General disjointed notes and comments on Saito engines.

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WLR.

ABC/AAC identification, o/haul inspection

Now to your FA-120.

First, look at the cam cover. Do the cylinder fins reach out over the cover, or does it look like the cover can be taken off with the cylinder in place? With the fins out over the cam box you have the ABC engine, the small fins are the AAC cylinder. The ABC version has bronze valve seats, OK to lap the valves. The AAC cylinder has hard chrome seats, plated on the base metal aluminum. Do not lap the valves in the AAC cylinder. If you grind the plating down, it will flake and the cylinder will have to be replaced. Use a pencil eraser (a big one) and spin it on the seat if it needs cleaning, chuck the valve in your Dremel after you clean the seats and use the eraser again to polish the valve. If the valve leaks after this, replace it. Install new valve springs, they lose their tension after a period of time, and they are cheap.

The cylinder bore, whether the ABC or the AAC, is the last thing that will wear out in your engine. I have replaced only two cylinders that weren't crash damage. One was destroyed by an owner who ignored the bearing noise, bits of the bearing scraped nice grooves in the chrome plating on the cylinder wall. The other was an AAC where the owner knew he should lap the valves. Cost him more than he wanted.

The piston, if you can check it, should have 0.0005" to 0.0015" skirt clearance. Or give it a good inspection by eye. If you still see the grinding marks over most of the skirt it's fine to re use. The con rod should have about 0.0005" clearance on the wrist pin, up to 0.002" on the crank pin is OK. Install a new piston ring.

Wear on the cam lobes is OK, pitting or visible damage is not. If you replace the cam you must replace the tappets at the same time, or risk cam failure.

Install a new ceramic bearing at the rear of the crank, and if you wish use a ceramic at the front also. Just be sure the front bearing is a rubber sealed one, the shielded bearings will leak oil badly.

The oil leakage from the push rod tubes indicates either a very high time engine, or a plugged crankcase breather nipple. The only way for oil to get there is past the tappets. If the ring has a lot of blow by, the internal pressure can force more than the normal amount of oil past them. Or they themselves are worn to a very loose condition.

The tubes don't have o-rings on them anyway, and the rubber seals are only sold with new pushrod tubes.

That's enough for now. Read it through, look at your engine, then ask more questions as you think of them.

AAC/ABC again, early 120S

Positive identification of the various big block engines can be a little difficult, but I think what you got is the latest version of the FA-120. If it's a white box it's almost definite.

ABC/AAC - in the first picture you can see the cylinder fins extending over the cam box, this is the ABC cylinder. Contrast that to the second picture with the fins much smaller. The smaller fins are the AAC type. Contrary to what you might think, the smaller fins give no loss of cooling since the brass/aluminum joint was less efficient, the ABC needed the larger fins, the AAC does not. The AAC therefore is lighter not only by eliminating the cast in brass sleeve, but less metal is needed for the fins.

In the first picture note the push rod tubes going all the way down to the cam box, this is the "Low cam" engine. In all the others, if you look closely, the "Lump" in the rubber is well above the cam box, this is the sign of the "High" cam. Fifth picture shows it clearly.

The third picture shows what you probably got. The early hot FA-120S still had the cast sign "FA-120" on the right side, the later ones have the sticker that says only "120S" there. This was probably an economy measure for Saito, using the same casting for all the big block engines and just putting the right sticker on each size. Internal machining is different, but the outside is the same.

All the parts of the original FA-120S and the later version will interchange

except the cylinder and intake pipe. Since the original version had only the o-ring seal for the intake pipe it also had a metal mounting bracket added to support the carb.

ABC Advantages

There are many things I prefer about the older ABC cylinders as compared to the later AAC parts.

The ABC has nicely finished ports, well radiused to flow the intake and exhaust with a minimum of turbulence. The AAC has all straight edges and hard corners in the ports, maximum turbulence and resultant restriction of the flow. The ABC has genuine bronze valve guides and seats, a damaged seat can be repaired. The AAC has brass guides and the seats are thin chrome plating over the base aluminum. Any valve seat damage and the cylinder is junk. The ABC has nice size fins on it, it looks like an engine. The AAC has small fins that look like they were stuck on as an afterthought.

The only advantage (to me) of the AAC is that it's a LOT lighter. And that's a BIG advantage.

AAC life

Is there a longevity issue with the aluminum bores?

In a word, no.

There are many ways to make an engine cylinder, the old classic is an iron block with a ringed piston. Works great, has a long life, but it's heavy. Many of the older engines actually had iron pistons, the "Stovebolt" Chevys for example. They were tin plated to prevent problems with similar metals rubbing. Some diesels still use iron crowns and aluminum skirts on two piece pistons. Strong, but still heavy.

Air cooled aviation engines often are built with the cylinder fins turned as part of the steel cylinder, using ringed aluminum pistons. The aluminum cylinder head sometimes has an iron "Skull" cast into it, usually it's plain aluminum, and usually has internal threads to allow it to be screwed onto the top of the cylinder if it is a radial engine. Some, like the old Kinner radials, had a flange at the top of the cylinder and the head was fastened with short screws.

In an attempt to lower the weight further, some makers used a finned aluminum "Muff" pressed on the steel cylinders. This worked, but the cooling was not as good because of the joint between the steel and the aluminum - it tended to open as the aluminum expanded more than the steel. With sufficient air flow there was no problem, but they did tend to overheat if idled too long. As an example, this was a problem with the early

Technopower radials.

Almost universal in our early model engines was a steel sleeve with either a ringed aluminum piston, or a piston made of "Meehanite" iron alloy with a lapped fit in the bore.

The first real change in construction was the ABC engine, using a brass sleeve in the aluminum muff, chrome plated tapered bore, with an aluminum piston. The brass expands more than the steel sleeves did heat transfer isn't a problem. And by taking advantage of the expansion, the piston fit could be controlled very nicely. But the brass was still heavier than the aluminum.

Two makers took a side track from the ABC; Thunder Tiger and OS engines started using nickel plating instead of chrome. TT has never had a problem with the ABN engines, I've only heard of one failure, caused by a bearing coming apart. Bits of bearing removed the plating. OS, on the other hand, has a lurid history of liners peeling. They seem to have it right now, shelling looks to be a thing of the past with OS. Their reputation was so badly damaged by the peeling that with the AX engines they started calling it "ABL" instead of ABN. It's still ABN even with their new name.

There were some experiments in here for running a ringed piston directly against an aluminum cylinder bore, probably the first one most of you heard of was the Chevrolet Vega engine. This engine had problems, but they were not caused by the piston/cylinder fit. The way this was made to work was a high silicon content in the aluminum. I have a Mercedes 500 AMG, 26 years old, with the same type block. At its last overhaul standard size pistons and rings went back in, wear is not a problem. There is a variation on this called "Nikasil," this is a process applied after the block is machined, it allows a less expensive alloy to be used for the block.

Chrome plated aluminum? Way back in the late 40s and early 50s, McCullough (yes, chain saw McCullough) started chrome plating directly on the aluminum cylinder bores, not just the chain saws but also the engines they built for target drones. Porsche (cars) was also working on the same thing. They both got it to work fine after some teething difficulties,

So now, using 50 year old technology, we can eliminate the steel liners that didn't cool well, and the brass liners that are heavy. What we can't do, is run a lapped piston. It has to be a ringed engine. I'm sure some have tried, but I know of none that have been successful without a ringed piston. For obvious reasons, this construction method is called AAC for Aluminum piston, Aluminum bore, Chrome plated.

This AAC is the best yet for our engines. Good heat transfer, light weight, and a bulletproof cylinder bore.

In the Saito AAC engines I have never seen a cylinder replaced due to failure of the plating. I have replaced them due to scoring from a disintegrated bearing, others due to crash damage, even one where the owner tried to lap the valves and ruined the valve seats. Plating failure? Never.

There are still other methods I've not discussed, for example Norvel has what they call "Revlite" which I think is a variation of anodizing, but I'm not sure.

And you can tell your buddy that YS uses something similar to Nikasil, but I'm not sure of their process. And OS four strokes are all ringed pistons in the easily worn steel cylinders, except the FL-70 which uses ABN in a tapered bore and no ring on the piston.

If you make it through this, congratulations. I did run on here.

After run oil – how the #% do I get it in the crankcase?

Some few twins have two crankcase ports, but none of the singles do. As a result when you try to force the ARO in it tends to blow back out. No problem.

Got a plastic squeeze bottle with a tapered spout, the sort that you put your tomato catsup or mustard in. Best if you can see the level of the contents. If the tip is small enough to go into the vent hose you're done. If not a short length of brass tubing can be forced in the tip, or you can cut the tip back to get a larger diameter that will let you push the vent hose inside.

Fill it about ½ way with your favorite AR oil, and you are ready.

Pull the vent hose out the top of the plane, or if not convenient turn the plane over, just be sure the hose is pointing up. Attach your new oil bottle to the hose. Then holding the bottle with the tip down turn the engine slowly.

