

By Mark Shively

Original publication source unknown

The elements of internal combustion engines are: correct fuel/air ratio, spark at right time, adequate cylinder compression.

There are many passageways and openings to check and clean. All are important in function and when obstructed or not working properly, have subtle to radical effects on engine performance. Vacuum leaks and carburetor synchronization also have effects on performance and should be inspected and adjusted following the below procedures.

Carb Cleaning 101

Warning: Remove all rubber parts before you begin. These parts usually include vacuum diaphragms, needle valves, o'rings, hoses, and other parts. Spray cleaners will damage these parts. Do not disassemble individual carbs from the carb bracket.

Air & Fuel Passageways: Trace and learn individual fuel and air circuits from beginning to end. Machines can only drill straight through the cast passageways. To change direction, another angled passageway must be drilled. The union is plugged with a brass or bronze bead. Inspect and clean each passageway with spray cleaner, brushes/pipe cleaners/etc, and compressed air. Remove any discoloration and debris. Look for spray cleaner to exit from one or more passageways.

Jet Cleaning: Inspect jets by holding to light and look through them. You should see an unobstructed round hole. Clean the jets with one or more of the following: jet cleaning wires, soak solutions, carb spray cleaners and compressed air. Re-inspect jets after cleaning and install when clear of obstructions. Some main jets have paper-like gaskets. Most have metal spacers between the jet and the emulsion tube. Some screw directly into a brass emulsion tube which is machined for a 7mm wrench at its float chamber exposed base.

Inlet Fuel Valve: Inspect the needle valve & spring. Press down the tiny metal rod that protrudes from the butt or float end of the needle valve. The spring should move freely and return the rod to its location. Check the needle valve's seat area for a groove or other wear. It should appear highly polished. Some needle valve seats are rubber and wear may not be visible. Inspect the needle valve jet seat. You can clean the jet seat with Q-tips and semi-chrome polish if necessary.

Carb Body Castings: Blow air through the atmospheric vent holes located on the dome of each float bowl chamber. Air should exit via hoses or brass nipples. Inspect the emulsion tubes and passageways (cast towers that jets thread into) for discoloration and debris. Clean interior emulsion towers with a soft bristle gun cleaning brush. Clean each Venturi (main carb bore).

Needle Jets & Jet Needles: Clean the needle jets, jet needles, and passageway or tower that needle jet screws into. Clean the emulsion tube (pipe between needle jet and main jet) (Main Jet may screw into emulsion tube). Jet needles are part of the throttle slides. See below...

Throttle Slides: There are several types of throttle slides: Mechanical linkage, vacuum, diaphragm, and cable. Disassembling the jet needle from the slide is not always required for cleaning. If you have vacuum

piston type throttle slides (large diameter solid metal slide), avoid cleaning the lubrication from sides and caps. If piston type check cap vents and passageways with air. Clean if necessary and re-lube. If you have rubber vacuum throttle diaphragms, inspect for dry-rot, defects, and tears by gently stretching rubber away from center. Do this until all areas around diaphragm have been inspected. Replace any defective part as described above. Clean carb body areas around diaphragm including air passageways and air jets. Diaphragms have a locator loop or tab fabricated into their sealing edge. Observe this locator upon reassembly. Avoid pinching the diaphragm when reinstalling caps.

Fuel Screws: Fuel screws have sharp tapered ends. Carefully turn one fuel screw in while counting the turns until it seats lightly. Warning: These screws are very easily damaged if over tightened into their seats. Record amount of "turns-in" and remove the fuel screw, spring, washer, and o'ring. The fuel screw is part of the enrichment (choke) circuit...clean passageways as described above. When carbs are assembled, spray low PSI compressed air into diaphragm air vents located at intake side of carbs. Throttle slides should rise, then fall when air is removed. Lightly lube external moving linkages. Reinstall carbs and follow through with carburetor synchronization.

