Tillotson OHV Gas Carburetor Tuning Tips

By E.C. Birt

Over the past few months we have several phone calls and e-mails on how to service your carburetor and is there anything that you can do to improve performance with simple tuning needs? The answer to this question is yes. Your Tillotson carburetor is a very user-friendly simple unit to service and tune. Here are some guidelines to go by.

First lets look at Service needs:

After a race weekend is over with and you're doing your thing to get ready for next the weekend of racing, remove your carburetor and clean it good. Now remove the pump stack and inspect the main pump skin. This is the one that you see in the schematic of the diaphragm kit (check schematic for your carburetor .. this part number should be a DG number) and is tan in color. If this pump diaphragm shows signs of stretching and has a pocket starting to show up in it, it is time to replace this skin. The main demand diaphragm (black in color) replace this one if there is any sign of wrinkles in it. The gaskets, as long as they are in good shape, there is no reason to replace them. Just put a coat of oil on them and reuse. While you're here cleaning we would also advise that you remove the inlet needle, which you see is in the (check schematic for your carburetor .. this part number should be an RK number). Clean the tip of the needle and if there is a sign of a ring forming in the rubber tip we would advise replacing it. As far as the seat goes you don't have to remove it. Just clean the inside of the seat with a Q Tip. Take your Q Tip and put it in your cordless drill and spin it down inside of the seat and polish it (toothpaste works very good for this operation also). Now clean with brake clean or solvent of some type and you're now ready to put your carburetor back together.

It is time to get into the fine tuning of your carburetor using the pop-off pressure gage in conjunction with the high and low needles to maximize your carburetors performance. To get the most from your carburetor, you need to understand how and why pop-off pressure is a valuable tool in making your carburetor happy.

Pop off pressure refers to the tension of the fulcrum arm spring (#29 on the schematic) and the pressure it takes to compress it enough to release the inlet needles seal on the seat. Over the years this is the way we have come up with spring tension to relate to vacuum signal.

Pop-off pressure has nothing to do with the fuel pump pressure of a remote pump or the pump that is part of the carburetor. What the pop off pressure controls is how much vacuum pressure it takes for the demand diaphragm to press hard enough on the foot part of the fulcrum arm to release the inlet needle off the seat. When this operation happens, it lets fuel into the fuel cavity above the inlet seat for the low and high side needles.
As the engine is running, the intake cycle air is being pulled in through the air filter and into the carburetor. As this air comes in the choke it crosses over the high side nozzle, or discharge port, then over the low side by-pass ports in the carburetor. This forward moving air created by the vacuum of the engine makes the fuel come out of the by-pass ports. As this is happening, a vacuum is being built on top of the fuel that is leaving. This pulls the demand diaphragm down.

Some carburetor engineers say that the pop-off pressure is a needless worry, and changing the pressure won’t affect the carburetor's performance. They feel that you are fine if the pop off pressure is high enough so the inlet needle will seal off the seat. NOTE... To some degree this is true as long as its high enough to seal off the seat. They are looking at maximum rpm and maximum engine vacuum. The demand diaphragm will come down no matter what you have the pop-off pressure set at, within reason, and the inlet needle will come off the seat opening the doorway for the fuel to come into the wet side of the carburetor through the inlet seat.

How do you check pop-off pressure?

With a pop-off pressure gauge which is basically a hand pump that mimics the effects of fuel pressure in the carb.

If you are doing bench work without the plates on the carburetor you simply fit the machined fitting into the fuel inlet passageway to the seat. If the carburetor is together, we put the line on the carb fuel inlet cap or some carbs require you to place the fuel inlet fitting into the carb body. If you’re checking the pop-off pressure of your carburetor at the racetrack, between heats for instance, remove the high side needle so you’re not blowing up a balloon. To get the right reading, we want the inside of the wet side of the carburetor to be at atmospheric pressure. The carb has to stay wet to give us the right reading. To do this, you need to replace the standard pop-off gauge line with a three foot long piece of tubing that is filled with WD-40 or any light oil. If you’re working on the bench, then just make sure that the carburetor is flooded with this mixture around the needle and seat.

What is the right pop-off pressure for your carburetor and why?

