DISPELLING THE ROTAX MAX MYTHS

Rotax is far and away the most popular karting engine in the world. BRP-Rotax, the manufacturer, recently passed the 50,000 mark for the Rotax Max series of engines and has produced in excess of 6,000,000 engines across its entire engine range.

Why are these engines so popular and why are there so many myths surrounding Rotax engines in Australia?

The following series of articles with technical material sourced directly from BRP-Rotax in Austria (and tested in Australia) will hopefully dispel the myths and provide interesting and useful technical information to benefit current and potential Rotax owners.

BRP-Rotax is a more than 80 year old company and the Austrian affiliate of Bombardier Recreational Products Inc. (BRP). It is a leader in the development and production of innovative 2- and 4-stroke high performance Rotax® engines for BRP products (Ski-Doo® and Lynx® snowmobiles, Sea-Doo® watercraft and sport boats, Can-Am™ quads and roadsters) as well as for motorcycles, karts, ultra light and light aircraft. Over the past 50 years, the company has developed more than 350 engine models for recreational products and has produced more than six million engines.

International Karting Distributors

Rotax BRP involvement in karting started in the 1980's when the company produced high performance Rotax 100cc engines.

In 1988 Rotax engines took nine of the top ten positions in the CIK World Karting Championship

Several of today's F1 drivers including Kimi Raikkonen, Jenson Button, Giorgio Pantano, Anthony Davidson and Robert Kubica started their racing careers in karts, using Rotax engines. Locally, karting legends Troy Hunt and Mark Winterbottom (to name only two) have campaigned Rotax engines.

Based on this experience Rotax introduced the Rotax 125 MAX in 1997, with the Rotax 125 Junior MAX following in 2001.

In 2002 Rotax stopped producing its range of 100cc engines to concentrate on the Rotax MAX range of products. That same year, Rotax launched the 125 MAX DD2 engine with direct drive (no chain) that is currently homologated for the Open class in Australia.

In 1999, Rotax started its own racing series, the ROTAX MAX CHALLENGE, on a national level in Europe. In 2000, the first ROTAX MAX CHALLENGE GRAND FINALS was launched and is now the largest international motorsport series in the world. In 2007 216 Driver drivers competed at the GRAND FINALS at Al Ain/UAE, including six Australians.

In 2008 the Rotax Max Challenge Grand Finals will be held at La Conca in Italy, again five lucky Australian karters will take part.

There are numerous engine types available to junior and senior karters in Australia from the old trusted Yamaha KT100J and KT100S to current development high performance 125cc motors such as Rotax MAX and Leopard.

What all of these motors have in common is that they are two strokes, but that is where the similarities end. The Rotax MAX is a 28 horsepower engine that only revs to 14,000 rpm and yet we regularly hear stories of Yamaha KT100S revving to 16,000 plus and Leopards to over 17,000.

Why are the Rotax engines different? And how are they able to provide such performance whilst maintaining a longer service life over other engines.

Firstly most Rotax engines have a power valve. The power valve is a valve that opens once enough pressure has built up in the exhaust system. What this means is that Rotax MAX engines effectively have two exhaust port timings. When the valve is closed the exhaust port is lower to give maximum bottom end power, when the exhaust port opens the port is then effectively higher to give maximum mid-range and top end

power. This is an ingenious way to have the best of both worlds in terms of bottom end punch and then top end superiority within the one engine.

Secondly the Rotax engine has a tuned exhaust pipe. The pipe is expressly designed and tested to give the correct back pressure to divert as much unburnt exhaust gas as possible back into the engine to maximise potential horsepower. That is why the Rotax engine has a unique exhaust system that is not adjustable by the user in terms of length like most other pipes. The tuned pipe works most efficiently at a particular RPM so Rotax has another feature designed to maximise the benefit of the tuned exhaust system… a digital ignition.

The digital ignition adjusts the ignition timing of the engine as the RPM increases to keep the optimum performance level of the engine synchronised with the tuned exhaust system. When high RPM is achieved the ignition changes dynamically to automatically limit the RPM to 14,000. This feature saves engine wear and as the Rotax engines do not produce usable horsepower above 13,000 RPM has practical applications as well.

Overall these features are unique to Rotax Kart Engines and make for an engine that produces horsepower and lap times equivalent to other high performance 125cc engines and yet uses far less RPM's. Remember it is the RPM's that cost money via more frequent engine rebuilds.

