Introduction:

At the 2009 AGM the Hydrofoil Commission were asked to put forward a proposal for a ballot to restrict lifting boats out of the water. The areas of concern are Rules (8) and (4), the “No Hydrofoils” rule and the “inner box” rule. During the meeting Rule (8) was discussed and it was decided that this rule’s true meaning was difficult to define, and if correctly interpreted could lead to disqualification of about 90% of the current fleet. It was agreed that this was not the intention of this rule and the development in the class towards canted centerboards has been allowed and accepted by the fleet. The Agreement of the IACA committee was that a certain amount of vertical lift was accepted by the class and the commission should concentrate on controlling the key factors to stop “Flying Boats”.

From this point on we try to explain our decisions so that you understand the ballot proposal we have put forward. Firstly let us say that is not our intention to add any more rules to the class than absolutely necessary to control the Flying boats issue. The Class has excelled for many years on a very simple formula and we believe this to be a very important factor for the continued success and growth of the class. Many new rules and restrictions won’t stop people from trying, but it usually leads to complicated and expensive solutions to get around the rules.

The First and most important point to explain is just how difficult it is to lift an A class out of the water. Luc du Bois and Mike Drummond both made calculations to arrive at the same conclusion. Both agreed that the likely hood of making a boat fly around the course even with completely open rules was highly unlikely and most likely to be slower than a conventional boat.

Calculations:

Luc’s Calculations are explained below,

- *To have a boat completely lifting off the water, we need a vertically acting force that we set, for the purpose of this study at 1470 newtons (the force equivalent to 75 kg of boats + 75 kg of equipped helmsman = 150 kg)*

- *We are limiting ourselves to study how to generate this force hydro dynamically only*

- *The only limitations we kept from the current rules are :*
    - *Maximum width : 2.3 m*
    - *A zone symmetrical on boat centerline of 1.5 m that must be exempt of any underwater appendages*

  This is leaving us with two 0.4 m wide zones on each side of the boat where we can try to add devices generating vertical forces.

- *The configuration we kept is the following : 0.4 x 0.15 m horizontal foils added at the bottom of each rudders and dagger boards*

- *This configuration creates a total horizontal area of 0.24 m2*

- *To calculate the maximum force this surface could create we use the following formulas*

$$Lift = (cl * V^2 * A * D) / 2 \text{ (newtons)}$$

where:

cl = lift coefficient (dimensionless)

V = boat velocity (metres/second)

A = foil area (square metres)

D = water density (kg per cubic metre)

The cl value typically depends on the angle of attack of the foil and on the section shape of the foil. We set this value to 0.4 mainly looking at what the Moth class is using for its foil design. We know it works!!!

Typical water density is 1025 kg per cubic metre

To get to this maximum lift the foil should have a reasonable aspect ratio. For foils of equal area, a foil with a long span and a short chord length is more efficient than a foil with a short span and a long chord length. The following formula gives the variation of induced drag with changing aspect ratio

$$Cdinduced = cl^2 / (Pi * Ar)$$

cl: lift coefficient

Ar: aspect ratio (Span length/chord length)

- *Using the first formula we can conclude that with ideally designed foils the required boat speed to generate the taking off force is around 10 knots. Now we have to consider the aspect ratio of the foils. Again let's go back to the Moth Class - their typical foil design has an aspect ratio of approx 7 (850mm span for 120mm chord). With the 400 mm available from the box rule we can only achieve an aspect ratio of 2.7. Using the second formula we can see that we have an increase in the induced drag of a factor 2.5 versus using an aspect ratio of 7. This translates to a new take off speed of 16 knots. To compute exactly by how much the total drag increases from 7 down to 2.7 of aspect ratio requires a full study involving an accurate modeling of the boat. Since we didn't have access to a full VPP, we have tried different approaches and asked different opinions to quantify by how much the take off speed will increase with this very penalizing low aspect ratio, and the range goes from 13 to 16 knots. We can see that even if we take the most favorable value: 13 knots BSP, this is still very high making it unlikely to take off upwind (between 45 and 50 TWA) in any wind conditions.*

- *Downwind, again, 13 knots is already pretty fast. (Marginal one hull flying downwind speed = 10 knots approx). That means the boat would not take off downwind before around 12 knots of TWS (depending on the wave conditions).*

- *Another factor that also needs to be considered is that as soon as the boat starts lifting, the horizontal side force generated by the vertical part of the dagger boards will start decreasing making it very difficult to point when going upwind. It will be like raising the dagger boards while going upwind. It doesn't work!!!*

- *Considering all of the above it seems very unrealistic that such a configuration (the most likely to allow a catamaran to lift completely off the water) could be faster than the boats we are currently sailing with. Actually the C-Class tried it and even without the box rule limitation this configuration was slower than their conventional boats, at least on an upwind/downwind course* *http://www.youtube.com/watch?vEiLaEaS5GLY*

- *One of the very important reasons why the Moth Class manages to have flying boats that can go upwind is because they can heel to windward. Once the boat is out of the water the vertical part of the dagger board is not generating much side force any more. When heeled to windward it is the horizontal part (not horizontal anymore) that compensates. With a multihull it is very difficult to come up with a concept that addresses this realty (loss of side force when airborne) if you can't put any devices in the center of the boat*

- *The conclusion of all of the above is that the current box rule is most likely good enough to guarantee that a flying boat would not be faster than a conventional boat around the buoys.*

Mike Drummond added some other comments about the extra drag a set of T-foils would add:

With 4 foils of 0.4m x 0.15m the Induced drag of the hydrofoils is about 10kg. At 10 knots boat speed this is like towing a 140mm diameter sphere! At 20 knots BS it is equivalent to a 75mm sphere!