While the piston is going down in the bore you'll see bubbles in the oil bottle, then when the piston is going up it will draw oil back into the engine. Keep turning until you have drawn an ounce or so of oil in. Unhook the bottle, turn the plane back upright (Or the hose back out the bottom) and spin the engine for a few seconds with your starter. This last will make sure the oil is run everywhere inside the engine, and blow any excess out.

Simple, isn't it?

After run oil – why use it?

As the engine runs acids are formed in the combustion process. Most of the acids are blown out the exhaust, but some also blow by the piston along with the oil for the bottom end. Some of the acid and other corrosives go out the vent, but just as with the oil, a lot stays in the engine. Some unburned methanol and nitromethane also get in the crank case. There is no way to avoid this contamination. The same thing happens in your car engine, one of the main reasons for regular oil changes.

There is nothing we can do to prevent these acids working while the engine is running, but they are not in a high concentration so their effect is minimal. If left in the engine after running though, they will continue to eat away at the internal metals.

The easiest way to prevent short term damage is using an oil with a high film strength. Synthetic oils do not have this high film strength, they tend to drain off surfaces quickly, and the acids remain, starting their damage. Castor oil on the other hand has an extremely high film strength. This not only makes your airplane harder to clean after flight, it leaves a coating on the internal parts that is resistant to penetration by the acids and other corrosives. An added benefit of the high film strength of the castor oil is decreased wear of the cam lobes and tappets.

We can also flush the engine, and neutralize the acids. This is where the after run oil comes in. An ideal after run oil will have chemical buffers that not only will neutralize the acid, they will also counter any alkaline corrosives left in the engine. The ideal oil will have high "Moisture Displacement" qualities as well, lifting any water off the metal and replacing the water with an oil film. Dexron automatic transmission fluid has all these desired qualities.

So when your day's flying is finished pump the tank dry, and spin the engine with glow heat applied, and run it dry also. Then pump a healthy slug of Dexron ATF into the crank case, turn the engine a few turns by hand to be sure it's not too full and apply your electric starter to give the engine a good spin, get all the inside coated, and blow the excess oil out the vent.

The castor oil in the fuel, and religious use of after run oiling, will make your engine last a lot longer before any repairs are needed.

Break in of a fresh engine

A piston ring is seated in the first few seconds of engine running after its installation. This holds from the smallest to the largest of ringed engines, and is dependent on cylinder pressure to force the ring against the bore. Therefore, the initial running should be done at a high power setting.

My way is to allow the engine a few seconds to come up in temperature, then I immediately peak the mixture at full throttle, then right back to idle. For the first few minutes of running the engine goes to full throttle for about five seconds, then back to a rich idle for twenty. This gives me the high cylinder pressure to seat the ring while at full, and then at idle more oil is spread on the working parts.

After these first few minutes I'll go back to full and get about 800 rpm rich drop, then lean the idle a bit but not all the way, and put the engine in a plane. Over the next hour or two I'll slowly lean the idle, and bring the HS closer to peak. After a couple hours total time the engine is all ready for extended high power, and I've been able to fly the fuel through the engine instead of oiling the grass at my house. Or not oiling the grass as much as many do.

Cylinder color and intake stacks:

The dark colors radiate heat better than lighter colors, the best for radiation is a flat black. Since a flat finish is difficult to maintain, and also has to be thicker than a gloss coat, I just use the shiny paint. Not a great difference between the matte and gloss finishes in radiation anyway.

The intake stacks help a lot, but not in power. I'm sure you've noticed the drop;lets of fuel shooting back out of the carb when the engine is running - the stack keeps them in the air flow of the carb, they get drawn back in, and used by the engine.

This gives two immediate benefits. One, the inside of your engine compartment doesn't get all that raw fuel sprayed around. And Two, you can generally lean the needles a bit, giving better fuel economy. As much as 15-20% longer flying time on the same amount of fuel. Really.

A few months ago we had a thread in Glow Engines about stacks, many posts told of people having the same result.

A third benefit, if you like, is being able to mount a Bru-Line air filter on the engine.

All my Saito engines in service have stacks with the air filters mounted.

Would you like a 20 minute flight from 14 ounces with a 120 engine? Truly, I don't know if I could make 20 minutes, but with 14 ounces my UltraStick has fuel left after 15.

More on intake stacks and air filters

The intake stack for your FA-82 is the same one that fits from the FA-56 up to the FA-100 - all the mid block engines use the same one. About $6 -$7 from Tower. And since they'll charge you the same freight whether it's one bit or several, order the Bru-Line fine mesh air filter at the same time. And a pack of extra filter elements.

And if you want to get "Saito Fancy" add the new Saito branded fuel filter. It's expensive, ($9.75) but it's really a show piece. A machined aluminum, base with a genuine glass bowl that removes for cleaning, and a fine mesh filter element. It even says "Saito" on the metal bas4 part. Just think of the bragging rights. I had to get one to examine when I first saw it. I like it.

Intake Stack: SAI50GK93 $6.75
F-1 Fuel Filter: SAI50109 $9.75

The Horizon web site crapped out while I was looking for the air filter, sorry. Total for the filter and the packet of spare elements is about $6, so it's well worth the expense.

Stacks again

In a manner of speaking, the stacks greatly increase the performance of the engine. In another way they do nothing. No power increase, but they contain the back spray of fuel, you can lean the needles a good bit, your

total fuel rate (and expense of operation) goes down. Also, the inside of the engine cowl stays a lot cleaner by eliminating the spray out of the carb. For maximum benefit use a Bru-Line air filter also - that catches the last bit of fuel and keeps it in the air stream.

More on intake stacks

...Could there even be a "tuned length"?

Yes, there could indeed. But...

A tuned exhaust is pretty easy because we only have to worry about the pressure waves at the exhaust valve. With fuel injection again we only worry about the pressure waves at the intake valve.

With a carb another monkey pops up to bother us - the spray bar. Not only does the protrusion of the spray bar interfere with the wave travel, there are speeds at which the positive wave is going to be there when it's supposed to suck fuel, and instead it pushes the fuel back out and the engine goes lean.

In post #1560, Ernie M is asking if there is a specific length for (intake) velocity stacks. In yours and other's replies you are talking (exhaust) tuned pipes. Did I miss something here or is this a misunderstanding? I just got a velocity stack and o ring for my Saito 100 and was wandering what you might have to say about the length of the intake velocity stack?

Guess I didn't make it plain. With true fuel injection the intake can be tuned just as the exhaust can. But it's a fairly narrow rpm band, and unless you always keep the rpm close to that band the tuning often works against you. Reverse cones and expansion chambers don't work on the intake.

Then with a carb having all the bits sticking in the air flow it's just frustration.

Best just to ensure the air flow and use the stack and air filter to keep the inside of the cowl clean, one, and improve the fuel economy, two.

Sealing the intake stack

I never said anything in particular about the o-rings, only that the gap between the carb body and the stack had to be sealed for it to work properly.

I've always been leery of using an o-ring in such a place, my preference is to cut a length of tubing that's a snug fit in diameter and length to go there, and dab some RTV on the outside of it to complete the seal.

What I've been told about the o-rings is someone taking the carb (or complete engine) and the stack to their local hardware store and just picking out one to fit.

My aversion to an o-ring here is for two reasons. One, the tubing will give a much smoother surface inside, the o-ring is either going to have two grooves or a bulge into the air flow, or both. Further, if the o-ring is loose it might not seal well, and it could work its way out of position and go into the carb. If it's clamped tightly, as the oil in the fuel works its way around the o-ring it might get squeezed out and get into the carb. I doubt it would hurt anything mechanically, but it could jam in the throttle barrel and be a fault that was very hard to find. Worse case would be causing a dead stick and still be a bear to find.

Of course you could find an o-ring that was a perfect fit, just lightly clamped, and it would work perfectly.

Sealing the intake stack – tubing

You will select a tubing diameter that will fit into the recess where the Teflon seal was fitted for the choke plate, and cut it to length to be a snug fit between the carb body and the flange of the stack. The picture is an old FA-80, the white ring is the Teflon seal. Its outer diameter will be 11 mm or 7/16" depending on which rack you visit.

And a small o-ring around the outside of the tube would probably make it as good as you can get. I'll try the outside o-ring on my next one.

Even more on intake stacks, fuel selection, and mess on the plane.

All that oil on the airplane? Two things to start. First, while 20% oil is in “The Book,” 17-18% is more than enough. In fact, the nature of a four stroke engine is such that once the oil level is established in the crank case going down to 10% would probably be OK. I am not recommending you try it, might be expensive. Just as an example of low oil, Technopower says use a MAXIMUM of 5% oil after break in.

The second thing. Does your engine have an intake stack? A lot of the oil could be back spray from the carb, the stack will decrease this, if used with a Bru-Line fine mesh air filter it will be eliminated. Trapping the fuel that is otherwise lost will also increase your flight time on a given amount of fuel.

Now. Is the YS 20/20 fuel “Better” than Omega 15%? Up to you. You will get a small increase in power with the 20% nitro, at the same time you’ll also get an increase in the oil on the plane along with higher fuel consumption. To me the extra power is not enough to justify the higher price, less mess and better fuel economy are the frosting on the cake.

