Dellorto PHBG Carburetor Tuning

By Andrew Brown

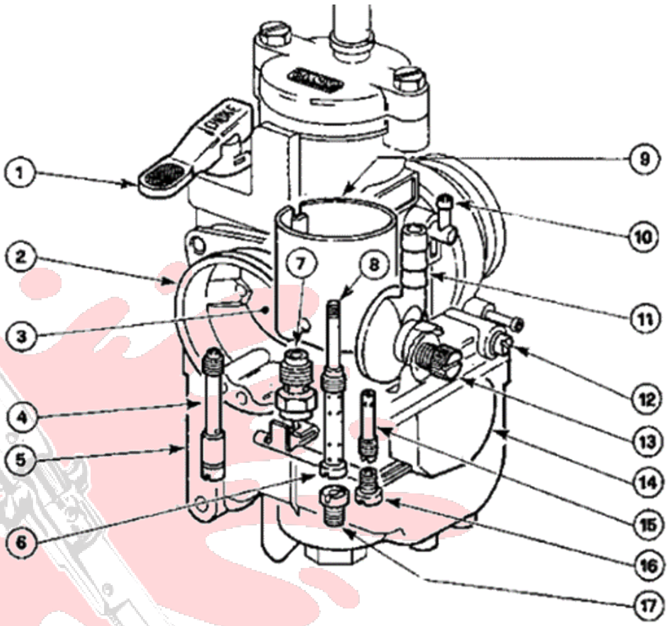
Goals

- Introduce the components of a Multi Circuit Carburetor and what their functions are.
- Outline the way in which these components interact with each other throughout the throttle advancement.
- Craft the fundamentals of tuning and identify the steps from start to finish.

Components

This guide references a Dellorto style carburetor, but the definitions apply to most other brands and varieties. Here's what's inside and out of a phbg for example:

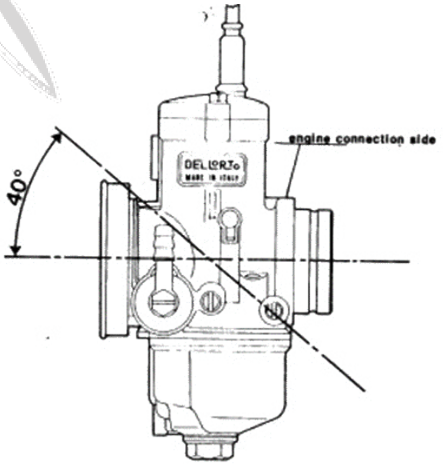
1. **Starter Lever** – Enrichens mix during start
2. **Air intake** – Where air is pulled into the engine
3. **Venturi** – Main channel where air mixes with fuel
4. **Starter jet** – Sets how rich starting mix will be
5. **Float Bowl** – holds fuel before use
6. **Needle Jet** – Atomizes Main Jet fuel with air to release through the venturi
7. **Float needle** – Regulates the fuel valve
8. **Slide needle** – Further fine tunes amount of fuel released from main and needle jet between ¼ to ¾ throttle
9. **Slide** – Meters air allowed into the engine between Idle and ¾ throttle
10. **Float air intake** – regulates internal air pressure
11. **Fuel connection** – where fuel enters the float
12. **Idle Mixture Screw** – adjusts a/f mix at idle
13. **Idle Screw** – regulates idle RPM/lowers slide
14. **Float** - measures amount of fuel in float bowl
15. **Idle emulsion tube** – atomizes mix at idle
16. **Idle jet** - delivers fuel when engine is at idle
17. **Main Jet** – delivers fuel at full throttle



Carb Features

Shape

- Carbs are horizontally mounted, although it can work effectively with up to a 40% angle.
- Whatever happens inside the carb comes out the venturi hole and goes into an attached intake. The two will mount together via a clamp or rubber flange and feed into the engine.
- A cable runs from the throttle to the carb and is mounted on top. A variety of ways that can be attached. Twisting the throttle pulls the cable and activates the slide.



3 main Functions

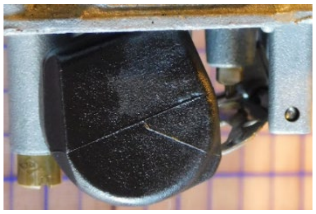
1. Controls power to engine, adjusting air to fit the need.
2. Sends the proper amount of fuel based on that need.
3. Mixes air and fuel evenly for optimum combustion.

Mixture

At this point I want to stop and give you some definitions that are going to impact the remainder of this guide.

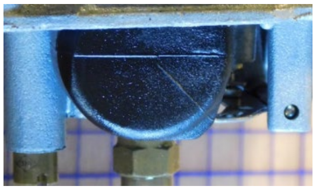
A Carburetor takes air and fuel and mixes it together to form what most people call a **Mixture**. The amount of air mixed with an amount of fuel forms an **Air/Fuel Ratio**. You may not be aware of this, but gasoline on its own does not ignite. It needs a certain amount of air to become inflammable (aka flammable.) A mixture that will catch fire is somewhere between 7 parts air to 1 part fuel, and 20 parts air and 1 part fuel. Now *Science* calls the perfect mixture ratio the **Stoichiometric Air/Fuel ratio** (stow-icky-o-metric), which is about 14.7 to 1. That's, 14.7 lbs. of air to 1 lb. of fuel. Let's now move on to seeing how that mixture is achieved.

Float



Fuel comes down from the tank and fills up the float bowl. How does it keep from overflowing? The float and the float needle. The float is usually hollow or made of a buoyant material that floats atop the fuel in the bowl. The float is anchored on a hinge and raises or lowers depending on what's in the bowl. When it's high enough, it will push the float needle into a seated position and stop flow from the fuel connection. When fuel is spent the float lowers, and the needle let's more in.

Vacuum



If you remember anything from elementary school, you may remember something about weather pressure. High pressure always moves towards low pressure. A balloon is filled with high pressure, and shoots out to a lower pressure. Engines use a **vacuum** to get mixture into where it needs to be. The engine piston moves in such a way that it will lower the pressure inside the cylinder, lower than the pressure inside the carb. High to low, carb gives the engine some juice.

The fuel level directly affects the amount of fuel going through the jets.

- High float level = more fuel delivered = richer = higher pressure
- Low float level = less fuel delivered = leaner = lower pressure

Want to raise or lower the float level? This can be achieved in two ways: there's usually a tab called a **Tang** somewhere in the middle that can be bent up or down so that the float has to go higher/lower to make the float needle seat completely. The tab should be such that the float rests parallel with the carb body. Unless you are a serious blaster or have a funky mounted angle. Additionally, the weight plays a factor.

- Heavier float = carb works harder to reach that fuel line
- Lighter float = carb works less hard to reach designated fuel level.

We now have a general concept of how fuel travels from carb to engine, let's talk about air for a moment.

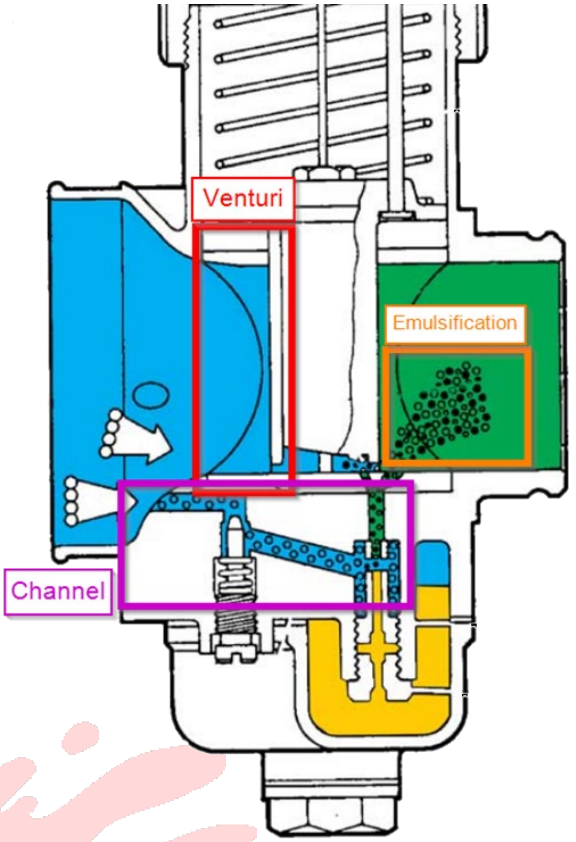
Air Filters

A final point to make on vacuum would be on the decision to use an Air Filter on your setup. There is a large variety of filters available for most carburetors and have mostly the same purpose:

- Keep external debris from entering the airway
- Block water from entering the venturi
- Muffle the overall sound
- Keep the carb from spitting out excess gas

Some are a metal mesh material and some are oiled to catch debris. The term Hi-flow indicates the filter material itself is porous enough to let the maximum amount of unobstructed air through. Make no mistake though, any filter will by nature have a negative impact on the amount of air allowed into the carb, thereby enrichening. Take the airbox off and the air restriction is removed, giving a leaner overall response. Depending on accessibility, removing this can potentially provide even further clarity if the bike is suspected to be too rich at any given point. Upjet and leave them off if you want a loud blaster.

