STRIKE

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National Karting Council,

Dear Sirs,

The purpose of this document is to provide a perspective and a proposal for the future of the Yamaha KT100J engine within the AKA class structures.

At the November 2010 NKC meeting (which was attended by members of the public), various considerations were made as to future engine classes. While the matter of the J engine was raised, the future of this in the long term is still undecided. Some other general ideas were discussed, including the consideration of a 100cc reed valve engine incorporating CNC machined ports, air cooling for simplicity, clutch and no on-board starting.

Taking the above into account, it is worthwhile to review the J engine and its current place in karting:

- The engine is relatively cheap (retail price of $1000 compared to a Comer SW80 $1500)
- Probably the largest number of kart engines used in Australia are J engines, with its use carried across 3 large classes; Rookie, Junior National & Senior National.
- Many senior karters run the J engine because they do not want the speed, cost, weight and grip of the alternative senior classes
- Due to the acceptance of aftermarket parts by the AKA, the replacement parts are very economical (piston, ring and piston pin from STRIKE is $105, compared to KSI $93, Comer SW80 $170, Leopard $173 & Rotax Max $174. Note that these are approximate only).
- An estimated 80% of all J engines used already have clutches and starters
- All run an AKA control airbox and exhaust plus the simple Walbro carburettor
- Engine rebuilding is simple, low cost and can be performed by virtually every engine builder in Australia.
- It is backed with a robust set of rules

- It is the simplest of all AKA engines to strip and inspect and, probably because of this, is the most inspected, particularly in relation to the “sophisticated” 125 cc TAG engines which due to their complexity, are regarded as complex and difficult to measure.

Given this, the engine clearly satisfies most, or all, of the AKA’s needs, with the exception of the CNC ports. The J engine has ports that are cast into the cast iron cylinder liner, the liner being subsequently plugged with sand cores prior to being cast inside the aluminium barrel. Whilst a low cost production process that is perfectly adequate for a non controlled applications, such as for industrial engines or small road motorcycles, it has limitations in a controlled performance application, such as karting.

The important areas of concern with the ports of the J engine are:

- the distance between the top of the exhaust port to the top of the transfer ports
- the variation in the transfer port heights
- the port and passage shape detail, both in the liner and the aluminium barrel
- “overflow” of aluminium over the port edges in the liner
- the possible mismatch between the liner port and the transfer passage in the aluminium barrel
- the variance between older and newer engines

The variation of cast ports is well known to the AKA: rumours and innuendo of spark erosion of ports, the good and bad engines, $3000-5000+ engines (not just J engines), attempts by Rotax to remove the variation with complex machining of the exhaust port, scalloping of the ports in the Cheetah etc. The recognized preferred porting style by the AKA is the CNC machined liner as used in ARC and Leopard engines, where tolerances of+/- 0.025 are easily achieved compared to 20 plus times that of cast ports.

To eliminate the cast port variable from the J engine gives rise to 3 main options:

1. Introduce the “grind to the line” concept, where engine builders could actually grind the transfer ports to the allowable maximum. Obviously other process could also be used, such as spark erosion to achieve the same result. Allowing such processes, predominantly dependent on manual skills and settings and, despite a necessary comprehensive set of rules, could result in problems with cutter damage to the sides of ports, variable upsweep roof angles, how far the machining enters the ports etc, making it a “difficult to control” rule, with the predictable potential for certain engine tuners charging a bomb for some trick grinding process that is (debatably) better than the others etc. However in saying this, it still represents an easy way forward for the AKA, but it would require great care in the writing of the rules.
2. Allow the existing cast-in liner to be machined out and replaced with a CNC liner. While good in concept, this has been investigated, but effectively ruled out for two reasons. One being the fact that the original iron liner has a band top and bottom of the liner, this would be no issue at the top as it would be machined out, but at the bottom the band would not easily machine out, creating both inlet passage sealing issues and mechanical fitting (during shrink fitting) problems. The other being the inevitable mismatch between the cast passages of the original aluminium barrel and those of the CNC liner, again requiring some manual work to rectify
3. Create a totally new cylinder assembly with accurately cast passages in conjunction with a CNC liner, to the same quality of match and precision of the Leopard. This would offer the all the advantages of such a construction, plus the added benefit to the karter that the liner could be replaced, rather than the total cylinder assembly.

As this document has come from STRIKE, the reader might be wondering where it is headed. From STRIKE's perspective, we have a reliance on the retention of the J engine as we manufacture pistons, clutches and starters for the J engine. Our involvement is certainly pecuniary, but we do recognise the importance of the J engine in karting and the many livelihoods that directly or indirectly depend on the engine.

STRIKE proposes that it (itself and others) could manufacture (directly or by sub contracting) and supply a new aftermarket cylinder assembly (pursuant to Option 3 above) to be used in all classes where the J engine is used. This would have a retail cost of around 2 sets of Dunlop SL1 tyres.

