Zeda Technology Co. Technical Comparison

This is a technical brief containing a comparison of the differences between the “Zeda80” 2-Stroke Engine and the commonly available 2-Stroke Engines known as the “PK80” and the “GT5”.

This brief will begin with a detailed description of each 2-Stroke Engine, with specific attention to details that differ between the compared Engines. It will then explain why the specific configuration of the “Zeda80” was chosen.

In addition, there is a modification made to the “Zeda80” 2-Stroke Engine that is not found in any other “Chinese 2-Stroke Engine”; “PK80”, “GT5” or any other (as of this writing). This modification significantly improves the stiffness of the rotating assembling; improving performance, and reliability. Pictures and description of this modification will be included in this brief.

The “PK80” :

- Engine Displacement : 69.398cc (40mm Stroke)
- Cylinder Bore Diameter : 47mm
- Crank Stroke : 40mm
- Rod Length : 85mm (Short Rod)
- Piston Type : A (Low Wrist Pin Location)
- Intake Port Bolt Hole Width : 38mm (Narrow Intake Port)
- Exhaust Port Shape : Rectangular
- Engine Mount Studs : 6mm x 1.00

All “PK80” Engines will have a -Short- 85mm Rod.

If a -Short- 85mm Rod is used, then a “Type A” (Low Wrist Pin) Piston MUST be used with it.

All ‘true’ “PK80” Engines will come with a -Long- 40mm Stroke Crank. Any “PK80” that differs from these measurement’s is a mislabeled Engine, and is not actually a “PK80”.

“PK80” Cylinders most commonly come with a Narrow (38mm) Intake Port, and a Rectangle Shaped Exhaust Port.

“PK80” Cases most commonly come with 6mm x 1.00 Engine Mount Studs.

The “GT5” :

- Engine Displacement : 65.928cc (38mm Stroke)
- Cylinder Bore Diameter : 47mm
- Crank Stroke : 38mm
- Rod Length : 89mm (Long Rod)
- Piston Type : B (High Wrist Pin Location)
- Intake Port Bolt Hole Width : 40mm (Wide Intake Port)
- Exhaust Port Shape : Circular
- Engine Mount Studs : 6mm x 1.00

All “GT5” Engines will have a -Long- 89mm Rod.

If a -Long- 89mm Rod is used, then a “Type B” (High Wrist Pin) Piston MUST be used with it.

All ‘true’ “GT5” Engines will come with a -Short- 38mm Stroke Crank. Any “GT5” that differs from these measurement’s is a mislabeled Engine, and is not actually a “GT5”.

“GT5” Cylinders most commonly come with a Wide (40mm) Intake Port, and a Circle Shaped Exhaust Port.

“GT5” Cases most commonly come with 6mm x 1.00 Engine Mount Studs.

The “Zeda80” :

- Engine Displacement : 69.398cc (40mm Stroke)
- Cylinder Bore Diameter : 47mm
- Crank Stroke : 40mm
- Rod Length : 89mm (Long Rod)
- Piston Type : B (High Wrist Pin Location)
- Intake Port Bolt Hole Width : 40mm (Wide Intake Port)
- Exhaust Port Shape : Circular
- Engine Mount Studs : 8mm x 1.25

All “Zeda80” Engines will have a -Long- 89mm Rod.

If a -Long- 89mm Rod is used, then a “Type B” (High Wrist Pin) Piston MUST be used with it.

All “Zeda80” Engines will have a -Long- 40mm Stroke Crank.

All “Zeda80” Cylinders will come with a Wide (40mm) Intake Port, and a Circle Shaped Exhaust Port.

All “Zeda80” Cases will come with 8mm x 1.25 Engine Mount Studs.

The “Zeda80” is different from the “PK80” and the “GT5” because it uses a -Long- 89mm Rod, with a -Long- 40mm Stroke Crank.

Crank Stroke

There are two different Stroke Lengths that can be chosen from currently. These two Lengths are 38mm, and 40mm. So, this begs the question: Which one should be chosen?

There are two MAIN factors to consider when making a design decision for an engine:

-Power Density (Power Divided by Mass)

-Efficiency (Fuel Economy and to a lesser extent Reliability)

As it relates to “Power Density”, the decision is simple. The longer stroke crank (40mm) will result in higher engine displacement. In our case, the extra 2mm of Crank Stroke (vs. 38mm) results in an extra 3.47cc of displacement (65.928cc to 69.398cc). All else being equal, the higher displacement engine will always have higher “Power Density” than the lower displacement engine.

There is also a smaller factor to be considered here and it relates to Port Geometry. The Intake and Exhaust Ports in a 2-Stroke Engine are arranged along the wall of the Cylinder Bore. As the Stroke (swept area of the piston) becomes larger, there is more physical room for ‘taller’ Ports that will yield higher Port-Flow-Area.