Venturi



The main hole in the carb is called the **Venturi**. The larger the venturi, the larger the amount of air can pass through. The size of this hole is the size of your carburetor. Stock mopeds come with anywhere from 12-15mm, while performance bikes require carbs ranging from 15mm to as big as 24mm. Now, putting a bigger carb on a bike doesn’t simply make it faster and there’s a lot to unpack regarding selection of the appropriate carb for your need, but we’ll save that for another tutorial.

Notice along the entrance of the venturi is smooth to provide the least wind resistance, and there are a few holes along the side. These are called **Channels**. These holes lead to the different jets we mentioned earlier. As the vacuum changes, more or less air is drawn into these channels. The channels in combination with the jets form **Circuits**. This is where we get the name **multi circuit carburetor**. As this slide goes up and down it changes the vacuum pressure and encourages air through those circuits. At a certain point in these circuits, the air and the fuel will **emulsify** together and become A/F mixture. This mixture goes into the bike and is ignited to operate. **Emulsification** is where the air and fuel **atomizes**. These are the technical ways to say air mixes with the fuel and creates a burnable ratio.

Having the wrong Ratio

You’ve heard the words **lean** and **rich** thrown around a million times at this point. If you’ve gone online and asked “why isn’t my bike working, you’ve definitely heard someone suggest changing the jets to make it leaner/richer. If we go back to that Air fuel ratio, we learned that the stoichiometric ratio is 14.7/1.

- The mix becomes richer when either there is less air, or more fuel introduced to the mix. Effectively bringing those two numbers closer to each other.
- The mix becomes leaner when those two numbers grow further apart. More air or less fuel.

Things to keep in mind with Rich and Lean:

- Generally, leaner mixes will burn the fuel quicker, and may make the bike hotter in return. This has the risk of overheating and may **seize** an engine. permanent damage.
- Richer mixes tend to dull the performance and offer slowed response. The bike is drowning in fuel and may produce unwanted side effects that ultimately **foul** the engine. This isn’t considered as bad as parts can be cleaned.
- Error on the side of rich if you are a responsible human being. Go lean if you are racing and have a lot of excess money lying around.

Now that we have rich/lean out of the way, let’s get back to the components and when they work the hardest.

Idle Circuit

Do you have to flutter the throttle at stop lights? Does your bike shut itself off when on the kickstand? Do you have to twist the throttle all the way when kicking it over? Your idle circuit is likely not setup correctly. Whenever the bike is at its lowest rpms, it doesn't need much mix to run, but it does need some. A perfectly tuned idle circuit will produce a smooth purr at a low RPM and will respond well when the throttle is twisted. Let's talk about what's happening on the inside here.

When the slide is closed, air cannot pass through the venturi much, so it instead is pulled through the idle circuit as it has the least resistance in this position. The circuit is located very close to the slide as that's where the most pressure exists. At the end of this circuit is the **Idle jet** also known as the **Pilot Jet**. Having the right idle jet not only lets the bike idle smoothly, but assists with the transitions between other circuits. So with the slide closed, none of the other circuits are in use right now. Here's where one of the exterior screws come into play. It's the screw w/o a visible spring behind it. This is the **Idle Mix Screw** which is responsible for metering the mix going through the idle circuit. Some carbs are idle **air** mix with a blunt tipped screw, and turning adjusts the amount of air let through the circuit. Some carbs are Idle **fuel** mix with a pointed tip, which adjusts the amount of fuel allowed through the circuit.

A perfect screw range is 1 ½ - 3 rotations out	To Enrich	To Lean
Fuel Mix screw	Open the screw	Close the screw
Air Mix screw	Close the screw	Open the screw

Want to know the current setting, rotate clockwise until it stops, *how many rotations did that take?*

Idle circuit is responsible for 0 to ¼ throttle position.

The Idle circuit is in effect when the bike is idling and up to ¼ throttle position. Maybe you don't know if your idle jet is correct, here are a few tricks to spot something isn't right.

Open the throttle slowly to ¼ twist and observe the sound/behavior.

- Slow and uneven – Idle jet is too small
    - This could also happen if the idle mix screw is too open or if the idle air screw is closed to much.
- Excess smoke and dull noise – idle is too large.
    - This can happen if the mix screw is too far in and oversensitive, or when the air adjust is out too much.

Another characteristic to consider is if the bike is having a hard time maintain a stable idle. Surging up and down means it's not getting enough fuel and is sort of pulsing as its waiting for more fuel. This is a smaller/leaner than necessary Jet. On the flipside, too rich a jet might make it sputter or even die when opening the throttle. If it's seemingly losing power when given throttle, the jet is likely too rich. Too rich might also more commonly foul/dirty spark plugs and be a pain in the neck to start.

After ¼ throttle, we move into the progression circuit, the transition between Idle to Main Jet.

Progression System

Multi Circuit carburetors allow the bike to progress through different circuits as the throttle is increasingly engaged. As the slide is raised by the throttle, pressure will decrease from the idle circuit and begin transitioning into the main circuit. This is because the hole created by the slide is increasingly larger than the idle circuit hole. At a certain point, the idle circuit is pushed to the side as it's no longer needed. At ¼ throttle and above, the vacuum in the venturi is greater than the idle circuit. The idle circuit doesn't stop completely, but is much less impactful further along the progression.

Progression circuits are responsible for ¼ to ¾ throttle position.

There are 3 main components in the Progression system: Atomizer/Bushing, Taper Needle, and Throttle Slide.

Atomizer

An atomizer is a special tube screwed into the body that effects the transition between idle and main operation. There is a circuit that goes from the idle channel into what is effectively the main channel. As the pressure changes from the idle to the main channel, more is coming out of the atomizer instead. An atomizer is a brass tube with holes in it that will vaporize fuel coming from the tube together with air coming through the holes before exiting into the venturi. Here are characteristics that affect an atomizers size:

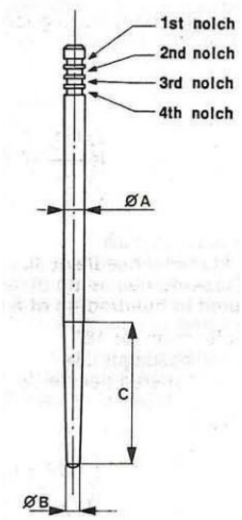
- Diameter of the tube - fuel
    - larger increases the amount of fuel delivered.
    - smaller decreases the amount of fuel delivered.
- Amount of air holes - air
    - More holes will lean out the progression.
    - Less holes will richen the progression.
    - 4 stroke atomizers typically have many holes
- Atomizer air hole position – usually placed at or around float level
    - Higher holes – above float – only pull air – leaner
    - Lower holes – at or below float – pulls fuel initially before air - richer
- Atomizer length
    - Longer – weaker mix at low speeds and acceleration.
    - Shorter – extra enrichment. For Serious Blasters only.

Atomizer Bushing

Further fine tuning is available through the **Atomizer Bushing** shape, but it's more appropriate for 4 stroke engines. The only thing to pay attention to for 2 strokes is what type of bushing is currently installed.

Furthermore, while it's good to understand these parts, the average tuner should not expect to be swapping these much, if at all. My advice is to find the variation that is generally regarded as the best for your application and run it.

