KEIHIN CARBURETION JETTING

The following information is offered as a guide for a practical interpretation of the workings of Keihin PE, PJ, PWM and PWK carburetors. Many people are intimidated by carburetion jetting. One of the easiest ways to work through your jetting frustration is to not view jetting as one big mystery. Jetting should be broken down into many small questions, which when thought through with some technical instruction and common sense can be deciphered into to the appropriate carburetor settings.

AIR SCREW: The air screw is a small (5mm in diameter) slotted brass adjustment screw located on the inlet side (air cleaner) of the carburetor. The airscrew is a fine-tuning adjustment designed to allow the carburetor to be slightly adjusted for variances in atmospheric conditions. The airscrew works with the pilot/slow speed system of the carburetor, mainly affecting the engines initial starting, idling and initial power delivery. Proper adjustment of the airscrew can offer direct feed back on the necessary setting required for the **pilot jet**. The airscrew is adjusted in a rather straightforward manor. **See Figure 1 for application chart**

The ideal procedure for setting the screw in the correct position is to warm up your ATV engine to the proper operating temperature. Then turn the idle up so it is idling about 500 RPM's higher than normal. Next turn the airscrew all the way in until it bottoms out, once bottomed out slowly back the screw out a ¼ turn at a time (give the engine 10-15 seconds between each ¼ turn of the screw, to allow the engine to catch up with the adjustments). Continue backing the airscrew out until the engine idles at its highest RPM. The preferred setting window is between 1 and 2 turns. If the engine idles at its highest RPM from 0-1 turns out this means the pilot setting is on the **Lean** side and a larger pilot jet should be installed. If the engine idles at its highest RPM at over 2 turns out, this means the pilot setting is on the **Rich** side and a smaller pilot jet should be installed.

If you get no RPM fluctuation when adjusting the air screw there is a very realistic chance that there is something clogging the pilot/slow speed system. Clean the system thoroughly with contact cleaner and blow out with compressed air. **Carburetor must be disassembled.**

If the airscrew adjustment process is unsuccessful and leaves you confused. Set the screw at 1 ½ turns out and consult a professional for further assistance.

PILOT JET: The pilot jet is a medium size (¾-1") brass jet located inside the float bowl next to the needle jet/main jet location. The pilot jet meters the fuel required for engine starting, idling and the initial throttle opening 0-1/8.

A lean pilot jet setting will cause your engine to surge at very low RPM's, bog or cut-out when the throttle is opened quickly and have trouble idling down.

A rich pilot setting will result in hard starting, plug fouling at low RPM's, sputtering as the throttle is cracked opened.

The pilot jet is not difficult to set. With proper air screw adjustment and a close initial setting from

your engine tuner, fine-tuning should be painless. Once set the pilot jet is not terribly sensitive. You should only be required to adjust the setting when confronted with large weather changes or altitude swings of over 2000 ft.

If adjusting the pilot jet gives inconsistent feed back, or does unexplainable things. Check and clean out the pilot/slow speed system thoroughly with contact cleaner and blow out with compressed air.

Pilot jet sizes are numbered in the following pattern; #42, #45, #48, #50, #52, #55, #58, #60 etc. repeating the pattern. Sizes available on most models are from #35 to #80.

SLIDE: The slide not only monitors how much airflow goes into your engine (its main job). But it has various angles cut on the bottom of the slide to monitor airflow at low RPM's. This is referred to as slide cut away. The slide cut away is measured in 4.0, 5.0, 6.0 etc. (see attached chart). The higher the number, the larger the cut away the leaner the slide setting is.

The slide cut away generally effects the jetting in the ¼ throttle range at almost the same throttle position as the needle diameter effects. The slide cut away is usually predetermined by the engine manufacture or engine tuner. As a general rule do not change the slide cut away unless instructed to do so by a skilled engine tuner.

For ¼ throttle jetting adjustments it is easier to adjust the needle diameter.

NEEDLE: The jet needle is the most important component in determining your carburetors jetting. The needle is broken into 3 main functions; Diameter, Length, Taper. These needle functions have a large effect on the carburetors jetting from ¼ to ¾ throttle. In the following paragraphs we will explain the needles functions and how to adjust them.

DIAMETER: The needle diameter controls the jetting just above the pilot jet, right as the engine begins to pull. On most engine combinations the needle diameter is felt in the ¼ throttle range. The setting of the needle diameter is crucial to both the engines low RPM power and reliability.