For these reasons, the 40mm Stroke Crank will have higher “Power Density” than the 38mm Stroke Crank.

As it relates to “Efficiency” the decision is just as simple, but will require more explanation. The basic concept involved, when evaluating the stroke lengths effect on engine “Efficiency” is the “Bore-to-Stroke ratio”.

An Engine with a Cylinder Bore that is larger than its Cranks Stroke is said to be “Over-Square”.

An Engine with a Cylinder Bore that is smaller than its Cranks Stroke is said to be “Under-Square”

An Engine with a Cylinder Bore that is the same size as its Cranks Stroke is said to be “Square”

Highly “Efficient”, low-RPM Diesel Marine Engine have VERY LONG strokes, with ‘relatively’ small Cylinder Bores, they are highly “Under-Square” and sacrifice “Power Density” in order to achieve peak “Efficiency”.

Highly “Power Dense”, incredibly high-RPM 4-Stroke Formula 1 Engines have VERY SHORT strokes, with ‘relatively’ large Cylinder Bores, they are highly “Over-Square” and sacrifice “Efficiency” in order to achieve peak “Power Density”.

Incredibly “Power Dense”, insanely high-RPM 500cc 2-Stroke MotoGP Engines were VERY often built with “Square” Geometry, Stroke exactly the same as Cylinder Bore. Because of some interesting quirks of the 2-Stroke Engine, peak “Power Density” was achieved in these Engines with “Square” Geometry. Interestingly, in terms of pure “Power Density”, the “Square” 500cc 2-Stroke MotoGP Engines of the 1980’s and early 1990’s surpass the “Over-Square” 4-Stroke MotoGP Engines that are raced today.

These examples are meant to demonstrate an accepted trend that applies to the Geometry of any Engine Design. Generally speaking, “Over-square” engines sacrifice “Efficiency” in order to achieve higher “Power Density”, and “Under-Square” engines do the opposite, sacrificing “Power Density” in order to achieve higher “Efficiency”. The reason for this trend, again generally, results from two competing dynamics:

As the Engines Cylinder Bore becomes larger, cylinder scavenging and thus cylinder filling is improved, and this allows the Engine to achieve higher RPM’s.

As the Engines Crank Stroke becomes larger, the Piston can more efficiently transfer Combustion Energy into Crank Rotation (Torque) instead of waste, in the form of Heat absorbed into the Cylinder Bore, and Piston Crown.

Again, we have two options in front of us currently; 38mm Stroke, and 40mm Stroke. All of the 2-Stroke Engines we are discussing in this Brief have the same Cylinder Bore Diameter; 47mm. Thus, We have two "Bore-to-Stroke Ratio" options. With a Cylinder Bore that is larger than the Crank Stroke, all of these options are going to be "Over-Square";

47mm (Bore) ÷ 40mm (Stroke) = 1.175:1 "Bore-to-Stroke Ratio"

47mm (Bore) ÷ 38mm (Stroke) = 1.236:1 "Bore-to-Stroke Ratio"

As it can be seen, the longer Stroke Crank (40mm) also results in a smaller "Bore-to-Stroke Ratio"; moving closer to "Square" Geometry. The longer Stroke will result in more efficient transfer of Combustion Energy into Crank Rotation (Torque) and a cooler running, more reliable Engine, as less Heat is transferred into the Engine Components.

In conclusion, it can be shown that selecting the 40mm Stroke Crank will not only result in improved "Power Density" (as compared to the 38mm Stroke Crank) but will also result in improved "Efficiency" and a more reliable Engine, as well.

All 'true' "GT5" Engines will come with a 38mm Stroke Crank and all 'true' "PK80" Engines will come with a 40mm Stroke Crank. Any "GT5", or "PK80" that differs from these measurement's is a mislabeled Engine, and is not actually a "GT5", or "PK80", respectively.

All "Zeda80" Engines are sold with the more powerful, efficient, and reliable 40mm Stroke Crank.

Rod Length

There are two different Rod Lengths that can be chosen from currently. These two Lengths are 85mm, and 89mm (Eye-to-Eye). So, again, this begs the question: Which one should be chosen?

There is a very interesting example that is highly relevant to this question. The Minarelli AM6 2-Stroke Engine is an incredibly popular power-plant for OEM Manufacturers. It comes in literally 100's of 50cc Scooters, as well as KTM Motocross Bikes. The AM6 comes from Minarelli with a 47mm Cylinder Bore, a 39mm Crank Stroke, and an 80mm Rod (sound familiar?). If one does a quick search for "High Performance" aftermarket Cranks for the Minarelli AM6, you will quickly find many of the best reviewed Cranks are sold with 85mm Rods. It is so popular, in fact, that a 5mm adapter plate is offered by many aftermarket manufacturers and at least one aftermarket Piston manufacturer (Malossi) offers Minarelli AM6 pistons with a new Wrist Pin Location to account for the aftermarket 85mm Rod.

