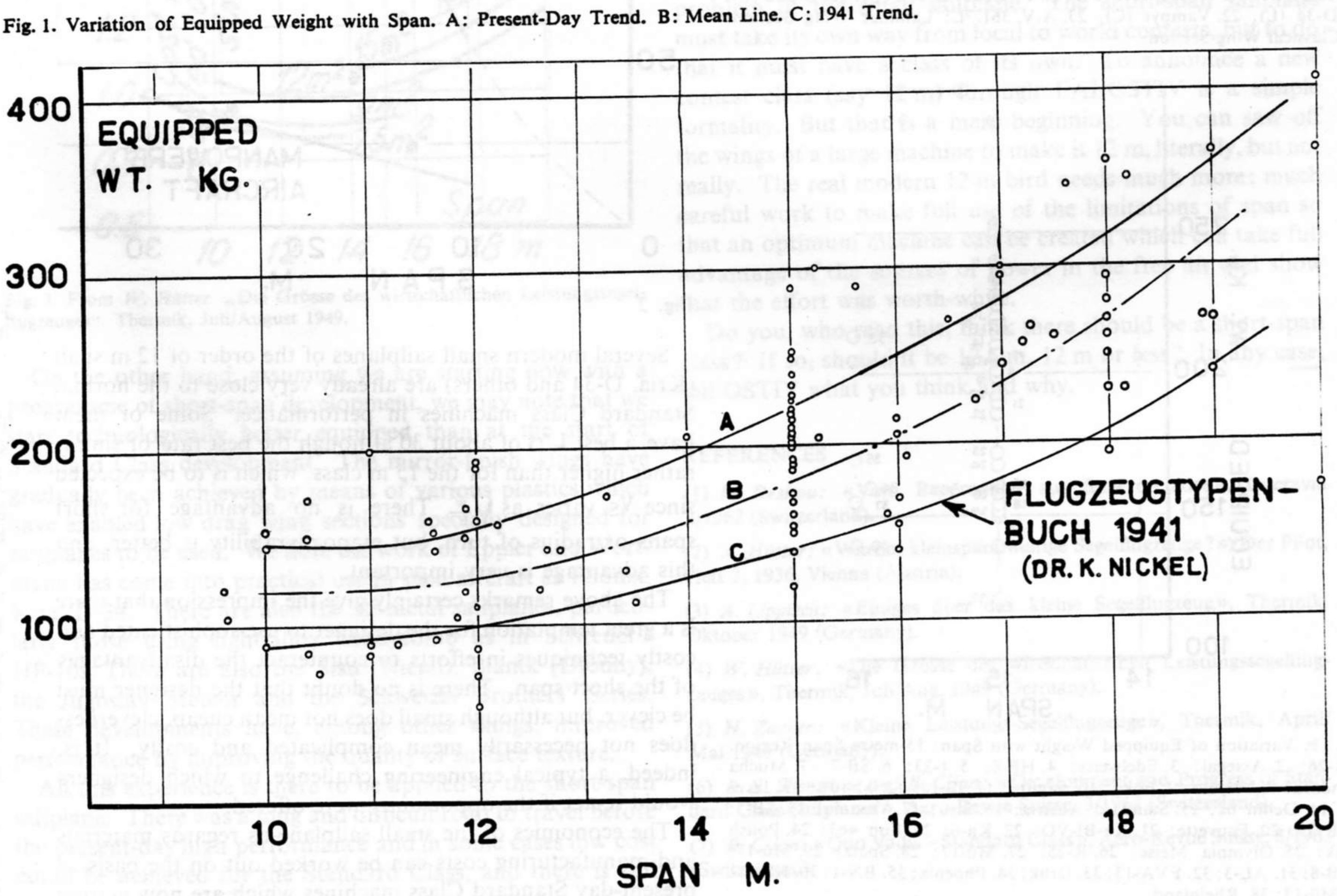
Many people think, a few say and even fewer write, that the Standard Class sailplanes are too big, and that one should get down to 12 m or even 10 m span. There is talk of a "Junior"-Class, a 12 m Class, a short-span class, midget or popular class, and such like. But everyone knows that World Contests are open for all classes, all spans. On the other hand, designers are loath to try their hands at machines other then "Open" or "Standard". In general, "Open" is more than 15 m and "Standard" is exactly 15 m. The fear is that unless both designer and pilot are exceptionally clever, the "under 15" will never get enough points or the designer enough prestige to warrant the effort and money. That is why if "under 15" sailplanes are to be built, there must be a contest class for them.

