RFS Head Rebuild and Rework

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This long article was originally posted in reply to a question here: Pulling the head-450exc - ThumperTalk. With Dave's kind permission I have reposted his article in its entirety. If you have ANY interest in your RFS cylinder head, please read the entire article - it includes a wealth of great tips for removing, rebuilding, modifying and reinstalling the head. If you don't learn a few tricks, I will be really surprised. If you have any comments, please send them to Dave, not to me. Oh yeah, send him your head too - he'll fix it right. He will be getting mine one winter. JD 03/29/07

Below is what I send to my head service customers

Chapter 1: KTM Valves

RE EXC/MXC/XC's
As a matter of economics KTM has opted for a fairly soft grade material for the intake valves. Example their exhausts valves (which are fine) sell for about $40 and the intakes for about $22. As a test, Stainless Steel is not magnetic, an alloy of "Steel" and Stainless Steel" however is magnetic. The KTM intake valve is magnetic, the KTM exhaust like the Kibblewhite replacement valves I use are non-magnetic.
The result is their intake valve is too soft to be compatible with the hard seats and the intake literally forms to fit the seat becoming what is known as "cupped". When the valve loses its shapes the valve adjustment is constantly changing, intakes clearance closing up. To deal with this KTM cuts the seats 45 degree face undersize to allow a thicker part of the valve head to beat on the contact area to keep the soft valve alive for a while. If you took a new valve & head and applied blue die to the valve and lapped it with fine lapping compound so you can see the contact area this leaves a contact area on the valve about 1.5mm smaller in diameter than the proper contact area which is nearer the valves edge. If a machinist where to cut the seat out to fit the valve proper as they are cutting on a 45 degree angle the valve is going down the same amount the contact area is going down about 1.5mm. This results in a nice valve job but the valve is so buried into the port that the combustion chamber volume is increased by the valve location, the compression ratio is compromised and often you are out of adjustment on the valve before you start!

MY VALVE CONVERSION:
A proper seat contacts the valve almost at its outer edge, a contact further in is like having a smaller valve, the area that can flow is reduced from its potential. The stock KTM seat has a 17° top cut, 45° face that is way down on the inner edge of the valve, then drops sharply to a approx 75° angle to the base of the seat where it becomes 90°.
What happens from here, a technician that knows seat work would want to move the seat out on the valve near its edge, it needs to move about .050" measuring on the radius. To do so the valve would also go down about ¾ of that amount (the amount it goes down is less than 1 to 1 do to the fact you working

down about ¾ of that amount (the amount it goes down is less than 1 to 1 do to the fact you working against the 17° top cut) so it really goes down about .040". Problem is now our valve is sunk, compression ratio is lost and we are nearly out of adjustment
Kibblewhite, a custom valve manufacturer, first has a better grade of material, second they make a valve 1mm oversize so I can make the seat right, hold the valve "up" into the combustion chamber and keep the compression ratio up. To make this work out right we also had to alter the stem length slightly to keep the stem length correct for valve adjustment and correct spring tension. In doing this we recapture what otherwise would works out to a .6 to 1 loss (example 11 to 1 could drop to range of 10 to 1 to 10.4 to 1) in compression ratio. Maintaining what has been lost from sunk valves yields a significant restoration in torque!
So when I am done we have a better valve, a proper fit in the combustion chamber, proper stem length and the meat within the seat to make the seat the way they are supposed to be and we have what some would call a 5 angle valve job;
1: 17° top cut is still there, now slightly narrower,
2: 30° cut, very small, there to take off the sharp edges which hinder flow,
3: 45° face that is now centered on the face of the valve (much closer to the edge),
4: 60° cut on the bottom side is used to narrow & size the seat contact area to its desired width, and
5: From there all the way down to the port is hand blended.
On the intake side I attempt to maintain a large bowl under the seat, and
on the exhaust as the air is flowing the other way I try to retain a slight radius below the seat to help guide the flow to the port.

Cost for reconditioning a typical head with these valves is under $300.