Diagnostics and tuning

If the compression is good and the bearings aren't noisy, don't take the engine apart.

If the compression is good and the bearings are noisy then don't pull the piston out of the cylinder when you take the cylinder off the case.

Bad compression and noisy bearings, then you have permission for a complete teardown.

Seeing the picture of your FA-120, it really can't be that old. It has not only the AAC cylinder, it also has the high tappet guides and the late type cast muffler just barely shows. I doubt it could be more than five years old, or around that at most.

It would not surprise me, if you showed the right side of the crank case above the mounting lug, to see "120S" in gold letters on a black background.

It's possible you're misjudging the engine. Remember the FA-120 is the runt of the litter when you get into the big blocks, it's the smallest of all, it's bigger siblings now go all the way to the FA-220, and even the FA-180 is not much bigger than the 120. So you might just be expecting more than it has to give.

Fuel burn: I see you have the intake stack on your engine. Adjusted properly you should get at least 13 minutes on a 16 ounce tank, and that's assuming full throttle the whole time. With "Average" power settings 16 ounces will give 20 minute flights. Truly, it's all in the carb adjustment.

Don't fret about the leakage from the push rod tube, you probably won't see any when you get the engine dialed in. I would suggest a close inspection of the carb and intake pipe, check carefully for any leakage there. Set the valves, my recommendation is set them both to 0.002" to get the best performance.

Tuning with Tach and AROil

What a tach does for tuning a four stroke is force you to wait for the engine's reaction. If you go slow, give the engine time to respond to a needle change, your ear works fine. The engine will usually be five to seven seconds behind you, learn to wait for it. Remember this is for a tuning change, not throttle response.

My oil of choice for pre-lube and after run is ATF Dexron. Costs a buck a quart instead of $4 for two ounces in a bottle that says "After Run Oil" on it. And I can't tell any real difference.

HS needle adjustment

Classic symptom of the HS being too lean. No, don't scoff, just turn the HS needle out five full turns and restart the engine. Don't bother the LS for the moment. Open the throttle to full. Unless you have a feed problem the engine should accept full throttle and continue running. VERY SLOWLY lean the HS until you get to peak rpm, and remember that you will always be about five seconds ahead of the engine - meaning the engine will run about five seconds before you get any response from a needle change. That's why you have to go slowly in the adjustment, this lag is the cause for many people getting a four stroke engine too lean.

> **ORIGINAL: Ernie Misner**
> **Why the 5 sec. or so lag time on a 4-stroke when changing the HS needle setting?**

The best explanation I can offer for the delay is the length of the intake pipe. The engine will draw a quantity of air/fuel mixture through the carb and intake pipe, then push an amount back into the pipe before the valve closes. So if you are running rich at a 6:1 ratio and want to go to 7:1 mixture, it takes a while for all the trapped fuel/air volume to change. If you turn the needle too rapidly you'll find you have gone suddenly from 7:1 and reached 9:1 (lean) with no in between time to let the engine tell you it was at an 8:1 f/a ratio.

I've noticed the engines with stacks installed are a little slower yet in their response, further confirming the greater volume of the intake tract.

Pinch test method

The pinch test is valid for getting close to the correct IDLE mixture, but doesn’t work well for the HS setting.

At idle a pinch of the fuel hose will give a slight rpm rise before the engine falls off. The final adjustment has to be done by checking how the engine comes off idle when the throttle is opened.

The HS needle must be adjusted with the throttle full open, slowly leaned until peak rpm is reached and then opened to get 300-500 rpm drop.

With experience and a lot of patience you can adjust both the HS and LS needles without a tachometer, but the delay in response of the engine makes it hard for many. So long as you take your time, waiting 10 seconds or so between adjustments, and make them just a little at a time, the engine can be tuned by ear.

The HS needle has no effect at idle if it is open far enough to run at full throttle, and almost no effect until you get ¾ open throttle. Since the LS has such an effect you have to go back and forth between the LS and HS adjustments to get everything right.

Lean run, or overheating?

The most definite test for lean mixture in a particular installation is to peak the engine rpm with the HS needle, open it to get your 300-400 rpm rich drop, then with the tank close to empty point the nose straight up and listen to the engine. If the rpm falls off at all, even after 30-40 seconds, the setting is too lean. Ideally the rpm will rise just a little bit with the nose up and the fuel almost gone.

This works because the fuel has to be drawn the furthest against gravity with the nose up and a nearly empty tank. You may find the engine is running richer than you think it should with a full tank on take off, but you wont go lean in flight, and the Saito engines run great even when they are a little rich. Too lean is another matter, too lean is to be avoided at all costs. Or the cost will go up.

If your engine is using an accessory muffler that also is fully within the cowl except for the exhaust pipe and no other air outlet vent you are most likely running hot. Not enough air outlet area. If instead you have the stock muffler going through the cowl, with at least ½” clearance all around it, you might be OK. Rule of thumb is the outlet area should be 2½ times the inlet area. If the opening in the front of the cowling is, say four square inches you need ten square inches of outlet area. Sometimes you can get away with less, but you have to be careful checking to be sure it’s OK.

How do I know if your engine is overheating? Unless you bring the plane to Western Florida and run it for me, I can’t tell. But you can. The common symptom of getting too hot is the rpm falling off in flight, the engine “Sags” and you have to keep opening the throttle to maintain rpm. Or at full throttle you lose power. You can also have a frying or crackling sound from the exhaust.

Running too lean will lead to overheating as well as a lack of cooling air. If you can fly your plane with the engine cowl off, do so, and confirm the needle settings. Then, without changing the needles, fly it with the cowling on. If the engine sags with the cowling and did not when it was running in the open you need more air flow.

Really not complicated in any of these checks, but many people don’t bother. And they have running problems.

Case vent

All the Saitos, going way back in history, have had the vent in the back plate until they replaced the metal back plate with the plastic one. Starting with the FA-72 and the plastic plate, the vent was moved to the bottom of the crank case under the cam box. Better cam lubrication was an added benefit.

If you wish, the first time you tear the engine down you can move your vent, either to the late location, or put it in the top of the cam box. On the bottom you'll need some reinforcement, JB Weld or similar should work. There's enough metal in the top of the cam box not to need anything else for the threads there.

Breather and cam oiling

Concerning the move of the breather nipple from the rear to the front.

Two reasons for the move of the breather. First, it does force more lube to the camshaft and tappets, but I think the main reason was going to the

plastic back plate. If the breather nipple were in the plastic it would be relatively fragile.

One of my experiments has the breather moved to the top of the cam box, from there to the exhaust rocker box and then across to the intake rocker box. Finally, the actual atmospheric vent is from the intake rocker box. Why? This forces the oil past the cam and tappets for better lubrication there, and ensures positive lubrication to the rockers and valve stems. This is mainly for upright engines, when they are inverted the rockers seem to get plenty of oil. Upright they are almost always dry.

PCV and normal venting

First, some back ground. The Japs have much tighter emission controls on engines, and they are influencing some Jap manufacturers of model engines. In this country the Eco-Nazis are trying to get all piston engines covered by federal regulations. In California where most of the nuts are already out of the wood work, the CARB has mandated emission standards on lawn equipment - that's why you buy weed eaters there with four stroke engines now.

The case vent going back to the intake is very close to the Positive Crankcase Ventilation on our cars, differing in that auto engine have valving to ensure a constant flow through the case into the intake over and above the amount of piston ring leakage. The model 4s engine vented this way would have only the ring loss to flow back into the engine's intake.

It does have the advantage of catching the oil that would otherwise go onto the plane or the ground, but if you're running a castor blend (as you should be) I really think there's about as much going out the exhaust as out the vent.

The disadvantage is the volume of air from the case will displace an equal or greater (because of temperature expansion) amount of fresh air being taken in, leaving less free oxygen, and not being able to burn as much fuel. This leads of course, to lower power available.

I think it is worth an experiment. Set your Saito up with the recirculation and see how much difference it makes. At the same time, to be fair, plug the recirculation on your OS and see how much power it gains. In both cases you'll have to reset the mixture.

Prop drive

The prop drive is on a centering cone with an angle that is referred to as a "Locking" taper. It requires a strong puller that will latch into the groove in the drive washer. Some have had success with inexpensive pullers, but many just ruin the cheap ones. Many auto supply stores will lend tools, you might visit one and pop the drive off while you're there.

The puller I use is a lot more money than you would want to have sitting unused for 99.999% of the time, but I do use mine often. It's a Snap-On tool.

Tappet changes and “S” models

Not mushroomed cams, but the tappets. The increased diameter of the cam end of the tappet will increase the valve duration and overlap with no other change. In the first attached picture the plain tappets are in the left column, what I call "Mushroomed" tappets are on the right.

This composite shows all the external differences between the old style big block engines and the "High Cam" versions. Also shown is the original "S" cam, just used for a short time in the original FA-120S. If you see a 120 with a curved intake pipe instead of the cast pipe it's an "S" model, the hot one. The later "S" 120s had the cast pipe and a normal cam, but still with the wide headed tappets so they were still a bit hotter than the early ones.