The jetting at ¼ throttle is adjusted by changing the diameter of the needle. On gold colored needles identified with the 3 stamped in letter I.D. system the last letter refers to the needle diameter size. By referencing the enclosed jetting chart you can verify your needles size, and be able to determine what needle size may be required for your specific situation. In many instances you can leave the taper and length settings the same (if they are correct) and adjust only the diameter. EXAMPLE: If you have a needle marked DGJ and change it for a needle marked DGK, you have effectively **Leaned** the jetting at the ¼ throttle position. Reference the enclosed jetting chart to clearly understand this adjustment.

When the needle diameter is **Lean** the machine will have a loss of low-end power. The engine will feel very zingy (like a 125cc engine). When an engine is in this condition and then put under a heavy load the engine becomes very susceptible to seizing.

When the needle diameter is **Rich** the machine will sputter at ¼ throttle and be hesitant to take the throttle. In extreme cases the engine can feel like the choke is on or the plug is fouling.

When the needle diameter jetting is set correctly the engine will accelerate evenly thru the first part of the power band. The proper diameter setting will provide maximum low RPM power and very ride able throttle response.

It is important to remember that even though the needle diameter is mainly responsible for the jetting at ¼ throttle there is some bleed effect. With experience this can easily be deciphered. An excellent way to pin point the feel of the needle diameter is test needles in your machine that have both the same taper and length but richer and leaner diameter settings. Try a needle of each setting in your machine for 10-15 minutes of riding and you will begin to understand specifically what throttle position your dealing with.

LENGTH: The needle length is determined by the clip position (grooves at top of needle) setting on the upper portion of the needle. On most needles there are 5 clip positions. The top clip position is referred to as #1 and is the **Leanest** setting. The clips are referred to in numerical order with the bottom position being #5, the **Richest** (refer to attached jetting chart illustration). The clip/length setting covers the largest percentage of jetting in your carburetor. With an emphasis at ½ throttle, the clip (length) setting will bleed both up and down to some degree to cover a wide portion of the midrange jetting.

When the clip/length setting is **Lean** the machine will be very zingy sounding and feel kind of similar to an 80cc or 125cc machine. Lean in the midrange will also rob power and cause the machine to run hot and seize easily

When the clip/length setting is **Rich** the machine will have a lazy feeling in the midrange. Exhaust note will be a little flat sounding. In extreme cases of richness the engine will even sputter or kind of crap out in the midrange.

The safest way to set the clip position is to richen up the clip position setting until the machine loses a little power (feels lazy/unresponsive) then lean it back one position. Ideally you like to run the needle setting in either the 3rd or 4th clip position, if possible. **The needle clip jetting is especially critical to your machines reliability because on average more time is spent in the midrange than any other part of the throttle. Most machines pull very hard in the midrange, putting quite a load on the engine. This makes a lean condition very detrimental to your reliability.**

TAPER: The needle taper is the angle of the needle at its lower half. The taper works the transition between the midrange and full throttle/main jet (¾ throttle position). The taper is the least sensitive function of the needle. Changes in the taper have very mild subtle changes in the jetting. The taper also affects the main jet size your carburetor requires. A leaner needle taper will use a richer main jet than a comparable engine/carburetor combo with a richer needle taper.

As a general rule, your engine tuner or engine manufacture should preset the taper. Once set correctly by a professional the taper setting should not need to be changed except for cases of extreme temperature reduction.

MAIN JET: The main jet affects the jetting in the upper quarter of the throttle position. Coming into play at ¾ throttle on through to full open throttle. Even though most people relate the main jet to their carburetor in general. The main jet is only responsible for the last ¼ of the jetting. The main jet does not effect the jetting for starting and idling. It plays no part on low RPM or mid RPM jetting either. The main jet is very important to your machines overall tuning, but should never be over emphasized at the expense of needle tuning or other facets of your carburetion tuning.

When the main jet is **Lean** the engine will experience detonation or "pinging". Exhaust note will be of a higher, tinier type note. Engine will over heat easy and can be down on horsepower. A moderately lean main jet can cause engine seizures. A severely lean main jet can cause the engine to burn a piston (whole in top).

When the main jet is **Rich** the engine will be a bit flat or lazy at ¾ to full throttle, giving off a flat, dead sounding exhaust note. When the main jet is severely rich the engine will sputter in the high RPM's and have a lot of trouble making power up top.

The safest way to get the main jet setting as near correct as possible is to richen the main jet setting up until the engine begins to lose power and not rev to as high of RPM as before. On a single cylinder machine this will signal that the jetting is beginning to get rich. Depending on your riding application you can lean it down a bit from there or leave it for conditions requiring extra fuel (desert racing, long high speed runs, etc.)