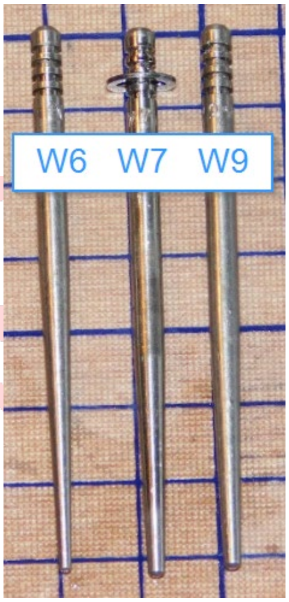
Needle



The atomizer is also called the Needle-jet as it works in tandem with the Needle, which is nested inside. As the slide goes up and down, the needle which is attached, will move up and down as well and allows more or less fuel through the needle-jet and into the venturi. It does this via the shape of the needle which is a Taper. If we think about our fundamentals, the higher the RPMs , the more fuel it needs. The needle is shaped wider at the top, and thinner at the bottom. As the needle raises, the taper gets smaller and smaller, effectively letting more fuel out of the needle-jet as the throttle is pulled. Here's more about the shape of a needle:

What determines a needle size:

- A – represents the diameter of the cylindrical part before the taper begins
    - Smaller A – richer up to ¼
    - Larger A – Leaner up to ¼
- C – determines the length of the taper, affecting ¼ - ¾.
    - Increase in C – earlier rich
    - Decrease in C – later rich
- B – Diameter of the tip
    - Larger B – Weaker mix
    - Smaller B – richer mix



Needles come a wide variety from practically no taper, down to extreme needle tapers. Middle of the road is suggested here when purchasing. Only buy every needle if you want to experiment or show off your collection. For PHBG, W6, W7, W8 are the most common needles depending on the venturi size.

Another thing to mention about needles; Performance carb needles always have a series of notches at the top that can also affect mixture, usually 3-4 of them. Since the needle rests in the slide, it can be lowered or raised based on these notches. Needles are held in place by a spring clip that can be easily removed with needle-nose pliers. When thinking about these notches, think about the numbers from top down. 1 is the highest/richest setting, and 4 is the lowest/leanest.

The point of these notches is to allow the entire profile of a needle to be shifted up or down. Move the clip down and the needle characteristics are realized earlier. Raise the clip and the characteristics are delayed.

- Raise clip – lowers needle – Leans
    - The slide has to move higher before the taper is reached.
    - Raise if hearing a bogging or deep sound when in range.
- Lower clip – raises needle – Enrichens
    - The taper is reached earlier
    - Lower if hearing 4 stroking or a thinner sound.

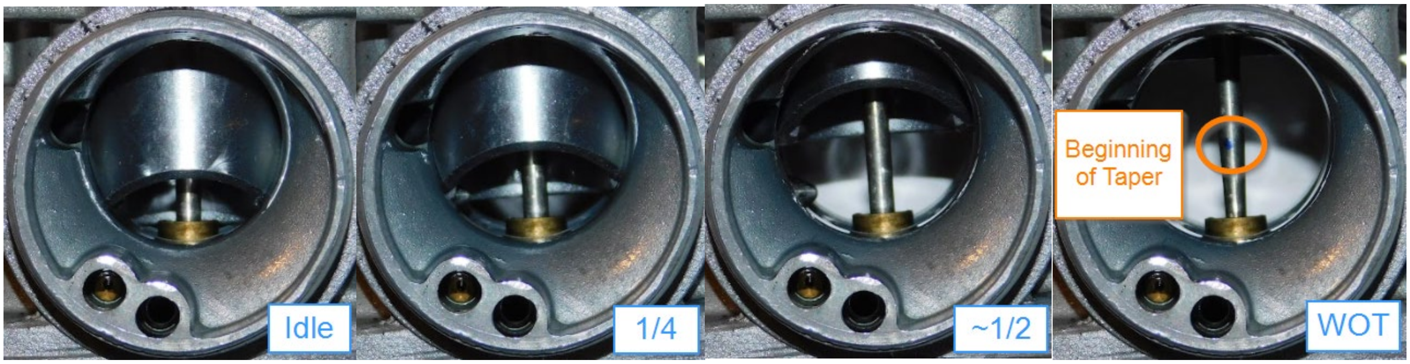
it's generally a bad idea to run a needle on the leanest setting as it tends to be dangerous for seizing on closed throttle from WOT at high rpm. Consider adjusting tuning so that the clip is somewhere in the middle.

Slide

The slide is that piece at goes up and down as the throttle moves, also called a throttle valve cutaway. The slide directly correlates with how much air is being let into the engine. After around ¼ throttle, the vacuum pressure transitions from the idle circuit and into the main venturi. It's also called a cutaway valve because the slide itself has a lip to it on the air intake side. This lip angle, or cutaway, regulates the air mix with its slope. If the needle measures how much fuel is released based on the vacuum, the cutaway measures that pressure. Here are the key takeaways for a slide:

- Larger cutaway – reduces airflow resistance and leans the mixture.
- Small cutaway – increases airflow resistance and richens the mixture.

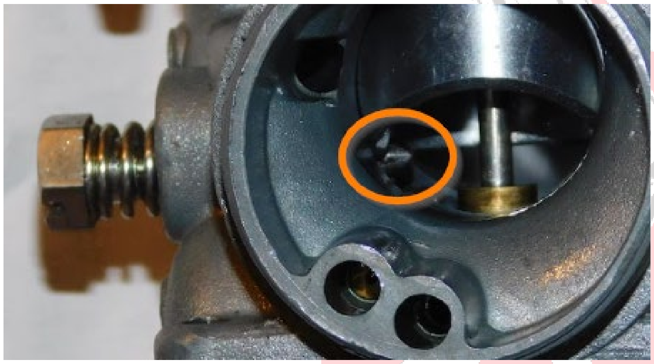
The slide cutaway plays a factor starting at 1/8 position up to ½ throttle. After about ¾ throttle the bottom of the slide is near the top of the venturi and largely becomes ineffective. Anything above ¾ is essentially all the Main Jet. When tuning, slide size differences will be most noticeable between 1/8 and ¼.



Idle Screw

Remember the two screws on the side? They are in different spots depending on the carb type/model but are visually distinct. The Idle screw usually has a spring that is visible, which functions to maintain tension no matter the position.

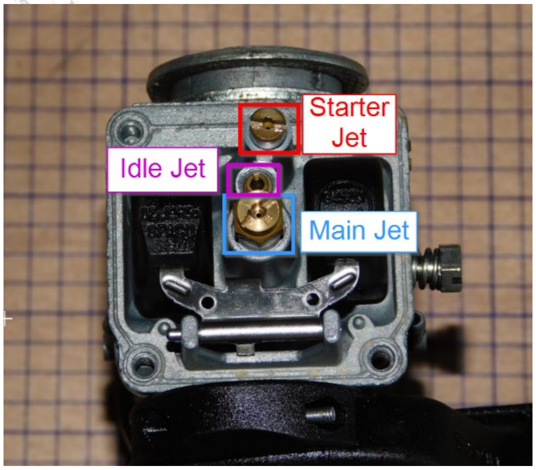
The **Idle screw's** sole responsibility is to meter RPMs when it's on and resting. Turn it inward and the screw actually forces the slide up via the notch seen in the below example. Turn it outward and the lower the slide is allowed to rest. Too high of an idle and we waste excess fuel. Too low and the bike might shut off on its own.



Main Jet

Main Jet is responsible for ¾ to full throttle position.

The Main jet is titled such as it's the main source of fuel when the carburetor is at its most open, aka full throttle, aka WOT, aka Full Hogging It. Remember, the bike at this point is running it's hardest, temperatures are higher, and things are moving extremely fast. Even the slightest deviation in fuel amount could catastrophically destroy an engine in an instant. That's why the jet is affixed at the lowest possible point in the bowl, so that it ALWAYS has fuel. A sudden loss in float fuel will make the A/F ratio way more airy than manageable. At high speed and high temp, this equals an almost assured Seize. Enough of the warnings, let's talk characteristics!