Throttle Cables: Lubricate cables periodically. If cables are disconnected from carbs or removed for replacement, etc . . . remember cable routing and ensure proper reinstallation routing. Avoid bread-tying, sharp bends, and pinching cables. Adjust cables so throttle grip has about 5mm of play or throttle slides or butterfly valves may not open completely (full throttle)(wide full open).

Float Bowls: Inspect float bowls for sediment, gum or varnish, crystallization, and defects. Clean all pipes, tubes, passageways, and embedded jets with cleaners and compressed air. Remove and clean the drain screw and area. Inspect bowl gasket and replace if necessary. Clean and inspect overflow pipes and tubes, look for vertical cracks.

Floats: There are several types of float materials: plastic, brass, black composite, tin, and others. Handle floats carefully. Avoid bending, twisting, denting, or other means of mishandling. Most floats are adjustable by bending a small metal tab near the float axle end. Do not change the float adjuster tab unless tuning fuel service levels. Clean metal floats by soaking or by spraying cleaner and wiping clean. Other material type floats may require replacement if cleaning is necessary. Inspect the needle valve (float valve) and seat. Check needle valve's spring loaded pin. It should depress and return smoothly and without resistance. Check the needle valve's tip for a worn groove. Replace needle valve and seat if either symptom exists. These parts wear together and must be replaced as a set.

Synchronization: This is a fine adjustment performed usually and preferably with the carbs installed and the engine running. The unusual part is performed with gauged wire with the carbs on the work bench. Carburetor synchronizing balances Venturi vacuum at the exhaust side of each carburetor, resulting with smooth idling and optimized performance at all throttle openings. Synchronization is checked using a set of gauges which are either air vacuum type or liquid mercury type. The gauges are connected to vacuum ports on the intake manifolds via nipple tubes or if sealed with screws, sync gauge adapters will be needed. With the engine running at temperature, and with a fan or means of forced convection aimed onto the engine, the carbs fuel screws and idle are adjusted, then the synchronization is adjusted via adjustment screws on the carbs. A reserve fuel tank is recommended for convenience of accessing carbs during this procedure. See gauge instructions and repair manuals for detailed use of synchronization gauges.