Second picture is the hot "S" 120. See the intake? Third picture is the standard 120 cylinder next to the "S", both shown with the intake pipe. Finally, current production FA-120S showing the return to the cast intake.

Cam bearings and oiling, gear lash

All Saitos have cam bearings, but if you mean ball and/or roller bearings, no. The camshaft has bronze bushes that run on a 4 mm steel shaft.

An alternate way to oil the cam, its bearings, and the tappets is to put a big slug of oil in the crankcase, then hold the engine nose down to get the oil to run up front, then angle the engine back a bit to get it all into the cam chest.

Other ways to get strange noises in a Saito: A seized crank bearing sliding the balls instead of rolling them, this is rare, almost unheard of. The other is an assembly problem, not leaving enough clearance in the timing gears. This is set by selective thickness of the cam box gasket. If you always use the gasket from the engine kit you're OK. If you have too much clearance the typical "Click" as you turn the engine will be louder - it's the intake tappet pushing the cam forward against the gear teeth.

Carb adjust

The flush initial setting of the LS needle was with the metal throttle lever. With the later plastic lever the flat of the LS adjuster is roughly 1/16" down at the factory setting - the thickness of the plastic at that point.

With the engine on the stand (if you can) peak the HS and drop to as low an idle as you can hold. then just start turning the LS in SLOWLY as the engine will take 5-7 seconds to respond. As you lean it the rpm will rise when you're getting close to optimum, lower the idle trim to keep it down. When you think you have it pinch the fuel line to check. The rpm should

stay steady momentarily, then fall. If the "Rs" fall immediately you've gone too lean, and if the rpm rises before it falls you're still on the rich side.

When you think you have it, open the HS needle about one turn and go to full throttle. Peak the HS, then go rich to get your 300-400 rpm drop, and check transition in the normal way, trimming the LS to get it right.

Now you should have an engine that idles a lot smoother, and burns less fuel, with no decrease in power available.

Slow return to idle

If the delay is just the last 500 rpm **or so in dropping to idle you might be able to tune it out, but I wouldn't think it worth the effort.**

On the other hand, if your engine slows to around 4K rpm and then slowly falls to the idle speed, that's another matter. Often you'll find the air throttle is open a good bit, to keep the engine running with a rich LS adjustment.

With the throttle drop the idle as low as you can, then do the "Pinch" test. The engine will probably rise a good bit in rpm before it falls. o ahead and peak the LS, but remember the delay in response will be even longer than it is at full throttle because of the lower flow. Go back and forth between the LS adjustment and the throttle, work it to get the +/- 2K idle speed, always trying for the lower throttle setting. Check the HS now and then while doing it. When the idle is as low and smooth as you can get it check the transition, richening the LS as little as you can.

You may well notice improved fuel economy too.

Carb adjust – air bleed type

Your carb is an air bleed, but Saito doesn't use your granddaddy's OS type air bleed. It is fully adjustable; idle, mid range, and high speed.

Hobbsy pointed out the idle adjustment, the Phillips head screw beside the throttle lever. Set it as he said, with the screw midway across the hole to start.

The mid range adjustment is done by turning the bronze colored disc on the needle valve end, start with its index set to neutral. Note the black line on the disc and the cast mark on the carb body in the first picture.

The adjustment has to be done high speed, then mid range, then idle. Any other order you'll be chasing the adjustments forever.

HS is normal, go to full throttle and peak the engine, then richen it for 300-400 rpm drop. Go to half throttle and let the engine stabilize, then pinch the fuel hose. When it's right the rpm will rise a little, then fall. Immediate fall is too lean. Adjustment is by rotating the bronze disc. Turn the disc to raise its index mark above the mark on the body to go lean, or down to go rich.

When you have the high and mid range working fine trim the air bleed for best transition first, and best idle second.

Things to be wary of. Make sure your throttle linkage does not pull the throttle lever away from the carb, the inner end of the throttle barrel is the moving part of the regulator valve, if the barrel is pulled out the engine will go to full rich. On the lever end of the barrel is a wire spring that keeps the barrel pushed against the disc on the other end, be sure it is there and is holding the barrel. Second picture. Finally, the regulator valve depends on the oil in the fuel for sealing. Synthetic oil wont do it. Castor oil is 100% necessary. But again, a blend with three to four percent of the total fuel volume will work.

Cam grind

The FA-72 was the first of the mid block Saito engines to get the really hot valve timing. In the big block it was the FA-120S about 1997-1998.

With these hot cams the idle is cobby, they wont idle the way the older engines with milder cams would. There is no increase in the red line rpm, they just swing more prop at the same rpm.

The only cams currently supplied by Horizon are these wild ones, so as you wear the lobes down and replace the cams all the engines will have the same higher idle.

I am hoarding my milder cams, for me the older cams gave enough power.
--

Carb barrel spring

It's not a stupid question. But it is a testimony to the excellent machine work in the Saito carb.

When you work the throttle lever you'll notice the throttle barrel also moves in and out of the carb body. This is what makes the metering (low speed) needle vary the mixture as the throttle setting changes. By moving nearer and farther off the LS needle the fuel port gets larger and smaller, changing the amount of fuel delivered.

Now, since we are depending on the consistency of the variation we have to be sure it changes only with turning the barrel, and not by the barrel moving straight in or out. The spring prevents this, keeping the barrel pushed toward the lever end.

Now we get to the excellent machine work. There is a screw, often the idle speed stop, that rides in a spiral groove on the throttle barrel. As the barrel turns, this is what makes it go in and out. With the outside of the barrel and its bore in the carb body smoothly finished, there is not much friction preventing the barrel's turning. Add the well finished side of the groove for the idle stop screw, the spring is easily able to push the barrel out of the carb body, thereby seeming to be spring loaded to full throttle.

All twin needle carbs except the cheapest possible ones, have this spring. But most others are rough enough in their production that you don't see the barrels being pushed out by the anti-rattle spring.

Please note that an ordinary air bleed carb does not need this spring. Saito air bleed carbs do have one, but they aren't ordinary air bleed carbs either. They could be the subject of another discussion if anyone is interested.

Oily engine

A Saito run inverted tends to collect a lot of oil in the rocker boxes, but it sounds like you're getting a lot more than should be expected.

The ring is a possibility, but unless the engine is really high time or you fly in a dusty area I'd look elsewhere. The power would be down too, but that could have come on gradually without your noticing it.

Is the case vent clear? Have -- oops. You said you were blowing into it.

Oil from the original equipment front bearing is normal, it's a shielded bearing that allows the oil to flow through, it is not a sealed bearing.

Are you perhaps running a "Heli" blend fuel? Heli fuels have a LOT more oil than you need with your Saito. If yes, that could be the whole thing. I recommend Omega 15% fuel, it's a synthetic/Castor oil blend. Works fine. Powermaster 15% is another good choice. Both in the "Plane" version please, not Heli.

Part numbers.

Horizon's listings all start with "SAI." The next two (or three) characters are digits, indicating the size engine the part was first produced for. Some times there are letters included, as in "50GK" indicating FA-50, Golden Knight version only. The last characters are usually the index numbers in a parts exploded view.

Finally, there may be a letter at the end indication a production modification.

The biggest problem is that the exploded view that was used to assign the part number is no longer available, and even if it were you wont know which illustration was used.

Let's use the FA-40 and FA-56 carbs as an example.

SAI40A821 fits the FA-40, (40A?) and SAI50821C is for the FA-50. Note the "C" on the number for the 50. Modification from original. In both cases note the "821" indication the carb.

With all this in mind we can generate a part number for the carb on the FA-45 as SAI45821. It might even be right.

Remember there are many part numbers that do not follow this convention.

Valve adjustment

You need 1.5 mm and 2 mm Allen wrenches, and a 4 mm box wrench. An open end 4 mm will work, but the box is safer.

The Allen wrench sets I use most commonly are the Bondhus 10687 ball drivers, and the 12592 folding set. These or equivalents are easily available from your LHS or mail order.

The box wrench set I recommend is from Sears, their number 42339 set of ten combination wrenches, approximately $15 from your local store.

Feeler gauge? I remembered an old trick we used on fuel mechanical governors to set the air gap - the cellophane from a cigarette pack. It's almost all 0.001" thick. Tried it in a Saito, works great.

Double it to get the 0.002" needed, use it as your feeler and adjust the valve. After adjustment if it slides out with no drag it's too loose. A little drag is fine, if the valve is too tight the cellophane tears. Fail safe adjustment and checking.

Valve adjust – old cams only

The way you're doing it is OK, but as W8YE said you should bring the piston up to TDC before checking/adjusting. When you feel the engine hitting compression, keep turning it until you feel a definite change in its resistance to turning. You should be able to rock the crank back and forth, feeling it wanting to continue away from that point. That point being TDC.

Another way is to look at the rockers. As you turn the crank in forward rotation you'll see the exhaust open, then start closing. Just before it has closed completely you will see the intake start to open. The point where both valves are open equally is TDC between the exhaust and intake strokes. From there, turn the crank exactly one full turn, and you will again be at TDC, this time between the compression and power strokes.