Rotax engines also run 40 to 1 fuel to oil ratios. All other main stream kart engines run 16 or 20 to 1 fuel to oil ratios. A fair percentage of the particulate matter dispelled by an engine (i.e. the pollutants) is due to the amount of oil used. The Rotax is the most environmentally friendly two stroke kart engine in use in Australia today, a fact that is becoming more important as days go on.

<u>Setting up your Rotax</u>

There have been many myths surrounding setup of Rotax engines over the years in Australia and whilst there are many useful tools available, competitive setup of a Rotax is best performed with some understanding of how the engine works.

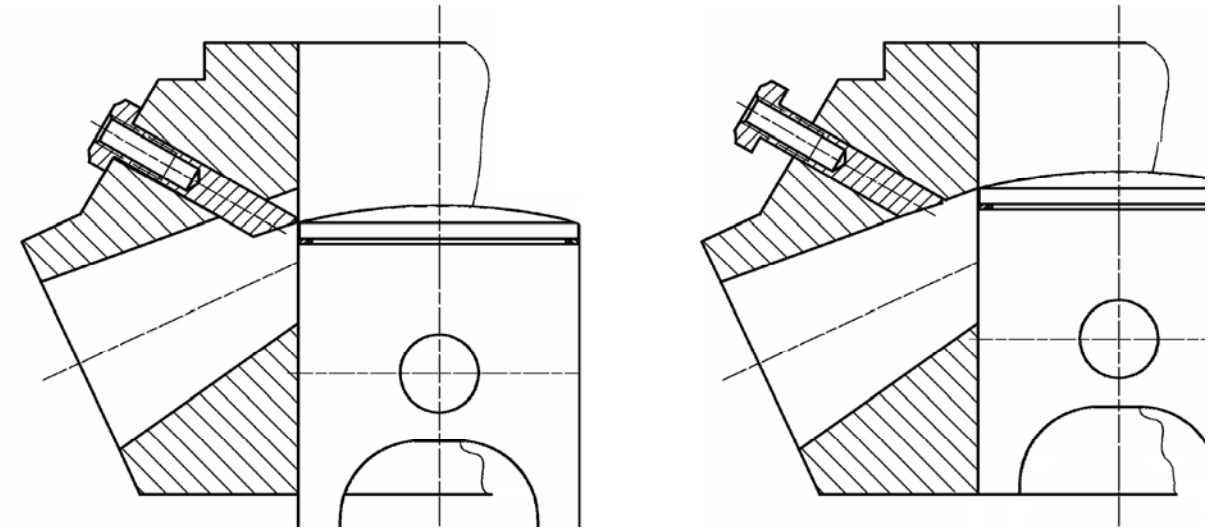
International Karting Distributors

TIP #1

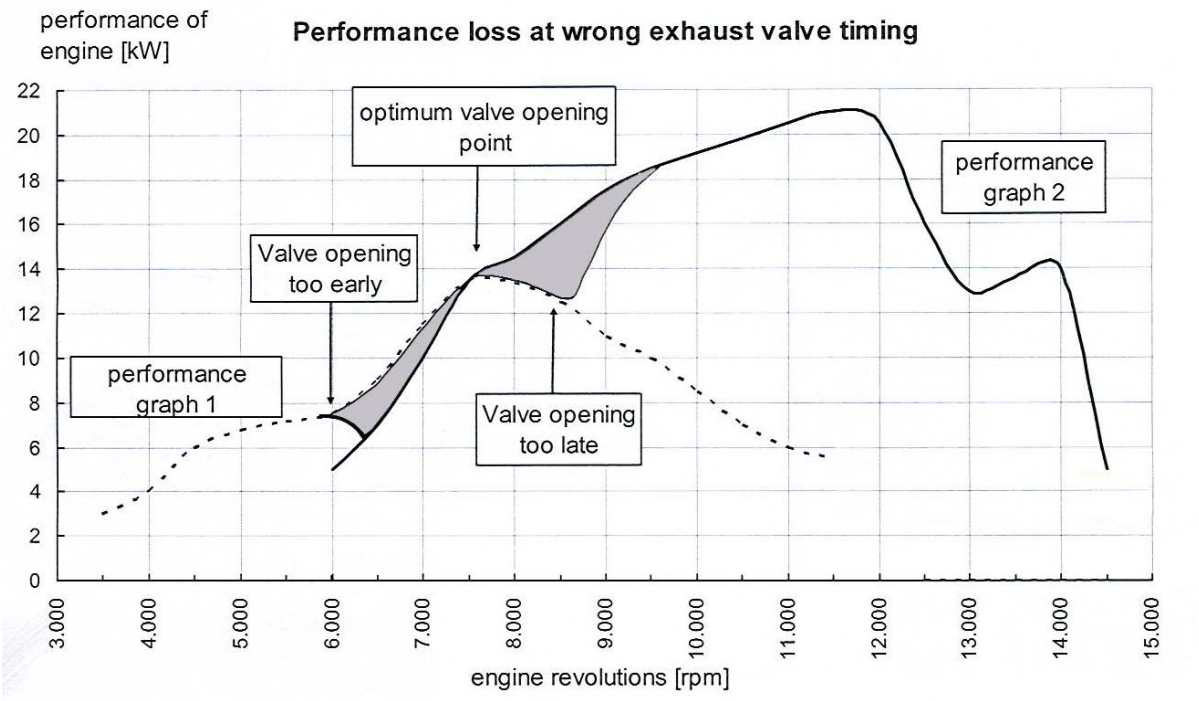
The power valve MUST completely close.