As a general rule, richen the jetting up as long as the engine likes it and continues to run just as well or better than the smaller size main jet previously installed. When the engine no longer continues to improve its performance you will know you have gone to far.

Main jets are offered from #90 to #230. Starting at #90, sizing cycles like the following #90, #92, #95, #98, #100, #102, #105, #108, #110, #112, etc…. up thru #200, #205, #210, #215, #220, #230.

NEVER USE ANY MAIN JETS THAT ARE NOT GENUINE KEIHIN JETS. ALL GENUINE JETS HAVE A KEIHIN TRADEMARK STAMPED IN THEM. CHEAP IMITATION AFTERMARKET JETS ARE NOT ALWAYS SIZED PROPERLY, WHICH CAN CAUSE POOR PERFORMANCE OR ENGINE DAMAGE.

TUNING TIPS-GENERAL

- Make sure machine is assembled properly and engine has passed a **pressure test**. It can be virtually impossible to tune an engine with an air leak. It is imperative that you establish a solid baseline with proper assembly and an air leak free engine. ***Note: On a 2-Stroke engine there**

is absolutely no way to be sure your engine DOES NOT have an air leak without properly performing a pressure test.

- Establish that the engines compression is not weakened. Any loss of compression for whatever reason will give off signs that engines jetting is rich. Consult your service manual or engine tuner for proper compression reading. Any loss of compression on a 2-stroke engine should be followed by a top end disassembly and inspection of piston, rings, cylinder liner etc.

- Compression Test How To: Always use a quality name brand gauge **(SNAP-ON Best Choice)**. Note length of threaded probe in relation to spark plug length. Perform test with engine cold, throttle wide open. Kick machine over until needle quits moving (10-15 kicks normal). Perform 3 separate tests, record results.

  It is always a wise idea to perform a compression test on a fresh engine right after break-in to use for future reference.- Spark Plug: To properly tune a 2 or 4 Stroke engine it is imperative to have a good quality spark plug that is functioning properly. This means that the plug cannot be too old or partially fouled. Spark plug gap is essential; an improperly gapped plug (or partially fouled one) can cause the engine to run poorly, sometimes appearing to be a jetting problem when in reality the problem originates at the spark plug. Also make sure you are using the correct heat range.

- Weak Spark: Weak spark is not only detrimental to your engines performance but can make tuning your engine a nightmare. Weak spark will make the engine run rich. When an engine is running rich due to weak or poor spark the machines performance will slowly continue to deteriorate. Some common causes of weak or poor spark can be a failing or faulty stator, faulty plug cap or plug wire, failing coil, improper ground etc.

- Plug Color: Ideal plug color is a chocolate brown. A rich plug will be a darkish brown or black. May be oily and sooty. A lean plug can be a light brown, or gray (some severe cases can be white). Plug color must be checked after a plug check has been run. To perform plug check run engine at specific RPM that reading is desired for at least 5 seconds, then turn off engine without letting RPM's fall. This test is very difficult to perform at any RPM other than wide-open throttle.

  It can take years to learn how to accurately and precisely read spark plugs. For amateurs, plug color should not be the only piece of evidence used to adjust jetting. Plug reading should be evaluated with other jetting evidence to achieve a proper conclusion on tuning.

- Fuel: The fuel used in your machine is very influential in tuning your engine. Nothing jets better or more consistent than a name brand Race Fuel designed for the specific engine in question. Things to stay away from are pump fuel and aviation fuel. Both can cause inconsistent jetting feedback and make your engine run hotter than normal.

- Silencer: 2 Stroke silencers must be functioning properly. A worn out, poorly maintained, silencer can cause the engine to run funny making tuning difficult. An excessively packed silencer can also cause a tuning difficulty, making the engine lose power and run rich.

- Exhaust Pipe: Check your pipe for severe dents in head pipe section or end cone area, dents in these areas may affect tuning. Also check for carbon build up inside pipe. Any carbon build up at all is not desirable. Heavy build up will hamper engine tuning and rob power. Pipes with these problems should be replaced.

- Silencer Color: Always take note of the silencer exhaust color where the exhaust exits the silencer. Inspect the core and corresponding end cap. Colors will be similar to plug color.

- Air Filter: It is highly recommended to do your initial engine tuning/jetting with a new air filter. A used filter will never quite work as perfect as new one. Old, dirty, improperly serviced filters will severely hamper proper engine performance and tuning. When performance is critical use a new filter.