RE 450SX
First you need to analyze what you do with the bike? A highly competitive MX racer has the problem that in the rush to the first turn he can not hear the engine and is very apt to miss shift points. The resulting over rev is where Ti valves are needed, for all other general off road riding the same valves I use in the XC line are more appropriate.
For stainless conversion, most but not all 450SX have a spring that is suitable but as they are not all the same I can not confirm this until I have it here.
For Ti there are a few options;
1: In 03 when KTM first switched to Ti they got stuck with a bad batch which was only the first part of the 03 production. As the early valve had a very short fuse most of those bikes have been retrofitted
2: Late 03 thru current production Ti has been quite good. The pricing is way up there, $160ish last time I bought some. Is my preference not to log a lot of hours on them as when they die they destroy the engine!
3: There are a couple aftermarket companies that make a "billet Ti". I consider these to be a special order, too expensive to stock. $500+ for a set, wana bump elbows with RC & Bubba, we need to talk, wana go trail riding, play on a track some, forget Ti, lets do a stainless conversion.
Another issue with Ti. With Stainless valves the KTM Bronze Guides are as good as it gets. Unless coated, Ti stems do not get along with Bronze. The Ti valves have some sort of coating but it is not satisfactory so from the first Ti in 03 450SX thru 05 the rate of guide wear has been very high. For 06 KTM changed the guides in an attempt to cure this. If you have many miles on the Ti your guides will have some wear, seldom re-useable.
One other 450SX issue, as the factory machined the crank smaller to save weight the bolt used to index the crank at TDC is too short. It is very common to miss TDC and thus miss time the cam on this engine! Remind me when I ship it back and I will send you a longer TDC bolt!

RE 525SX
This being a bit lower RPM engine has the same valves as the XC line, for some reason they have a goofy valve spring that I usually toss.

RE 525 SMR

Prior to 06 these have had some serous issues with guide wear. The head/valves/springs are the same as the 450SX but the RPM they are subjected to is much higher. Don't be surprised when I tell you the guides are wasted!

Springs:
When springs are needed I can get a superior spring from Kibblewhite that has a Ti retainer for only a few dollars over the cost of the KTM EXC spring. (EXC is well over $110, KW is about $138).

CHAPTER 2: Performance work:
Porting;
On the RFS engine the intake ports in this engine are generally considered to be too big. Thus "Porting" is not so much "more, bigger, better" but a little reshaping and smoothing, blending the port to the seat and then adding a polish job offers an improvement over stock.
Un-Shrouding;
As a result of design compromises from using one head on several sizes of engine, the valves are quite close to the side of the combustion chamber, I like to run a radius cutter around the outside of the seat and open this area up a bit. How far I cut this out varies with the application and how many CC's of volume we dare sacrifice and retain compression ratio.

Combustion chamber diameter;
As the combustion chamber is sized for the 89mm bore. On the 95mm & bigger engines I will blend the lower edge of the chamber below the intake valves out to more closely match the bore.

To help you understand compression ratios, lets say we have a combined volume in the head, head gasket and valve relief's in the piston of 47cc with the 89mm head gasket or 49 with the 95mm gasket, then:
Example: note these numbers are estimated and include cylinder head of 40CC, head gasket, deck clearance and valve notches.
400 400 + 44* = 444 ÷ 44 = 10.0 to 1
450 EXC 450 + 47 = 497 ÷ 47 = 10.6 to 1
450 SX 450 + 43** = 493 ÷ 43* = 11.5 to 1
520/525 510 + 49 = 559 ÷ 49 = 11.4 to 1
*has a dome of approx 3cc
**has a dome of approx 6cc

As you can see as the engine gets bigger the compression ratio goes up with the same head! Do to this I remove less material when unshrouding the valves on the smaller engines.

I recently measured the cylinder head volume at various stages;
A stock valve/combustion chamber has the intake valve when open about 3mm for ¼ of the circumference of the valve is only 1.25mm away from the side of the chamber and exhaust is about 2mm, thus flow is impaired, opening the valve is doing almost nothing for ¼ of the circumference of the valve. On a compression ratio sensitive application unshrouding I set the radius cutter so that there is 2.5mm clearance around the valve. This allows for a healthy flow and only a 1CC increase in volume (approx a 2/10 point loss in compression ratio). On a big inch domed piston job I set the cutter slightly larger.

