INSTALLATION AND TUNING TIPS FOR THE MAGNUM MX COMPONENTS YZ295

By Eric Gorr

HISTORY AND DEVELOPMENT OF THE YZ295

The Yamaha YZ250 is 50 years old now. In 1974 I bought my first YZ250A, an insanely pipey and lightweight bike with 4 inches of suspension travel and a powerband like a Cobra 50! Ever since 1974 I've focused my attention on making YZ250s the best 250. Half a century of YZ development.

This kit has an interesting development that dates from 1992, while working for TUF Racing, the biggest Kawasaki KX dealer the USA, I experimented with big bore 250s converted to 300s. Our collective goal was to make a 250 run with a KX500 on outdoor motocross tracks. Many people helped us like racers, engineers, and brand name companies involved in off-road. The modern 2-stroke 293cc Japanese dirt bike has over 32 years of new product evolvement but limited to the Kaw KX250 1992-2008 and KTM.

In 2008, the F.I.M. started the Moto GP3 class, an experimental class at the time, which allowed 650cc 4-strokes to race against 293cc 2-strokes. Back then KTM was the only 2-stroke dirt bike eligible, and back then it was a trail bike and wasn't competitive with 650cc 4-strokes. So, the importer of Suzuki in Scandinavia asked me if I could convert a 250 into a 295 and make it reliable and FAST! I ran the numbers through the design software and started testing. I started building prototypes for the RM250 and YZ250 since they were so similar in basic dimensions, then I applied the things we learned from building the KX295 from the previous 16 years of evolvement.

For the RM & YZ big bores we worked with Wiseco and designed a piston, Cometic designed an MLS head gasket, and Millennium Technologies plates the cylinders and we started testing. Since 2008, my company and Millennium have converted thousands of 250s (KX,RM,YZ) into 295s. Yamaha is the best performer and most popular bike. Two American companies asked me to design YZ295 kits, Magnum and Cylinder Works. The porting and head designs are slightly different making the Magnum designed for mx and Cylinder Works for trail riding. Both kits use a similar platform of dimensions with interchangeable parts like the cylinder, cylinder head, piston kit, head gasket, and powervalves. The companies that support this kit include MAGNUM, WOSSNER, WISECO, NAMURA, COMETIC, ADVANCED SLEEVE, CYLINDER WORKS, VERTEX, EGR, AND MILLENNIUM.

Over the years we've discovered all the tricks to make the YZ295 easier to ride with a wider powerband like a 4-stroke and 2-stroke reliability and low maintenance costs. This Magnum MX Component YZ295 kit is the sum total of our experience and the latest manufacturing techniques and materials. The cylinders feature the latest investment casting technology with 3D-printed lost foam polymer molds. The look and feel of the castings are better than an original Yamaha cylinders. The bore is plated with a modern nickel-composite electrolytic coating thicker than the original Yamaha cylinder.

Please review the installation and tuning tips in this guide. These installation tips are thorough and intended to help you get your bike back running fast and reliably, without making costly mistakes. This guide applies to the Magnum and Cylinder Works YZ295 big bore kits.

PARTS INCLUDED IN THIS KIT

This kit includes 1 cylinder, 1 cylinder head, 1 powervalve set of a center and two side valves, and a piston kit and gaskets including a steel head gasket that replaces the original O-rings.

The cylinder powerband is best described as wider with less mid-range hit, and especially better top end power. The cylinder head is made for pump gas and it can be modified for less squish clearance for higher octane fuels.

The cylinder porting and cylinder head shape can be customized to suit your precise riding needs. We included tuning tips and related aftermarket accessories at the end of this installation guide.

PARTS RECOMMENED FOR INSTALLATION OF THIS KIT

6 head studs $6ea. Yam# 90116-08027-00 Head studs are prone to failure because of "torque to yield". People over-tighten head bolts and they lose tension. Its best to install new studs with a medium locking agent like Blue Loctite. You can install the new studs with a socket tool like ASM or just use 2 flange nuts tightened together as a driver.

2 Allen bolts 4mm $5ea Yam# 90109-05002-00 Allen bolts are easier to torque than a Phillips screw. Installing new Yamaha Allen bolts with Blue Loctite in the linkage assembly will help insure its tightness and orientation. If the linkage assembly becomes loose and the left and right sub-valves rotate, they may strike the piston and seize the ring.

