YZ250(X) Jetting Instructions

Congratulations on your purchase of an Apex Technical Innovations Cylinder for your Yamaha motorcycle. The recommendations in these instructions are based on use with our billet cylinder heads, however every bike, combination of mods, and location is different and additional tuning may be required. The general tuning principles provided will apply to all two strokes. Two stroke carburetors require background mechanical knowledge and should only be attempted by experienced individuals. Please consult your owners manual for information on assembly and disassembly. We strongly recommend professional installation, and are not responsible for any injury or damages resulting from use or installation.

1) Ensuring Proper Working Condition

Before tuning your carburetor, the proper working condition of the engine and carburetor must be established. Taking some time here can help eliminate headaches later as problems with the motorcycle can make jetting changes difficult to identify. Below are listed the essential things to check, and these are good things to look for whenever troubleshooting a bike.

A) Oil ratio: Oil types and ratios can be a controversial subject so I'll keep this brief. Pick a good quality oil that is appropriate for your application. Use it at the ratio recommended by the manufacturer and stick to that ratio. Do not try to change your jetting with your oil ratio.

B) Fuel quality: Make sure your fuel is fresh and of adequate octane for the head you are using. Octane is a fuel's ability to resist detonation. You can run higher octane than required without issue, running lower octane than required WILL damage your engine. Running higher octane than required will not add power. Rich jetting can sometimes hide detonation, and lean jetting can cause detonation. Detonation should be avoided at all costs.

C) Spark Plug: Make sure you have the correct spark plug for your motorcycle

D) **Air leaks**: Air leaks are a common cause of engine failure and jetting issues as they can make the engine run lean without warning and also run lean inconsistently. Trying to jet around the leak will lead to frustration as the bike will then act intermittently rich and lean. The only concrete way to rule out air leaks is a leak down test. The engine should hold 5psi for no less than 5 mins. Do not pressurize to more than 7psi. Common locations for air leaks include, carburetor joint, reed cage, and crank seals.

E) **Top end condition**: Make sure your piston and rings are in good condition. Poor ring seal will cause excessive blow by, lack of power, excess smoking, and a false rich sensation

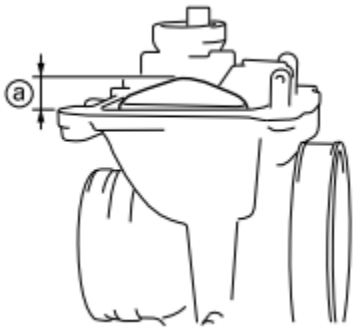
F) **Reed petal condition**: check reeds for good seal. No light should show through between the petal and the cage. Poor reed sealing will make the bike hard to start, have less low end torque, and have a false rich sensation.

G) **Jet block gasket**: these are often overlooked but can lead to running rich at low throttle openings and excess exhaust spooge that's hard to eliminate. Test by setting carb upside

down, blocking vent holes, filling with some gas and blowing compressed air in the jets. If bubbles come from around the jet block, replace the gasket

H) **Float needle**: If your float needle is worn, it may not seal against the seat properly. This will cause fuel overflow, plug fouling, and running rich

I) **Float height**: Ensure that your Float height is 6.5mm as shown in the figure to the right



2) <u>Baseline jetting</u>

There are two ways you can start jetting your carburetor with this kit. You can start with our starting recommendations in the chart on the last page of these instructions, or you can start with your current/OEM settings. For those who are looking for a deeper understanding of what each circuit does in the carb and how you can change the power characteristics with jetting, I would recommend starting with OEM settings and following the steps to find what's ideal for you. For those who are looking to get their bike quickly optimized for their riding conditions, our starting recommendations will save you time and effort.