New stock was 39CC
Stock with some use, intake valves receded into the head 40CC
Stock with lots of use, intake valves receded into the head 41CC
With my oversize Kibblewhite valves 37.5CC
With my "un-shrouded" chamber at 3mm valve clearance 38.5CC
With my "un-shrouded" chamber at .3.5mm valve clearance 39.5CC
(there will be minor variations from these numbers)

400: On 400's the compression ratio is too low to start with so it is vital to maintain every cc of material in the combustion chamber available, so I set the valves as high as possible in the combustion chamber and leave the chamber alone to maintain all possible volume!

450EXC/MXC: On these 89mm bore application the compression ratio is a little less critical, a very light unshrouding of the valve is my preference setting that valve to combustion chamber clearance of around 2.5MM and polish the combustion chamber.

450XC: On this 95mm bore application I do it the same as the 450EXC except at the lower edge of the valve pocket I blend the chamber out to slightly towards matching the 95mm bore size.

450SX: On this 95mm bore, hi compression piston application I do it the same as the 450XC except at the lower edge of the valve pocket I blend the chamber out to more closely match the 95mm bore size.

525: On the 525's mathematically the compression ratio is less of an issue so even though the piston is flat top we can treat the head the same as the 450SX.

525-560 and High compression piston combos: As the compression ratio is less of an issue my preference is to un-shroud the valves to about 3.0mm clearance and open up the combustion chamber to blend to more closely match the bore.

SXF This is almost identical to the Husky head and I do a few of those, as stem length, valve location in relationship to the cam is much more critical the labor/pricing is a bit more, in time I anticipate I will be having custom stainless steel valves made for them as well. On these engines you need to send me all of your cam, finger follower, shims etc. and labor rate is $20 extra to cover setting the stem length.

Chapter 3: Parts and service items;
Cam chains: I hear a lot of talk about cam chain wear, so far I am not convinced that counting 'clicks" on the chain tensioner means anything. The proper test is to lay the chain out flat on the bench, count out ten rollers, then with a dial or digital caliper measure the inside to inside dimension. It should not exceed _____". If you want to send your chain with the other parts I can make this measurement for you.

Cam bearings
I recommend changing the cam bearings every year or every time the engine is open, if you want to send the cam I can pull the old ones off and press the new ones on.

Gaskets;
I usually have "top end" gasket sets in stock.

Valve seals;
Typically in stock

Rings, if there is any question remove the top ring and ship it and the cylinder with the head so I can check the "end gap" for you.

6x55 bolts, there are two bolts on the right side, top of the cam box cover just for & aft of the spark plug that locate the rocker shafts. The rocker shaft works against the bolts and makes a notch in them, the bolt is under additional tension when the engine heats up and these break at the notch. There are two cures;
1: de-burr the holes in the rocker shaft, you can send those shafts with the head if you want me to do so.
2: replace the bolts with extra hard "Allen head" bolts.
I have those bolts in stock, under a buck a piece

Chapter 4: Updates
00 bikes should have the water pump impeller changed to a newer one
00-01 bikes should have the cam bearings replaced
00-02 bikes should have the cam sprocket replaced with 03 or newer
00-02 bikes should have the lower cam chain guide replaced with 03 or newer
03-05 450 SX usually need valve guides
All 525SX should have valve springs upgraded.
Any should have the two 6 x 55mm bolts on the cam cover that locate the rocker shaft upgraded to hardened bolts!

Chapter 5: Carburetors;
A carb service includes
Identify the model & use of the bike and try to tailor it to suit the riders needs,
Each carb is given an ID # for future reference,
check the vacuum release plate,
set the slide height,
I drill the spray nozzle for the AC pump oversize for most applications (has a similar effect as the O-ring mod without adding the pressure on the rider's arm the O-ring does).
Check, test/clean the check valves for the AC pump
Check/adjust the starting point of the AC pump
Check/adjust/modify as needed the duration of the AC pump
Check the idle mixture screws tip, O-ring, washer & spring, set at estimated setting
Check float level
Note jets, make recommendations as seen fit
Re-route and tag the vent hoses.
This service is $100, Owner needs to acknowledge that I can not run and test their bike but the setup will be as close as I can make it at the shop! Actual jetting in 99% of the cases will be close enough to enjoy the next ride but perfection may require some additional tinkering.