6 copper washers for head bolts $5ea Yam# 90201-080L8-00 Copper washers are used under the head's cap nuts. The washers seal around the stud to prevent coolant leakage. Its best to replace the washers whenever the cylinder head is removed for service.

Holder plate, center powervalve $15 Yam# 5CU-1131U-10-00 The holder plate on a YZ250 is the stamped metal plate the holds the center powervalve in the cylinder. It’s common for the holder to crack at the thin corners because that’s where the opening energy is focused. Even if your old holder looks ok, it may break in the future. Best to start with a new holder plate.

Needle bearing for the piston $20 Magnum# AT-1003

INSTALLATION GUIDE

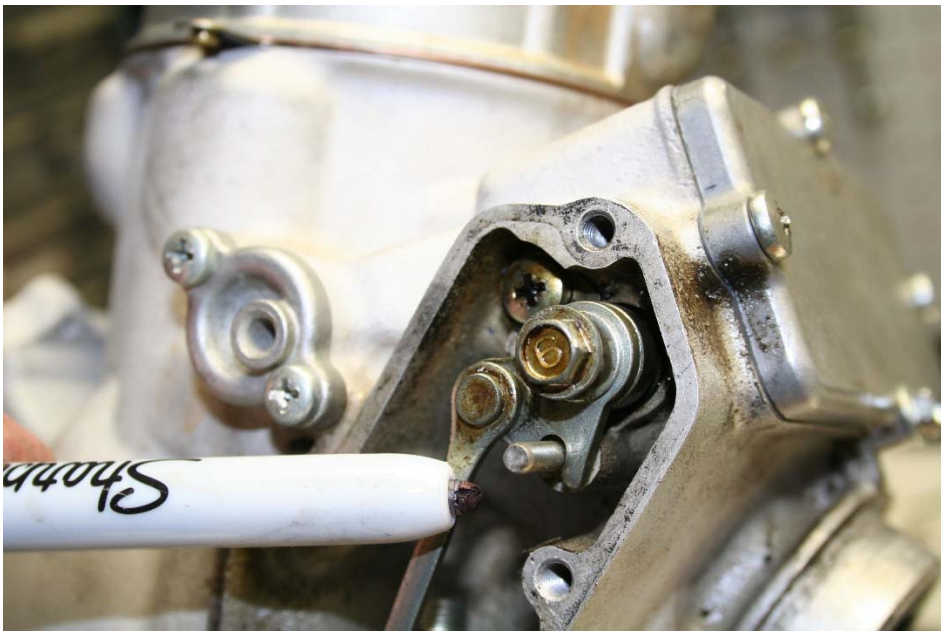
PREPPING THE BIKE

1) Power-wash your bike to eliminate dirt from falling into the disassembled engine.

2) Drain and retain the engine coolant.

3) Remove the exhaust pipe and silencer, sub-frame, carb from boot, and gas tank.

4) The powervalve lever must be un-fastened from the powervalve shaft so remove the cover from the right-side of the cylinder. The powervalve lever must be pinned closed in order to remove the 8mm bolt. The reason to hold the lever is because if it moves up and down it could discharge the 4 steel balls that serve as weights in the powervalve governor control located under the right side cover. Use a 4mm pin from the factory tool kit to pin the lever in the closed position.



A 4mm pin from the Yamaha tool kit is installed to retain the linkage on disassembly and assembly.

5) Remove the head-stay mounting bolts, the 4 nuts from the cylinder base and the 6 cap nuts that retain the cylinder head. If you have a YZ250X you may have to loosen the motor mounts in order to remove the cylinder head from the cylinder.

6) Remove the reed valve and intake boot from the cylinder and inspect it for wear and damage. The 1999-2001 models. DO NOT have a reed spacer like the 2002 and newer models. The reed stops could contact the piston face on the intake side. You will need to remedy the impairment with the options of installing Boyesen Pro Series reeds that eliminate the reed stops, or install an aftermarket reed valve like a Boyesen RAD or Moto-Tasinari V-Force. Always check the intake boot for dry rot. Replace it if you spot cracks near the clamp. Cracks can create a dangerous air-leak that can seize the piston and make the jetting finicky. Check the reed petals for leaks by holding it up to a light and look for gaps in the petals. Replace if worn. I recommend replacement of the stock reed valve and intake manifold with a Boyesen

RAD valve which includes all the parts you need. If you choose a V-FORCE buy the latest model 4 and a new Yamaha rubber manifold. Take care to position the V-FORCE logo to the left side of the bike so the reed valve aligns with the manifold, otherwise it could get partially blocked, thereby posing a restriction. Neither aftermarket reed valve requires the use of the 5mm aluminum spacer that is stock on the 2001 YZ250 and newer.