Using the first method you know you're between compression and power because you felt the compression as you turned the crank, the second method will work with the glow plug out when there is no compression to feel.

To maintain the proper timing percentages between the intake and exhaust valves, you should have them both adjusted to the same clearance. Get them as close as you can. (N.B. on multi-cylinder model engines the clearances are sometimes set differently, but this is for cylinder balance purposes only.)

Now we come to the point of contention. I set all my Saito engines at 0.0005" clearance. Right. That’s 1/4 of the minimum given in "The Book." In point of fact, even if you have to force the 0.002" feeler strip between the rocker and the valve stem, so long as you can feel some wiggle in the rocker the valve is not too tight. When set at 0.0005" cold, the running, hot clearance is close to the 0.002" specified. The clearance always opens as the engine warms up.

There are many advantages to using the minimum clearance, including more power from the greater open duration, less valve gear wear from lessened hammering, and so forth. But it does take a dial gauge set to do it with precision, or a very good feel with the wrenches.

Pictures attached show the use of the dial set-up.

Another way to check for a tight valve is just flipping the engine with the throttle open. If you have good compression the valves aren't too tight. Might be too loose, but not too tight.

The people I've convinced to use the half thousandth clearance wont go back to two thou, but it's hard to make the converts.

Rocker arm thrust washers

Saito has eliminated the thrust washers on the sides of the rocker arms. The rockers don't fit any better, Saito is still using the same forging dies and molds for the castings. It's just that the side loads on the rockers are so slight that wear isn't a real problem. But to me side float is a problem. Due to the angularities in the valve train the valve spring load pushes the rocker to the inside, then when the valve closes the clearance lets the rocker slide back to the outside. This changes the valve clearance – loose when the rocker is to the inside, tight when it slides out.

If you run the valves at the high end lash, 0.004" range, it wont make a lot of difference. But if you want all the engine wants to give, and run 0.0015" lash, the side float can make a difference. For this reason I try to eliminate as much of the float as I can. Whether it's the early Teflon thrust washers, the later tabbed steel ones, or just thrust washers from the cam axle, I think they are worth while.

I have found a part number for the rocker shaft thrust washers on the big block engines. It is SAI120S37 - still supplied for the FA-450R3 engine.

For the smaller engines you can get the SAI170R37 which includes three sets, or the SAI325R37 to get five sets. Both include other washers as well – stock up.

Old and new cams

"...this engine has not been run in ten years." This could mean the engine was new ten years ago, or it could have been an older engine even then. The point here is that it could have an early or late type cam shaft in it.

The older one responds very well to a valve clearance setting of 0.0005" while the later should be set at 0.0015" lash.

If the engine's real age is at least fifteen years try the half thousandth setting. If it runs fine there keep it set there. If it doesn't run well or if you're not sure of the age then use one and one half thousandths clearance. In either case you wont hurt the engine with the tighter setting.

In any case the engine will run fine with the 0.0015" setting, even as much as 0.002" lash is OK, but you get better power with the tighter setting.

Feeler strip for valve adjust

Most feeler "Sets" other than the basic ones have a 0.0015" strip included. As you can see in the attached picture this is also 0.038 mm, just 0.002 mm under the desired minimum clearance for the late cam grind.

If you set the clearance to 0.0015" and then tighten the lock nut, there will be enough distortion of the adjuster screw threads to get you the 0.04 mm clearance.

TDC Again

If you are at TDC either of two conditions will hold, assuming the valve adjustment is reasonably close.

1) Both valves will be slightly open, this is TDC between exhaust and intake strokes, the cam is in the "Overlap" position.

2) Both valves will be fully shut, with clearance in the pushrod/rocker gear. This is TDC between compression and power strokes, and is the correct position for adjusting the

valves. Both rockers should be free to wiggle a little bit at this point, and the free clearance between the rocker end and the top of the valve stem should be no more than 0.002" - as I said, this is where I use the 0.0005" setting.

Hope this makes it more clear.

More on ½ thousandth clearance

Decreasing the valve clearance increases the valve open time, similar to putting a hot cam in your car. It allows the engine to breathe more freely and develop more power, but the idle does sometimes get a little lumpy. So don't be surprised by a slight increase in idle roughness. Closing the lash doesn't give you that hot a cam, but it's hotter than it is with loose valves.

Now go down to 1/2 thousandth clearance and you'll get even more, the idle still wont be bad.

As I said, the folks who have tried my 1/2T lash don't want to go back.

Quieting ramps

Since my post of 4/11/04 I have profiled several different Saito cams. See attached chart. While I did it out of curiosity about the actual valve timing, the dial indicator showed me that some of the Saito cams also have "Quieting ramps" in their grind. It is a "Lump" in the lobe intended to take up the clearance in the valve train, it eliminates the hammering of the parts *when the lash is adjusted correctly.* The correct adjustment is the height of the quieting ramp. If the lash is too great the ramp wont take up all the clearance, if too tight the valve will open too soon.

Attached graph is typical quieting ramp, degrees of rotation to the right, amount of lobe lift is vertical.

The 1/2 thousandth lash adjustment is still the best for engines *without* the quieting ramp, engines *with* the quieting ramp will work best at 0.0015" to 0.002" clearance.

Mike:

It is very hard to maintain engine heat to check the difference in the valve lash between ambient and running temperatures, but the crude measurements I've been able to make indicate the Saito engine's clearance opens about 0.0005" while running. That's why I can use 0.0015" clearance with the 0.002" ramp height.

Finally, having found no consistency in later checks concerning the quieting ramps I no longer recommend the 0.0005" clearance setting. You (I) have to check each cam individually to see if it does or does not have the ramp. Without the ramp the best running is with the tight adjustment, but the 0.002" is safe with either. If you don't know, stay at 0.002" lash.

Quieting ramps again

As near as I can tell, the later engines all have the quieting ramps. If your FA-100 has an early code date it may not.

I suspect the late engines I've found without ramps were assembled with earlier cams. All the replacement cams I've gotten, even for older engines, had them.

A quick note. Back in the timings chart I posted, the FA-72 and FA-80 use the same part number cam, the FA-120 and the FA-150 also use the same part number. In theory I should have gotten the same timings from each engine pair. Production tolerances make them a little different. OK, so maybe measurement error had an influence too.

If you look at the cam out of the engine, inspect the leading edge of the lobe, where it starts opening the valve. You might see what looks like a hard line on the face of the cam, usually about 90 degrees from the peak of the lobe. That is where the ramp is staying at the same height momentarily after taking up the clearance in the valve train. If you see the line it almost definitely is a quieting ramp, but not seeing the line does not mean there is no ramp. The only way to be sure is get out your degree wheel and dial gauge.

Experiment. Set the valves to 0.0005" and see how it runs. Check high and low rpm. Then reset to 0.0015-0.002" and try it again. Then use whichever pleases you more. Don't worry about burning a valve or a piston strike. Wont happen. If the valves are too tight, standing open, the engine wont run or will run so poorly you'll shut it down yourself.

Loose valves now tightened

Immediate difference? Maybe a little more power and faster rpm gain, possibly a slightly rougher idle.

Long term gain is much lower cam wear, it eliminates the hammering of the tappet and the rest of the valve gear. For maximum benefit use a castor blend oil in your fuel.

On your engine, with the inlet clearance opening 0.005" in that time I'd check the clearance at least one every weekend to be sure it's not opening again. It may be you've already taken a chunk out of the inlet lobe of the cam. Keeping the clearance down will, along with the castor, slow the wear down.

Don't be concerned, if it's done it's done. Just plan on a cam inspection and possible replacement when you do the bearings next time.

Lash change with temperature

On the older ABC Saitos the valve seats were bronze, they did wear, but a very small amount. Later engines with the AAC cylinders do not have any measurable seat wear - the seat is the same hard chrome of the cylinder plating. The only AAC seats I've seen damaged were by people who insisted on lapping their valves, the chrome was damaged, it flaked off. Repair is a new cylinder, the seat can not be serviced.

The valves are interchangeable from intake to exhaust, I suspect they are austenitic or a similar steel alloy, they just about do no wear on the face. If the engine is run a lot with loose clearance the ends of the stems will wear very slightly, the major damage is to the top of the retainer groove - it will mushroom slightly and wont pull out of the guide until the ridge is cut away.

The small and mid block Saitos use steel push rods, combined with the aluminum cylinder and heat the clearance does open as the engine warms up. Very hard to maintain the temperatures to check, but as nearly as I can

determine the increase is a little under 0.001" when hot. The big block engines use steel tipped aluminum push rods, they open less than 1/2 of one thousandth inch. Again, as nearly as I can measure.

300TTDP

Adjustment/operation of the Saito FA-300TTDP engine.

Preparation:

Before we talk about settings, let's check the installation. Set properly, this engine can suck two ounces of fuel per minute, so we want a tank with the large size hoses all the way down to the clunk. And the clunk drilled out to match. This needs to feed a tee, again with a large bore. From the tee medium hose can feed the two carbs, but make the two hoses as close to the same length as your can.