Chapter 6: DISASSEMBLY:
Remove seat, tank, exhaust, carburetor, radiators & hoses.
Remove the left of those bolts that hold the rubber piece the gas tank slides onto.
Remove the top Banjo bolt from the head oil line, be careful not to loose two copper washers.
Remove the 6 bolts holding on the 2 valve covers, be careful not to loose any copper washers, typically the center bolt on each cover should have a washer (those bolts go thru to oil which wicks up the threads).
Remove the 6? Bolts that hold the top cam cover on, note the middle one will not come out, also note there are several lengths of bolts, you may want to lay these in some order?
Remove the water pump cover, remove a snap ring, then with two screw drivers slide the impeller off, be careful not to loose the drive pin behind it. If you break the impeller, the good news is its very inexpensive.
With a punch tap up on the inside of the top of the water pump, the cam box cover should come loose, if it does not recheck for a missed bolt, then tap again. Once it is broken loose you should be able to lift it up, hold up that center bolt, tilt the cover up on the left and rotate about 1/8 turn counter clockwise to get it out.

Locating TDC: I have had too many customers (and myself once) assemble the engine with the TDC lock down bolt in, piston at the top and think that they are at TDC but been tricked by a notch in the crank that is not TDC! 450SX, 525 SX & SMR are double prone to trick you!!
1: Remove the magneto cover, with a 17mm wrench (not a ratchet) roll the crank counter clockwise until the cam lobes are down at 5 & 7 O'clock!
2: Note on the flywheel there is a small block of steel (steel block) welded to the outside. Also note about 2 O'clock a black box, KTM calls the "Pulse Coil". Top Dead Center (TCD) is when the right/clockwise edge of the steel block matches the left/counterclockwise edge of the Pulse Coil.
3: On the bottom front of the engine case a bit right of center there is an 8mm allen head bolt. This needs to be removed, the thick washer it has needs to be set aside. On 400,450,525 EXC/MXC you can screw

to be removed, the thick washer it has needs to be set aside, On 400-450-525 EXC/MXC you can screw the bolt in and it should go into a notch in the crank. 250, 450SX maybe 525SX, defiantly 525SMR this bolt is often too short! If so the crank can rock forward and back slightly even with the bolt in place. If so get a longer bolt and grind it to a point so the crank can be properly secured!
This bolt should go into a notch in the crank, when in;
a) the steel block and pulse coil should alien as above, and
b) the cam lobes should be down, 5 & 7 O'clock
c) now look at the cam sprocket, at the inner edge of the chain there should be a punch mark matching each gasket surface of the top of the head.
Will the crank move fore & aft? If so try to tighten the bolt, if the crank can still be moved we need a longer bolt!! If so tell me when you send the head! I would much rather make you a bolt then have you have a crisis on assembly!

