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Holley Carburetor Tuning Tips

Carb CFM Sizing

One of the first things to determine is what size carburetor do you need? A number of factors come into play. What cubic inch size is your motor? What do you do with it? Race, street use, towing, street use with occasional trips to the track? What type of intake manifold do you have, split plenum, open plenum, tunnel ram, individual runner? How fast do you spin the motor? What is the volumetric efficiency of the motor? Do you have a manual or auto transmission? What is the rear gear ratio? Do you want to get the best gas mileage possible or do you want to develop the most power possible? Keep in mind that a carburetor is just one part of the engine combination. All of the parts need to work together. Putting a larger carburetor on is NOT going to immediately put 100 more horsepower at your disposal. The carb needs to work with the other parts you have chosen and your intentions concerning how the vehicle is going to be used.

One general rule of thumb uses a formula to determine the CFM requirements of your engine. It goes like this: You need to know the CUBIC INCHES of the motor. You also need the maximum RPMs the motor will be spun to. Finally you also need the VOLUMETRIC EFFICIENCY PERCENTAGE (VE%) of the engine. The first two items (CUBIC INCHES and RPMs), are relatively easy to determine. The engine VE% is another matter. If an engine could use all of the air it ingested, it would have a VE% of 100%. Many performance engines reach this level. Certain race engines can actually exceed this and reach a VE% of over 100% at certain points in their RPM range. Most production engines and most street performance engines have VE levels below 100%. In fact, stock, production, low performance motors will fall around 75%-85% volumetric efficiency.

The math formula is:

$$\text{Carb CFM} = \left(\frac{\text{Cubic Inches} \times \text{RPMs}}{3456} \right) \times \text{VE\%}$$

In a controlled situation on an engine dyno, the amount of air actually ingested by the motor can be measured. Since most folks don't regularly have access to a dyno, the above formula will get you in the ballpark. There are some exceptions of course. Using a split plenum type street manifold allows the use of a larger than "normal" carb CFM. This is because the plenum volume is cut in half by the divider, so each cylinder only has half of the total plenum volume and carb CFM to draw thru. Likewise a carburetor with vacuum secondaries will only open the secondaries enough to feed the engine what it needs. Consequently, on a street driven vehicle a split plenum intake with a vacuum secondary carb is the way to go. The vacuum signal stays high for good throttle response at low and mid-range rpms. Fuel mileage is good. An "open" plenum intake, generally speaking, has opposite effects. Low rpm throttle response is decreased,

but high rpm breathing is improved because of an increase in available manifold plenum volume to each engine cylinder. Consequently, open plenum intakes are a little more sensitive to the CFM size of the carb. If you are drag racing, most folks are willing to sacrifice some low end power for high rpm horsepower. Fuel mileage isn't a concern and the engine spends most of its time at full throttle. Open plenum race intakes and "double pumper" carbs are the norm.

JET CHANGES AND ALTITUDE AND TEMPERATURE

Holley carbs are calibrated for sea level operation and an inlet air temperature of 70 degrees Fahrenheit. Once you know the correct stock jetting for your particular Holley carb, you can determine whether you live or race at an altitude above sea level. For every 2000 foot increase in altitude, you can reduce the jet size by one size. If you had a carb which has a stock jet size of 80 and you live or race at 2000 feet above sea level, then you would use a #79 Holley jet in the carb. Similarly, a change in the carb's inlet air temperature may require a change in the jet size from the stock calibration. Many racers go a step further by combining all of the weather variables, temperature, barometric pressure, dew point and humidity with the altitude of the track they are racing at to determine the "density altitude". This is a "corrected" altitude above sea level. From there they can determine whether a jet change is necessary to maintain performance or whether to change their "dial in" (if they are bracket drag racers). You can look at Mortec's HOLLEY CARB INFORMATION page to find the stock, standard, sea level, calibration jets for your particular Holley four barrel carb.

DRAG RACE JET CHANGES and MPH

Drag racers should try to optimize jetting by looking for the jet size that gives the best MPH, rather than best elapsed time (ET).

ACCELERATOR PUMP CAMS AND SHOOTERS

Accelerator pump cams come in various sizes and are color coded and number coded by Holley. The cams have different shaped ramps that the arm from the accelerator pump rides on. By changing the size and shape of the arc on the cam, the pump shot can be tailored to start early or later as you go from off idle to full throttle. Changing the cams can have an effect on the way a vehicle leaves the start line in a drag race. If you leave the line off idle or at a higher RPM (while foot braking or when using a trannie brake or when using a clutch with a manual transmission) experimenting with the pump cams can help. There is no set rule for use, you just have to experiment with the different cams and the different cam positioning holes in the throttle linkage of the carb. Holley sells individual cams or you can buy their kit which includes an assortment of cams to choose from.