A better set up is using a tank with two clunks in it, and individual feed hoses for the two carbs. Again, make the two hoses as close to the same length as you can. With two clunks medium fuel line will do fine.

The Saito pump does not pump fuel, it pumps air to pressurize the tank. Depending on the age of your engine you could have either of two systems. The early type had a diaphragm pump mounted under the left cylinder cam box, the late one has what seem to be two breather nipples on the crank case. With either system roll the engine, you will feel air blowing from only one of the nipples. That nipple should have a hose going to the next part. You should also have what looks like a remote needle valve, with one extra nipple on it. This is the pressure regulator. Two of the nipples will be directly across from each other, and the third down on the side of the part the needle screws in. The first two are one from the pump or crankcase nipple, the other to the tank vent. Doesn't matter which is which, they interchange. the third nipple is the bleed line, you can leave it open if you have the real pump, or if you are using the crank case nipple it is also the excess oil drain from the engine, run a hose out the bottom to keep the inside clean. The hose needs to be a minimum of 4" length to give the vent the restriction needed.

My choice for the glow plugs is the OS "F" plug in the rear holes, K&B 1L plugs in front. The new "Saito" plug from Horizon seems to work as well as the "F" plug, in front almost any medium to cold plug will work.

Now the initial settings:

Now pull all four rocker covers and set the valves as close to 0.002" as you can. With the twin carb version you wont have to bother with them, except for routing check and adjustment.

Holding the engine pointed away from you check the throttles. They should reach full throttle together, and close off on the low speed end at the same time. Diddle/bend/adjust the linkage to get them together.

Set the low speed needles to have the flat level with the face of the throttle levers, if you have metal levers leave them there. If your levers are plastic turn them in exactly one turn from even.

The most common mistake with a Saito pumper is running the pressure too high. Turn the regulator needle in to seat (gently, please) then out five full turns.

Seat the HS needles, open them three turns.

Now with your starter choke the engine, get fuel to the carbs. If you're running two clunks you can choke them one at a time, with a single clunk you have to choke them together – the one being choked will draw air from the other.

Now hook your glow driver to the rear plugs – you don't have to heat all four – set the throttle to 1/4th, apply the starter. It should start right off.

If the engine starts, runs momentarily and quits, open the main needles another ½ turn, reprime, restart it.

It has been my experience that a cold Saito wont start at an idle setting, ¼ throttle or a little more seems to work best. Let it run at ¼ for 30-45 seconds, it wont idle until it warms a bit.

For initial running adjustments turn both HS or both LS needles equally. Check/adjust the high speed first, then the low. As you set the low needles go back and check the high speed regularly. The LS will affect the high a lot more than the HS affects the low.

When you have high and low running nicely set the engine to approx ½ throttle, and check it there. Now is when you can adjust the pressure. If the mid range is lean, turn the regulator needle in ½ turn at a time, or if rich turn it out, until the mid range is close. Go back and adjust the low and high needles again – the pressure affects both high and low as well as the mid range.

From this point there should be no problem to get it run in, or if it has some time on it, to set it for flying.

Fuel tank vertical location

The tank center should be level or slightly below the center POINT of the carb. This holds for mounting at any angle. The center point of the carb is

the reference. Visualize the fuel nozzle inside the carb, this is the location/height that matters.

Three blade props

Nothing wrong with using a three or even four bladed prop for break in, so long as it is in the right load range for the engine. All the engine sees is the load, and the only other thing the engine cares about while running is air flow for cooling. Doesn't matter how many blades are blowing the wind.

Piston Ring Fitting

Hold the piston firmly, a vise with padded jaws clamped on the rod works fine. Then hold the ring flat on top with the gap over the edge. Push one end of the ring down gently and feed it into the ring groove. Slowly work the rest of the ring down and into the groove.

Pumps on twins

ENTIRE SECTION REVISED 5/27/06.

Saito builds three mechanically different series twins.

First, the smallest have a single cam shaft. All four push rod tubes go to a single cam shaft chamber on the bottom of the crank case. This type has even firing intervals.

The second and third types use two cam shafts, one for each cylinder.

The second type has only one crank pin, the pistons move in the same direction at all times; while one is going up the other is coming down. As a result the crankcase volume is constant, there's no pumping action for crankcase venting. As a result the acids from combustion leakage will accumulate in the case and destroy the bottom end of the engine unless the operator is religious about flushing and oiling the engine after operation. Not many people are, and the early odd-fire twins suffered because of this. The later odd-fire twins have an added scavenge pump for forced breathing of the case. The FA-90T and the FA-100Y have a vane pump at the rear of the case, the FA-130T has a diaphragm pump driven by the number one cylinder cam.

The third type twin is, of course, even firing. They have two crank pins, the piston movement is opposite, giving them sufficient pumping action in the case with no added complexity.

So what do we do with the pumps where fuel tank pressure is concerned? Still talking about the odd-fire engines. The vane pumps and the early diaphragm pumps are internally ported to the crankcase, to use them for tank pressure is the same as using the vent on a single cylinder engine for pressure. The later diaphragm pumps have two nipples on the pump body,

tank pressure set up is covered in the owner's manuals as well as in these notes – look at the section on the FA-300TTDP.

The diaphragm pump on the FA-300TTDP is purely for tank pressure, again, the connections and adjustment are in the manual, and covered elsewhere in these notes.

Thanks to all who pointed out my errors in the earlier version of this section.

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"Pumps" on big block singles.

What Saito is now calling a pump uses two check valves in the back plate, other than the source of pressure the "Back plate valve" pump works exactly like the diaphragm pump version, it is connected and adjusted exactly the same. Check with Hobbsy, he recently got the back plate version as an option for his new FA-220.

What's wrong with it is the same reason you don't see many people using it. It's a royal bear to get set up properly. Consider the Perry pump, almost bolt it on and go, or the Cline and Iron Bay systems which ARE bolt on and go.

Perry VP-30 pump

There are two basic versions of the Perry pump, the VP-20 "Shaker" pump operated by engine vibration and the VP-30 which uses pressure pulses from the crank case to operate. Usually, the VP-20 is used with a four stroke engine and the VP-30 with a two stroke. Sometimes, for whatever reason, people want to use the VP-30 pump with a four stroke engine.

Since most four stroke engines require a vent to the atmosphere, some alteration of the standard pump installation has to be made, and the adjustment of the pump is slightly different from the instructions included with the pump.

First, as the instructions state, mount the pump as close to the engine as practical, and use the supplied hose to connect the pump to the crank case vent nipple. Only one caveat here, if the pump is mounted behind and in line with the crank case use at least a one inch spacing between the engine and the pump.

Now with the pump positioned cut the red hose and insert a tee, use the largest bore tee you can get to go in the red hose. Warming the red hose will help, put the straight legs in the red hose, the case vent hose will go on the tail. The vent can be regular silicone fuel hose, but keep the stiff red between the engine and the pump if possible – the pump will work much better.

Red hose? It is a very stiff hose that does not tend to balloon with the pressure. Normal silicone will absorb some of the peak pressure pulses, use silicone hose as a last resort.

Now we get to the fun part. Adjusting the pump.

Strong advice – have your engine fully broken in, and the needles set for a normal tank with muffler pressure. The first time you set up one of these pumps you don't need to be worrying about the engine as well.

Remember please, to plug the muffler pressure port and use only an atmospheric vent into the fuel tank, adding muffler pressure is another complication you don't need.

Now with a length of silicone hose (try six inches to start) on the tee for the case vent, start the engine. Let it warm up, then go to full throttle. Ideally it will take about twice as many clicks to reach peak as it did with muffler pressure. If it takes more than a full turn to reach peak cut an inch off the vent hose. Huh? Right. The restriction in the vent hose is controlling the pressure pulses into the pump, and therefore how strongly the pump is working.

If you find the mixture too lean on first running you have two options. Try doubling the length of the vent hose, or put a restrictor in the vent hose. An ordinary remote needle valve can be used, if one is handy. An alternate is a short length of brass or aluminum tubing, pinch it a little at a time to increase the restriction. The needle has the advantage of being adjustable for both more and less restriction. In other words mistakes can be corrected more easily.

Once you have the high speed set as we want, adjust the low speed in the normal manner, checking both for good idle and good transition. If all is well, you have finished.

Now you may wonder about the pressure regulating screw in the pump. So far we've not touched it. We will use it for fine tuning only if needed.

After the low and high speeds are running nicely check the mid range. The pump pressure regulator will have the greatest effect from mid to ¾ throttle on the Saito two needle carb, if too low the engine will tend to stumble a bit going from mid to full, too high the response will be slow. And it's really hard sometimes to tell the difference. Pinch test time. With the engine running a little over ½ throttle pinch the hose between the pump and the carb. We want the rpm to rise just a little, 50-100 rpm, before it falls off. If it rises too much turn the pump regulator screw out about ¼ turn and try it again. If it falls immediately turn the regulator screw in about the same amount and recheck. Please note also, this will affect both the low and high needles, you'll have to check them with every change of pump pressure. And this is where many people decide it's "Good enough." It can be a bear.