In order for the two stage exhaust timing to be effective the power valve must close completely. It is simple to check. Remove the power valve cover and press the bellows, you should hear a slight click as the valve hits the metal stops. If this does not happen, unscrew the exhaust valve piston together with the bellow a quarter turn and check again. Repeat the procedure until you can hear the slight click.

You can see from the diagram below the function that the power valve performs.



It is clear from the diagram that if the power valve is not fully closed at low (below 7.500) RPM, the exhaust valve do not seal with the piston, resulting in lack of bottom power.



As you can see from the diagram above, the power valve has a direct impact on the overall performance of the tuned Rotax system. If the power valve opens too early or too late engine horsepower production will drop off. As you can see from the graph, the optimal power valve opening setting is 7,500 rpm.

Setting the power valve correctly is very simple and is an easy step to ensuring competitive Rotax racing.

TIP #2

Carburettor and Jetting

Unlike most other two stroke engines in common use in Australia the Rotax MAX series of engines use a 'slide' carburettor. These 'carbys' do not have externally adjustable jets; rather Rotax engines have internal jets. Those familiar with motorcycle engines will be familiar with this concept.

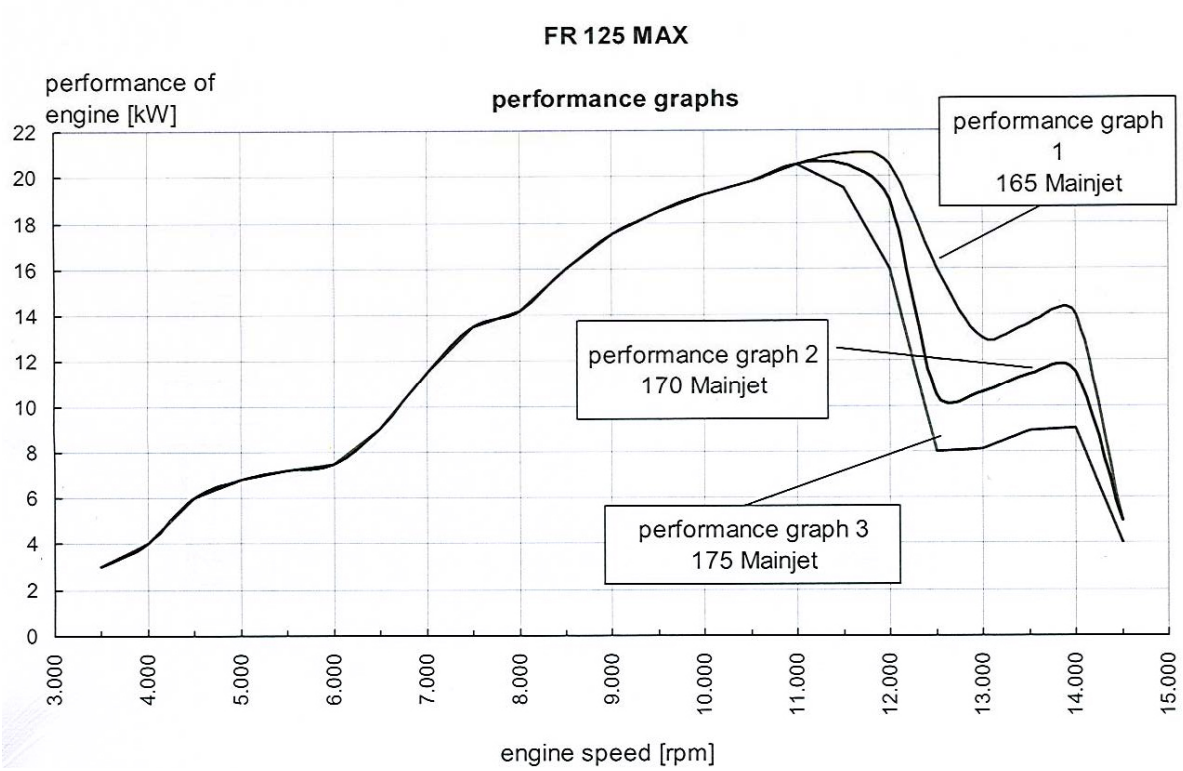
Many new comers to karting using engines that require the driver to tune the carburettor find out the hard way that a small mistake tuning in can result in engine seizure.