3) <u>Rich vs lean</u>

Rich and lean refer to air to fuel ratio, or AFR. Every fuel type has an ideal AFR that it wants to burn at for ideal performance. Most two strokes perform ideally with an AFR in the 12-12.5:1 range, with lower AFRs representing more fuel and higher ones representing less fuel. Rich refers to more fuel than ideal, and lean refers to less fuel than ideal. DO NOT confuse rich and lean jetting with your oil mixture. They are related but should not be used to change each other. <u>More fuel does not equal more power!</u> Complete, efficient combustion of the correct amount of fuel to match the amount of air the engine can draw though is what gives you the most power. That said, running slightly rich is preferable to running lean, as a lean combustion can cause excess heat, piston seizure,

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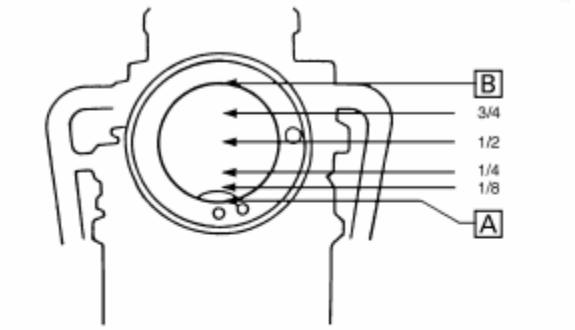
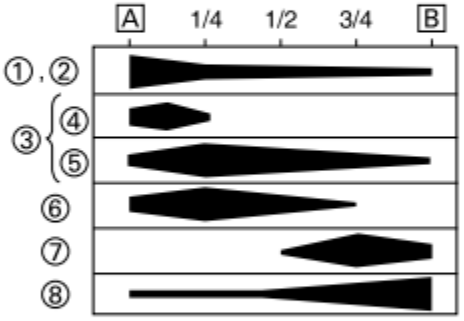
THROTTLE VALVE OPENING





A. Closed
B. Full-open

1. Pilot jet
2. Pilot air screw
3. Jet needle
4. Diameter of straight portion
5. Clip position
6. Throttle valve
7. Power jet
8. Main jet

detonation, and severe engine damage. There are two ways to determine your current AFR for each circuit: Plug readings, and by feel. I prefer jetting by feel and using plug readings as a verification, however this can take time to get proficient at. I will describe how to identify using both methods. The parts of the throttle range that each circuit affects is shown in the image above.

4) <u>Main jet</u>

After you have decided on your starting settings. The main jet will be checked/adjusted first. The main jet mainly effects from 1/2 throttle to wide open throttle (WOT) and is the jet that is a 6mm hex within the float bowl. Testing the main jet should be done at WOT, preferably under relatively high load (up a slight incline).

If jetting by feel there are a few things to look out for:

Running rich: will have more torque but be slower to rev. Holding at constant throttle may cause sputtering or loading up of the plug (rich bog). There will be excess smoke and the engine noise will be deeper but sound muffled and "wet" or like the choke is on.
Running lean: will rev faster but have less torque. Will fall noticeably flat in power in the high revs. Will run hot and may bog when opening the throttle very quickly (lean bog). Exhaust note will sound hollow and raspy.

If jetting using plug reading, you will want to do a plug chop. To do a plug chop, use the following steps:

1) Warm the bike up in a wide open area
2) Install a new spark plug
3) Start the bike and immediately go WOT through as many gears as you have room for
4) When you top out the last gear you get to, pull in the clutch and hit the kill switch.
5) When you come to a stop, remove the spark plug.
6) Cut the threads off the spark plug
7) You want to look at the ring at the base of the insulator, there should be a coffee colored ring at the base of it about 2mm thick. Too thick or black indicates too rich and you should go to the next smaller number main jet. Too thin, light tan, or no ring at all indicates too lean and you should go to the next larger number main jet.
8) Repeat until you have the correct main jet

WARNING: Expert level riders, drag racers, and dunes riders will require richer settings than those riding woods and general motocross. Please ensure you are giving your bike enough fuel as Lean combustion can cause engine damage.