What does a short-span do for you? Does every metre saved save you money? Do you have to spend so much on the metres that remain that there is no cost advantage?

Those who have designed and built short-span sailplanes with great care and hard work can, indirectly, tell us more about the problem. The first Darmstadt D. 28 (12 m span) achieved as a result of much careful detail work an empty weight of 54 kg (119 lb.). In those days of the early Thirties this "Windspiel" broke a world record.

In 1935 Wolfgang and Ulrich Hütter designed a short-span sailplane, the Hütter 28 of 12 m span and an empty weight of 85 kg. Later the span was increased to 13,5 m to fit later requirements and the empty weight grew to 115 kg. The first post-war Darmstadt development was the D-34

Fig. 1. Variation of Equipped Weight with Span. A: Present-Day Trend. B: Mean Line. C: 1941 Trend.



(1955) with 12.65 m span, an aspect ratio of 20 and equipped weight of 140 to 144 kg. Various versions were built. Calculated best L/D was 36.6 at 76 km/hr, but measured values were 31.5 at 84 km/hr for D-34 d. Based on his Phoenix experience, Nägele designed the 11.9 m "Kria" in plastics

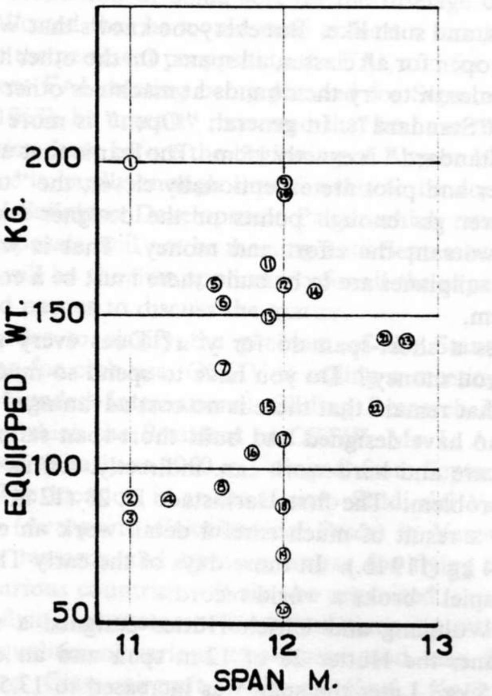


Fig. 1a. Variation of Equipped Weight with Span: 12-metre Span Region. 1. Screamin Wiener (C); 2. Prue 160 (C); 3. Prue 160 (C); 4. EP-1 (C); 5. IS-5; 6. Rigid Midget; 7. XM1B (C); 8. Greif (C); 9. SZD-6X (C); 10. WKS-IV; 11. BKB-1; 12. R-27; 13. ES-56 (L); 14. 1-26 (C); 15. Kria (L); 16. T.S. 1/34 (C); 17. Kolibri; 18. H-28-I (C); 19. D-28 b (C); 20. D-28 a (C); 21. D-34 (L); 22. Vampyr (C); 23. A.V. 361. L: Laminar Wing Section; C: Classical Wing Section.

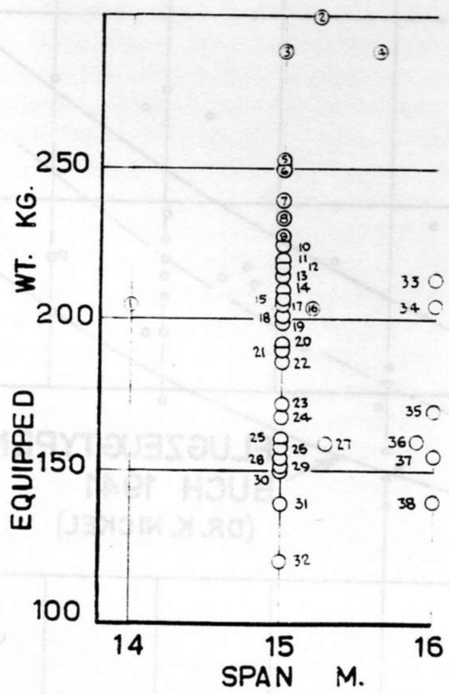


Fig. 1b. Variation of Equipped Weight with Span: 15-metre Span Region. 1. R-26; 2. Assegai; 3. Edelweiss; 4. HP-8; 5. 1-23; 6. SB-7; 7. Mucha Standard; 8. Urendo; 9. Foka; 10. Sagitta; 11. IS-10; 12. M-10b; 13. Javelot; 14. Delfin 62; 15. Standard Austria; 16. Sisu; 17. Vasama; 18. SB-5; 19. R-25; 20. Fauvette; 21. Ka-BI-VO; 22. Ka-6; 23. Eon 463; 24. Polish Orlik; 25. Olympia Meise; 26. R-25; 27. Mü-17; 28. Spatz; 29. Mü-17; 30. B-8; 31. AL-3; 32. FVA-13; 33. Orlik; 34. Phoenix; 35. BN-1; 36. HP-11; 37. Mü-13; 38. Rheinland.

with an empty weight of 120 kg (Ref. 1) and best L/D of 30 at 92 km/hr.

