F3 Aerobatics proposals 2021 – some thoughts about proposal a)

Comparison of IC powered F3A models with E powered

ICE powered F3A models	Electric powered F3A models
Wingspan max 2m	Wingspan max 2m
Fuselage length max 2m	Fuselage length max 2m
Weight 5 kg + 1% without fuel	Weight 5 kg + 1% with battery
Weight checked at 2019 WCh 4775 g -5035 g	Weight checked at 2019 WCh 4425 g -5050 g
Weight of World Champion (ICE) model 5030 g	Weight of rank 2 (EP) model 4685 g
Advantage: Higher speed possible in windy conditions because engine rpm speeds up in the air. APC propellers may be cheaper than CFK propellers for EP.	**Advantage:** Constant speed flight easier to achieve, possibility to break on down lines, better regulating of rpm, compensation of thrust moments possible, easier to handle than ICE. Operating cost lower then with ICE, if set up is correct..
Disadvantage: Vibrations of engine needs firmer structure of airframe, complicated silencer systems, oil on model aircraft. Worse breaking on downlines. More difficult to handle than EP. Expensive. Increasing costs for Fuel. Restrictions on airfields.	**Disadvantage:** RPM fixed by rpm per volt. Handling of batteries may be dangerous. Expensive. CFK propellers used with most engines and gears are very expensive.

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F3A Propulsion Devices

At the beginning not more than 10 ccm, at the end of the eighties 20 ccm for 4-cycle engines were allowed. The 4 cycle engines were introduced to reduce noise. From 1996 no limit for IC engines anymore. Use of 2 cycle and 4 cycle IC engines with higher displacement is allowed, no limit till today. Interesting that 2 cycle engines at these times had more power than 4 cycle engines with same displacement and produced less noise. Nevertheless F3A flying with 4 cycle was preferred by most of the pilots. Costs were much higher, but constant flight speed was easier to achieve. Sometimes gas engines with more than 30 ccm occurred like 2017 in Argentine.
First competitive F3A electric model by Jason Shulman at the 2003 World Championship in Poland. Rules allowed not more than 42 volts with fully charged battery because of national and transport restrictions. Power was mostly higher than with IC engines.
After 2003 the number of EP models increased. In 2004 first Champion at a Category 1 event in F3A. Batteries and propulsion devices were very expensive and lifetime was not so long.
First EP models had gears with high rpm electric motors. First contradrives could be seen at the 2007 F3A WCh. They were noisy. Also outrunners were designed especially for F3A, had a lot of power and worked reliably, but were expensive, too. The regulators got better and allowed exact regulation of RPM and breaking on downlines. This and noise limits for IC powered model aircraft on airfields were the reasons why many pilots changed to electric.
More and more pilots changed to contradrive devices to avoid influence of the propeller on yaw and roll axis. This increased costs a lot and often problems with broken gears occurred. So some went back to the more reliable outrunners with expensive very exactly working regulators and three blade propellers.

Problem of all EP models was that flight speed in windy conditions did not increase as with IC engine which increase rpm in the air.
But ICE powered aircrafts don't break as much as EP models on downlines because of smaller propellers. So the displacement of IC engines needed to be increased to use similar propeller size as EP engines. If the manufacturer increases displacement the power may increase, too a little bit. The main advantage might be that bigger propellers can be used for better breaking on downlines similar to EP models. Weight limit will stop this development, soon.
Unlimited displacement being the current rule may have led to larger and larger engines but the whole case is limited by current weight regulation. It will be hard for engine developers to increase displacement without increasing weight.

During the last 20 years F3A model aircrafts got larger and more voluminous, costs of new models and propulsion devices increased and older models became obsolete. That was happening with IC powerded models and electric powered models. Electric powered models had the same development, only cell structure can be made lighter because vibrations of the engine are less.
We had and have a lot of developments during the last 17 years with electric: Direct drive, gear devices, and contrarotation systems. May be the next step will be a compensation of turning masses to avoid negative effects of turning rotors. Batteries got lighter and provided more power. The efficiency of motors got much better with same or lower power consumption.
At the last World Championship we had less than 10 % of pilots with IC engines. On many airfields flying with IC engines isn't allowed anymore because of noise restrictions.
So we need to ask ourselves whether it is necessary to implement additional restrictions for such a minority and stop development of better IC engines or change it in a more complicate way? May be engines with a little bit more dislacement can work with less nitro? This is an important item because in EU there will be a regulation which doesn't allow more than 16% of nitro in fuel.

And if the combustion engine would have so big advantages, there would have been more in competitions. We all know that for using such an engine a lot of knowledge and experience is necessary and we know, too that it is much easier to use electric "plug and play". Each pilot can choose his favoured propulsion system. If he chooses EP he can have different possibilities like direct drive, gear drive and contra drive. For IC we only have the YS as competitive engine. We only have this manufacturer for F3A IC engines. Do we want to force him to other development to improve IC engine methods like direct ignition, tubo boost, … which would increase costs much more?

Ok, the World Champion Christophe Paysant Le Roux used an IC engine. But is the engine the reason that he has won? He is an excellent pilot, flies very well and didn't win with the "advantage" of his propulsion device.
There were Continental Championshisp where he did not win. Pilots with EP models flew better. This already happened in 2004 when Roland Matt became European F3A Champion and it happened in 2014 and 2016.

May be a really good running 2 cycle cheap gas engine with higher displacement may be developed. Do we want to prevent this?

Costs are high for F3A IC engines and for F3A electric propulsion devices. Same for models because nearly all use ARF models with prefabricated finish.

During the eighties and nineties a big number of well known F3A pilots built heir models by themselves with much lower costs. They normally built at least two every winter, own design or with a kit. What is now? You need to install equipment and connections from servos to the control surfaces. And especially EP models can be used for a long time. Radios are working without failures, engines running reliable. IC engines cause problems with vibration, oil and getting expensive fuel, a lot of knowledge is necessary. Many pilots don't have this knowledge anymore and so prefer electric power and I think there will be more in the future.

F3A began with IC engines, later on EP joined F3A instead of F5A and many pilots changed to EP. We don't need a fight between fans of IC and fans of EP. This will not be in favour of our sport.
So before we talk about restrictions for one part of the competitors which is already a minority, we should think about doing some investment in the future of F3A. How can we get more pilots interested, how we can reduce costs for all. We don't need to adjust some smaller screws, we have to reflect some more!