Notes: While carbs are apart, record the jet sizes. Look for a very small number imprinted on the body of the jets. Verify that numbers are the same for all jets on models with in-line cylinders. A few transverse-4 models and V-engines, the inner and outer carbs use some different size jets and it's important to not mix them up. If you have dial or veneer calipers, measure and record float heights. Perform measurements with floats just touching needle valves, though not depressing the needle valve rods. Replace fuel and vacuum hoses. Be sure to use fuel rated hose for fuel. Install or replace in-line fuel filters. It's a good time to remove and clean interior petcock fuel filters. Inspect carb manifolds for dry-rotting, inspect all clamps and air ducts. Inspect, clean, lube, and/or replace air filter(s).

~~~~~

What does "balancing" mean and why do I need to do it to my bike?

Balancing keeps each carburetor working the same to deliver the same amount and mixture of gas and air to each cylinder. We determine how "hard" each cylinder is working by measuring the vacuum at each of the carburetors which is provided by the downward motion of the cylinders on the first of the 4 strokes (the opposite of the compression that takes place in the cylinders on the 2nd stroke). There is a pressure "drop" that occurs as you pass by the butterfly throttle valve (the flat circular piece that pivots about its center when you move the throttle grip). The throttle valve will never close all the way - or else the engine would die without another source of air. What balancing does is to make sure that each throttle valve on each carb is allowing the same pressure drop to occur, therefore "sucking" the same amount of gas up through the jets.

- OK -now how do I do this?

Each bike is a little different, so I'll try to be general, but keep it specific enough so that you have a clue as to what I'm talking about.

The first thing you'll need to do is to print this page out (unless you have a service manual that will step you through the process). Before you gather your tools - you will need a set of VACUUM GAUGES. There are basically two different types - the dial type and the mercury type. Sure, you can get good and bad mercury-type gauges, but unless you're planning on really going into business for yourself, the cheaper mercury-type gauges are probably your best bet. You can order them from a number of sources including Dennis Kirk and J.C. Whitney in Chicago - ask for a motorcycle catalog (312)431-6102. When you order the gauges, tell the supplier what kind of motorcycle you have and ask them if you need any special adapters to use the gauge. The adapters are sold separately and cost less than \$15.

- Now that you've got your balancing "sticks" let's get down to it
  - o Warm the engine to operating temperatures. Adjust the idle speed. Shut the engine off and put it on its center stand.
  - o Disconnect the vacuum line (the small hose) to your fuel tap.
  - o Take the gas tank off. If you can leave the gas lines connected and still take the tank off, do so. If not, you'll have to find another container to supply gas to the carbs. I've heard of using inverted plastic bottles with a tapered cap. Small moto-cross MC gas tanks work well. Motion-Pro markets a variety of carburetor servicing tools, including plastic auxiliary fuel tanks. Connect the fuel line to the fuel supply and fill the container. If using a make-shift type container, invert it and make a small vent hole in the bottom. Raise the fuel supply above the carbs. Keep a fuel rated fire extinguisher on hand.
  - o There should be one small rubber vacuum tube connected to one of the "nipples" that are located on

the rubber carb intake manifolds (usually on #2 carb). Disconnect this small vacuum hose and set it aside (the other end was connected to the fuel tap). Remove the other vacuum caps on each carb intake manifold nipples or rubber vacuum ports.

o Now you have 4 little brass tubes or small pipes sticking out from each intake manifold. Connect the vacuum gauge hoses to each of the carb vacuum ports. Make sure the hoses seal and there are no vacuum leaks.

o Start the engine. Do not rev the engine above 3,000 rpm. Opening the throttle doesn't create a big vacuum, but if engine rpm's are high, closing the throttle will create a momentary high vacuum in the venturi that may draw Mercury into the combustion chambers. That is a REALLY BAD THING.

Mercury vapor is extremely toxic and exposure to it in sufficient quantities and for a certain time has shown to cause brain damage. So..... don't slam the throttle closed when the gauges are hooked up and with the engine running.

- Ok, gauges hooked up, engine warm and running.....

- 

o Set the idle speed to specs. Idle speeds may raise and lower while synchronizing. They may already be low and hardly readable or very high. You'll notice idle change with extreme adjustments.

o Adjust the fuel/air mixture screws to obtain the highest idle speed. These screws are located on the back, near float bowls of most carbs. These screws are precision made with a fine point. FYI: seating them tightly will damage them-use care. Turn each screw both directions until minimum and maximum idles are obtained. Then set each screw in the middle of these settings. It's hard to tell exactly, but manage.

o Readjust idle speed to specs if necessary with the idle speed adjuster.

o Look at the gauges. The quantity (usually measured in millimeters or inches of mercury) of vacuum is not nearly as important as whether all of the carbs are pulling the same vacuum.

o To synchronize them, we adjust the position of the throttle valves in each of the carbs. If you don't have a service manual to show you where the adjusting screws and locknuts are located, open and close the throttle a few times while you are looking at the carb assembly. Look between each of the carbs. There will be moving linkages with a screw adjuster and lock nut. These are the adjusting screws.

o If you have a 2 cylinder bike, you've only got ONE screw adjuster to deal with. Loosen the locknut and try turning the screw in either direction until you see that the mercury levels are about the same.

Motion-Pro markets a combo screw drive/lock nut tool for simplifying this task.

o If you have a 4 cylinder bike, you will have THREE screw adjusters. Adjuster screws located between carbs 1 & 2 adjust only these carbs. Same for carbs 3 & 4. The center adjuster adjusts the carbs 1/2 and 3/4 together Adjust each bank of carbs, then adjust the two banks together by adjusting the center adjuster.

Open and slowly close the throttle a few times. Each time bring rpm's over 3,000 rpm's.

o Recheck Mercury Levels and repeat the procedure until each carb is within about a quarter to half inch of the others, or within two gauge lines of another.

- When done, shut the engine off and remove the vacuum gauges. Reassemble everything that you took off. If your carbs were out of balance, you will notice the difference in power and/or gas mileage.