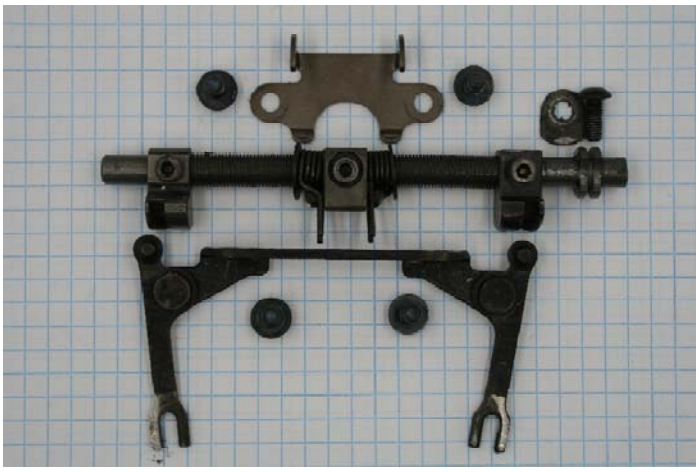
Check the intake manifold for cracks

The 1999-2001 models have reed stop clearance issues

7) Remove the head and take care not to lose the two 4mm alignment pins. Remove the cylinder and observe the two alignment pins on the cylinder base studs. If they stay in the cases then don't try to remove them. If they get stuck in the cylinder, its best to replace them because the old ones could suffer bi-metal corrosion and be seized in place. Clean the cylinder base gasket surface and remove the piston assembly. Stuff a clean shop towel under the piston and take care removing the piston circlips so they do not fall into the open crankcase.

PREPPING THE CYLINDER

8) Remove the front cover from the powervalve because you will need to extract some powervalve linkage and actuation parts and install them on the new kit cylinder. The powervalve shaft is retained by a clip on the right-side of the cylinder. Now the three 4mm screws can be removed from the powervalve shaft using a 3mm Allen socket. Remove these parts from the cylinder: powervalve shaft, 2 springs and washers, left and right pulleys, center yoke, holder plate, and linkage assembly. The new cylinder has the rest of the parts like the shaft seal, and powervalve set. The stock powervalve will not work in the kit cylinder because they will contact the piston. Clean the parts and ready them for installation.



These are the powervalve parts that must be removed from the old cylinder

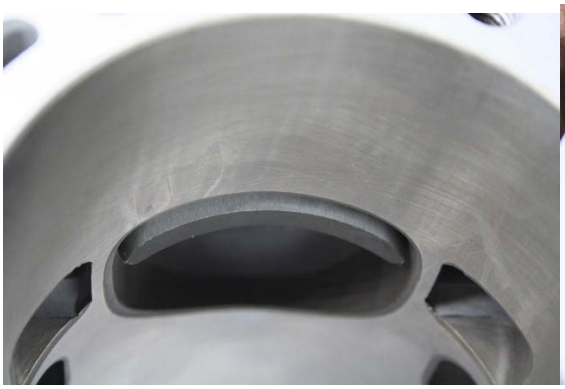
9) Check some of the powervalve parts for wear. Check the tips of the center powervalve holder for missing fragments, check the pulleys for excessive wear at the channels. Replace if necessary because the top end power could be affected it the channels don't allow the sub exhaust valves to open.

The pulley on the right is worn out, replace

Apply a locking agent to the head studs

ASSEMBLING THE POWERVALVE IN THE CYLINDER

10) Ready the kit cylinder by installing new head studs with at least 150 inch/pounds of torque. Insert the rubber seal in the powervalve shaft pocket, install the center valve and holder with Allen bolts with a dab of Blue Loctite on the threads. Pay attention to the orientation of the powervalve as it can be installed upside-down. The widest face of the powervalve faces the piston without protruding into the bore. If you install the center valve upside-down it may damage the piston and valve. The left and right sub exhaust valves require orientation because they can fit either way and be rotated 180 degrees. See the photos for the best installation procedure and checking for right/wrong positions.