The main jet in the Dell'orto carburettors is easily accessible via the large bolt on the bottom (as you can see from the picture right). The jet selected is based upon a number of factors, keeping in mind that you cannot change the jet when you are on the track. The smaller the jet number the 'leaner' the engine will run. The standard jet in newer Rotax engines is 165 with jets are available in increments from 150 to 185.

There are a few schools of thought with regard to jet selection. The first is use of a weather station (readily available from electronics stores for around $100) and a jet selection chart (which is available as a free download from the IKD web site at www.internationalkarting.com). The two most important factors are barometric pressure and temperature.

Once you have the pressure and temperature, the jet chart will provide the correct jet to insert. Usually you select a jet for the conditions and you will not need to change it during the meeting, unless temperature or pressure dramatically changes (i.e. it rains).

The second school of thought is to start with the standard jet and try successively leaner jets until the engine 'pops' and then go back one jet richer (assuming that the selected jet was not too lean to begin with!).



As you can see from the graph above, correct jetting has a direct impact upon performance. In the example the correct jet for the day was a 165.

The 170 and 175 jets (providing a richer mixture) provide similar power in the rev range up to 11,000 but result in noticeable drop off thereafter when compared to the 165 jet.

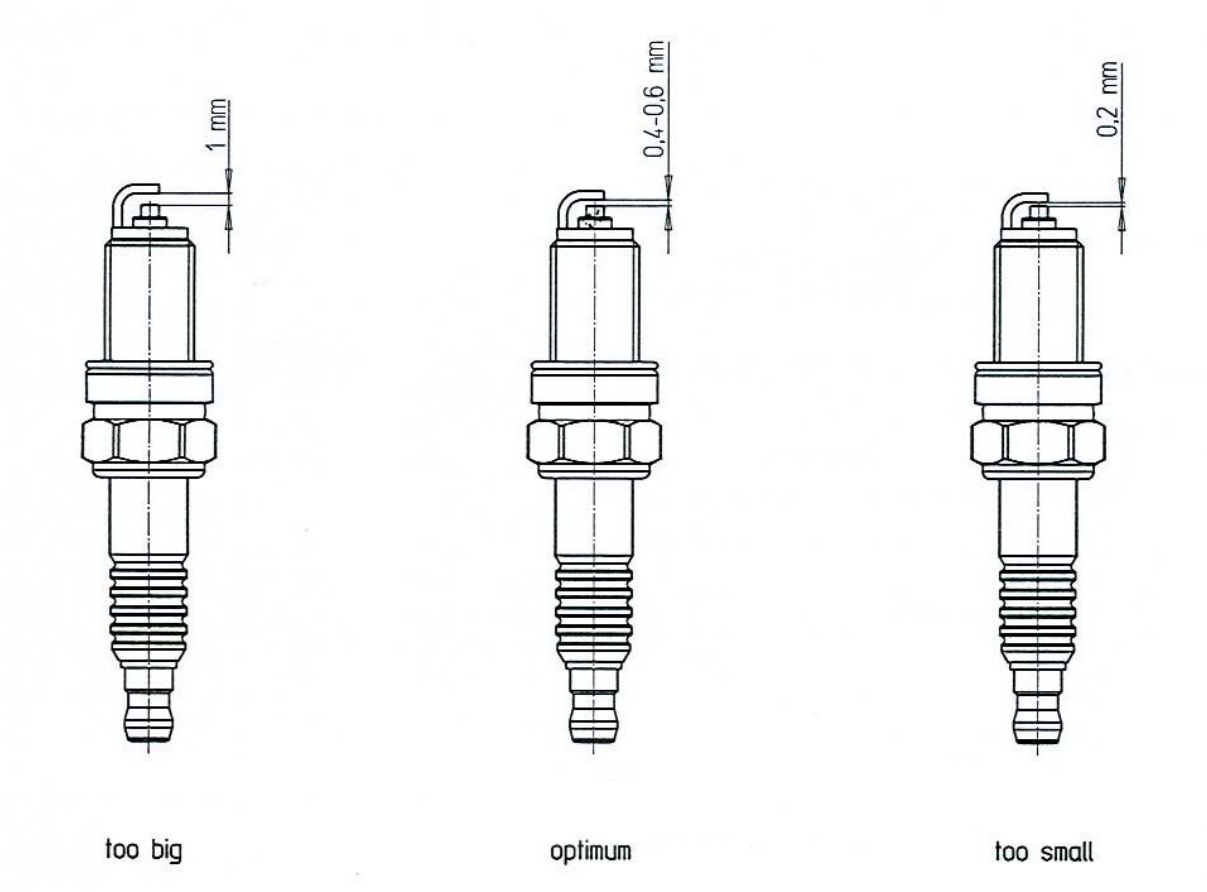
This is not to say that the 165 jet should be used in all conditions rather in the example above it was the correct jet to select.

Another area that requires some attention is placement of the carburettor overflow bottles. If these are placed higher than the carburettor or in the direct flow of air pressure differentials can develop that can cause issues such as 'popping'. The best mechanism is to place the overflow containers below the carburettor, perhaps cable tied to a seat support.

TIP #3

Spark Plug Gap

When replacing spark plugs most karters tend to install new spark plugs without setting or checking the plug gap. The gap in the spark plug is very important. Rotax have performed many tests and found that 0.45mm gap provides the best overall performance from the engine. When set to this gap the engine will provide maximum mid-range horsepower and the engine will be less sensitive to atmospheric conditions (i.e. will be easier to tune).



The gap can be set with an inexpensive set of feeler gauges, most auto parts stores or kart shops can supply these for only a few dollars.

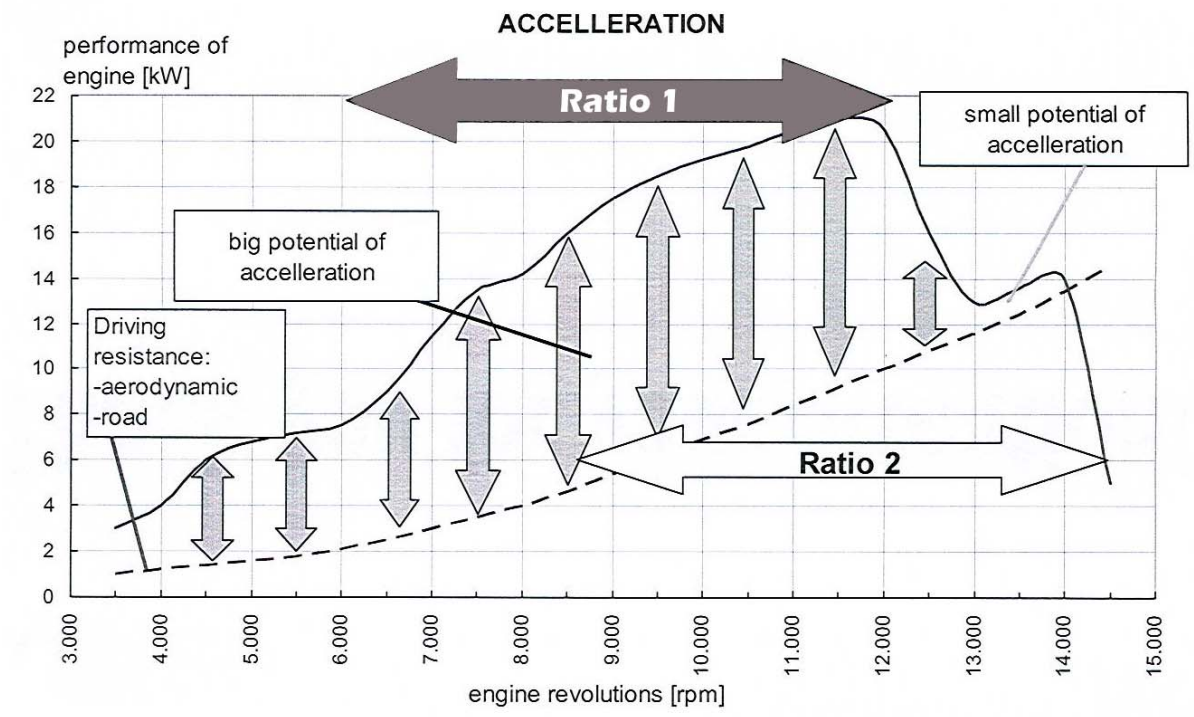
The smaller plug gap makes it easier for the plug to ignite the fuel, thereby allowing a smaller jet to be run. Remembering that the leaner main jet increases top end power without much effect on bottom end performance.

