DEFINITION OF LIGHT AND ULTRALIGHT SAILPLANES:
BACKGROUND FOR THE USE OF OSTIV AND FAI

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1. Lack of generally accepted definitions.

In addition to the sailplanes belonging to the FAI Classes, mainly intended for competition, badge and record flying, other types exist, aiming at different objectives like instruction, training, recreational flying, cheap and simple construction from kits by homebuilders.

Among these, sailplanes of reduced size and mass, like Light and Ultralight Sailplanes, already existing in the early times of the sport of soaring, seem to attract again a particular interest. Some confusion exists, however, in their definition.

In the U.S.A. in particular, where these developments are widely pursued, the acronym ULS (Ultra Light Sailplane) has a precise meaning, i.e., compliance with FAR 103 (single seater, empty mass not exceeding 70 kg, other operational limitations, much freedom from administrative obligations).

In the FAI Sporting Code the Ultra Light Glider is the one with a maximum take-off mass not exceeding 220 kg.

In the U.S.A. FAR 103 covers the hang gliders, the performance of which has steadily increased in the past decades, leading to designs like the *Swift* and the *Carbon Dragon* where the foot launching capability in no wind conditions is marginal or precarious. In the evolutionary process many of these advanced designs resemble in shape and structure the traditional sailplanes - indeed they are at the borderline between hang gliders and gliders (or sailplanes).

It has become customary in the U.S.A to name LS (Light Sailplanes) a variety of sailplanes relatively small and light, however not complying with FAR 103 (empty mass in excess of 70 kg). They are mostly used for recreational flying but also for badge and record flying within the FAI take-off mass limit of 220 kg for "Ultra Light" gliders. Well known examples are the *Woodstock*, *Silent, Russia, Apis* and others.

Some types of American ULS and LS are available for construction from kits by homebuilders. Except the case of typical hang gliders, they are seldom offered on sale in the completed form.

2. Exploitation of microlift.

In the domain of hang gliders (therefore within FAR 103), striving for improved performance, such designs as the above mentioned *Carbon Dragon* have been realized, where you recognize the general architecture of a conventional sailplane but luckily enough also an exceptional combination of two high performance characteristics.

Whereas a conventional high performance Open Class sailplane achieves a minimum rate of sink of about 0.5 m/s but a large minimum circling radius of 30 to 50 m; whereas a high performance hang glider achieves a relatively high rate of sink in the range of 1 to 2 m/s but a small circling radius of about 15 m, the *Carbon Dragon* succeeds in combining good values of both characteristics: a low rate of sink of about 0.5 m/s and a small circling radius of about 15 m !

Accidentally the *Carbon Dragon* was found capable to exploit weak and very variable soaring conditions, also in close proximity to the ground, to which the name has been given of *microlift*. This extraordinary capability resulted from the adoption of several design features, but basically through a combination of a high C_{Lmax} (=2 approx.), a low take-off mass (=160 kg=70 kg empty mass + 90 kg pilot and equipment) and a low wing loading (=12 kg/m^2 approx.).

The practical experience has largely confirmed that conventional sailplanes, including LS in most cases, are unable to exploit microlift. They exploit the same air motions of the conventional sailplanes. Main reason for this is that even LS of small size, high C_{Lmax} and low empty mass have a high (or not low enough) wing loading, therefore too large a rate of sink and circling radius.

From both the scientific and sporting points of view the exploration and exploitation of *microlift* opens a new scenario to soaring flight. It is certainly of great interest that both OSTIV and FAI encourage these new opportunities for recreational aviation by their respective appropriate means.

3. The OSTIV initiative.

The OSTIV Sailplane Development Panel, SDP, under the chairmanship of Dr. Michael Rehmet, has fully recognized the importance and the implications of this new type of soaring flight. Also full support has been given by the OSTIV President Prof. Loek Boermans. Since 1999 SDP has agreed to promote a specific Working Group, partly within the Panel, with the main objectives to propose definitions of LS and ULS and guidelines, possibly standards, to cover the airworthiness aspects related to safety.

Actual members of the Working Group are: Dan ARMSTRONG (USA), Bruce CARMICHAEL (USA), Eric DE BOER (The Netherlands), Helmut FENDT (Germany), Daniel HOWELL (USA), Piero MORELLI (Italy), Gary OSOBA (USA), Dieter REICH (Germany).

Preliminary results of the work done so far, reported to SDP, are summarized as follows.

Ultra Light Sailplanes and Light Sailplanes belong to two different categories.