- One Change at a time: When tuning a carburetor, only make one adjustment at a time. This is a good rule to follow so the tuner will not get confused or mislead from false information. Keeping to one adjustment at a time will help ensure that you will always know what effect each adjustment had on the engine.

- Unresponsive?: If during the jetting/tuning process you have made a number of adjustments (especially main jet or needle clip) to the carburetor and the engine has not changed. There is a strong possibility that something other than carburetion jetting is causing your engine to perform incorrectly. Jetting is a constant. When adjustments are made to a machine with all components working properly the engine will respond in some way. Depending on the adjustment made the machine will either run better or worse, but there is almost always some form of change. When changes are made without any response it is a sign of other problems. Things to check out would include; low compression, weak spark, fouled plug, failing reeds, air leak, clogged air filter, clogged or over packed silencer, etc.

- Idle Adjustment: To adjust the idle on PJ and PWM model carburetors it is necessary to turn the knob on top of the choke clockwise to lower idle and counter clockwise to raise idle. PWK models are adjusted by a screw/spring approximately ¾" below the carburetor cap on the left hand side of the carburetor. Screw in to raise idle out to lower. On many models screw must be screwed in most of the way for proper idle speed. PE models also have a screw/spring that manually raises the slide. On PE models idle screw is approximately 2" below carburetor cap and perpendicular to the slide.

- Free Play: It is highly recommended that at least a ¼" of free play is kept in the throttle cable. Failure to run proper free play can cause the throttle to stick.

- Proper Slide Throw: It is always a good idea to confirm that the carburetor slide opens and closes all the way. This should be done with carburetor hooked up but off the machine, as to physically see slide travel thru its complete stroke.

- PWK Cable Holder: The cable holder on PWK model carburetor must be unscrewed to remove needle for adjustment. The only way to properly remove cable holder is with a ¼" ratchet and a 6mm socket. Turn counter clockwise to loosen. During reassembly do not over tighten. **Do not put screwdriver in slot to attempt to loosen. This will cause severe damage to cable holder and slide.**

TUNING TIPS-4 STROKE

- Cam Timing: Cam timing must be properly set before engine can be jetted/tuned. Improper cam timing will cause poor engine performance and in some case internal engine damage.

- Ignition Timing: On engines that allow for ignition timing adjustment, the timing must be set to the correct mark. Too much Advance will cause the engine to overheat and have trouble revving to full potential. Too much Retard will cause engine to be down on power, and generally run weak.

- Intake Leak: An air leak on the intake side of a 4-stroke engine will cause the engine to run lean. Intake leaks make tuning a 4 stroke very difficult. Unless the leak is very large and easy to locate and correct, tuning can be quite troublesome because a small leak will give very inconsistent feedback to the tuner. Common causes of intake leaks can be; loose carburetor, loose inlet manifold, worn damaged or missing sealing o-ring at inlet manifold or carburetor, pin hole or crack in inlet manifold, etc.

- Exhaust Leak; An exhaust leak especially at the header connection can cause tuning difficulties and engine damage in extreme cases. In most cases exhaust leaks will cause inconsistent tuning feedback and unexplained popping during deceleration. Before beginning to tune your engine check your complete exhaust system thoroughly for any sign of an exhaust leak. Common causes of exhaust leaks can be; loose exhaust nuts/bolts, missing or damaged exhaust gasket, broken or stripped exhaust studs, improper fit at couplers, etc.

- Valve Clearance: Valves must be adjusted to their proper setting. Excessively tight or loose valves will affect engine performance.

- Cam Chain: Cam chain must be kept in adjustment at all times. A loose cam chain allows cam timing to be altered, effecting engine performance.

TUNING TIPS-BANSHEE (TWIN CYLINDER)

- Carburetor sync; It is ***absolutely imperative*** that all facets of the carburetion be in sync (work in unison) for the engine to perform properly throughout all RPM ranges. **This includes; slide**

opening and closing, airscrew settings, idle settings, jetting in each carburetor, etc. Failure to keep all components in sync will cause the engine to drop a cylinder in various RPM ranges, resulting in poor performance and possible engine damage if not corrected.

- Engine Compression: To have positive results tuning a Banshee engine compression must be with in 5 psi in each cylinder. (Testing method has been previously explained) If compression difference varies by more than 5 psi the problem must be corrected.

- Plug Gap: Spark plugs must be of same manufacture, model and heat range. It is also very important that the plug gap be set exactly the same for each spark plug. Most plugs should be gapped at .028". Gap with a round style or feeler gauge type gaper. It is not recommended to gap the plugs with a wire type gaper.