There are many advantages to using the pump, including being able to put the tank anywhere it's convenient and not worrying about fuel feed, the engine can be run closer to peak mixture since you don't have to worry about going lean with a low fuel level or a nose up attitude, and so forth.

It can take a while to get everything right, but when it's done I think you will be well satisfied.

Poor idle

The three biggest reasons for not being able to get a good idle are an intake air leak, the tank is too low, or three, the engine just doesn't have

enough running time to idle well;

With the tank too low the engine, running at a low speed just doesn't have enough suction to maintain the fuel flow. an air leak makes it that much harder for the engine to pull the fuel. Low time? You know how to correct that.

And yes, the spray bar is the reference point for tank height.

Valve clip removal/installation

What I do is use a plastic handled screwdriver, clamp the shank in a vise and set the cylinder over it, the handle going inside the bore to hold the valves. Then with a haemostat handy I push the spring cap down with my thumbnails opposite each other. Then while holding the spring down with my left thumb pick up the haemostat and use it to grab the clip and pull it off. Then just let your left thumb come up to release the spring. Going back together clamp the clip in the haemostat first, push the spring down with the same two thumb nails. Again, holding the spring with one thumb use the haemostat to reinsert the clip.

Jim is right on another point also. There will be an edge turned up at the top of the retainer groove. An emery board, a flat jeweler's file, a small whetstone, a scrap of 600 grit paper, almost anything will serve to take it off. Just be sure to take it off. If you leave it and push the valves out an amount of metal will be cut from the valve guide bore.

Finally, if you lose one of the "C" clips it's no big deal - the new spring set includes two new spring caps and two new clips. But don’t throw the old ones away, sooner or later you will lose one, handy to have a replacement on hand.

Valve train clicking

As Jim said, it's normal to have the clicking noise, but only when the intake is closing. If you are hearing it with the exhaust closing as well as the intake closing you either have a lot too much lash in the timing gears, or more likely the valve adjustment is very loose.

Normally the intake opening resistance keeps the exhaust from pushing the cam shaft, you only hear the noise when the intake tappet goes over center on the lobe.

Set the valve clearance down to 0.0015" and see if you still have the double click. If yes I suppose I'll have to go ahead and write the procedure for setting the gear lash, a task I've been avoiding.

Another note on the click

The clicking is normal. If curious pull the intake rocker cover and watch as you turn the engine. You will hear the click as the inlet valve is closing.

When the inlet tappet goes over center on the cam shaft the cam is driven in forward rotation, the click is the clearance (lash) in the timing gears.

Cam box gasket

I have checked several new gaskets, for both the old and new pattern cam boxes. They have all measured within a few tenths of 0.0075” thick.

General engine lubrication

Saito, in common with most other model four stroke engines, depends on luck as much as engineering to oil the cam and its bearings.

On the engineering side, the piston ring has a much larger gap than would be expected, this is to allow more leakage, blowing the unburned oil from the combustion chamber through the ring gap into the lower part of the crankcase where it accumulates. After the engine has been running this accumulated oil gets to be more than needed, the excess is blown out the case vent.

Where the luck comes in, with the older style rear vent nipple, is getting the oil to the cam. As the engine runs the oil is whipped into a vapor, this works its way through the rear bearing into the cam area, also oiling the front bearing. The rocker gear depends on the little oil that goes up front, and then leaking past the tappets to get to the overhead. When the engine is mounted inverted enough oil puddles in the cam box to get plenty into the valve gear through this leakage, but an upright mounting usually needs to have the rocker covers pulled for oiling often.

The newer engines have the vent nipple on the forward part of the case, opposite the cam box. This forces the oil through the rear bearing and does a much better job of lubing the cam and tappets.

Now. The oil itself. Since only a small part of the oil goes through the rear bearing (With the rear vent) it’s important to have a good oil. And since all the oil has to leak past the piston ring, and synthetic tends to burn in the combustion chamber leaving very little to leak past the ring, you should see this is another argument in favor of castor oil which does not burn in normal engine operation.

OK, so you say the oil leaks past the ring on the compression stroke, before the synthetic has a chance to burn. Some does, but the majority blows past the ring on the power stroke, the cylinder pressure is much higher then than on compression. The synthetic has burned by then, the castor survives and goes into the crankcase.

Valve and rocker lubrication

As stated, so long as the valve gear is oiled any good oil will do. Personally, it's ATF Dexron.

A note on "Moly" grease. The chassis lube has a very small amount, but if you want a grease with a high percentage of molybdenum disulfide get a can of "Nevr-Seez" and use that. MoS2 greases are commonly used as break-in lube for cam lobes and their matching lifters, but using them anywhere else in an engine is not encouraged. The two elements will separate under high heat and pressure, the remaining crystalline sulfur acts as a polishing agent. If used in excess more places will be polished than desired, and this is nothing but preliminary wear.

If you want to use a grease on the rocker gear it's better to use a white lithium grease such as "Lubri-Plate" in your engine.

Ball bearings

New precision steel bearings and new ceramics are equally smooth. After ten hours the steel bearings are starting to get loose, after 30 hours the steel bearings are due for replacement. The ceramics, after 30 hours, still feel like new.

OK everybody, OK! I know the steel bearings will often run 100 hours, 'specially if you get them with the polycarbonate retainers. But to get that life you have to run the engine dry every time, use after run oil religiously, and castor oil is needed in the fuel.

I've seen both open and shielded bearings as OEM in Saitos, but I've never seen a true sealed bearing ex-factory. At the same time, I don't think I've ever installed anything other than sealed bearings in front. As a matter of fact, on some engines I've used stainless front bearings instead of ceramic when Paul didn't have the right ceramics to fit.

I don't feel too bad about stainless in front, it's the rear that has the high

loadings, and using the –2RS bearings I leave both seals in place, so lubrication is not a problem. Paul assures me the original grease is good for the life of the bearing even in the high rpm use. So far I’ve had no failures, or even questions, about the completely sealed front bearings.

The rear bearing MUST be an open bearing, otherwise oil to the cam and tappets would be either restricted or eliminated. Cant live with that.

”Paul” is Paul Macintosh, RC_Bearings.com

You need to get the –RS or the –2RS bearing for the front of the Saito engines.

In your case the 698 (8x19x6 mm) is the base number for the front bearing, ordered by that number alone you would get a plain bearing with open construction. The “Stock” Saito bearing is a 698-ZZ, still a standard bearing but with the addition of steel shields. These are supplied packed with a high temperature grease, but after running a while the grease can be forced out, then your leak will come back. A 698-rs or a 698-2rs will have a true seal, or double seal in the –2RS, and will not leak until it’s well worn.

The best is the 698C-TH9, which has the “Polymite” ball retainer and the double seals. Supplied with the double seals it is, again, packed with the high temp grease, and so long as the seals are not disturbed the bearing is lubricated for its life. Which is, as stated earlier, about ten times the life of a conventional steel bearing.

Forgot to say the 698C is the bearing with ceramic balls.

All the comments are good, but in my experience I've found that in sport use one $30 set of ceramic bearings outlasts ten sets of "Stock" bearings. This does depend on not crashing or running lean.

The ten sets is a guess. Using ordinary bearings in an engine with "Normal" service I replace them every year or two. None of the engines I've put ceramics in have needed a replacement set.

Standard bearing sets for $10 and ceramics at $30? I think it's well worth the extra money.

We hear about the crashes, and we hear about the engines damaged by lean runs. We do not hear about the successful flights, and the engines that just keep on running.

In my club I'd say the successful flights outnumber the failures by at least 100 to one. This makes the ceramics a good buy.

The bearings I have been getting from RC-Bearings.com are, in appearance, made with high chrome stainless steel races. I haven't worried about any specification beyond high quality "Ceramic" ball bearings. They have worked fine for me, I have yet to experience a failure.

The "Side" load is an axial force. The propellor thrust is a side load. I have seen no sign of excess wear, or any wear at all, in the ceramics.

On crash damage. With steel balls, stainless or not, the crash loads can Brinnell the balls and races. This puts flat spots on the balls, and dents in the races. The bearing is ruined. With ceramic balls, the balls do not get the flat spots, the dents in the races are on the "Non" thrust side, so many times the ceramics will survive where the steel bearings will not. Might hear a little noise with a starter, but when running the thrust will pull all the parts to run on undamaged areas. This part is speculation, I've not crashed a set of ceramics.

At the same time, do remember that no bearing will survive a lack of lubrication.

Bearing cage orientation

It's not a stupid question, and I'm sure there's a difference. But I have no idea what the difference is. I generally install the rear bearing with the flat side of the retainer to the front, just seems like the open side will let the oil, in its forward travel, wet the balls better. When I install the front bearing with both seals in place I have no idea of the orientation of the ball cage - can't see it.

New bearings tight when turning

One or both are not seated.

Break the prop driver loose again, everything should then be free. Set your oven back to 250F (this will not hurt the bearings or seals) and reheat the whole assembly. When it's properly cooked slide the prop drive back on, and using a dowel push the crank forward as you press the prop drive on. Everything should now go to seat, when it cools you can continue assembly.

Crankshaft location and end float.