Pump shooters are another area of experimentation. Holley carbs come with a standard shooter size which differs by carb list#. If you are experiencing a bog or hesitation off idle, you can try a larger, higher # shooter size. The bog or hesitation may be caused by a momentary lean condition when the carb goes from the idle throttle position to the main metering system. The shooters help

richen this momentary condition and eliminate the stumble. Keep going up in shooter size until a puff of black smoke comes out the exhaust, then go back one or two sizes. Playing with the shooter sizes is particularly helpful, when you have an intake with a large plenum area, such as a large open plenum or a tunnel ram. Keep in mind that as you increase the shooter size, you may also need a "hollow" screw to hold the shooters in the carb. At shooter sizes over .039, Holley recommends that you use the "hollow" screw (PN-26-12) which allows more fuel to flow to the shooters.

POWER VALVES and ENGINE VACUUM

There is a lot of misunderstanding concerning power valves in Holley carbs. Many 4-barrels come with a particular power valve depending on the carb list# and application. Some carbs have two power valves, while others only have one. The power valves are numbered by the amount of engine vacuum in inches at which they will open and add additional fuel to the power circuit. In other words a 6.5 power valve will open when the vacuum signal on the engine drops below 6.5" and will remain closed above that amount. One of the misconceptions is that they can't be trusted to work because an engine backfire or "belch" can "blow out" the power valve. Many Holley performance carbs models and list#'s now come with built in power valve "blow out" protection which eliminates this problem. If you have an older model carb you can purchase a small, inexpensive, easy to install kit from Holley (PN - 125-500) that will also protect the power valves in case of an engine blowback thru the carb. CENTEK in Redmond, Oregon, (website no longer works) also sells an inexpensive Holley power valve blow out protector, "Power Valve Shield", which takes about two minutes to install and does not require any drilling.

Many tuners will automatically remove the power valves and use a "plug" thinking this is the "hot" ticket. However, if the power valve is removed and plugged, the main jet size must be increased 6-10 jet sizes to make up the required fuel amount lost by the removal of the power valve. In addition, when the power valve circuit is plugged, the part throttle fuel economy is worsened and may become overly rich. Plug fouling may become a problem at part throttle.

Stock engines can have high vacuum readings (10-18 inches at idle) and the Holley power valves with higher readings like 6.5 to 10.5 will work correctly. Long duration non-stock camshafts and other performance related parts can cause a problem, because engine manifold vacuum may be lowered with these performance parts and the power valve, if incorrect, will always be open, even at part throttle, leading to an overly rich air/fuel mixture. The solution is to choose the correct power valve and to do that you need a vacuum gauge. On a manual transmission vehicle, hook up the vacuum gauge and take the reading with the engine at idle. Then use a power valve that is rated 1-2 inches below that amount. For example, a motor that shows 7" of vacuum at idle should use a 6.5 or 5.5 rated power valve. If you have an automatic transmission, take the vacuum reading at idle in "Drive" (with the emergency brake on and the wheels blocked) and chose the power valve 1-2 inches below that figure. You can get a little more detailed information by driving the car with a vacuum gauge hooked up with a longer hose so you can read it while driving. Drive the car at medium loads and while cruising and note the various vacuum readings. Then chose the appropriate power valve rating. Holley makes performance

style "standard" flow or a "high" flow power valve which has a large opening. "Single stage" power valves are available in 1" increment sizes from 2.5" thru 10.5". There are "two stage" power valves available that are more for "economy" minded users rather than "performance" enthusiasts.

ADJUSTING THE OPENING POINT OF VACUUM SECONDARIES

There are a number of ways to tune the moment when the vacuum secondaries open on a Holley four barrel carb. The vacuum secondaries are controlled by a diaphragm and a color coded spring. Holley makes a number of different springs with different tension on the springs. You can change the springs and change the opening moment. The color coded springs run from light tension to heavy:

- White - Lightest
- Yellow (Short Spring)
- Yellow
- Purple
- Plain (Steel grey)
- Brown
- Black - Heaviest

If there is a bog or hesitation when the secondaries open, the spring tension is too light, go to the next heavier spring. Holley offers a kit (PN-20-13) which contains one each of the above color springs. When you change springs you'll note that the stock cover over the spring and diaphragm is not all that easy to get to. Holley makes a special cover (PN-20-59) that makes spring changes quick. Finally, Holley also makes a completely adjustable thumbscrew operated diaphragm cover (PN-20-99). This cover limits the travel of the diaphragm and therefore limits how far the secondary throttle plate can open. It makes secondary throttle opening adjustable. It's very nice to have if you are a bracket racer and are using a carb with vacuum secondaries. You can adjust the throttle for changes in weather and track conditions or for changes in your "dial in".