TIP #4

Gearing

The digital ignition system of the Rotax 125 MAX engine changes the ignition timing at 14.000 RPM such that the performance of the engine is drops significantly. Operation of the engine on the track (under load) the engine will not rev higher than approximately 14,100 RPM. This is one reason the engines have such long engine life compared to other 125cc engines.

Between 8,000 and 12,000 RPM the Rotax 125 MAX engine provides an extraordinary high output. Obviously gear selection is track dependant; however you should gear your kart to spend as much time in that range.



The top curve in the diagram above represents the power curve of the engine under load. When selecting 'Ratio 1' which is the lower of the two rear sprockets the engine performs peak efficiency, when selecting 'Ratio 2' the engine spends too much time in the 12,000 to 14,000 rev range when less horsepower is developed.

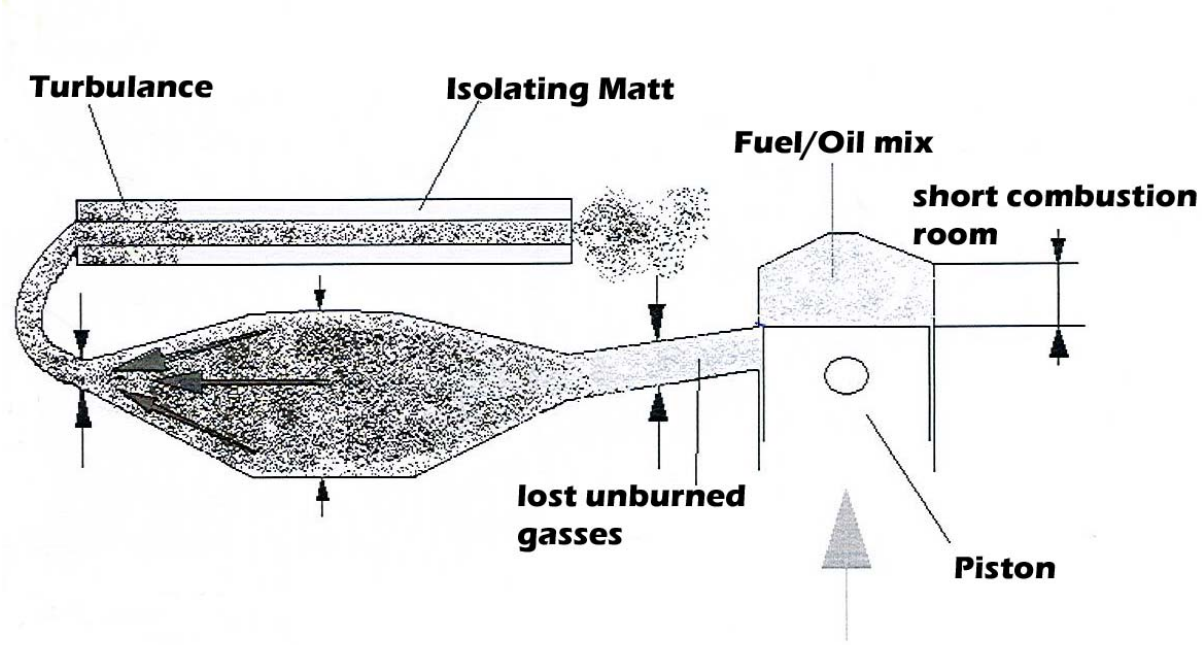
TIP #5

Exhaust

The exhaust system provided with Rotax engines is unique in that it is tuned. This is why you cannot change the length of the exhaust on a Rotax, and in fact it would be of no benefit to you if you could.