Wrong, upside down, valve contacts piston!

Right way, widest valve face to piston

The left side valve is correct and the right is wrong

Installing linkage for sub exhaust valves

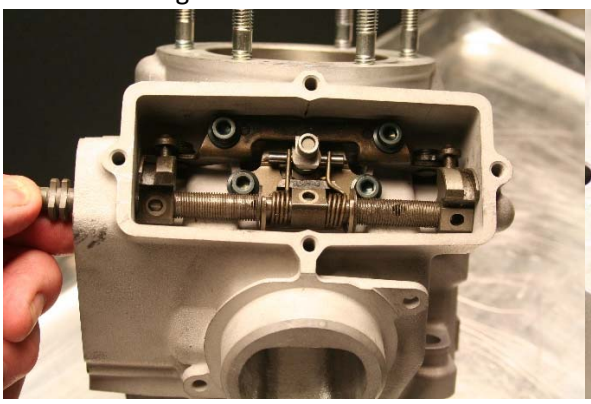
11) Once the sub exhausts and center valve are set in the closed position you can install the linkage assembly. See the photos for the best installation procedure and checking method for right/wrong positions.

The linkage is disengaged, that's wrong

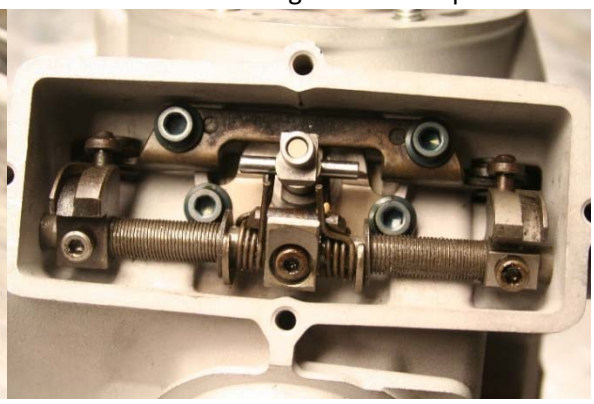
The linkage is engaged right into the sub-valve

12) Now the powervalve shaft can be installed. Position the half-moon shape in the 10 o'clock position. Install the right pulley, spring, washer, then into the center yoke, through the holder and into the left side washer, spring, and pulley. Closed the valves and slide the powervalve shaft back and forth until the

screw holes align. Install the 4mm Allen bolts and be careful not to overtighten and strip the bolts.



Insert shaft with the half-moon upwards



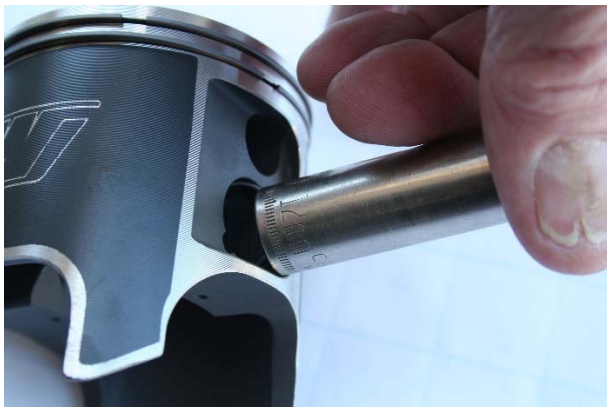
Correct position of pulleys and center valve

13) The last steps are to install the retaining clip on the right-side of the powervalve shaft and test the operation of the powervalve by twisting the powervalve shaft clockwise. The powervalve on a Yamaha open in stages with the center opening first and the sub exhaust valves opening second. Take care not to rotate the shaft too far otherwise the center powervalve will because disengaged. Make sure the shaft rotates without sticking or binding, that would indicate that you need to loosen the three 4mm Allen bolts and slowly tighten them from left to right. It's easy for stiction or binding to occur when the pulleys and center yoke of the powervalve to get a little wonky through tightening. Just be careful and double check the operation of the powervalve.