- Coil: Banshee coils have a history of failing prematurely. A good initial sign that your Banshee coil is beginning to fail is an erratic miss in the power band, combined with an unexplained popping (usually during acceleration). If coil failure is suspected, it is should be replaced with an OEM coil and OEM plug caps should be replaced at the same time. During new coil installation be sure coil mount is filed cleanly for a proper ground. Coil plug in leads coming off wire harness should be thoroughly inspected; they easily crack and break without warning.

- Stator; Banshee stators especially when over 2-3 years in age can have some of the epoxy that holds the post connectors in place begin to crack, causing an intermittent short or miss in the engine.

- Stator and flywheel should also be kept free from rust and corrosion. Any rust or corrosion can cause stator to weaken or fail. If either of these conditions is suspected, stator should be inspected/repaired by a trained professional.

- **TUNING TIPS-VARIOUS WEATHER CONDITIONS**

- The engines fuel requirements are in a large part determined by the amount of air getting into the engine. More air requires more fuel, less air requires less fuel.

- Temperature; Cold weather conditions require the richest carburetor jet settings. This is because cold air condenses allowing more air into the engine than warm conditions where air expands allowing less air into the engine.

- Humidity; Conditions of high humidity cause your engine to run richer and make less power than moderate to dry conditions. The moisture in the air displacing oxygen causes this rich effect from humid conditions. Allowing less air into the engine, requiring less fuel.

- Rain: Is humidity at the next level. During rainy conditions your engine will require leaner jetting because the rain displaces the air. *Always note the ambient temperature. Sometimes cold temperatures during rain sessions can off set oxygen displacement.

- Elevation: Knowing the elevation is critical in fine-tuning an engine for maximum performance. Base line elevation should always be sea level. As engines are used at altitude above sea level for example 2000 ft, 4000 ft. etc. adjustments must be made to compensate for the loss in compression. (Atmospheric pressure decrease as altitude increases causing less air to be compressed into the cylinder)

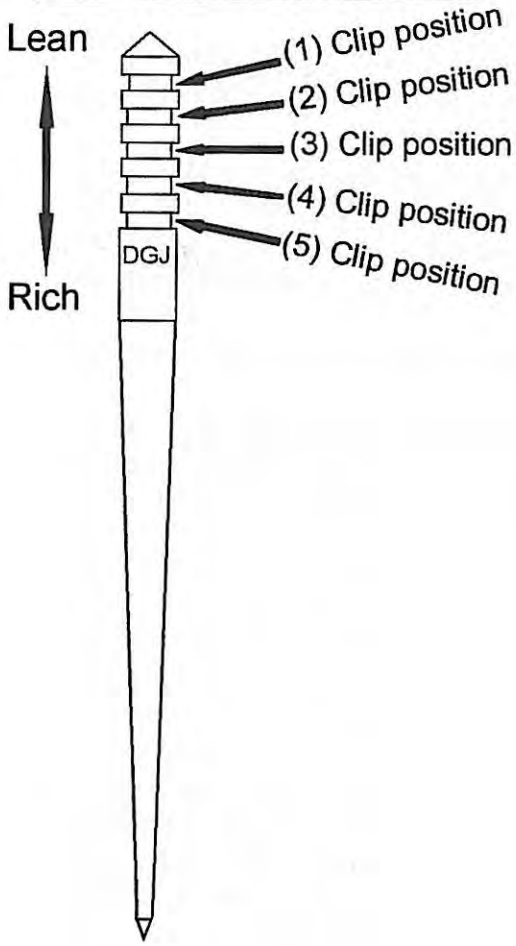
- The proper initial adjustment is to alter the cylinder head volume (consult your engine tuner for specific instructions) to try to off set the loss of air to compress.

- After this adjustment is made the engine must have the jetting checked and possibly adjusted.

- If the engine is not modified for the new altitude, then the carburetion will most definitely need to be adjusted. As a basic rule of thumb the higher the altitude, the leaner the jetting.

DR KEIHIN APPLICATION CHART

JET NEEDLE



NEEDLE JET SIZE CHART

Rich

Taper	Length	Diameter
E=2° 00'	C=36.35	F=65
D=1° 45'	E=38.15	G=66
C=1° 34'	G=39.95	H=67
B=1° 15'		J=68
A=1° 00'		K=69
		L=70
		M=71
		N=72
		P=73
		Q=74
		R=75

Lean

SLIDES

Cut Away Identification
4.0
5.0
6.0
7.0
8.0

Rich

Lean

EXAMPLE

D **G** **J** = 1468

Taper Length Diameter