U. Hütter wrote in 1936 (2): "... obviously smaller dimensions mean less empty weight, less material and resulting cheapness, and good manœuvrability around all axes. That says everything." Dr. Alexander Lippisch wrote in 1949 (3) on the subject of small sailplanes as follows: "In practice most people have discovered that "small" doesn't equate to "cheap", because the small sailplane is much more sensitive to weight changes than sailplanes with more normal spans of the order of 15 m. This means that the small sailplane is only competitive if every gramme of weight is saved by the most refined design. That means not only high quality and therefore expensive material and much detail work, the finest there is, but also superior aerodynamic design which can be easily produced."

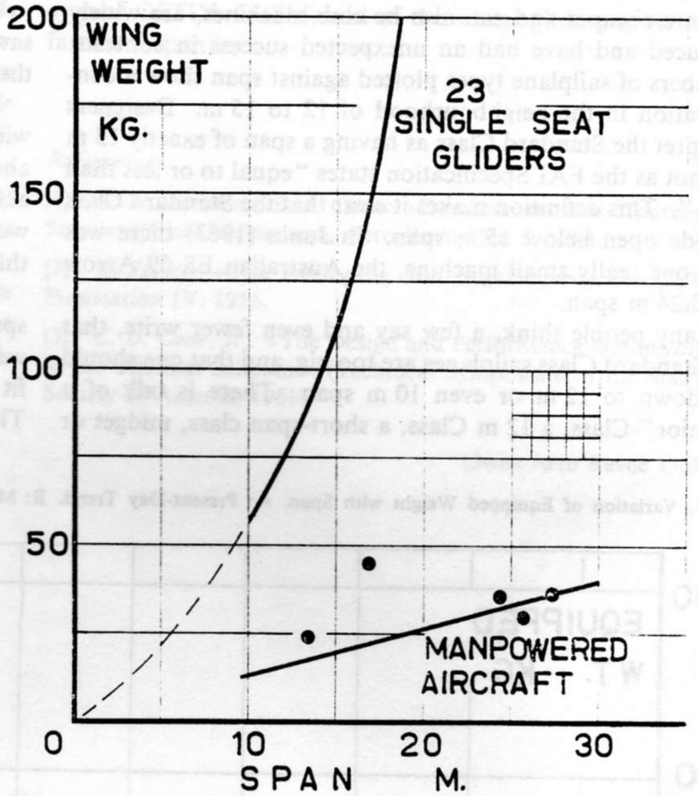


Fig. 2

Several modern small sailplanes of the order of 12 m span (Kria, D-34 and others) are already very close to the normal Standard Class machines in performance. Some of them have a best L/D of about 30 although the best rate of sink is rather higher than for the 15 m class, which is to be expected since V_S varies as $\sqrt{\frac{w}{b^2}}$. There is no advantage for short spans or radius of turn, but manoeuvrability is better, and this advantage is very important.

The above remarks certainly give the impression that there is a great temptation for the designer to use sophisticated and costly techniques in efforts to counteract the disadvantages of the short span. There is no doubt that the designer must be clever, but although small does not mean cheap, cleverness does not necessarily mean complicated and costly. It is, indeed, a typical engineering challenge to which designers would re-act if the opportunity were offered.

The economics of the small sailplane as regards materials and manufacturing costs can be worked out on the basis of present-day Standard Class machines which are now getting good experience with laminar wings and high speeds. There are also the brand-new OSTIV Standard Class Airworthiness Requirements. It is quite clear that a modern short-span sailplane cannot really attain the low empty weights attained by the early experimental aircraft in this field, such as the D-28 Windspiel (12 m) and the Hütter H-28 (12 to 13,5 m). These early aircraft were designed to lower load factors and to requirements based on far less knowledge than is now available. As may be seen from Fig. 1, no extrapolation forwards in time would give any hope of lower empty weights, using present-day structural techniques. Only by basic re-thinking, for example, on the lines used by designers of manpowered aircraft, could any real improvement be made. Admittedly, the load factors used are low, but the wings built and flown have to be so very much lighter (Fig. 2) that the balsa/plastic film technique might well merit further study.