Remove the center bolt from the chain tensioner and the spring that comes out with it and set aside. Next remove the outer two bolts, slide the tensioner off, then holding it upright (same orientation as when installed) grip the center plunger in the middle and pull it outward while watching the little ratchet that runs on the top of the plunger. If it clicks two or more times you're good to go, less than 2 you're close to ready for a chain. Then try to push the plunger back in. If it can be slid in and out with out clicking your tensioner is shot.
Then remove the cam chain tensioner,
First I would have the cam in the position that the lobes are at 5 & 7 O'clock, piston at TDC, and the crank locked down.
Next if the engine is not completely coming apart stuff rags around the chain & sprocket are to prevent dropping stuff inside.
Next take two tie wraps and go thru the holes in the cam sprocket and around the chain at 11 & 1 O'clock so the chain does not flop & fall when you "break it".
Then working on the top center of the upper sprocket we must break the chain, picking a link straight up is easiest, there are two ways:
1: Without the KTM Chain Tool. Use a small grinder such as a Dremel tool and grind down the pins on a pair of the tips of one chain link, tap them out the back. OR
2: With the KTM Chain Tool:
The center screw of the tool needs to be backed out so that tip is retracted.
The Anvil is set aside, not used for disassembly
The hole in the outer threaded part is going to go over a rivet.
The C clamp like part goes around the chain, the machined "notch" on the back goes around the chain pins on the back side
The outer threaded piece needs to snug down against the chain
Then the inner threaded portion is tightened and it pushes the pin all the way thru, have a small magnet in hand to catch it.
Next loosen the center part an inch or so, loosen the outer part way out so the centrer pin is retracted again, then the entire "C" clamp moves to the next pin of the same link plate, repeat, again catch the pin with the magnet.
Now then this is where we get in trouble, when you loosen the outer (big) thread both side plates are going try and fall into the engine! Two magnets and three plus hands is recommended. Also recommend you inventory the link pins & plates as it comes apart, when you confirm two pins & two side plates, toss them!
Remove 3 small bolts (front, left & rear) that hold the cylinder to the head, (the rear one is a pain)
Remove 4 head bolts, with a couple of taps of a mallet it should break the seal of the head gasket and easily lift off.

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450SX! 450SMR! 525SX? 525SMR? Let me know if you need a longer lock down bolt to get full engagement on the crank!

Send the head with,
cam if you want me to change the cam bearings and
carb if you wish it to be serviced/modified.
When shipping please drain gas, put carb, head etc in Zip Lock bags, then pack properly for protection.

Chapter 7; REASSEMBLY

Crank is still locked down at TDC?
Look at the piston and confirm that it is at the top!!!!!!!!!!!!!!!!!!!! Some cranks have another notch or hole that the TDC bolt can go into so some get tricked into a false TDC and 450SX & 525SMR have too short of a TDC bolt! An error here can lead to valves hitting the piston! Double check at the flywheel & pulse coil as I explained in Chapter 6.

De-carbon the top of the piston taking care to clean out the valve pockets.
Make certain all old gasket material is removed from the top of the cylinder, water pump cover etc.
Put the head gasket in place note there should be a tubular dowel over the front & rear small bolts! If either is missing from the cylinder, is it stuck in the head? If so that's fine we just don't want to loose it.
Make certain the gasket is over that dowel AND confirm that no portion of the gasket is hanging inside of the bore! (89mm head gasket on 95mm bore makes a nasty knock!) 97mm big bore kits etc, same problem so pay attention!
Optional; once we are confirmed that we have the correct head gasket, remove the gasket and spray it with Silver paint. This helps the new gasket seal.
Press the head gasket in position, note there are two hollow dowels in either the head or the cylinder to align the gasket.
Set the head on.
Put Anti Seize compound on the threads and under the washers of the head bolts and drop them in place, screw them down until they just contact, work around in a crisscross pattern first time until they just touch, second time until snug, the continuing with the crisscross pattern torque first to 20, then 25 then 30, then 30 to 37 foot pounds (40 to 50 NM).
Install the 3 small bolts (front, left & rear) that hold the cylinder to the head, (the rear one is a pain on Estart bikes)
Lay the cam in place in the position so that the lobes are at 5 & 7 O'clock.
Rotate the cam as needed so the punch marks in the cam sprocket match the gasket surface of the top of the head, flop the cam chain up into place,
Double check that the cam sprocket punch marks are in alignment!
Take two tie wraps and go thru the holes in the cam sprocket and around the chain at 11 & 1 O'clock so the chain is secured.
Slide the new master link in from the rear,
Pack some rags around as its easy to drop the side plate.
Now put the outer side plate on and pinch with pliers so it is secure (although probably not totally seated in place.)