Most of the time when people are talking about tuning they are referring to the main jet. For bikes that live on the main jet, it is super important to pick the correct size. Every carburetor type is equipped with its own 'not so exact' range of jet sizes. It's best to pick a jet in the range of what everyone else has used and go from there. There is one constant, the bigger the jet number, the larger the size. There are a few jetting calculators that will input your moped specs and generate what others have used based on a similar build. Take a look at one of those before proceeding with tuning, as you'll likely need to do some shopping beforehand.

The best advice to give when tuning a main jet is to start high and work your way down in sizes. A larger jet = a richer mixture. It is always better to have a bike that is too rich or to foul a plug, as opposed to too lean and melting your piston rings. You can always clean a foul, but can't clean a hole in the piston. Whatever the website told you to use, go 5 – 10 sizes up. Again, it won't give you the best performance initially, but it won't blow up either. Here are some signs of a high/low jet:

- Too big – Dark/wet ring around exhaust, a wet plug, 4 stroking sound, dull throttle response
- Too small – White smoke from exhaust, Dry plug, sputtering sound, powerless throttle response

The ideal main jet will keep the bike running and feeling smooth all the way up to the fastest speed it will physically go. Someone riding at top speed with a less than ideal jet may notice 1 of 2 characteristics, the first one being 4 stroking. An engine with too rich a mixture is receiving more fuel than the cylinder can expel and must work even harder to burn or get rid of it. This often can sound like a 4 stroke engine which expels ignited mix at half the pace of a 2 stroke working at the same RPM. Long story short, your bike will sound like it's firing at half the speed it should. Feel wise, the bike might feel sluggish and quite slow to respond to whatever is happening.

On the other hand, too lean at WOT may sound thinner as the bike is burning through all its fuel and is begging for more. Feel wise, the bike won't feel like it has any power even though it seems to be making plenty of noise.

Let's say you don't have internet, don't know what jet is currently installed, and don't know if it's rich/lean. Get on the bike and hog it. At full throttle, pull the choke. If the bike runs noticeably worse, the jet is high. If it actually goes faster or runs better, it's too lean. Go up or down in sizes until that behavior largely stops.

At this point after tuning through the WOT characteristics, it's all about fine tuning. Fine tuning means starting to consider engine temperatures, spark plug colors, and overall top speed.

Independent Starting Circuit

Each multi circuit carb has a starting channel that's only purpose is to start the vehicle. There are two components to this, the starter Jet, and the Choke.

Before a bike is initially started, it is considered cold. It's not at a normal operating temp yet and will need a slightly richer a/f ratio to begin performing. When an engine is cold and the outside air is also cold, some of the initial mixture won't make it to the cylinder and instead will collect or condense on the cold walls of the intake. Because of that collection, the mix is often lean. Too lean to start actually. When started cold like this, the bike will run weird until the temps are raised and there's no more condensation.

The choke is designed to enrichen the ratio and bypass any collection that might have occurred so that it can run for the first few minutes. It gets us closer to that stoichiometric ratio until the bike can handle things itself.

If you are ever having trouble starting your moped, the starting circuit could be the problem. Since this circuit is independent of the rest of the operating carb, the throttle shouldn't need to be twisted to start a bike. If your bike is stalling before it gets to a normal temp, inspect this circuit. Check the plug on a bike having issues.

- If the plug is too wet = mix is rich = lower the starter jet
- If the plug is dry = mix is lean = raise the starter jet

To bring it all back together, a bike at rest will normally have unspent fuel sitting in the emulsion tube from when it was running last. Kicking a bike over for the first time will seem very rich because of that pooling. As it's starting up, the mixture will naturally lean out as that excess mix gets spent and the emulsion tube is pulling in air again. Operation will begin once it leans out a bit. Simpler carbs a plunger aka tickler that pushes the float down to let more gas in. As we've learned earlier, higher float level makes the bike run richer. These are pickier as pushing that mechanical tickler can easily flood the engine.

That's pretty much it for component interactions. You've learned what each part is, what it does, as well as key characteristics if incorrectly sized. Pack all these concepts up and let's now move to application.

Fundamentals of Tuning

Before we can even get tuning, we have to get some assumptions out of the way.

Your bike works everywhere else:

- You have properly mixed gas and oil.
- The petcock works to allow fuel into the carb.
- The timing is set to Factory aka ideal settings.
- You have no air leaks of any kind.
- The engine itself past the intake otherwise functions properly.

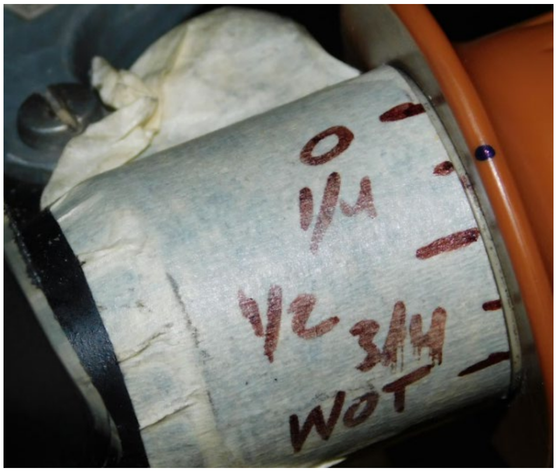
If any of these are out of sync you risk wasting hours chasing the tuning dragon. Additionally, we have to keep in mind that mopeds are not perfect. Sometimes the A/F mix isn't fully used. Mix doesn't always make its way to the chamber due to multiple reasons and sometimes mix doesn't exit the chambers completely, leaving residual mix. On occasions where the pipe is too big, it will take a fresh charge of mix from the chamber before it has had a chance to ignite. Improperly cut gaskets or uneven transfers can also affect a peak performance setup. Consider if the components you have installed are a good fit for each other before proceeding.

If you've gone through this entire manual, have filled a whole worksheet with changes and still are not getting closer to the results you are after, the problem likely is not the carb. Try these tests to narrow down the issue further:

- With the bike running, briefly spray carburetor or brake cleaner at the gasket locations. (carb clamp spot, intake gasket, cylinder, exhaust, visible seals. If the bike fluctuates while spraying a particular spot that is a giveaway there is an air leak in that location, and air is getting into the engine and disrupting any attempts at a proper tune.
- Recheck your ignition timing and all of those components are working. If your timing is not at factory or 'tuned' settings, it will never fire at exactly the correct spot and will completely change how/when the mixture is ignited in the engine. This is especially apparent if all the settings have been tried, or the bike doesn't seem to want to go higher in RPMs.
- Check all your other mechanical components. Are the piston rings ok, are the wheel bearings damaged, are brake plates engaged, is the wheel rubbing the swingarm or fender, is there a rogue wiring connection,
- The final avenues of diagnosis would be assessing if the installed parts are damaged, appropriate for the build, and if there is any internal damage like a chipped gear, damaged clutch, or a seized internal bearing.