The pop off pressure is adjusted by changing the pop-off spring. The springs differ by length or by wire tension. We carry about 12 different pop-off springs at any given time. We have also designed shims that fit under the pop-off spring to split hairs which makes the job a lot easier than shaping springs by hand, heating them, or any of the tricks used before then. Never cut a spring off letting it set on a spring end that is not flat. Why? Because a spring with an end cut off will never do the same thing twice. If you have to cut a spring you have to take extra time to shape the end back so that it is at least flat enough to set on a workbench with out falling over. This is no small task. We also offer springs with double coils on the end so that one coil can be cut off and you still have a flat bottom for proper shimming.
Higher pop-off pressure usually makes the carburetor a bit more user friendly and lower pop-off pressure will give you more torque off a turn and can be faster. But you have to watch your needle settings a bit closer so that you don't go too lean on the top end and burn the engine. The following settings for a start position on the tune is only a guide line if the carburetor has been blueprinted and set up to fit your needs. In short if in doubt set the needles richer to start with... You never hurt or turn your engine into a one-piece unit by being on the rich side.

4- stroke pop off pressure.

With the F-200 classes we use gas as the fuel of the day and this is the type of fuel that we will relate to. With the OHV engines 12 to 14 lbs. of pop-off pressure is the norm with .085 on the fulcrum arm height. The low side needle should be 1 ¼ to 1 ½ turns out and the high side about 1 turn out. OHV engines don't seem to like a lot of fuel.

The above pop-off pressure is with a fuel pump. The R&D department at Burris has been doing some testing and racing without using a fuel pump and if you use no fuel pump the pop-off will have to be lower. Due to driver knowledge and track needs you will find a happy spot somewhere in the range of 7 to 10 lbs.

Note: The reason we use and recommend that you also use a fuel pump that gets its signal off the intake is on a real tight track without the pump you may find a bit of a flat spot coming off the turn. You can order an EC manifold with a pulse hole machined into it and the fitting for the external fuel pump if you wish.

By now you should have noticed that we have stated that we have the low side needle out more than the high side. All this time your buddy has told you to be out more on the high side needle than the low side needle. Wrong, here is why. We need to return to the subject of vacuum and how it affects your needle settings.

Racers only have one position for the go-peddle and that is pushed into the front bumper. The moment the green flag drops the carburetors shutter is wide open. At that point, the engine is at low rpm and working its way to max rpm. This also means the engine is in a low vacuum mode and working its way up. At this low rpm and engine vacuum, 70% of the fuel for the engine is coming from the low side by-pass discharge ports and 30% of the fuel is coming from the high side nozzle discharge port. As the engine builds rpm, the air speed in the carburetor is getting faster as it travels over the venturi of the carburetor. A change on the fuel curve starts to happen, which is like a teeter-totter. The area behind the venturi is bigger where the throttle shutter is. The air speed is getting slower and there is less vacuum, so the fuel curve changes to 30% of the fuel coming from the low side by-pass ports and 70% coming out of the high side nozzle. Having the low side needle out more than the high allows us to get all the torque we can with a richer mixture when needed from the low side discharge port. When the engine is at max revs and vacuum, the 30% of fuel coming from the low side won't make your carburetor go to the rich side because it's almost nothing.

Sometimes, when more mid range power is needed, the needles are set closer to each other. But if you stay at max revs very long the carb may go rich on you. When this happens a 4-cycle the engine will just cut off like you hit the kill switch then it will come back on.
Once your carburetor is tuned and is fast on the track you may find it difficult to leave the grid area without major stumbling problems. To remedy this problem do not open the low side needle. On the track the high side needle is a lot easier to get back to the sweet spot than the low side needle. Open up the high side needle another ½ turn and let some more fuel come into the engine from the carburetor off the high side discharge port. Once on the track and up to speed reach back and take the ½ turn off.

**Back together again:**

Now that your carb is all set, it is time to test. You plug your starter on and hit the go button or give a yank on the pull rope. The engine spins over and the fuel heads for the carburetor as it disappears under the fuel cap and the engine comes to life. You pull the starter out, and hit the throttle a couple of times, then one more time for good measure to make sure it will tack up. As your engine thumps away and fills the garage with smoke you notice raw fuel is dripping out of the carburetor mouth to the floor. You ground out the sparkplug and kill the engine as quickly as possible. Raw fuel is still dripping out of the carburetor and you can see it's coming from the high side discharge port. You think, “Where did I go wrong? I know I put all the parts back in. Something must be wrong.”