Chapter 8, DOUBLE CHECK THE CAM TIMING:
Next as that new link is not yet swedged mark that link with fingernail polish or paint.
Remove the two tie wraps

Next lets install the cam chain tensioner! (note, for 00-01 models we will have it back off when we get to water pump seals as the cam has to be lifted slightly so install temporarily) First we need to remove the center bolt, this has a washer, then a long skinny ball point pen like spring. Set those parts aside, on the main body of the tensioner you need to lift up a small ratchet pawl so that you can compress the plunger, push the plunger in, bolt the assembly back on, then with a large nail or small punch poke in the center hole and push the plunger back against the chain firmly, then if this is final assembly re-install the spring & center bolt.

Now lets temporarily reinstall the cam box cover with 4 or more bolts snug,
Run the valve adjusters down until they contact, then back off 1/6 turn, snug the jamb nuts lightly.
Loosen the TDC lock down bolt 2 or 3 turns.
Ignition cover is still off, with a long 17mm wrench (not a ratchet as it will get away from you when the cam followers pass over the nose of the cam lobe) turn the crank ONE REVOLUTION. (Cam turns ½ crank speed so even though we can't see them the cam lobes are now 11 & 1) stopping at the TDC point identified by the small steel "block" on the flywheel I described in the disassembly section. That is TDC on the Overlap stroke, both valves are open a small amount and a equal amount, such as 1mm!
Now roll the crank fore and aft slightly, maybe a couple inches at the end of the wrench you are turning it with.
IF there is a tight spot you're a tooth off from the correct timing spot.
IF it stops solid you're more than a tooth off from the correct timing spot.
When complete turn the crank the other direction one turn to get back to where you where. Note, the cam comes back to the same point every other turn but the link that you need to swedge does not come up at the same spot every turn.

Chapter 9, Riveting the chain:
Next, turn the outer part of the chain tool out so it has an opening about 1¼ ", turn the inner part in so the pin sticks in a ¼" or so, slide the chain tools Anvil onto the pin so the side that will go against the chain has the piece that is shaped like a chin link go against the chain.
Slip the C clamp like tool over the chain at the link we need to swedge, run the outer screw in so the anvil is pressing against the chain. The only thing the pin in the center is doing at this point is keeping all the parts in alignment.
Tighten the large thread so as to apply some pressure to squeeze the side plate firmly onto the pins, then loosen.
Next Rotate the Anvil so the grooved part is against the chain, again the pin should still be centering the parts.
Tighten the large thread so as to apply considerable pressure to swedge the pins, then loosen. Those swedged pins should look exactly like the other factory swedges!
If you borrowed my chain tool, please please be careful, its $140 and if the anvil is lost or that pin trashed the tool is junk.
When you are done rotate the engine back to where the cam lobes are down at 5 & 7 O'clock and the cam sprockets timing marks match the top of head gasket surface. Lets avoid rotating from here until we have adjusted the valves, put the lock down bolt in if you wish.

Chapter 10, Water pump seal retainer;

Water Pump Seals! Installing the seals into the retainer:
First there are two types of seals, in 04 the old "single lip" seals where upgraded to a "double lip seal". If you buy new seals today for an early bike you should get the newer seal!
Seals have a "finished side" referring to the smooth, normally outer part to the "dry side" and a "lip" side, the lip being the sharp edge of the rubber that runs on the shaft to the "wet side"! The "lip" always faces the liquid! Most applications have liquid in, finished side out, here the liquid is out and the dry area in, so we have to install the seals backwards. Pressing them in backwards often leads to a seal getting bent,

trick here is, using two sockets, a "pushing socket" that is slightly smaller than the seal OD, and a "receiving socket that the seal will fall into:
1. push out the old seals,
2: push in one new seal we will call it seal "A", forwards, not backwards!
3: push that seal "A" on thru to the back and on out, now set it aside, it is now "sized" so it will push in backwards without bending!
4: Push seal "B" in forward, then push it thru to the far side so it is now "backwards" for the far side.
5: Retrieve seal "A" and press it in "backwards" for the front or other side.
We now have the retainer with two seals pressed in, the "lips" are facing out, they are flush on the outside with a space between them.

