



**ROSSIER ENGINEERING**  
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## Sea Doo Tech

Welcome to R.E.'s Sea Doo tech section. We have established this document to provide you with what we consider to be accurate and up-to-date tech information for Sea Doo watercraft. We base our confidence in our opinions on the many years of experience we have accumulated in preparing highly modified Rotax engines. With Sea Doo continuously increasing its' lead as the most popular PWC, the number of people wanting to boost their performance levels also continues to rise. Therefore, we are taking this opportunity to share with you a wealth of information that we have gathered through a variety of channels; exhaustive dyno testing, hundreds of hours of on-water testing, and regional racing by R.E. staff.



We feel this extensive experience lends weight to our opinions. Many other shops can and will provide you with good information and services, but if you find a direct conflict between advice you're getting and something you read here, we advise you to investigate more thoroughly before making expensive decisions.

**Some things are consistent throughout all our engine combinations.** These include the use of NGK plugs, style BRES. The heat range number varies with application, but we prefer this inexpensive resistor plug to it's more expensive "V" counterpart because we feel they are a little easier to read. Always use the "R", or resistor, designation. We prefer running pre-mix instead of oil injection because it allows tighter control of your oil/fuel ratio. It also allows the use of higher quality aftermarket oil. Be aware that if you convert to pre-mix on rotary valve engines, you must continue to provide oil to the rotary valve drive gear cavity.





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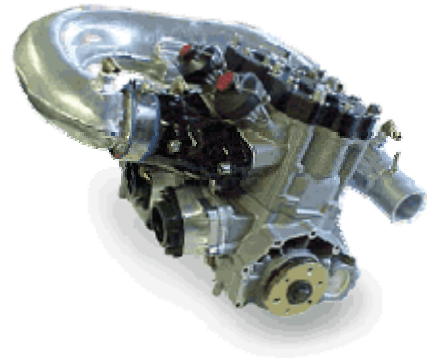
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## 951 Engine Tech

The Sea Doo 951 Rave engine has proven itself to be a real powerhouse. Reed valves are the biggest change in design to the latest engine. Some people have said the reason for this is to make the crankshaft shorter, owing to no rotary valve drive gear in the crank center. We believe this change was due to the fact that the intake port size was too small with a rotary valve. The new engine has even bigger and beefier cases than the 800cc RAVE engine! There is also a counter balancer to keep things smooth at running rpm's. In stock form, the new engine produced 130 hp at 6800 rpm's on our dyno.



We were surprised to find SeaDoo's '97 engine had port timings that we would consider quite radical. They were even more radical than specs that we typically run on full mod engines! We also found the compression and squish clearance to be on the low side. This combination produced a powerband that featured big top speeds, but very anemic acceleration rates. The anemia was further aggravated by a strange prop design that helped the high top speed, but cavitated severely off the line. Happily, the '98 package corrects all these perceived problems. Port timings are more conservative, compression is up, the squish band is tighter, and a new pump/impeller combo vastly improves the acceleration rate and cavitation problem, with little loss of top end speed.

*The '97 engine was a one year only edition with numerous problems. We will only deal with the '98 and later engines, as all the teething problems were solved by then.*

Impeller selection is always a big topic of conversation among performance enthusiasts. The 1997 GSX Ltd can benefit from a 14-18 impeller, which helps solve the cavitation problem and also nets huge acceleration gains. However, to get these gains it will cost approximately 1 mph of top speed. For '98 and newer LTD boats, some impellers may accelerate harder than others while some will offer better top speed. In the end, your selection should depend on what you are looking for. The stock impeller in 98 and newer boats is still our choice when using a Stage One Kit or for stock engines in LTD boats for all around performance. If top speed is all that is desired, you may consider either a Solas or Nu Jet impeller, however you may experience increased cavitation off the line. **Remember:** when looking for higher top speed or greater acceleration, you will almost always have to give up one for the other.

Carburation should be the first place you find a nice performance increase. With the use of quality products like RE's 951 Air Filters and Jet Kit, you can end the richness and soggy midrange experienced after the '99 airbox update kit. Our jet kit has a completely different fuel curve from the factory due to the free flowing nature of our filters. Gains from these mods alone are worth 6 hp. On the dyno, they make the 951 peak at around 6900 rpm's and 136 hp. Jet kits come with needles, seats, mains, and pilot jets with recommended Hi and Lo screw settings to give trouble free jetting with no soft spots or hesitation off the line. *Be careful to follow our instructions when jetting your new boat!*



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**Step Two** usually involves increasing your engine's compression by modifying your stock heads. Increased compression will give you great mid-range hp gains and a couple of hp on top. Cranking compression can vary with altitude, but on a broken-in 951 engine it seems to be right around 135 psi on the 1997, and slightly higher (around 140 psi) on the 1998 engine. This is measured on our gauge and is for comparison only. Your gauge may read differently. Squish clearance is very important on all performance 2 stroke engines, but on the 951 engine you cannot change the squish clearance by machining the head. The OEM head has a zero squish lip. Leave head mods to very knowledgeable shops only as the combustion chamber has to be carefully reshaped to prevent engine damage when raising the compression.