I believe there is NO way this will work upwind at this foil span - at very best the drag reduction will cancel the hull drag saved. And this doesn't take into account the reduction in righting moment due to the windward hydrofoils lifting the windward hull - about 40% reduction!

Considerations of the new rule proposal:

Reducing further the possibility for a boat to fly means reducing the amount of vertical lift it can create and maintain. There are several ways we could achieve this. The first consideration was to increase the gap of 1.5m between the centerboard tips. That would create problems for all the already measured boats that would not comply with a new limit. We probably would have to accept them under a grandfather clause and that could create some trouble if those boats were turning out to be faster than the one complying with the new rules.

Our approach is to create limitations within the current 1.5 m limit in order to make it impossible to use fully the 0.4 m of horizontal area (max possible area per side of the boat). "Movable and retractable hull appendages shall be inserted from the top or be capable of being fully retractable into the hull". Such a rule will straight away ban any kind of T-foils or multi-surfaces foils (impossible to insert these kinds of foils from top of trunk). And also the width measurement shall include hull appendages in all positions (completely down and completely up flush with the bottom of the hull). Without an additional surface extending to the windward side of the foil it is very difficult to use the full 0.4 m of horizontal area efficiently. It is also working toward keeping foil construction simple (cost limitation effect). "Inserted from the top" also takes care of a security issue. When landing on a beach in windy conditions and/or with waves, it would be complicated if we all should jump in the water at 1.5m depth and pull foils down through the cases.

The change from 1.5 m between tips of appendages to 0.75 m from centerline is to address the fact that with adjustable canting angle of appendages it was possible to have one board with a lot of angle and the other board in a vertical position and comply with the 1.5 m rule. This is just to fix a loophole of the rule.

The question about banning flaps and/or trim tabs on appendages generated a lot of thinking and sweating but at the end we concluded that this was not a primary feature to make a boat fly but only a necessity to be stable while flying. If the boat doesn't fly there are no fundamental reasons to limit the devices that control the stability while flying

We also debated if we should put a limitation on "moving appendages" such as self-tacking dagger boards. This was not perceived as a feature fundamentally helping making a boat fly. Rotating an entire dagger board around the transverse axis (pitch axis) could be used as a way to actively control the amount of vertical lift but it is not a very efficient way since you have to move the most loaded part of the boat. It would be complicated, heavy and slow to adjust. It is also very difficult to find the correct wording for such a rule. Currently dagger boards and rudders are moving. Up and down the trunk for the dagger boards and around the vertical (steerage) and the transverse axis for the rudders. Self tacking dagger board is a well known technology. The question is more why is it not already use on A-cats?

Concluding points to consider

The Hydrofoil commission concluded the main problem with the existing rule was that no ISAF definition of the word hydrofoil exists, and therefore the wording of the existing rule 8 "Hydrofoils are not permitted" would continue to give us problems in the future.

Great efforts were put into the work, aiming to keep the rules as simple and easy to understand as possible, and at the same time ensure that no A-Class successfully would be able to fly around the course. Also we wanted to ensure that almost any boat that is legal by the existing rules will be legal after the new rules.

The wording of rule 4 has been slightly simplified and uses terms as defined by ISAF.

In rule 8 we have removed the word "hydrofoil" as it has no proper definition in the ISAF Equipment Rules of Sailing, and put in the limitation that we believe will be sufficient to stop boats to fly successfully around the course.

Below is a list of some of our thoughts and conclusions during this work:

- The cost of curved foils is not very high considering their potential life span. So far doesn't seem like a major step up in price. The trunk modification is not more complicated or costly than the move to the narrow boards we saw few years ago. Lets put it in perspective versus a new sail or a new mast

- Historical the class made some major steps forward like changing to carbon masts, new sail cloth etc. At that time the performance impact was bigger and the costs higher, but still the class didn't ban that.

- Simple rules are usually the most efficient. (E.g. 75 kg limits achieves a lot with very few words and without targeting anything in particular). With complicated rules you need a full time "rules interpretation committee". That's what we have in the America's cup!!!

- Lately all the major championships have been won with mainstream technology. All the new developments have been evolutions and not revolutions. It shows how evolved the class is and how difficult it is to come up with improvement that are efficient in every wind conditions and every sea state. The Curved foils are falling into this category without a doubt. So we should not take radical actions that could kill the long term future of the class

- The class will only survive long term if it keeps attracting new sailors (most likely young ones) and with the emergence of new radical and fun boats it would not be smart to become extra conservative.

- The class has survived all this years with an open rule. We don't see anything new showing us that we should change that concept.

- It is worth noting that no boats using curved boards managed to fly at Belmont despite using the full dagger board size available under the box rule – this shows how effective the box rule is.

Next steps:

The next step is for all members of the national A-Class associations to vote for or against the new rule proposal. A majority of 2/3 of all votes is necessary for the rule to pass. So we would like to encourage all of you to vote to make sure we get the right result. We would like to ask you all to take your thoughts away from your own current boat while considering the proposal, and let your decision be based on what you think would be best for the future of the class.

If this proposal should fail, the Hydrofoil commission has to go back to work again and come up with a new proposal. This proposal is liberal, but it's strong enough to stop boats from flying successfully around the course. A new approach would have to be more restrictive and take the words of the existing rule 8 more literally. Basically this would mean banning all dagger boards that are not vertical! This will make the majority of the racing boats of today illegal and may destroy the class.

The spirit of the A class has been to develop. This freedom of development is what has made the boat so great. We have to maintain this “spirit of the class” so that in 20 years time the A class is still the greatest multihull class in the world. Our future relies on staying at the leading edge of technology. If we fall behind the class will slowly fade away, while other classes move forward and prosper.