Installing the seal retainer into the head! There are two kinds of retainers;
Early (00-02); Nothing wrong with this style, the trend is to update to the newer piece in fact I prefer the early one but it must be assembled before the cam box cover goes on!
We have two identical O-rings, the retainer has two grooves and a "lip" between the two grooves. Note that the "Lip" is partly cut away! Give both O-rings a thin coating of Loctite 515 and put them on the two grooves of the retainer!
The cam chain should be hooked up and riveted but the chain tensioner off. If you have the bullet tool install it on the cam, if not give the seals a good coating of grease and holding the seal retainer at a slight angle slide it over the cam. IF you hold it square the seal lips may get mangled by the cams snap ring groove! Once the seals are part way on the cam, past the snap ring groove we need to lift the cam slightly and rotate the retainer so the cut away part of the flange is down at 5 & 7 O'clock so the retainer can go into place against the cam bearing. Once all the way in the lip drops down into the groove in the head. At this point you proceed to complete the cam chain tensioner, the water pump assembly and cam box cover. Note the cam box cover does not use a gasket, KTM specs Loctite 515, Yamabond is fine, in either case apply it to the head, not the cover and spread it very thin, we want to minimize the amount that can ozze in as any excess will end up in you oil screens!

Late 02-07: The groove in the head mentioned in the prior section has a steel washer in it which holds the cam bearing in place. This must be put into place, then the cam box cover and the Note the cam box cover does not use a gasket, KTM specs Loctite 515, Yamabond is fine, in either case apply it to the head, not the cover (its too easy to get the sealant on the chain when sliding the cover in) and spread it very thin, we want to minimize the amount that can ozze in as any excess will end up in you oil screens!
We have two O-rings, the inner one is slightly larger?? We want to give both a thin coating of Loctite 515 and put the inner one into the head up against the washer that is in the head! The outer O-ring we also give a thin coating of 515 and put it into the outermost groove of the retainer. If you have the bullet tool install it on the cam, if not give the seals a good coating of grease and holding the seal retainer at a slight angle slide it over the cam. IF you hold it square the seal lips may get mangled by the snap ring groove on the cam! Slide the retainer on into place. It commonly trys to come back out slightly like there was a small spring pushing it out, what is happening is the O-ring is rolled up and doing the spring thing. Take a pair of needle nose pliers and put the tips into the two small holes in the retainer, then give it a twist, this will relax the tension in the O rings that was pushing the retainer out! Some of the retainers have a dimple on its face that while not critical is typically installed at 12 O'clock. At this point you proceed to complete the water pump assembly.

Chapter 11, finish up;
Adjust the valves;
We are locked down at TDC with cam lobes pointed down?
If so you get to take the short cut!
Loosen the jam nut (10mm box wrench) and very lightly tighten (one at a time) the adjuster till it contacts the valve, note where the screw slot is aimed, turn the jamb nut so a corner of the hex aliens with the slot, make a small scratch in the cover gasket surface in line with the next hex point left (hex being 1/6th turn to the next point). Then turn the slot to that point, then tighten the jamb nut. In doing so often the adjuster will creep tighter slightly and cause the adjuster to tighten up. What you need to do as you tighten the jamb

creep tighter slightly and cause the adjuster to tighten up. What you need to do as you tighten the jamb nut is do kind of an isometric exercise where you are holding the adjuster against rotation with equal and opposite force of the rotation of the jamb nut! This may take several practice attempts. As soon as you have tightened the jamb nut just double check that it did not creep, the slot should be aimed at the mark we made 1/6 turn left of the slot when contact was made. Do all four and do not be timid about tightening the jamb nuts!!!

If you are not locked down at TDC with the lobes at 5 & 7 no short cut for you! Go to KTMtalk.com and print out my article.

Reassemble the rest of the stuff, as always when you fill the radiators, fill to the top, loosen the bleed screw that is near the spark plug and wait for coolant to come out, otherwise you have a air pocket in the head. Some models have another one on the top tank of the right radiator. When all the air is out set the coolant level just ¼" above the bottom of the top tank with the bike level.

Finish up, don't forget to take the TDC lock down bolt out and put its thick washer back on.

Go ride!