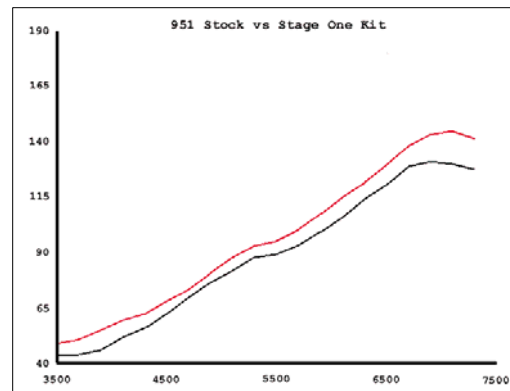
**Next on our hop-up menu** is reed valves. Many companies produce a variety of reeds for many applications. We've chosen to work with Carbon Tech because of their vast experience in this field. Our dyno has shown their best design can provide a 3 hp increase and a 50 rpm gain on the water on top. We feel the Carbon Tech Reeds we offer are simply the best all around, reliable recreational reeds out there to use with your stock cages.

### EXHAUST SYSTEM

We have found a noticeable power increase by altering the water injection calibration in the stock exhaust system. We sell a kit that allows you to alter these calibrations by way of removable Mikuni carb main jets. We provide you with the kit already jetted to our specs, and easily obtainable jets allow you to experiment and find custom combinations that may better suit your application. Call for more information.

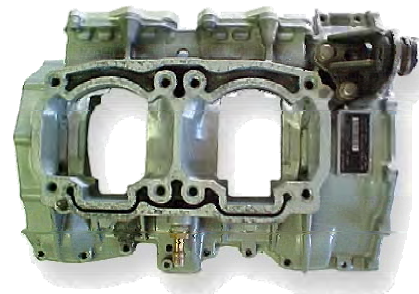
### RE STAGE ONE KIT

The stock GSX LTD's maximum RPMs are usually around 6800 to 6850 (62mph) on a good running 951 engine. RE has developed our Stage One Kit to safely take your 951 to around 7050 to 7100 RPMs (65mph), depending on your climate and tuning skills. As a bonus, we've found that the stock rev limiter will work fine at these rpm ceilings. Typical gains with this kit were 3-4 mph top speed, with a healthy dose of midrange pull that it certainly didn't have as stock.



### 951 Engine Porting Vs Big Bore

After extensive dyno testing, we've found a 4-5 hp gain can be expected from a stock bore cylinder with careful porting.





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## 800 Engine Tech

**This engine is big!** It's got beefy crankcases, a counter balancer shaft, and durable pistons and crank. It is ported quite radically in stock configuration, but use of the variable exhaust port timing provided by the RAVE valve still provides adequate bottom end. Mid range and top end is excellent for an OEM offering. These engines are extremely reliable in stock trim and respond very well to proper modifications. Our dyno testing shows most of these engines producing about 108-110 horsepower @ 6800 rpm.

### Compression

Cranking compression is a touchy subject. No two gauges seem to agree. For the sake of comparison, we will discuss cranking compression measured by our gauge. When we build engines or modify heads, all measurements are arrived at mathematically. We use corrected compression ratios rather than reciting cranking compression numbers.

Cranking compression on a stock, well broken-in (4-5 hours) 800 RAVE will read approx. 155-160 p.s.i. on our gauge. At cranking speeds, the RAVE valve is closed, so at high rpm, when the valves open, they bleed off more "real world" compression. Squish clearance is about .060-.065.

A typical '96 XP800 will run 56-57 mph at approximately 6800 rpms. While slightly soft on the bottom end, they accelerate very hard and reach 50 mph in about 7.5 seconds from idle.

**The most economical performance improvement you can make is to bump up the compression.** These particular engines love compression! Every 15 pound increment it's raised will give you a substantial boost in both acceleration and top speed. We find these engines to be extremely reliable on 92 octane pump gas with 180-185 pounds on our Snap-On gauge. This 20 pound increase over stock is very safe on 92 octane, but only if adequate squish clearance is maintained. We feel .040 to be the bare minimum and .045 even better. **Remember: Always check your squish clearance upon re-assembling your engine when you've replaced or modified your head.**

Adjust your clearance by substituting thicker or thinner base gaskets if necessary. Always measure your OEM base gasket, as counting holes is no guarantee that you have the right thickness. First measure your stock one, and then substitute a verified thicker or thinner gasket as is necessary to adjust your squish.