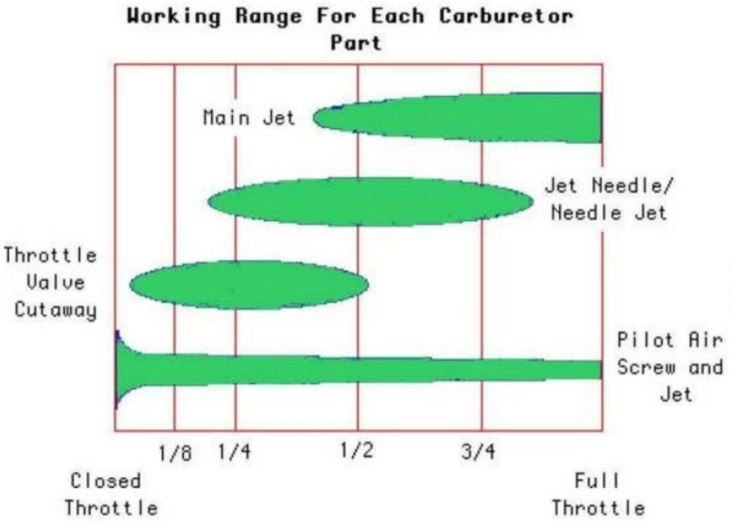
Throttle Tape

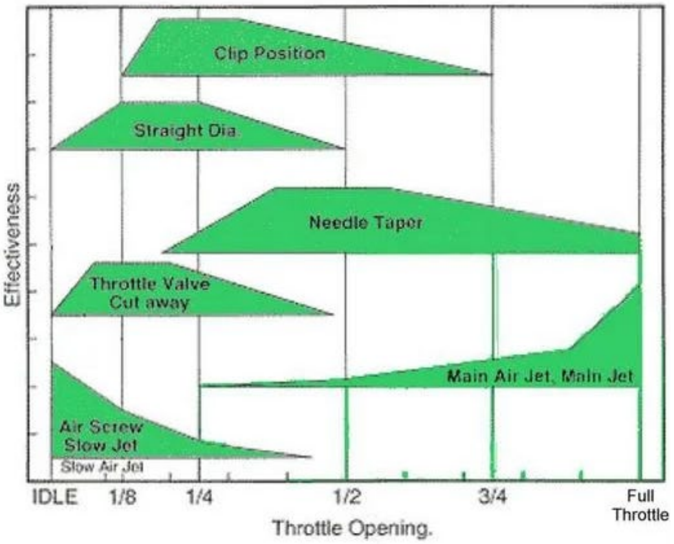
During tuning you will be attempting to adjust settings at different parts of the progression, so let's make the progression crystal clear by applying a light colored piece of tape to the left of the throttle grip. Mark a spot on the tape that will be 0 throttle. Make sure throttle play isn't taken into account. 0 should be just before the slide begins to raise, not including slack. Also make a marking on the throttle so it's easy to see when riding where the throttle is. Pretty much like a needle gauge. With 0 figured out, twist the throttle all the way open and mark WOT. Now take the tape off and use a ruler to add three more markings equally spaced apart. You should now have 0, ¼, ½, ¾, and WOT labelled. Now when you are riding and notice something funky, the throttle position is easily identifiable.



Putting it all into Perspective

While the above image shows which components engage as the throttle valve is opened, the following two graphs attempt to give a relative visual comparison of how each of these parts relate to each other.





As you can see, it's not as simple as 'put in the perfect main jet and send it.' Every carburetor type contains components with ranging effects throughout the progression and therefore multiple factors can sometimes play into why a bike is performing a certain way.

Is my carb ready to go?

- Is it clean?
- are all the fittings securely affixed and everything is tightened down?
- is the float even when the carb is turned upside down?
- is it getting fuel?

What size parts should my carb have?

There are a few key resources to figure out your starting points for what jets, needles, and emulsion tubes you should have. Go to the Moped Tuning Spreadsheet and try to find someone with a similar build as you. Same cylinder, pipe, and carb would be best. Start with those numbers.

Most of the time the Starter Jet, the Idle Jet, and the Atomizer that came with the carb is fine. When you figure out the suggested main jet, the best practice is to purchase a few above and a few below. I would say buy the five to ten away from that starting point just to be safe. If you can't find someone that matches your specs then buy from what you have. Here are a few solid reference points for PHBG specifically:

Carb size	Idle	Slide	Atomizer	Needle	Needle Clip	Main Jet
21mm	40	30	262au	W9	3rd	90
19mm	35	40	262au	W7	3rd	85

Like we've mentioned earlier, richer is safer. You can replace a fouled plug, but a lean seized engine is everyone's nightmare.

Tuning Steps

Start your tuning adventure with the idle circuit. Start your bike and let it warm up for a few minutes. Idle tuning should be done on the kickstand.

Idle System

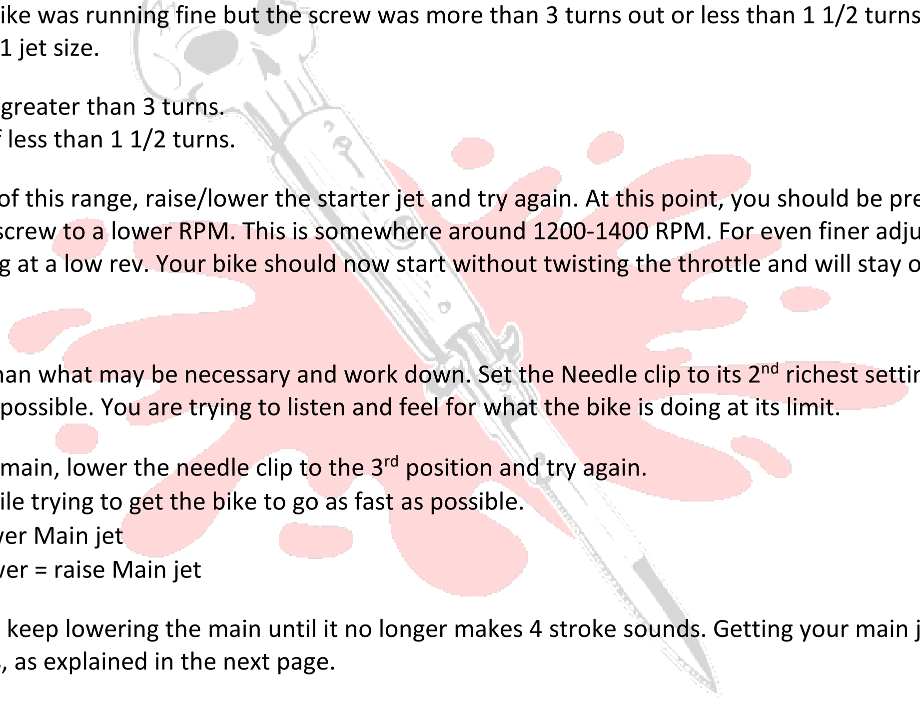
1. Raise the idle a little above normal resting level. ½ turn of the idle screw should be enough, or if you can get it to about 2000 RPMS.
2. When you feel it's sufficiently warm, adjust the idle mix screw in/out in ½ turn increments, wait 5-10 seconds, and adjust again until the bike is running steady and smooth. No rising/lowering of rpms.

With the idle jet within range, flip the throttle from closed to 1/8 a few times. The response should be quick, smooth and should return to the idle range quickly.

- Turn the Idle Mix in if = hesitation, sluggish…
- Turn the Idle Mix out if = Bogging, loss of power, 4 stroking…

A quick way to know if your idle jet is within range is to turn in the mix screw in all the way, recording how many full rotations it made along the way in. If the bike was running fine but the screw was more than 3 turns out or less than 1 1/2 turns, your jet is wrong. Every ½ turn is roughly 1 jet size.

- Increase the jet size if greater than 3 turns.
- decrease the jet size if less than 1 1/2 turns.



If the idle mix screw is outside of this range, raise/lower the starter jet and try again. At this point, you should be pretty close to solid and can now unscrew the idle screw to a lower RPM. This is somewhere around 1200-1400 RPM. For even finer adjustment, use 1/8 to ¼ turns with the bike running at a low rev. Your bike should now start without twisting the throttle and will stay on by itself.

Main Jet

Always start with a richer Jet than what may be necessary and work down. Set the Needle clip to its 2nd richest setting. Get on the bike and try and ride as fast as possible. You are trying to listen and feel for what the bike is doing at its limit.

- If you can't get to the main, lower the needle clip to the 3rd position and try again.
- Adjust up or down while trying to get the bike to go as fast as possible.
- 4 stroking sound = lower Main jet
- Bogging or lack of power = raise Main jet

If starting from a high main jet, keep lowering the main until it no longer makes 4 stroke sounds. Getting your main jet to the perfect number will require plug chops, as explained in the next page.

Progression

Now that Idle and Wot are approximately set, move backwards to the progression range from ¼ - ¾ throttle. To test this range you'll be riding steady at those throttle positions as well as quickly/slowly going between them to listen/feel for changes in quality.

- If feeling/hearing 4 stroking = lower Needle clip by 1 and test again.
- Use the effectiveness chart, the throttle tape, and key bullets from above to pinpoint what component is doing what.

Recheck 1/8th throttle and repeat the idle System steps again if that range has become richer/leaner based on progression changes.

At this point, your bike is pretty close to tuned and it's all about fine-tuning going forward. See the **Other Tuning Considerations**, **Appendix**, and the **worksheet** for additional information to get the perfect tune.