5) Pilot jet/air screw

Next you will want to verify/change your pilot and air screw. The pilot and air screw work together to control AFR primarily in the 0-1/4 throttle range. The Air screw is the brass flat blade screw on the side of the carb near the intake side. The pilot jet is near the main jet within the carb bowl and is removed with a flat blade screwdriver. To determine the optimal pilot and air screw settings, use the following steps:

1) start with the air screw at 0.5 turns from all the way in, and turn in the idle screw (black plastic screw)so the bike stays running without blipping the throttle. Using a new spark plug is advised
2) Check for a lean condition by opening the throttle from fully closed to WOT and back to WOT as quickly as possible. If the engine bogs or hesitates, your pilot jet is too lean. Go to the next larger number of pilot jet and go back to step 1.
3) Slowly turn out the air screw, 0.25 turns at a time. Be sure to keep track of how many turns from all the way in you are.
4) Stop turning the air screw out once the idle starts to rise. If you get to 2.5 turns from all the way in and the idle does not rise, your pilot jet is too rich. Go to the next smaller number pilot jet and go back to step 1.
5) Once you have found the air screw setting and pilot jet where the idle starts to rise, turn the air screw in 0.25 turns. This should be your ideal setting.
6) Verify that you are not too lean. Check for a lean condition by opening the throttle from fully closed to WOT and back to WOT as quickly as possible. If the engine bogs or hesitates, your air screw is too lean. Turn the air screw in a quarter turn and repeat until the bog goes away. Ideally you will not have to change the air screw after step 5, but it is smart to double check. If you are having difficulty during this step check for air leaks

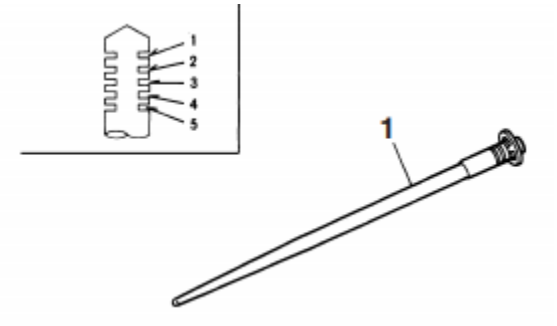
Note: Throttle response can be changed using air screw settings based on rider preference. Slightly richer settings can be used to smooth out throttle response, and slightly leaner settings can be used to help keep the engine from “loading up” on long descents. Going 0.125 turns in either direction can achieve these results. Rider preference is key here to having an enjoyable bike. As long as the bike does not run hot, bog, hang idle, or foul plugs, some variation is allowable.

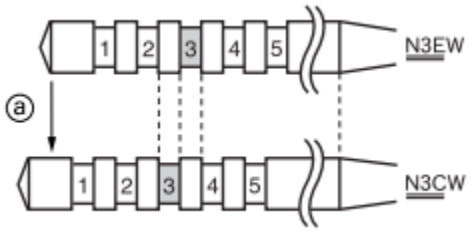
6) <u>Needle and clip position</u>

Next you will want to verify/change your needle and clip position. The needle and clip position work together to control AFR primarily in the 1/4-3/4 throttle range. The needle protrudes from the throttle slide. For instructions on how to remove the throttle slide and needle, please consult your owners manual. Needle selection can be subjective and a matter of rider preference.

The four most commonly used Yamaha OEM needles are dual taper needles (N3EW, N3EJ, N3CW and N3CJ). The standard needles that come with a yz250 are N3EW from 2007-current, N3EJ from 2001-2006, and N3CW in 2000. There are two variables you can change with dual taper needles: Clip position, and starting diameter.

Clip Position: The clip position of the needle affects the AFR primarily between 1/4 throttle and 3/4 throttle. Clip positions are numbered from the top down. The difference between N3C# and N3E# series needles is the starting clip position, with N3C# being a half clip leaner than N3E#, as shown in the figure below. You can also buy shims that are the equivalent of half a clip, so for example if you found clip position 3 with a shim (equivalent of clip 3.5) on the N3CW needle to be ideal, you could also use the stock (for 2007+) N3EW in clip position 3 without the shim with the same result.





Starting Diameter: The starting diameter of the needle affects the AFR primarily between 1/4 throttle and 1/3 throttle. The last letter of the needle name (ex: N3C<u>W</u>) indicates the starting diameter of the needle. Needles ending in W have a smaller starting diameter and are therefore richer than needles ending in J.