Obviously there are some important considerations with such a proposal:

a) **ARGUMENTS <u>AGAINST</u> THE PROPOSAL:** One argument is that it would diminish the value of the $5k good engines. This is true, but to tolerate these is not good for the sport, so would be a case of "too bad, too sad" for the very limited number of owners of these. The AKA is not around to support a market for overpriced engines in a sport designed around engine performance parity. Another is that people who buy a new engine (eg entering the sport) would be faced with buying a new CNC barrel. This is exactly the situation we have now, in that if a new engine is purchased and it is not a good performer, then the really keen competitor would be faced with chasing around for an overpriced high performing engine (which, incidentally, would be much more than the cost of the CNC barrel).

b) **ARGUMENTS <u>FOR</u> THE PROPOSAL:** The main argument is that a high degree of parity could be achieved, making the vast majority of karters happier that they are not competing against a "fast" engine. This would remove all the innuendo about fast engines and eliminate the trade of high $ engines. Another argument is that by introducing a CNC barrel, it would provide the opportunity to tighten up all rules pertaining to the cylinder (eg as per Leopard) to minimize or eliminate any permitted changes or modification. By having a control design and full engineering specifications, there would be no reason to accommodate evolution (or other changes) that would affect performance. It would be STRIKE's intention, should the proposal favour STRIKE, that the design of the barrel would be given freely to the AKA for their ownership. It is also suggested that the AKA receive a royalty for each cylinder sold.

c) **DESIGN CONSIDERATIONS:** To simplify the transfer porting, it is proposed that the port roof be level rather than sloped as the standard port and the top and bottom of all ports be square to the cylinder axis ie, no angled edges (Note that this is a feature of the Yamaha J cylinder). This simplifies tooling and manufacturing, but the main reason is to simplify the inspection of the engine, whilst still using the current PTG system. The level and square transfer port is a practice in other linered engines eg, ARC. Irrespective, the basic port and passage design would emulate those in the J cylinder as closely as possible.

   The ideal situation must be that the barrel would, at least, have the same performance as the "best" good J barrel. This is the only way to go. If the alternative was considered and the cylinder was "slow", no-one would buy and nothing would be gained.

d) **INTRODUCTION OF AN ALTERNATIVE CYLINDER:** A guess of the number of actively used J engines might be around 2500, although it is conceded that this may be conservative. Irrespective, it does raise the question as to how a higher performance cylinder may be introduced (as it would be impossible to provide this number on any Day 1) and the impact on karters with an average performance cylinder. One way to overcome this could be to provide a restrictor with the cylinder that is compulsorily used for an initial period. At the end of that period, then it is no restrictors. While this might sound to be a difficult thing to do, it would be much more seamless than trying to introduce another completely different engine (again with more performance) into the National class, taking into account the effect on the competitor. However,

when it is all said and done, it might just be easier to allow the cylinders to be run “as is” as soon as supplied, but it must be acknowledged that those with the cylinders would stand to benefit over those without. Again, it must be pointed out that this would be no less unfair than the present situation. Obviously this raises many questions on supply and distribution, which would have to be addressed.

e) **EVALUATION OF CONCEPT:** It obviously would be necessary to demonstrate that such a design offers both the performance and also a very limited range in performance variation. It is proposed that an initial liner be manufactured and fitted to a J barrel (despite the technical difficulties indicated above) and this is dyno tested to demonstrate the general performance level. Should this prove successful, the next stage would be to create the tooling to produce the inner core (this would be a one piece sand component that creates the exhaust, inlet and transfer passages) and the mould tooling to create the external features of the barrel. From this, a small batch of pre-production prototypes could be created and these evaluated with the focus being on demonstrating some agreed-to target levels of the variation between each of the cylinders. This is not a trivial step in terms of time and expense. STRIKE would be willing to undertake this, but clearly would require formal approval from the AKA that they would commit to allowing the subsequent commercialization of the cylinder, should it meet the technical objectives.

f) **CONTINUITY OF SUPPLY:** Should such a proposal go ahead, it would be critical that the supply of the cylinders be guaranteed (at some predetermined supply rate) for the AKA life of the engine. The key to this would be the AKA having total ownership to the design (this includes formal (and toleranced) engineering drawings for both the liner and barrel.

The basics of such a supply plan might be:

- Formal design of cylinder assembly (including liner and barrel separately) by STRIKE
- Blank liners cast by W
- Liners machined by X
- Barrel mould & inner core box tooling by STRIKE
- Barrel cast by Y
- Barrel machined by Z
- Liner shrink fitted into barrel, packed & distributed by STRIKE

On a much longer term perspective, it could be that the AKA could take total control of the J engine. This might come about should Yamaha come to the conclusion at some stage in the future that it is no longer viable to manufacture the J engine in the very small volumes that it does for the Australian market only. This is not to take away anything from Yamaha as the AKA must be grateful for supplying the KT100 J & S engines in the same design format for decades, providing the sport with a high degree of stability. At present, the piston, rods, bearings, piston are produced by the aftermarket suppliers, with the possibly of the CNC barrel. This essentially leaves the crankshaft, crankcase, cylinder head and ignition as items that are still Yamaha. An example of addressing these could be that the crank could be made by KSI, the crankcase & cylinder heads by a range of suppliers and the ignition could be supplied also by a range of existing manufacturers (eg PVL, KSI etc). Thus the engine could be completely controlled and owned by the AKA. All suppliers would necessarily be AKA approved and could manufacture “their” component to the AKA design. Again a royalty fee would apply to each component sold.

We make this proposal on the basis that it be considered as a genuine constructive suggestion for the future of all classes using the J engine. Obviously this would only represent the start of a fairly comprehensive programme should it go further, but everything must start somewhere.

Taking all the above into account, there are two obvious questions to be asked when considering this proposal:

1. Would Yamaha be willing to develop and supply such a cylinder? We have informally asked this question, but should the AKA show interest in the approach, then Yamaha should be formally asked by the AKA.

2. Should the J engine be completely replaced with another engine, eg Vortex Mini Rok engine, Honda/Chonda GX200 4 stroke, etc, etc., ?

STRIKE would be appreciative of any feedback from the AKA on the above and obviously be willing to participate in any further discussion.

Yours Faithfully,

Ken Seeber