Other Tuning Considerations

Engine Temperature

Engine temps work opposite of air temperature in that a higher temp will encourage more fuel burning. Too hot of a bike can cause excess wear on the engine. So depending on where your normal operating temperature is, you may want to enrichen the overall mix (lowers temps) or lean out the mix (raises temps). Spark Plugs are not covered in this material, but play an important part in temperatures as there are ‘colder’ or ‘hotter’ types of plugs. Generally, the higher the numbers on the plug model, the colder. The lower the number, the hotter it operates.

Plug Chop

A plug chop is a technique best reserved for final granular tuning. The bike has effectively been narrowed down to a 1-2 jet range. The spark plug can give more clues about the mixture based on its color. Too dark of a plug and the bike is rich. Too light and it’s lean. The steps of a chop are to put a fresh plug in and run the bike briefly at a specific operating range, usually WOT. After a brief amount of time, the engine is quickly shut off and the plug is removed. If the goal is to check the color at full throttle, we don’t want the plug to be soiled by any other part of the operating range. Killing the engine is the quickest way to avoid the other parts of the progression discoloring the plug. This is a heavily visual task, so it’s best to research online relevant photos to compare plug colors. Essentially, the white ceramic part of the plug should be dry and a light shade of brown. Sprinkle cocoa powder in a coffee mug and that’s pretty much it. Whatever that plug read will inform whether the main jet can go up or down a single jet size. Install the next jet and a fresh plug before repeating the process again, and again, and again until you are happy with the results. As a reference:

- Darker = jet is too big
- Clear/light = jet is too small

Oil Mix Ratio

The standard for majority of 2 stroke engines is to mix 2t oil with fuel at a ratio of 50:1, or 2.6oz per 1 Gallon. There are active philosophical debates about what’s best, 40:1 (3.2oz), Saber 100:1, but it all comes down to lubrication and heat. Less oil will offer less lubrication of the engine and will translate to leaner/hotter operating temperatures. Racers might prefer this. More oil in the mix increases lubrication and lowers temps, but can also prematurely soil spark plugs, dirty up the exhaust, etc…

External Forces Beyond your Control

Let’s say you live on a little old rock called Earth. And on that Earth the temperature changes, or you have suddenly found yourself on top of a mountain. Your moped is going to react differently depending on what’s going on outside of it that you can’t control. Let’s quickly cover a few of those external forces:

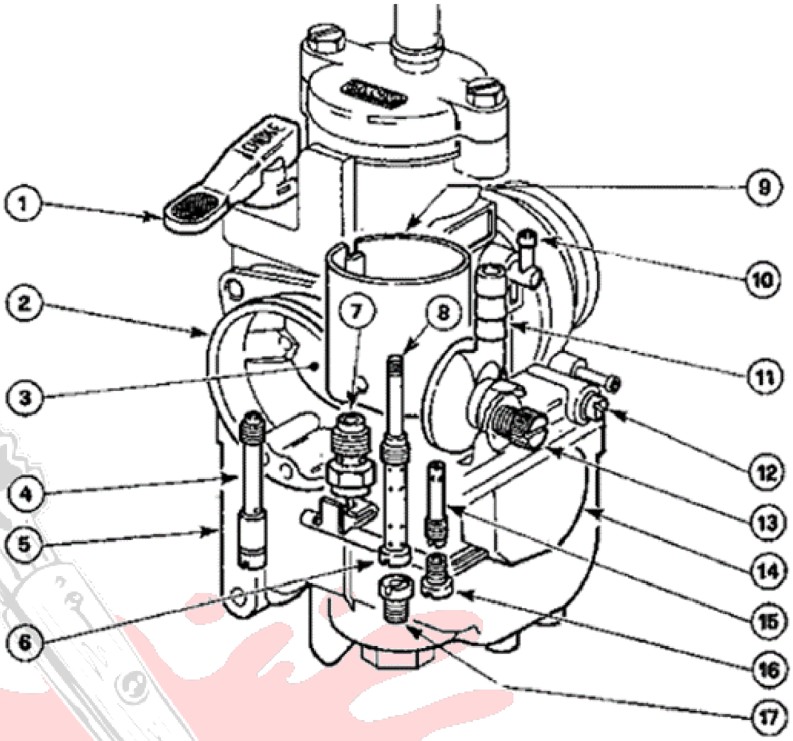
- Temperature - Colder air will be denser, more of it, and will therefore lean out the bike.
    - Warmer weather expands and will enrichen things.
    - If all of a sudden it’s a nice day outside and your bike rides like crud, it is probably too rich.
- Humidity - If there is more moisture in the air that will in turn make the air less dense and richer.
    - Dryer environments generally exhibit leaner qualities.
- Altitude - The further the moped is from sea level, the thinner the air is. This richens things.
    - As a general rule of thumb - move 1 jet size for every 2,000 ft. of elevation change.

Bottom line, don’t try and tune your moped on top of a mountain during a heatwave next to a humidifier.

Worksheet

Try filling this out as a reference for all the definitions you've learned so far:

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________
6. ____________________________
7. ____________________________
8. ____________________________
9. ____________________________
10. ____________________________
11. ____________________________
12. ____________________________
13. ____________________________
14. ____________________________
15. ____________________________
16. ____________________________
17. ____________________________



- The ___________________ determines the size of the carb.
- Stoichiometric Ratio is also called ____ /____ ratio. That ratio is ________ to 1.

Circle one:

- Less air or more fuel in a mix makes it **Richer / Leaner**
- More air or less fuel in a mix makes it **Richer / Leaner**
- Raising the needle clip will generally equal **Richer / Leaner**
- Lowering the clip will generally equal **Richer / Leaner**

What position are these components **most** effective at?

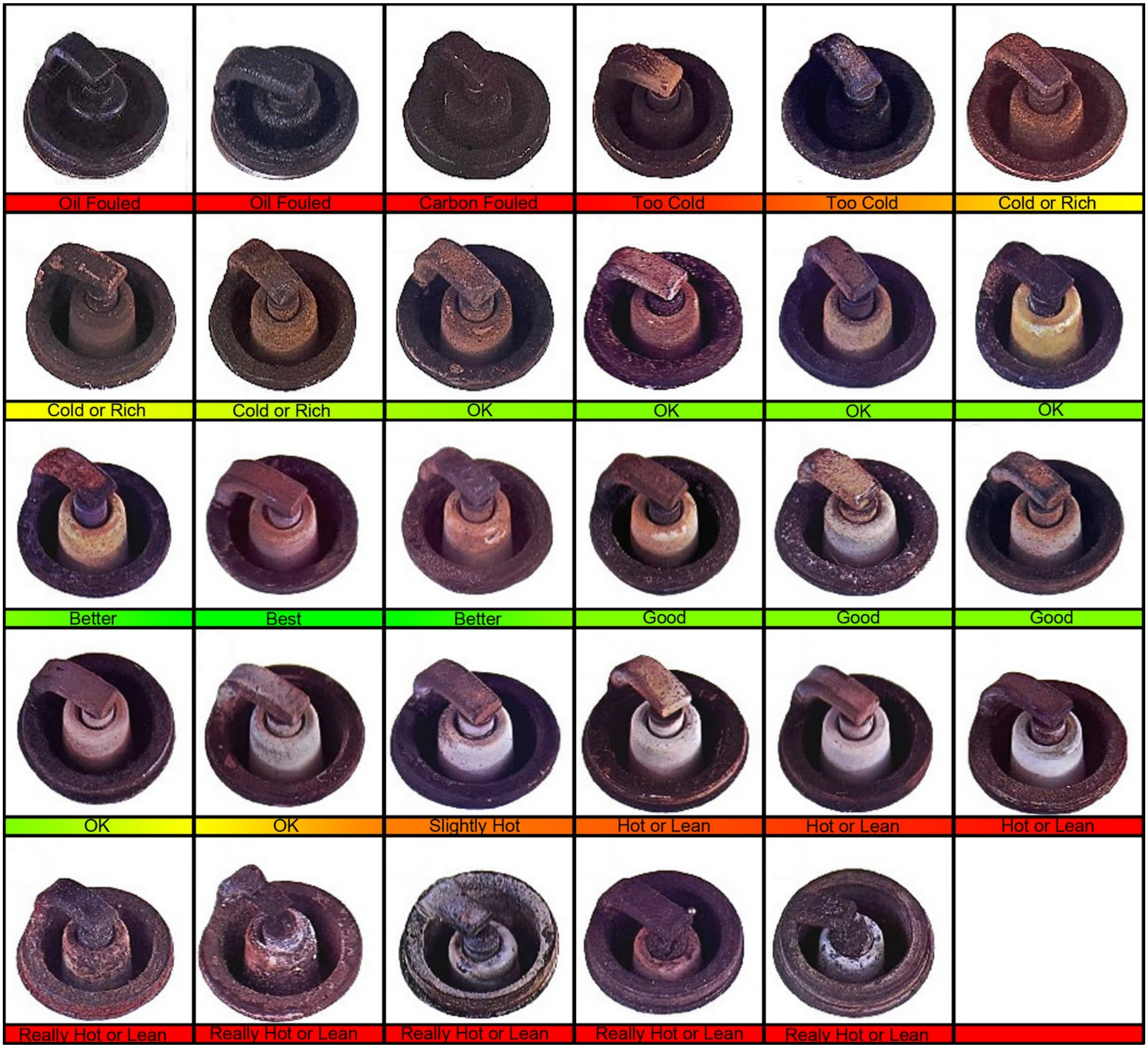
• Idle Jet	closed throttle	¼	½	¾	Full throttle
• Main Jet	closed throttle	¼	½	¾	Full throttle
• Needle taper	closed throttle	¼	½	¾	Full throttle
• Slide cutaway	closed throttle	¼	½	¾	Full throttle
• Needle clip position	closed throttle	¼	½	¾	Full throttle