Determining Clip Position: We recommend starting with a needle with the W starting diameter. OEM position would be 2.5 (2nd clip with a shim), and our recommended starting positions are in the chart. I recommend putting a zip tie around your throttle tube and marking where 0, 1/4, 1/2, 3/4, and WOT are so you can be consistent with your throttle inputs. You will want a good amount of space for this. Start off riding at half throttle in 3rd gear constant throttle for 20-30 seconds. Steadily roll the throttle open from 1/2 to 3/4. Repeat this several times. Repeat this

while going from 1/4 to 1/2 and from 1/4 to 3/4. Do this several times each, varying the speed that you roll the throttle open.

The bike should pick up cleanly. If it sputters or loads up from riding at constant throttle, you are rich. When accelerating, rich symptoms include: the bike intermittently cutting in and out, smoking excessively, exhaust note may sound “wet” or feel like the choke is on. The solution is to go to a half clip leaner clip position and repeat.

If the bike bogs and the bog gets worse the faster you open the throttle, it is too lean. Other lean symptoms include: If the bike feels like it revs up quickly in neutral but lacks torque under load, runs hot, detonates, or sounds hollow and raspy. The solution is to go to a half clip richer clip position and repeat

Tip: Generally too lean will not like the throttle being opened quickly and too rich will not like the throttle opened slowly or held constant.

Note: as with the pilot, there is some degree of rider preference. Being slightly rich will run well under high load, but not like constant throttle (motocross, sand, etc). Slightly lean will run well at constant throttle, but not high load (flowy woods, play riding, beginners). Ensure your bike is not running hot, detonating, or fouling plugs.

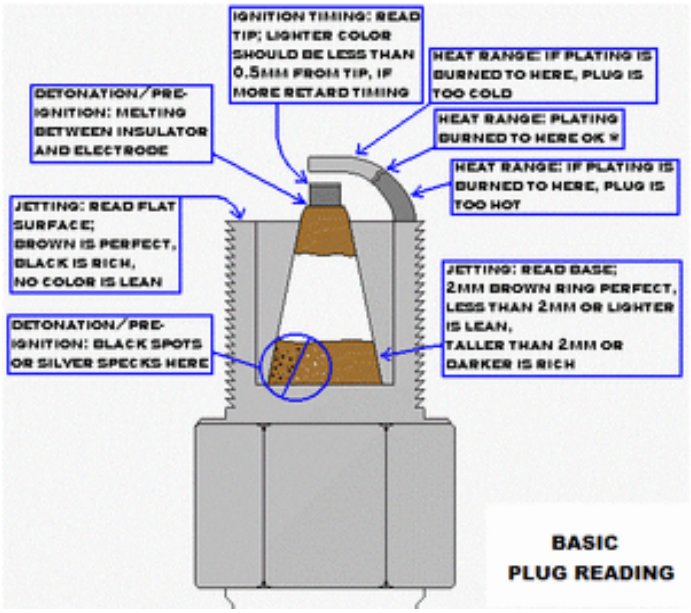
Determining Starting Diameter: For most riders, the “W” needles are ideal. However, “J” needles offer a smoother, cleaner transition from the pilot to the needle, similar to the changing to a Suzuki triple taper needle. If you find that your bike is slightly rich right around 1/4 throttle and you can't get rid of it without making it too lean over 1/4 throttle, try switching to the equivalent “J” needle. If you ride woods and feel like your bike is jetted perfect but has a little too much oil on the exhaust, try switching to the equivalent “J” needle. Lastly, if you feel like the throttle response is a little abrupt around 1/4 throttle, try switching to the equivalent “J” needle. If using a “J” needle, be sure that you’re not too lean under load and detonating.