ULS are high performance sailplanes capable of flying at very low speed and of circling with a small radius and low rate of sink. This type of performance is required for the exploration of those air motions, the so called *microlift*, which conventional sailplanes and LS are unable to exploit.

Different standards or guidelines should apply to ULS and LS. A simplified JAR-22 could apply to LS. Simplification should not affect the level of safety. For ULS guidelines and recommendations would probably be more appropriate at this early stage. In both cases reduced complexity of analysis, testing and supporting documentation would be desirable in order not to discourage development.

For the definition of ULS restraints of both the empty mass and the wing loading seems to be favoured. Suitable combinations of the two upper limits could be as follows:

(1)	W_e = 70 kg	W/S = 11 kg/m^2	resulting W with a 90 kg pilot:	W = 160kg
(2)	W_e = 85 kg	W/S = 12kg/m^2	"	W = 175kg
(3)	W_e = 100 kg	W/S = 13kg/m^2	"	W = 190kg
(4)	W_e = 115 kg	W/S = 14kg/m^2	"	W = 205 kg

The first combination corresponds approx. to the *Carbon Dragon*. The other combinations correspond approximately to hypothetical empty mass increases of the *Carbon Dragon*. Other combinations could be proposed. Daniel Howell, for instance, suggests W_e = 70 kg and W/S in the range 13 to 18 kg/m^2.

Increasing the 70 kg upper limit of W_e could be motivated by the following considerations:

- Due to the still limited experience with *microlift* it is still unknown which max. mass and wing loading are still compatible with *microlift* exploitation.
- Sophisticated technology and materials are required for building very low weight structures, hence a high cost results and a remarkable skill is required. This is amply proven by the few successfully completed *Carbon Dragon* realized only by highly skilled homebuilders. An increase of the We upper limit, if compatible with *microlift* exploitation, would greatly simplify the construction and lower the cost.
- A higher W_e limit would encourage and enlarge the possibility of experimentation.

An alternative combination has been suggested for the definition of a ULS: an upper limit for both W_e and the minimum speed for sustained steady flight, V_{min} (e.g., 50 km/h). If the difficulty of an accurate estimation and measurement of V_{min} is reasonably overcome this combination would offer the advantage of taking automatically into account the effect of varying C_{Lmax}.

The adoption of one of these criteria is still an open matter. There is a feeling, however, that a rather definite convergence exists on the specification of upper limits for both W_e and W/S.

4. The situation at FAI - IGC.

Since several years a ULTRALIGHT Class has been created by the International Gliding Commission, IGC, of FAI for the acknowledgement of records. However, the FAI definition of an ULTRALIGHT is different from the FAR 103 definition. The FAI definition reads as follows: "a glider with a take-off mass not exceeding 220 kg". In consideration of what has been reported in the preceding pages of this paper it is clear and evident that such a definition includes ULS and LS (at least a large part of them) if we accept the meaning given by the Americans to these acronyms. Two classes within the definition of one!

What we have seen happening in recent years in this class is that records previously established with real ULS like the *Carbon Dragon* have been broken by LS, i.e. by sailplanes with take-off mass within the limit of 220 kg but with a relatively high wing loading which makes them capable of exploiting the same soaring conditions as conventional sailplanes and behaving as real *racers*.

More important, it puts sailplanes capable of utilizing *microlift* and those not capable of doing so, in the same class. If however specific emphasis on exploring and utilizing *microlift* is to be pursued a separate class for such ULS is desirable. Therefore it would be sensible to define the latter class and call it ULTRALIGHT Sailplanes and to rename the present FAI class LIGHT Sailplanes. The definition of the LIGHT class in terms of take-off mass could remain the same (220 kg or a little more) or converted into empty mass (130 kg or a little more, assuming a pilot mass of 90 kg).

The definition of the new ULTRALIGHT Glider Class could be one of those suggested in Chapter 3 of this paper or some slightly different combination.

The following words by Bruce Carmichael reinforce this solution:

"In these early days we should encourage those features which will enhance *microlift* exploration. While this may eliminate conventional towplane use, and thus limit wider production and utilization, one cannot have everything. The ULS and *microlift* exploration is unique in the soaring world and should not initially be compromised. It should be separate from light and conventional sailplanes."

Bruce Carmichael then expresses a preference for a W_e upper limit of 70 kg so that the Americans would not miss the benefits of complying with FAR 103. It can be argued, however, that even with a higher upper limit nothing would prevent a particular design to keep the W_e limit within the FAR 103 limit. At the same time Carmichael would suggest 14 kg/m^2 as the wing loading upper limit.