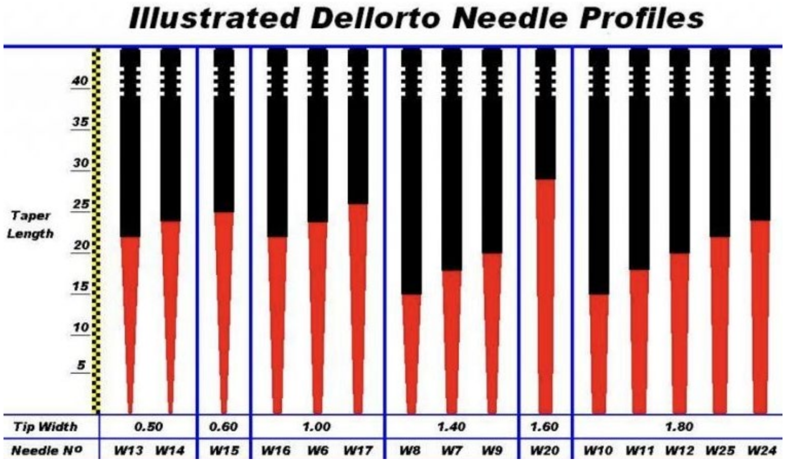
- Colder air will ___________ a mixture.
- Dryer climates exhibit _____________ qualities.
- Air is thickest at ___________ level.

Appendix

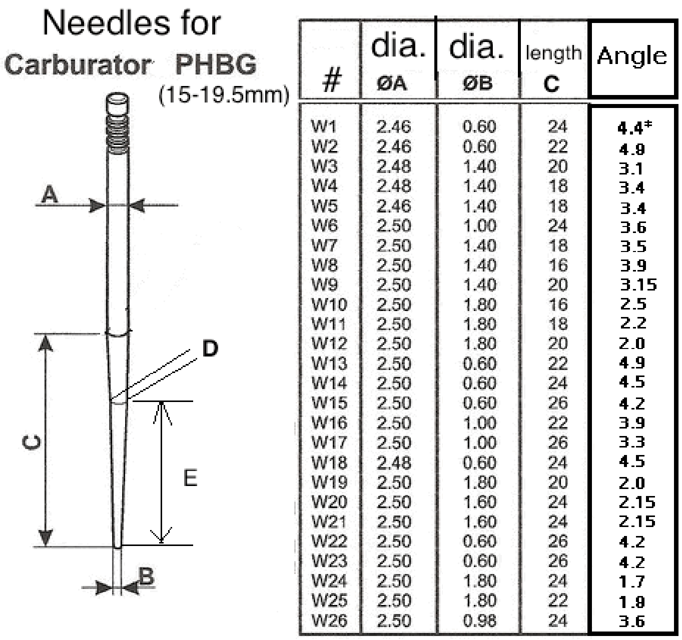
Re: Two Stroke Performance Tuning – Checking mixture strength via spark plug reading

Spark Plug and mixture condition	**Indications**
Normal – Correct Mixture	Insulator nose is a light tan to rust brown color.
Fuel fouled – Rich Mixture	Insulator nose is black and likely wet.
Overheated – Lean Mixture	Insulator nose is chalky white or may have a ‘satin sheen’. Likely very dry.
Detonation – Dangerously lean mixture	Insulator nose is covered in tiny pepper specks or possibly beads of aluminum from piston crown.

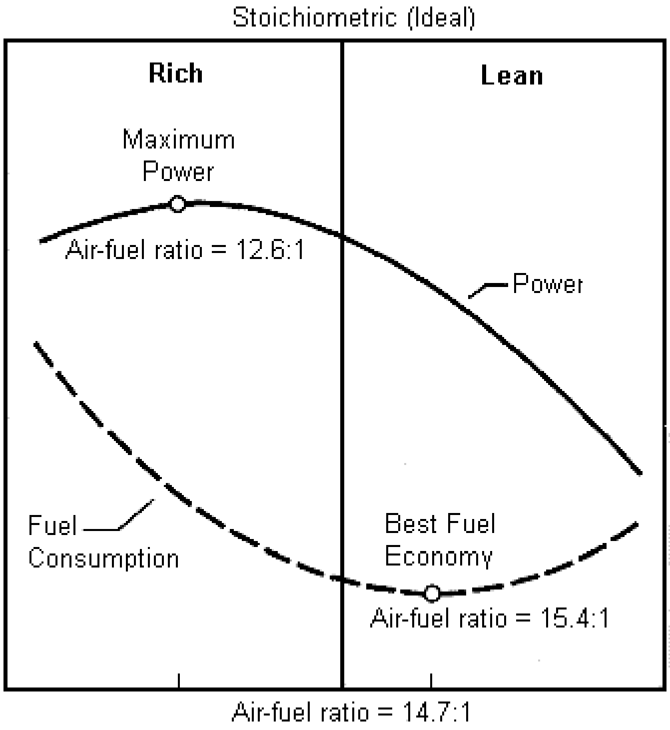




2.50mm Needle	Taper Length ▶	Dellorto PHBG Needle Chart						
Tip Ø ▼	15mm	18mm	20mm	22mm	24mm	25mm	26mm	
1.80	W10	W11	W12		W24			🟥
1.60					W20			▲ Leaner
1.40	W8	W7	W9					
1.0				W16	W6		W17	
.60						W15	W23	▼ Richer
.50				W13	W14			🟩
		◀ Later				Earlier ▶		



#	dia. ØA	dia. ØB	length C	Angle
W1	2.46	0.60	24	4.4*
W2	2.46	0.60	22	4.8
W3	2.48	1.40	20	3.1
W4	2.48	1.40	18	3.4
W5	2.46	1.40	18	3.4
W6	2.50	1.00	24	3.6
W7	2.50	1.40	18	3.5
W8	2.50	1.40	16	3.9
W9	2.50	1.40	20	3.15
W10	2.50	1.80	16	2.5
W11	2.50	1.80	18	2.2
W12	2.50	1.80	20	2.0
W13	2.50	0.60	22	4.9
W14	2.50	0.60	24	4.5
W15	2.50	0.60	26	4.2
W16	2.50	1.00	22	3.9
W17	2.50	1.00	26	3.3
W18	2.48	0.60	24	4.5
W19	2.50	1.80	20	2.0
W20	2.50	1.60	24	2.15
W21	2.50	1.60	24	2.15
W22	2.50	0.60	26	4.2
W23	2.50	0.60	26	4.2
W24	2.50	1.80	24	1.7
W25	2.50	1.80	22	1.8
W26	2.50	0.98	24	3.6



Additional Resources:

- Mikuni Specific explanations – Search online for "**Mikuni VM Super Tuning Manual**"
- Polini CP tuning instructions – Search "**CP Carburetor instructions**"
- A guide released by Dellorto Carburatori – Search "**dellorto_manual_a_guide_1.1.pdf**"
- *Moto Technica Magazine* released a similar manual that incorporates deeper, although still technical, explanations of carburetor components with many visuals showing how pressure works at different points – Search "**carburetor dellorto guide technique**"
- If none of this made sense, Search online for "**Fred's Guide**" for an introduction to moped maintenance.