Prepping the Piston

14) Now it's time to prepare the piston assembly. Don't worry about ring end gap just install the rings with the marking facing up and over the ring centering pins using your thumb tips. An easy way to install the first circlip is to insert the pin with a bit of clearance gap, then position the clip on your index finger on a 45-degree angle with the gap up and try to insert it into the clip-groove with fingers only and test it by pushing on the pin while pushing against the clip with a 10mm socket. You'll feel it lock. Don't worry about the orientation of the clip opening, they won't eject as long as they are in the groove.

Use your fingers to install circlips

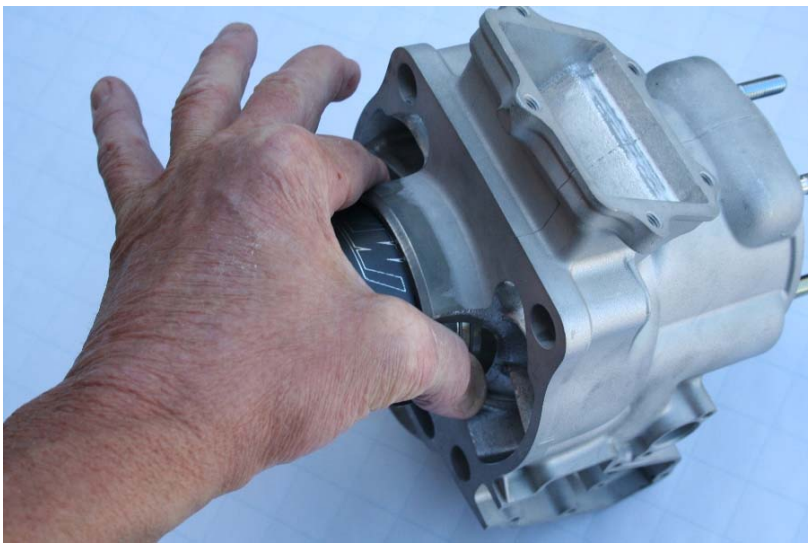


Use a 12mm socket to seat the circlip

15) Take a dab of your pre-mix oil and apply a thin coating all over the piston, rings, bearing, and on the cylinder wall. Oil is good because it makes it easy to assemble and start.

INSTALLING THE KIT CYLINDER ON THE BIKE

16) With you clean bare hands, squeeze the piston rings around the centering pins are carefully install the cylinder onto the piston assembly with the cylinder facing forward just like it aligns on the base studs. If you twist and turn the cylinder the ring can jump off the pin when traveling through the large intake port and get jammed. Normally the rings don't travel through the port, they stop above the port, so be careful! Sometimes I use a flat-blade screwdriver to push the rings in the groove from the intake port in order to get the rings to clear the top of the intake port.



Squeeze the rings with your fingers and keep the piston and cylinder straight so the rings don’t hook!

17) Once the cylinder is installed and you rotate the crank in the direction of rotation and everything feels smooth, you can install the base nuts and powervalve lever, make sure you pin the lever before tightening the bolt. If the lever moves too much it could cause a problem with the governor control cartridge.

18) Install the head gasket and don't worry that the gasket doesn't align with the water jackets, the head don’t match the cylinder either. Yamaha designs this mis-match in order to regulate the coolant speed. The mis-match serves as a baffle like a thermostat. Tighten and torque the head to 200 inch/pounds and torque it in 2 stages in a crisscross fashion. Wait 5 minutes and repeat the at 200 inch/pounds because you need to let the compression bumps of the gasket take a set.

The head gasket is the baffle that regulates the coolant flow, its ok if it doesn’t align

19) Now you can install the rest of the parts like the head stays, intake, and exhaust.

MAINTENANCE INTERVALS

Check the head torque periodically and use an hour meter to track engine hours. Ring changes aren't needed because of the design so change the piston assembly as a package. Replacement top end kits are available from around $250 and there are 4 piston brands available to choose from. Magnum stocks all of them. The 4 brands are Wossner, Wiseco, Namura, and Vertex. The first 3 are forged from 4042 billet aluminum and the Vertex is a lightweight cast piston with a high silicon content suited for wide-open throttle applications. Cast pistons have an average useable life of 30 engine hours compared to 50 for a forged piston. The Wossner piston features an intake boost port for a harder mid-range hit as opposed to the other 3 brands of piston.