No nothing is wrong with your carburetor this is normal. With a Tillotson carburetor, we install the carburetor up side down from the way it was designed to be mounted. The pump plates are up on the top and not on the bottom. The low and high side needles are open and all of the fuel that is in the wet side of the carburetor is just draining out past the tips of the needles and out the discharge ports. It will keep dripping till all this fuel is gone from the wet side of the carburetor and only takes a bit of time to do.

Since you don't have three hands, two to hold onto the starter with and one to work the throttle with you set the idle screw so the engine could get some air through the carburetor to start. Next, take your screwdriver and back this idle screw off till it doesn't touch your idle stop tab on the throttle shaft. Now screw it in just enough to touch the tab and just a tiny touch more so the shutter in the carburetor is closed but not slamming into the throttle bore. You want the shutter to be completely closed where no air can come by it in the closed position for racing. At least not enough so the engine will idle. No idle? That's right. No matter the engine, you don't want this idle screw set where the engine will idle no matter what the carburetor is. Here's why.

First, we don't race at idle speed or on a kart stand. Aside from turns and the occasional setup for a pass, we race at full throttle. Remember back a ways we learned that the rich mixture gives us torque. Is a light coming on? Ok if you put your hand on the back of the carburetor when running you’re choking it and a ton of fuel will be pulled into the engine by this stepped up vacuum pull on the carburetors by pass ports. Ok when the throttle idle screw is backed off for no idle and the shutter goes closed in a turn, in a way you are doing the same thing. You now have an increased vacuum signal to the first idle discharge port from the low side fuel well. This gives us a very rich mixture for a moment and the added fuel gives us more torque to come off the turn or pass the guy in front of us.

With that, we are ready to dial the carb in on race day. Yes, we know some of you have dynos for testing, but we prefer the track. It is less harsh on the engine and conditions will likely be different on race day anyway.
**Track tuning your 4 - stroke Tillotson carburetor:**

Due to the way your Tillotson carburetor has had the pop-off pressure set, the needle adjustment and the track performance will vary. The following is only a starting position for the needles. From this point on, track tuning will be necessary to dial in the Tillotson that you have. Low side needle out 1 ¼ turn, high side needle ½ to 1 turn out. If your carburetor won't dial in somewhere in this range then you will have to change the pop-off pressure.

**Track tuning your 4 - stroke Tillotson:**

Set the high side needle 1 to 1 ¼ turns out for gas or ½ to ¾ turns out for methanol for a starting position. Set the low side 1 to 1 ½ turns out for gasoline or 2 to 2 ½ turns out for methanol for a starting position. Be sure that the carburetor idle screw is set where it just cushions the throttle plate when it closes but not open enough so that the engine can idle. Start the engine and move out onto the track. Give the engine a couple of easy laps to warm up. Be sure in these warm up laps that you are running the motor in a spot where it is running clean. Bring your kart down to parade lap speed and accelerate hard as you would for the start line break. If you have a flat spot or a bog problem this could be due to a lean condition on the low side needle. Come out 1/8 of a turn on the low side needle. Try again. Keep coming out on the low side needle till the engine pulls hard with no bog or flat spot. Now try the same test coming off the turn. Once you are satisfied with the performance off the bottom and the engine pulls clean, you are ready to turn your attention to the top end.

With the engine under full throttle it should run clean all the way to the end of the longest straightaway. If the engine shuts off then comes back on by itself before you get to the end of the longest straightaway, this is more than likely due to the fact that the carburetor is set too rich on the high side needle. The cure here is to take the high side needle in (lean out) in 1/8 turn increments till the motor pulls clean the full length of the straightaway.

As you lean in the high side needle for the best top end power you are also leaning out the bottom a touch. So to assure yourself of good corner speed and no flat spot off the bottom you need to go back and check for this one more time. As you can see, the tuning of a Tillotson on a 4-cycle is a fine balance line between the high side and low side needle adjustments plus the pop-off pressure in the carb.