The Saito crankshaft is a light push fit in the bearings, with the prop driver removed light to moderate hand pressure will push the crank shaft out the rear of the case. After the engine has some running time the crank will tend to lock itself in the bearings, and it becomes a moderate press fit because of the dried oil accumulation between the crank and the inner races of the bearings.

With the front and rear bearings fully seated and the crank pushed all the way forward, there will be a small gap between the thrust face of the crank web and the back of the rear bearing. When the engine is first run, and gets fully warmed, the dynamic loads from the prop will pull the crank forward, and the hot crank case will allow the front bearing to move forward slightly, pulling the crank against the rear bearing. From this point the rear bearing has assumed all forward thrust loads on the crank, and the fit of the front bearing in the case prevents any apparent end float.

If you have perceptible end float in a Saito crank after it has been run for a while, dismantle the engine and check the fit of the front bearing in the case. If it's loose the fit can be tightened by plating the outside of the front bearing, but the "Correct" repair is a new crank case.

FA-125 carb barrel spring

Barrel springs are the rule, not the myth. The FA-125 is the first Saito without a barrel spring, Even the Saito air bleed carbs, because of their regulating valves, have barrel springs. I know of NO other engines without a barrel spring except for the simplest of air bleed carbs.

Loose Exhaust

The method that works for me is to tighten the locking nut when the engine is fully warm. Others have had good results using Teflon tape on the threads. Maybe the best would be the tape and tighten when hot.

Muffler through bolt loosening.

I've never had your muffler problem, but I'll guess the star lock is causing the problem. As the muffler heats and cools the ears are compressed and released, loosening it as time goes by. The only lock washer that will stay in such condition is the plain split lock. But no washer is really needed.

Tighten the through bolt, and while holding it with the Allen key still in place, tighten the lock nut. By using the Allen key to hold the screw you will prevent its turning out as the nut is tightened. Should resolve your problem.

Thread locking compound

Thread locker on an engine? I'm against it. Properly tightened the screws do not back out.

I must admit I have a screwdriver specially ground to tighten the rocker pivot screws. Hard to find one that fits correctly, and without a good fit they can't be tightened correctly.

Plastic back plate, gasket sets

You have one of the early FA-72 engines, with the "Springy" back plate. The wonder is that it ran for as long as it did without eating the intake seal. The new ones look the same, but they are much stiffer. You can order a new one from Horizon, you'll get the stiffer one.

The failure of the muffler pressure tap is rare, but it happens. If you have access to a TIG welder you can build up a nubbin, then drill and tap it for better thread engagement.

I have never gotten a Saito gasket set without having extra bits in it, I just save them for whatever need comes to hand.

A couple you mention though - the white ring is Teflon, it is used to seal the choke plate when one is fitted, it goes in the groove on the outside of the carb, the choke slider holds it in place, There are two places for the tiny ones, inside the needle valve as an air seal, and on the front end of the axle the cam turns on. The Viton seal? Who knows? I've never seen one as OEM, and the plastic back plate can be sealed with a smear of RTV at assembly.

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10 mm exhaust in 12 mm cylinder threads.

Well, doggone! The flex pipes supplied for use on the mid sized engines with a 12 mm exhaust thread come with 10 mm threaded gland nuts. You need to purchase an adapter fitting, Horizon part number SAI170R3130 for each cylinder. Thanks, W8YE Jim.

Spinners.

On a four stroke engine, because of the potentially violent backfire, you should never use a spinner with a plastic back plate, one pop and the prop can come flying off.

If you want to go cheap, there are several on the market with aluminum back plates and plastic cones, these should be your last choice other than the price. Using an electric starter you can have the cone shatter, if you hand start they will generally be OK.

The best is an all metal spinner.

Lowest priced ones are "Spin-Right," available from Cermark, your LHS, and others. The Spin-Right have some parts in some sizes cast, this makes them more prone to shattering in a crash where others might just bend, and allow straightening. Also, I have never gotten a Spin-Right that was not badly out of balance. This needs to be checked before mounting on the engine. Available in two and three blade cuts.

I have never used a Dave Brown spinner, but what I've seen seem to be of good quality. They have a fully machined back plate, the cone is formed by "Spinning" the metal. Since it is spun aluminum the metal has to be soft to allow the forming. The DB "Vortech" spinners are available in standard two and three blade cuts, or with special cuts for any propellor you want. Available direct and LHS.

The best of the lot are the "Tru-Turn" spinners. They are fully machined so they can use harder alloys than Dave Brown, and using the better alloys they are stronger as well. And they are light. I was very surprised to fine a Tru-Turn 2 1/2" three blade standard spinner was lighter than a Du-Bro plastic three blade spinner of the same size. You will pay for them though. pair of 2 1/2" 3b spinners with **adapter nuts is close to $100 at your door. Standard cuts cost less.**

Piston rings, rocker pivots, valve springs, and Loctite.

The rocker pivots are often pretty tight. I have a special screwdriver I ground just for them. If you have a micro torch warming the pedestals, both on the threaded and off sides, sometimes helps. The valve springs can be changed with the rockers in place, but it’s much easier with them off. And reinstalling the cylinder is MUCH easier with the rockers off.

Since you’ve already pulled the piston out of the cylinder in this case it’s moot, but removing the piston does pull the ring also, and even though it may be hard to accept the ring will reach a working position and seat itself there. When it’s pulled out of the bore it will never be reinstalled in the same place, it will have to reseat itself. Doesn’t really hurt anything, but the performance will be down a bit until it has reached a new accommodation with the cylinder bore.

So how do you replace the valve springs with the piston in place? Use a small haemostat in the port, hold the valve stem, and proceed normally. If you don’t have heavy deposits on the valve stems you don’t even need to pull the valves.

Trust your gut on the Loctite. Don’t use it anywhere on these engines.

> *quote:*
>
> ORIGINAL: loughbd
> ...most rings will rotate unless pinned...

A common belief that is false.

Several years ago, when I was still a field service representative for a European car maker we had a batch of engines with excessive oil consumption. In almost every case we found the piston rings with the gaps aligned. Traced to a new hire who hadn't been told to stagger the gaps at assembly. Pulling the engines down the gaps were still where he had set them.

No matter how well machined, the cylinder walls and the ring surfaces will have local peaks and valleys, the rings will "Key" into them and will not rotate.

Vibration, singles and twins, causes and comparisons.

The Saito twins with dual cam shafts have, lacking only a second crank shaft, twice as many moving parts as the equivalent size single cylinder engine. As a result they also have almost twice the friction losses. Seventy to seventy-five percent power of the single is s good approximation.

There are two classes of Saito twins, the even fire, and the odd fire. The even fire engines have one firing point every 360 degrees of crank rotation, the odd fire engines will fire one cylinder, then after 180 degrees of rotation the second cylinder will fire, then there is 540 degrees of crank rotation before the first cylinder fires again. The different feel is obvious when turning the propellor, and looking from the top the even fire engines have the cylinders directly across from each other, while the even fire engines have the cylinders slightl;y offset.

From an engineering standpoint the odd fire engine is easier and less expensive to manufacture, it has only one crank pin on the crankshaft, and uses a “Fork and Blade” assembly for the connecting rods. One rod has a much wider big end with a slot in the middle, the con rod for the opposite cylinder fits into the slot, both rods riding on the single crank pin. This also allows both con rods to be made in one piece, no bolted joint in the big end.

The even fire twins have two throws on the crank, with one con rod on each. There are several ways to assemble the crank and rods for this type. Using one piece rods the crank can be built up from several pieces with field service capability, several pieces supplied only as an assembled unit, or a one piece crank shaft with the rod big ends bolted together. Saito even fire engines use the bolted big ends.

Let’s compare the FA-91 single, the FA-90T odd fire twin, and the FA-90TS even fire twin.

FA-91 single. For reasons I wont get into here it is not possible to have a single cylinder engine fully balanced mechanically. The mechanical vibration can be minimized with a heavy crank shaft and flywheel, but this weight is not good in an aero engine, mechanical balance will always be a compromise. Also, since the engine is developing power (in a four stroke engine) only ¼ of its running time and coasting for the other ¾ of the time, there is a dynamic imbalance as well. The resultant vibration can not be eliminated, there will always be an amount of vibration we can’t get rid of.

FA-90T odd fire twin. The odd fire twins have both pistons going to the left, they stop, then both pistons go to the right, stop, and the cycle repeats. They are, from a mechanical balance standpoint, the same as a single cylinder engine. With the two power strokes overlapping the peak torque is less than the single cylinder equivalent, the dynamic imbalance is lessened.

FA-90TS twin. This is an example of the even fire engines. With both pistons going in opposite directions they each balance the other. The rotating parts can be brought to almost complete balance, the mechanical vibration is almost totally eliminated. With the power strokes evenly spaced the power-coast ratio is now 1:1. This basic design is the smoothest common model engine, but being more complex mechanically it’s more expensive to make.

Summary: If you can stand the weight (and price) of the larger twin for the equivalent power of the smaller single, the even fire twin is the best engine to use. The odd fire twin is a compromise for reasons stated.