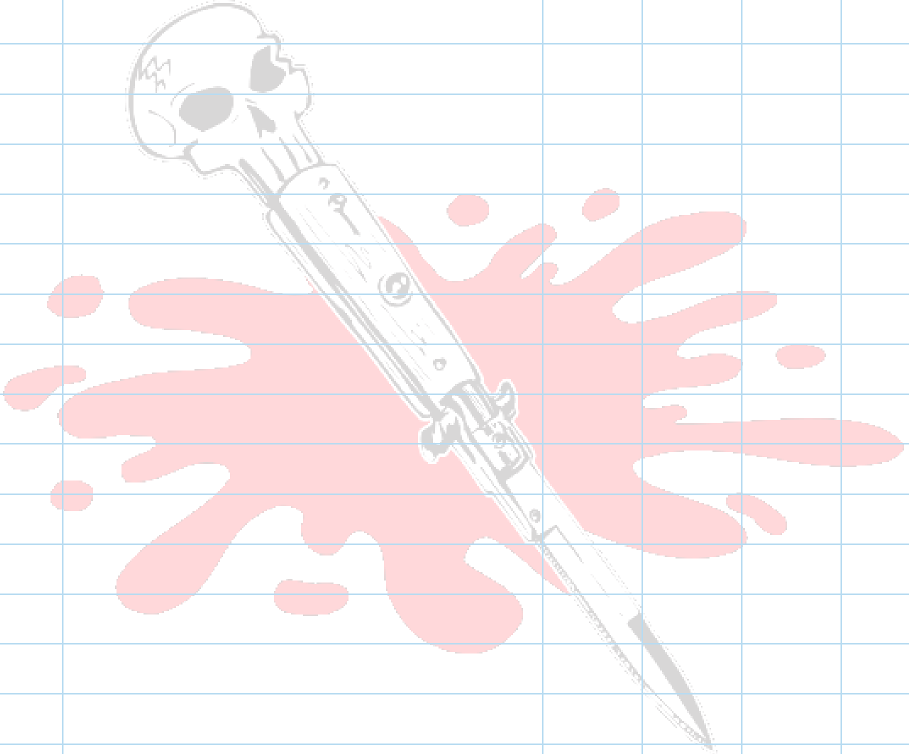
Did I mess up? For any issues or identification of corrections in this guide, please contact me at musichoard@yahoo.com

Carburetor Tuning Chart

By Andrew Brown

Use this worksheet to determine your perfect tuning. The metrics labelled are good standards, and columns on the right are for anything extra you want to track.

Idle	Slide	Needle Type	Needle Clip	Main Jet	Top Speed	Tach	Notes								
45	50	W7	2nd	99	26	7600	Cuts out after ½ throttle								



Even more tuning metrics: type or using an air box/filter, atomizer, idle screw turns, temp, float weight, rich/lean at specific throttle positions
Wizard level tuning metrics: Timing, clutch engage tach, plug chop color, var. weights, Spring color, gearing, cylinder compression
Elites only: Foot stance, color helmet, piston seize tally

CARBURETOR TUNING CHART

By Andrew Brown

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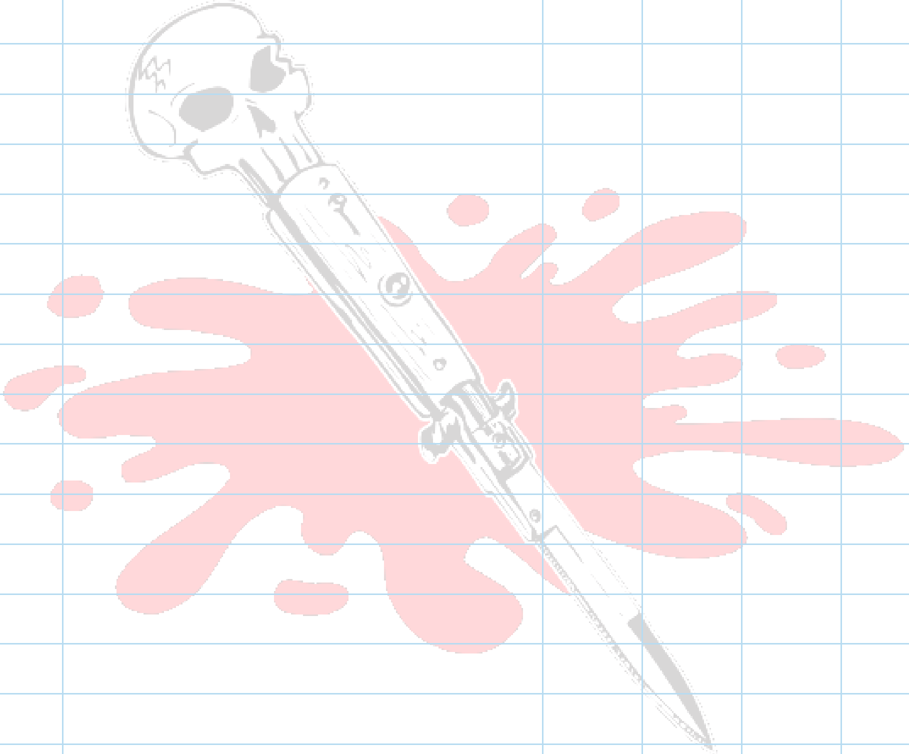

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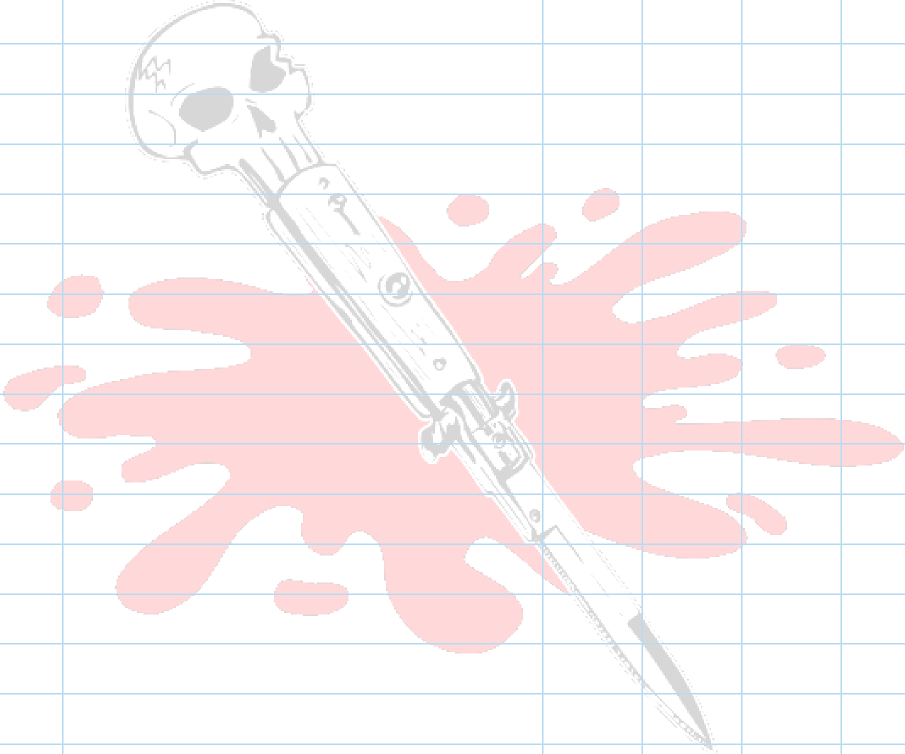

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