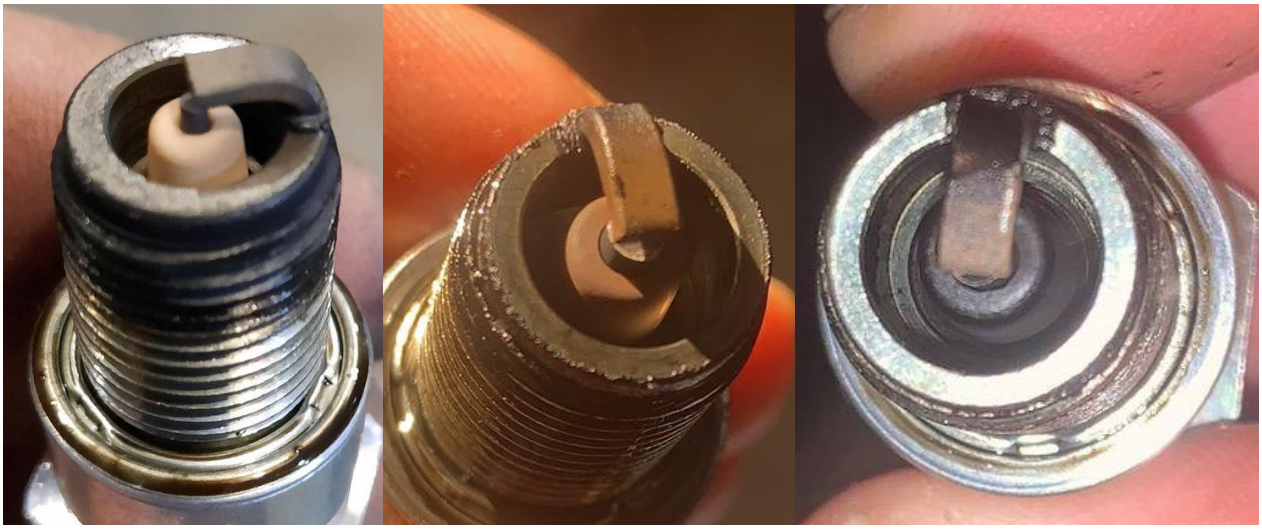
7) Power jet

The power jet is an additional circuit that the YZs CDI controls with a solenoid so that it can be richer under high load under 8500 rpm while leaning out to increase over rev past 8500rpm. This circuit affects 1/2 throttle to WOT under 8500 rpm. We have found that for most riders the standard #50 power jet yields the best results for most conditions.

Final verification

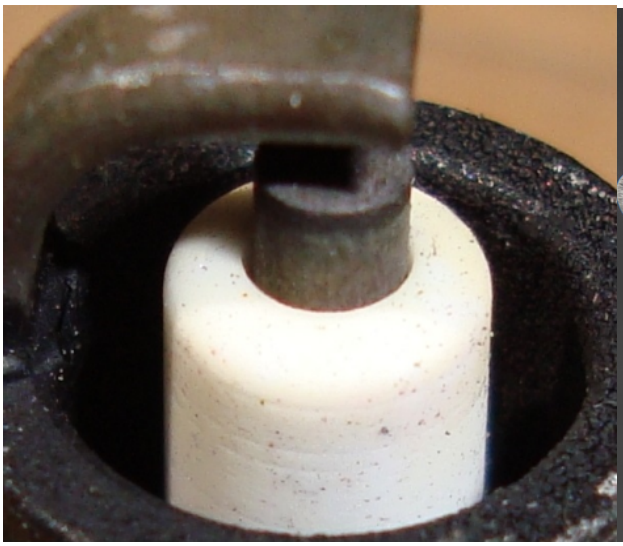
After all the steps above have been completed, your bike should be jetted correctly and ideally. At this point I would advise doing a day of riding under the conditions you normally ride at. Pay attention to how the bike feels to ride and if any parts of the throttle or rpm range feel rich or lean. Especially pay attention to the bike running hot, detonating, or making any unusual sounds. After putting at least two hours on the bike with these jetting settings, remove the plug and look closely at it. Note that the plug may not fully color in until 5 hours of run time or so. Use the below figures to compare your plug to. Coloring should be a coffee colored brown. Light tan or white and you are too lean, black and you are too rich. Some leaded fuels will make the plug appear more grey than brown. This is normal, just make sure that the shade of grey is dark enough. Make any adjustments if necessary, and start with a new plug before re-verifying.