Top end rebuilding intervals are based on how hard you ride and RPM range. Expert MX riders can expect to change the piston assembly at 50 engine hours whereas novice off-road riders may get as long as 100 engine hours before they notice a loss of performance from significant piston and ring wear. Vertex cast pistons should be changed every 30 engine hours.

START-UP AND BREAK-IN TIPS

There is no special break-in procedure for Nikasil plated cylinder using a piston with hard-chrome rings. Don't believe the BS on the Internet regarding heat cycling. Dirt bikes need air flowing past the radiators in order to keep the fluid from boiling over. Also don't put an abrasive scouring powder in your oil. Assemble your new top end with pre-mix oil as assembly lube. Then start your bike, warm it up and ride. Pay attention to the throttle response. If it bogs its too lean, if it blubbers its too rich. Stock jetting works pretty good for air temperatures of 55-70 degrees Fahrenheit.

TUNING AND AFTERMARKET PARTS FOR POWERBANDS

The Magnum cylinder kit is designed for a wider powerband and can be customized for more low to mid-range or more mid-range to top end, by changing aftermarket accessory components like expansion chambers, silencers, reed valves, flywheel weights, gearing, and ignition timing.

Exhaust Systems

The stock Yamaha exhaust system works great, as long as it doesn't have dents and the silencer has fresh packing. And if you want more power for your target powerband, here's the basics.

Intake Systems

Intake systems consist of the reed valve, rubber manifold, air filter and gas filters for air vent and fuel flow to the carburetor. Before you attempt to make improvements in the intake system, make sure the basics are maintained. The gas tank's cap vent tube and 1-way valve must be cleaned and the filter should be cleaned periodically so un-obstructed fuel flows down to the carb but doesn't flow out of the vent during a crash. The vent hoses that are attached to the carburetor need to be open and cleared of mud at the ends. Otherwise, the float bowl will develop a vapor-lock and restrict fuel flow. The gas tank control valve (petcock) has a filter built-in. The filter requires periodic cleaning to prevent low flow through the gas valve.

The Boyesen RAD valve or the V-Force 4 aftermarket reed valves are excellent. Its best to buy a new Yamaha rubber intake manifold for the V-Force. Regarding carburetors, the stock carb is great because it's linked to the engine management system matching the ignition timing with the accelerator pump. Take care to clean the carb and make sure it's in good working order. The average jetting is a 48-pilot jet, 40 power jet, 7.0 slide, needle in the middle position, 175 main jet. The stock spark plug heat range is equivalent to an NGK B9EV which is good for moderate running like motocross. For single-track trail riding you may need a hotter spark plug like an NGK B8EV just to keep the throttle response crisp and prevent wet-fouling. Generally speaking, a hotter spark plug can represent ½ of a jet change in the leaner dissection. So, experimenting with spark plugs can help you fine tune jetting. The effective spark plug range in NGK brand spark plugs is B7EV, B8EV, B9EV, and B10EV, 7 is the hottest and 10 is the coldest.

Flywheels and Clutches

There are many options for bolt-on flywheel weights and aftermarket clutch parts. The addition of a flywheel weight conserves crankshaft motive force for better traction before the powerband kicks in and reduces the chance of stalling in tight turns. Clutching options range from Magnum rebuild kits to billet clutch baskets, inner hubs, to autonomous clutch assemblies like the Rekluse. Generally speaking, when you install a performance kit like the Magnum YZ295, you should replace the clutch plates and springs just to get the most from the performance enhancement.

Gearing

Gearing is subjective and situation dependent. This Magnum big bore kit makes for torque at the same RPM so you can try a smaller rear sprocket or a bigger countershaft sprocket. This will serve to lengthen the time before upshifts so you pull each gear longer. If you're an off-roader, you may be able to do most of your riding in second or third gear. Its just trial and error and personal preference.