One item of impact on overall performance that is most overlooked by Rotax competitors is that of the exhaust matting. This matting covers the exhaust 'stinger' and is used to lower noise levels. Due to the heat generated by the exhaust this matting burns and degrades over time at the end closer to the engine (marked as turbulence in the diagram).

When this erosion of the material reaches a certain level it causes turbulence in the exhaust stream that changes the nature of the tuned system which in turn drops the performance of engine. This is usually most readily identified by the engine running 'leaner' with the associated 'popping' noises.



The matting should be checked on a regular basis. A rule of thumb is after every three race meetings.

The solution to this is simple, relace the matting. This is consumable item and most Rotax stockists will have it readily available and can assist with the replacement if necessary.

TIP #6

Battery

One of the problems Rotax users may encounter is engine 'popping'. This can be caused by a number of factors as has been discussed but *by far* the most common reason is due to low battery voltage.

The Rotax electrical system is a 'lossy' system. This means that there is no onboard mechanism to charge the battery. Whilst this might seem like a feature the package should have, this was a considered design choice by Rotax engineers. The more parts that are included in a package the greater the likelihood of failure. A key component of the design of the Rotax series of engines has always been reliability.

One of the pre-race procedures for every Rotax owner should be to charge the battery prior to every race meeting and if you are able, trickle charge the battery during the meeting to ensure maximum charge. A fully charged battery will provide sufficient voltage to last an entire day without causing any problems.

TIP #7

Don't confuse a slight hesitation on corner exit with a carburettor problem.

As a driver brakes for a corner the pressure in the tuned exhaust system drops off causing the power valve to close. This may result is a slight delay when throttle is applied again. This delay is due to the pressure building up again in the exhaust system until it is sufficient to re-open the power valve.

Another reason for potential lag is driver throttle application. The throttle should be slowly fed in on corner exit. Most clubman drivers tend to go 'full noise' at the exit of a corner; this is not the correct technique for a Rotax driver. The best method is to ease the throttle on from the exit of the corner.

TIP #8

MOJO Tyres

An integral part of the overall Rotax race package is the MOJO D2 tyres. These tyres are the same as is used at the ROTAX MAX CHALLENGE GRAND FINALS each year and by most countries around the world for the Rotax classes

The MOJO D2 tyre offers good levels of grip whilst maintaining excellent durability. When operated in accordance with the recommended pressures, karters can expect exceptional life from the tyre.

The pressure recommended by Rotax for use with this tyre is 8psi +/- 1psi. Obviously this is only a recommendation and should be tested to local track and environmental conditions.

Rotax Heavy drivers in particular regularly run 1-2 psi higher pressures.

Junior Max

The Rotax 125 Junior MAX engine is fundamentally the same as the 125 MAX engine. The only exception is that the Junior MAX engine does not have a power valve.

With the exception of TIP #1 and TIP #8, all of the information presented in these articles applies equally to Junior MAX competitors.

Summary

Rotax racing offers karters the opportunity to compete in a class that is run all over the world. The engines are fast, competitive and yet offer simplicity of use and maintenance. Rotax is a club, state, national and international class offering levels appropriate for all karters.

The National Rotax Ranking system operated by International Karting Distributors (the Australian importer) provides a mechanism to measure against drivers from across the country without the expense.

The Rotax Nationals is the top level Australian event held each year for Rotax competitors. This year the Todd Rd circuit just outside Melbourne will host what is sure to be the premiere karting event for 2008.

Things to remember:

- Correct Jet – one jet above popping
- Keep your battery charged
- Correct plug gap
- Exhaust matting in good order and condition
- Power valve fully closing
- Power valve opening at 7,500 RPM

Now, get your Rotax out and go racing…..