Too Lean **Ideal** **Too Rich**

Notes on detonation



Detonation is the spontaneous combustion of fuel outside of the flame front initiated by the spark plug. Normal combustion occurs subsonically, whereas detonation occurs supersonically, causing sharp pressure rises and heat that will damage pistons, cylinders, cylinder heads, and crank bearings. Detonation also breeds more detonation and should be avoided at all costs. Early signs of detonation damage are pitting on the piston crown and the perimeter of the cylinder and cylinder head. Slight pitting of the spark plug as shown in the image below is also an early sign of detonation. Detonation can also be felt and heard while riding if it is severe and the engine should be stopped immediately if you experience any of these symptoms.

There are several causes of detonation. The first three causes are linked.

1) Ignition advance: Igniting the fuel/air mixture too early will cause excess pressure that can cause detonation. Most yz's come slightly advanced from where they are supposed to be from the factory. If you are struggling with persistent detonation, I would start by checking your timing using this info: https://thumpertalk.com/forums/topic/584339-yz250-timing-thread/
2) Fuel octane: octane is a fuel resistance to detonation. If a fuel's octane is too low for a given cylinder head and ignition advance curve, detonation will occur. Raising the octane will solve this.
3) Cylinder head: A lot goes into cylinder head design other than compression, but too high compression, inefficient cylinder head design, hot spots, or too aggressive of a head setup for a given fuel can cause detonation.
4) Insufficient cooling: heat build up can cause detonation. Ensure that your water pump and radiators are in good condition and working properly

5) Lean jetting: lean combustion creates excess heat that leads to detonation. Detonation from lean combustion typically occurs on the exhaust side of the piston and causes more damage and faster engine failure than octane induced detonation. Ensure that you are giving your bike sufficient fuel
6) Air leaks: air leaks also cause lean combustion and can be difficult to identify. They can also allow dust into your engine and cause premature wear. If your jetting is inconsistently lean, do a leak down test to rule out air leaks.
7) Too hot of a spark plug: make sure you are using the recommended heat range for your bike (std plug for a YZ250 is BR8EG)

APEX YZ250(X) Jetting Recommendation Chart									
	< 30°F, Dunes, Pro Riders			40°F - 90°F			> 90°F		
Altitude	Main	Needle-Clip	Pilot	Main	Needle-Clip	Pilot	Main	Needle-Clip	Pilot
0	182	N3EW-2	48	175	N3CW-2	48	175	N3CW-2	45
1000	180	N3EW-2	48	175	N3CW-2	45	172	N3CW-2	45
2000	180	N3EW-2	45	172	N3CW-2	45	170	N3CW-2	45
3000	178	N3EW-2	45	170	N3CW-2	45	168	N3EW-1	42
4000	175	N3CW-2	45	170	N3EW-1	42	168	N3EW-1	42
5000	175	N3CW-2	45	168	N3EW-1	42	165	N3EW-1	42
6000	172	N3CW-2	45	165	N3EW-1	42	162	N3CW-1	42
7000	172	N3CW-2	45	165	N3EW-1	42	162	N3CW-1	42
8000	172	N3CW-2	45	162	N3CW-1	42	160	N3CW-1	40
9000	170	N3CW-2	45	162	N3CW-1	42	160	N3CW-1	40
10000	168	N3EW-1	42	162	N3CW-1	42	160	N3CW-1	40

Note: This sheet should serve only as a reference, every bike and rider is different and additional tuning may be required

These recommendations are only to be used with Apex cylinder heads installed, not for use with oem or other cylinder heads

All jetting recommendations are based on a #50 power jet, we recommend using the #50 power jet with our heads

Jet your bike according to the lowest altitude you plan on riding. You can expect the bike to run well up to 6000ft higher than your base jetting

Different modifications interact differently and should be accounted for on a case by case basis (ex: Rad valve usually requires a leaner main jet)

Different Fuel types can effect jetting (ex: oxygenated race fuels require richer jetting)

Please verify jetting with a plug chop and bog test before extended use

Apex is not responsible for any damage/injury from use of our products or reference materials