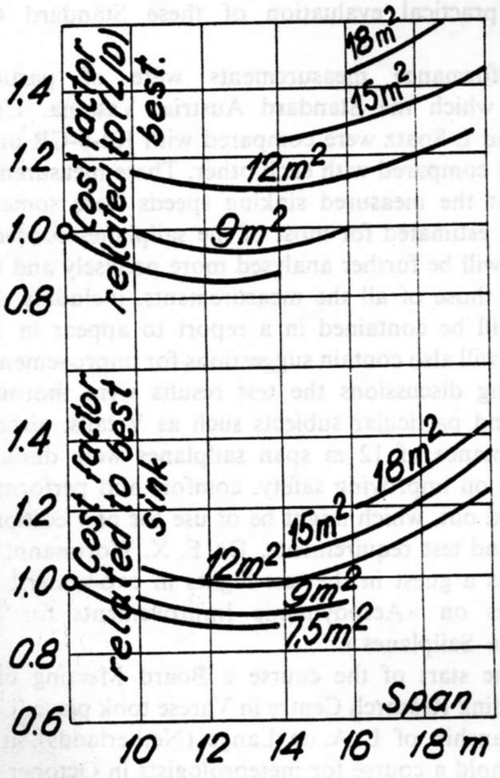


Fig. 3. From *W. Hütter* „Die Grösse des wirtschaftlichen Leistungssegelflugzeuges". Thermik, Juli/August 1949.

On the other hand, assuming we are starting now with a programme of short-span development, we may note that we start technologically better equipped than at the start of Standard Class development. The mirror-finish wings have gradually been achieved by means of various plastics which have enabled low drag wing sections specially designed for sailplanes to be used. We note the work of Eppler and Wortmann has come into practical use in such aircraft as Phönix, Kria, D-34. There are also the all-metal sailplanes, particularly those using light-alloy honeycomb as in Schreder's HP-10. There are also the Sisu (Niemi), Blanik (Dlouhy), the Jugoslav Meteor and the Schweizer Brothers' Series. These developments have, among other things, improved performance by improving the quality of surface texture.

All this experience is there to be applied to the short-span sailplane. There was a long and difficult road to travel before the present-day high performance and in some cases low cost could be achieved for the Standard Class, and there is still much to be achieved. But the road, or rather the rough path, toward the highly developed short-span sailplane is much more difficult, to get performance up and weight down without cost going up. As past experience tells us, even with short-span sailplanes we will be finding "hot-house plants", "super orchids" and the like, appearing at contests, and such jewels will certainly be no cheaper than Ka-6 or Foka. As Lippisch has already remarked: "small does not mean cheap" is a logical result if one wants high performance. W. Hütter (4) has introduced a cost and economic factor as his analysis of the most economical size of Sailplane (Fig. 3), taking into account span and wing area. He concluded that the limit for the economical sailplane in the sense of achieving relatively low cost and good performance was this sort of size:

Span	12 to 14 m
Wing Area	7,5 to 8,5 m²

Hütter's considerations favour the short-span sailplane as long as one is satisfied with moderate performance. Such machines should be club machines and not racers. Production costs should be less than for Standard Class, if one wishes to talk of success. Success is essential here as in any sphere, but real success is the combination of low cost and competitive performance. However, it would be administratively very difficult to prevent pure racers being included in the short-span class. But why should we try to cut them out? Their high cost will classify them, but if such costly aircraft do really excel in performance, they indicate a target, a possibility which might later be achievable at less cost. Such costly aircraft thus increase and maintain interest in a class.

Variations on the theme such as a series of "Standard" machines or multiple class contests do not really help the problem of the small sailplane. The short-span sailplane must take its own way from local to world contests, but to do that it must have a class of its own. To announce a new contest class (say 12 m) through FAI/OSTIV is a simple formality. But that is a mere beginning. You can saw off the wings of a large machine to make it 12 m, literally, but not really. The real modern 12 m bird needs much more: much careful work to make full use of the limitations of span so that an optimum machine can be created which can take full advantage of the sources of power in the free air and show that the effort was worth-while.

Do you, who read this, think there should be a short-span class? If so, should it be 12,5 m, 12 m or less? In any case, tell OSTIV what you think and why.

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