It is out of doubt that ULS (in our meaning) open a new scenario for soaring flight. It is likely that, through the exploration of *microlift*, the number of soaring days in many places worldwide would be dramatically increased.

For the time being, however, only one type of sailplane, the *Carbon Dragon*, through the impressive flights of Gary Osoba is reported to be really effective on exploring and exploiting *microlift* conditions.

This type of sailplane, however, in the present situation, can only be homebuilt. Due to the extremely low empty mass its construction requires high quality craftsmanship and a large number of manhours. If produced in small series it would probably be very expensive.

The construction would become simpler and the number of manhours smaller if the mass limit were raised, as per definition (2) or (3). At the same time the structure would be less frail and less delicate to handle. But, would the capability of exploiting *microlift* be thus considerably compromised?

This is a basic question to be answered, as this highly interesting exploitation of the *microlift* will remain the privilege of the lucky few who possess a homebuilt machine unless production of *microlift* gliders at accessible costs is started, opening new possibilities and interest in soaring flight.

Through the creation of this new class FAI-IGC would stimulate experimentation in this direction.

5. IGC-CIVL.

This chapter is co-authored with Mr Tor Johannessen, President of IGC.

The FAI Hang Gliding Commission (or *Commission Internationale de Vol Libre, CIVL*) is contemplating including the *Carbon Dragon* in one of its classes, or, alternatively creating a new class for similar aircraft.

The definition of a hang glider as given by the FAI Sporting Code (General Section, 1st January 2001 edition, art.2.2.1.13) is:

"A glider capable of being carried, foot launched and landed solely by the use of the pilot's legs",

CIVL's problem is that it will be hard to carry, foot launch and land a *Carbon Dragon* unless a head wind of adequate strength and smoothness is there to help the pilot. IGC's problem is that the existing classes have so far not constituted a proper "home" for this type of glider.

The best solution would probably be for IGC to redefine its classes in order to insert a class between today's ultralight and the hang gliders. This would probably best be named the Ultralight Glider and today's UL could then be renamed the Light Glider.

If CIVL introduces a class "on top" of their existing classes, a problem will arise with the definition of a Hang Glider.

6. Conclusions.

This very interesting "interphase" between CIVL and IGC should be discussed between representatives of both Commissions in order to introduce a proper "home" for the *Carbon Dragon* and similar aircraft to come.

As far as OSTIV is concerned the SDP Working Group should finalize the preliminary phase of its work by proposing to the Panel one of the definitions offered in Chapter 3.

The mass upper limit can be expressed either in terms of take-off mass W (as by FAI) or empty mass W_e (as by FAR 103). The difference between the two is obviously the mass of the pilot+parachute+equipment, the latter being equipment additional to the basic compulsory one. The sum of the three items is often conventionally assumed as 90 kg. Therefore: $W = W_e + 90$ kg.

Taking into account the considerations and opinions expressed by the members of the Working Group so far, I would suggest to recommend combination (2) or (3), with a slight preference for (3) but with the wing loading slightly increased, i.e., $\mathbf{W_e = 100\ kg,\ W/S = 14\ kg/m^2}$.

The definition of a LS could be $W \leq 230$ kg, where $W = We + 90$ kg, or simply **We £ 140 kg**.

After approval by the SDP, the Working Group could proceed further with draft guidelines and recommendations on airworthiness aspects applicable to ULS.

As far as FAI is concerned, thinking of competitions for Ultralight in the future, the fact should be acknowledged that LS are typically *racers* whereas ULS can't help being typically *floaters*. This characteristic could suggest to adopt a different *task philosophy* for ULS, in addition to *speed* and *distance*. Without going back to endurance flights of good old memory, new ideas could perhaps come up. This could be an interesting study in itself.

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Note:

On the name of the potential new FAI Class Eric de Boer has offered the following considerations.

The name ULTRALIGHT being used in both the FAR 103 American regulations and the FAI Sporting Code with different definitions, some confusion may arise.

*He explains: The basic reason to create this new class is to enhance the development and use of sailplanes capable of using **microlift**. To make this clear it might be smart to express this in the name of the new class. Renaming the present FAI-IGC Ultralight Sailplanes into Light Sailplanes probably will be more cumbersome than leaving this name and adding a new name for the new class.*

*An appropriate name for the new class might be **Microlight Sailplanes**. This indicates an understandable connotation with the **microlift** phenomenon, as the prime driver for the new class.*

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