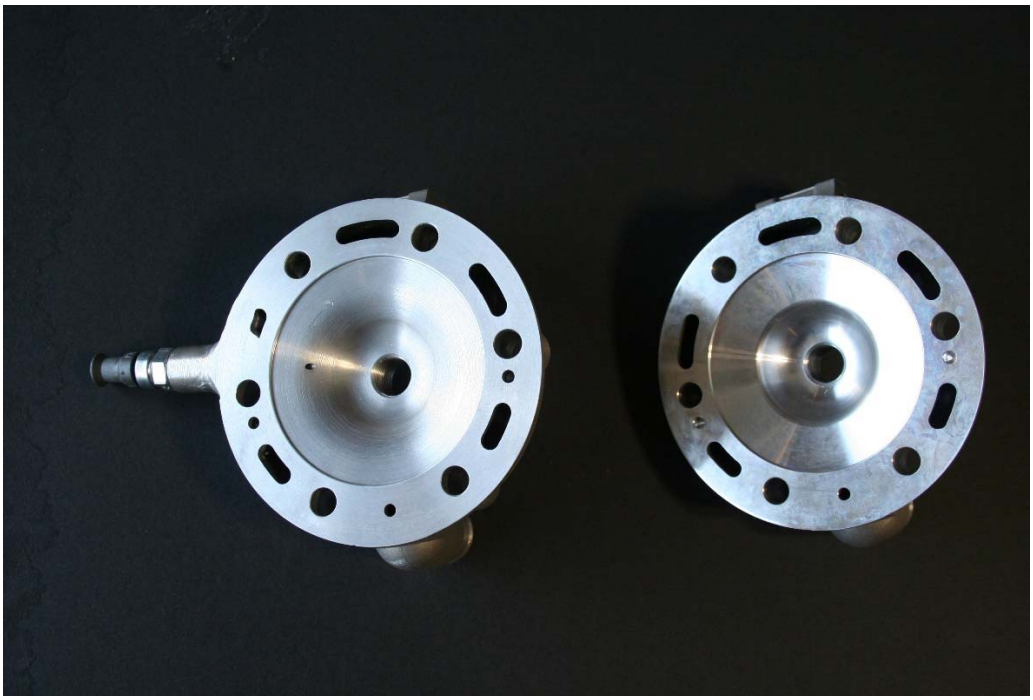
Ignition Timing

Yamaha machined a standard timing mark on the stator plate and crankcase. It is a conservative setting. If you attempt to alter the ignition timing, never rotate the stator plate counter-clockwise from the original setting. Instead rotate the stator plate clockwise incrementally with trial-and-error experiential testing. Listen for a pinging noise that sounds like a diesel truck, that is detonation, an erratic combustion process that produces a pinging noise. An incremental distance of how far you rotate the stator plate clockwise, is limited by the jetting, altitude, and fuel quality. Generally speaking, when the ignition timing is advanced by turning the stator plate clock-wise, the throttle response and low-end torque will feel stronger.

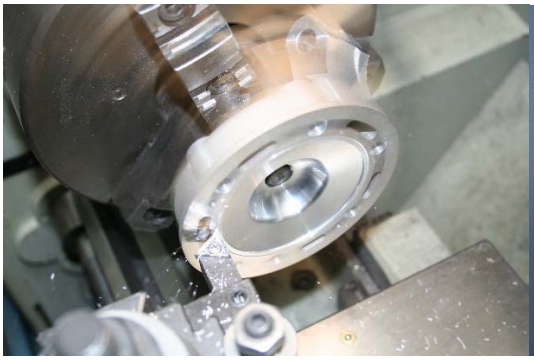
Cylinder Head Mods

Theres options for the cylinder head. The compression and squish clearance of the cylinder head in the Magnum kit, are set conservative for a wide variety of pump fuels and riding altitudes. Aftermarket mods include a decompressor button for easy starting to mods for more torque for high altitude for racing fuel. Generally speaking, when metal is machined off the gasket surface of the head will gain up to 40 psi of compression pressure with a simple tester. The minimum squish clearance (gap between piston and head at TDC) is .040 of an inch, or 1millimeter. The wider the squish band the greater the turbulence velocity of gasses accelerating towards the spark plug. But that can cause combustion detonation and "pinging" under hard acceleration. Especially if you advance the ignition timing and rely on a fuel grade

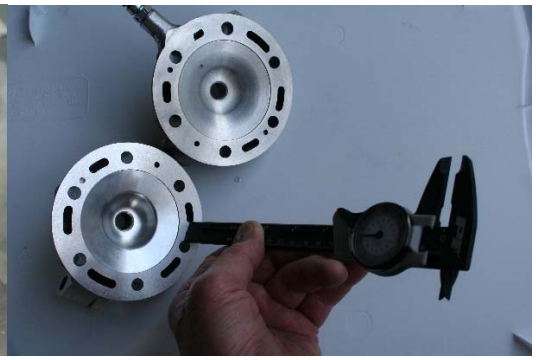
that doesn't have the correct fuel curve. This is a custom trial and error tuning process that yields great rewards.