**You can arrive at this raised compression one of two ways:** You can have a reputable shop machine your stock head or you can buy an aftermarket unit. We advise our customers to have us modify their head if they don't need to switch back and forth between fuel octanes. Racers will want a removable dome head so they can practice or play on pump gas during the week and then bump up to race gas for race day. We charge \$95 to modify your head. Some folks like the looks of the billet part - let your wallet be the guide. **Warning** - a properly modified stock head should always have the squish band machined as well as the gasket surface. If your



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machinist doesn't know how to do this properly, then find one who does. There are no shortcuts here.

**Here are our octane guidelines:** We feel 200-205 p.s.i. is safe with 103 unleaded race gas. 210-220 p.s.i. would be leaded race gas only. If running straight race, squish can come down to .040. Even in our full mod engines we never exceed 205 p.s.i. so we recommend you follow our lead. People do run a lot higher than that but engine wear, starter and battery life reductions, and reluctance to rev out on top are all good reasons to park it at 205. One point to note: Our on-track acceleration testing has shown that compression increases are very beneficial, contrary to what you might hear elsewhere. If proper fuel octane and squish clearance requirements are met, you should have no reliability problems whatsoever. We feel that free-breathing filters and a properly calibrated carb jetting kit should go along with your compression bump. R.E. has completely calibrated kits for all carb sizes and mod levels, so we encourage you to use our engineered setups to save frustrating "dialing in" by the seat of your pants. If you choose to use your stock flame arrestor set-up, allow for some cautious jetting experimentation before you use your craft under heavy load conditions.

In mild modified and stock applications, we strongly recommend replacing your stock rotary valve with ours. It enhances bottom end acceleration and improves the slightly "boggy" feeling of the OEM valve, and has exactly the same top end. **At \$40.00, it's the most cost-effective mod you can make.**

**We find the stock carburetors are very good when properly re-calibrated.** We set up all our pre-jetted kits to run with Prok flame arrestors. We strongly suggest using the Outerwears water repellents to keep from wetting down the Proks. We sell all these parts as an integrated kit.

### **Ported cylinders**

Owing to fairly radical OEM port timing, we typically steered potential porting customers to more cost effective performance mods. However, with the advent of the 1997 Superstock ruling for IJSBA novice and expert racing, we devoted serious dyno time to finding the most effective combination possible. Just as we suspected, getting significant gains was a major project. We ended up with carefully re-shaped ports at nearly stock durations. After extensive testing and dozens of combinations tried, we ended up with a nice 6 hp gain. We also picked up 8 ft lbs of torque. Nothing outrageous, but certainly usable in the Superstock class. If anyone promises you more than 6 horses, I would be very cautious. They're either extremely good or they're fibbing! Porting is not something we would recommend to the average recreational rider unless he had all the previous mods in place.



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## 720/650 Engine Tech

Now we'll talk about Sea Doos' "stand up" engines. Since very few people race any other models equipped with the 717 (commonly known as the "720"), most references in this column will lean towards the HX although most of our products will work on all models. All the following information also applies to the 650 cc version.

These engines benefit immensely from higher compression ratios and will still be very reliable if proper precautions are taken when machining cylinder heads or purchasing aftermarket heads. If you will be using premium pump grade gasoline the highest "safe" cranking compression is about 170-175 psi. Please review our comments on compression from the 800 RAVE section.

**Squish clearance** - the area between outer circumference of piston dome and cylinder head with piston at top dead center must not be less than .045 on any 720 or .050 on 650's, regardless of fuel quality.

If using high quality race fuel of 108-110 octane, cranking compression can be raised to as high as 220 psi with substantial gains in torque and horsepower. We never exceed 220 psi due to loss of peak horsepower, accelerated starter and battery wear, and higher operating temperatures associated with excessive cylinder pressure.

As with any performance modification, head mods require a slight change in carburetion, so always check your jetting carefully to be sure you are not running too lean. Any reputable shop that performs head mods or sells aftermarket heads should be able to provide you with jetting recommendations.

R.E. offers complete jetting kits for all OEM applications as well as kits that accommodate all of our performance packages. All dual carb jet kits sell for \$75.00. Call for specific applications.



**Aftermarket flame arrestors** are a cheap way to add about 2-3 hp and clean up low rpm throttle response. We use the Prök brand which sells for \$120/pr with adapters. When using any aftermarket flame arrestors it is necessary to properly brace the carburetors to the motor to avoid possible intake manifold cracking due to engine vibration. This problem is seen only with 717 and 657 engines. The 800 RAVE doesn't have this problem.