The head on the left is modified for race gas with higher compression and a decompressor.



The head is turned-down on a lathe



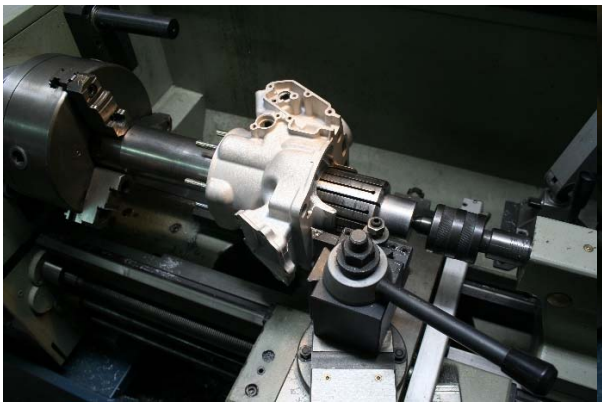
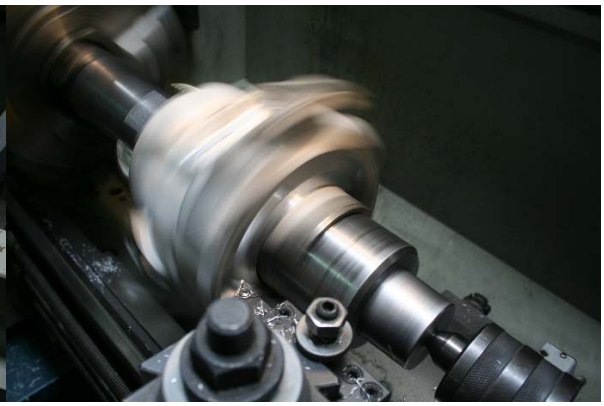
The pin holes need to be 5.5mm in depth

Cylinder Porting Mods

The Magnum cylinder can be ported for powerbands that are more low to mid-range, and more top end for race fuel. For most riders, the aftermarket accessories previously mentioned will make a huge difference. And if you're a home machinist tinkerer, here are the basics for both powerband types.

More low-end torque to mid-range hit is ideal for off-road trail riding

Modifying the cylinder for reduced port duration and a longer power-stroke along with reducing the area angles of the transfer ports reduces the Port-Time-Area and shift the powerband lower in the rpm spectrum with more intensity. This requires machining skill and a lathe with special mandrels.

An expanding mandrel is used to mount and turn the cylinder base on a lathe to improve low end

More mid to top end for race fuel is ideal for fast outdoor mx racing

Modifying the cylinder for increased port duration and a higher rpm can be accomplished in a few different ways as long as the cylinder head is machined in relation to the port changes. There are some easy ways to do this like modifying the exhaust side of the piston dome .040 inches and turndown the head gasket surface .040 inches.

Another set-up is to add base gaskets (up to 3 total) and turndown the head gasket surface approximately .070 inches and re-drill the alignment holes .160 inches diameter and an additional .070 inches in depth for a total of .270 inches (5.5mm).

MAGNUM MX COMPONENTS SPARE PARTS BUYERS GUIDE

These part numbers interchange for the Magnum and Cylinder Works brand cylinders as well as original Yamaha cylinders modified to 295 by EGR and Millennium Technologies. Not for Athena 300 kit.

TOTAL KIT MX-09153K $799.95

CYLINDER MX-09153C $399.95

CYLINDER HEAD MX-09153H $199.95

POWERVALVES MX-09153PV $199.95

PISTON KIT MX-09153 $155.00

GASKET KIT MX-09153H $34.95

USE THIS COUPON AND SHOPPING GUIDE TO SAVE 10% ON YZ TUNING ACCESSORIES

PC pipe and silencers: Shorty, 304, Spark Arrestor

Boyesen RAD, Waterpumps, Carb wings, Twin-Air filters

V-Force

Clutches