But the question still stands; why is the Longer Rod better?

Again, I will evaluate the reasons in relation to "Power Density" and "Efficiency".

Starting with “Power Density”; the factor I am going to focus on is “Dwell Time”. In this case, “Dwell Time” refers to the amount of time (in millionths of a second) the Piston stays at a given Crank Angle Position, as the Crank is rotating. I am going to be focusing on “Dwell Time” at Top Dead Center (TDC), and “Dwell Time” at Bottom Dead Center (BDC).

Starting from the top, let’s take a look at how Piston “Dwell Time” at TDC can affect “Power Density”. By increasing Piston “Dwell Time” at TDC, there is more time for the freshly ignited Spark Kernel (the “Spark Kernel” is the first phase of combustion, and is the result of the spark beginning ignition) to physically expand across the dome of the Piston. This allows the expanding Spark Kernel to consume the intake charge more completely, improving combustion efficiency. The improved combustion efficiency is SO significant, that increasing Piston “Dwell Time” at TDC can have an effect similar to increasing total Engine Displacement.

Based on this effect alone, the Longer 89mm Rod should result in higher “Power Density” than the 85mm Rod. But, there is also an effect at BDC.

So, how does Piston “Dwell Time” affect “Power Density” at BDC? In a word; Scavenging. So, what is Scavenging? Scavenging (in our case) refers to the process inside of the Cylinder of replacing burnt Exhaust gases from the last Stroke, with fresh Intake gases for the next Stroke. This is a subject that could encompass an entire book unto itself, so I will hesitate to examine the entirety here; but, it can be said (again generally) that the MAJORITY of gas exchange (exhaust for intake) that happens in a 2-Stroke Engine, happens while the Piston passes around Bottom Dead Center. By increasing the Piston “Dwell Time” at BDC, Scavenging efficiency is improved SIGNIFICANTLY. By increasing Scavenging efficiency, Exhaust gasses are more completely replaced with Intake gases, resulting in less dilution of the new Intake Charge with old Exhaust gases, which -finally- results in increased “Power Density”.

Based on the increase in Piston “Dwell Time”, it can be said definitively that the longer 89mm Rod will result in higher “Power Density” than the shorter 85mm Rod.

But, how does this decision effect “Efficiency”?

When evaluating the Rod Lengths effect on “Efficiency” there is one main consideration; Rod Angularity. In any Engine, the Connecting Rod will be at its greatest Angle in relation to vertical at 90 degrees in-between Top Dead and Bottom Dead Center. The greater this angle, the greater the “Thrust Forces” in between the Piston and the Cylinder Wall. This results in higher friction losses (reduced “Efficiency”) and higher wear (reduced reliability).

For this reason, less “Rod Angularity” (a smaller Rod Angle at 90 degrees in between TDC and BDC) will result in higher Engine “Efficiency” and reliability.

Let’s examine our options:

85mm Rod x 40mm Stroke – Rod Angle = 13.60°

89mm Rod x 40mm Stroke – Rod Angle = 12.98°

The smaller Rod Angle of the 89mm Rod will result in a more "Efficient” and reliable Engine than the 85mm Rod.

Another smaller factor to consider is "Piston Rock"; the tendency of the Piston to 'rock' back and forth in the Cylinder Bore. With a longer Rod, the Piston will be higher in the Cylinder Bore at Bottom Dead Center, and will thus have less tendency to 'rock'. The reduced "Piston Rock" of the 89mm Rod will also result in a more "Efficient" and reliable Engine than the 85mm Rod.

In conclusion, it can be shown that selecting the 89mm Rod will not only result in improved "Power Density" (as compared to the 85mm Rod) but will also result in improved "Efficiency" and a more reliable Engine, as well.

All "Zeda80" Engines are sold with the more powerful, efficient, and reliable 89mm Rod.

Cylinder

All of the Cylinders referenced in this Brief have the same Bore Diameter. So, the main point of comparison will be Port Configuration. The actual Port Timing found in the Cylinders available on the market is too varied to do an accurate comparison here, so I will stick to what is similar among the "GT5" and the "PK80" variants.

There are two Intake Port Bolt Hole Widths to choose from; 38mm wide, and 40mm wide. When considering "Power Density" the very obvious choice would be the wider (40mm wide) Intake Port. This decision is based on the greater intake port volume that can be achieved with the wider Bolt Hole spacing. Greater Intake Port Volume will result in improved cylinder filling, and thus improved "Power Density".

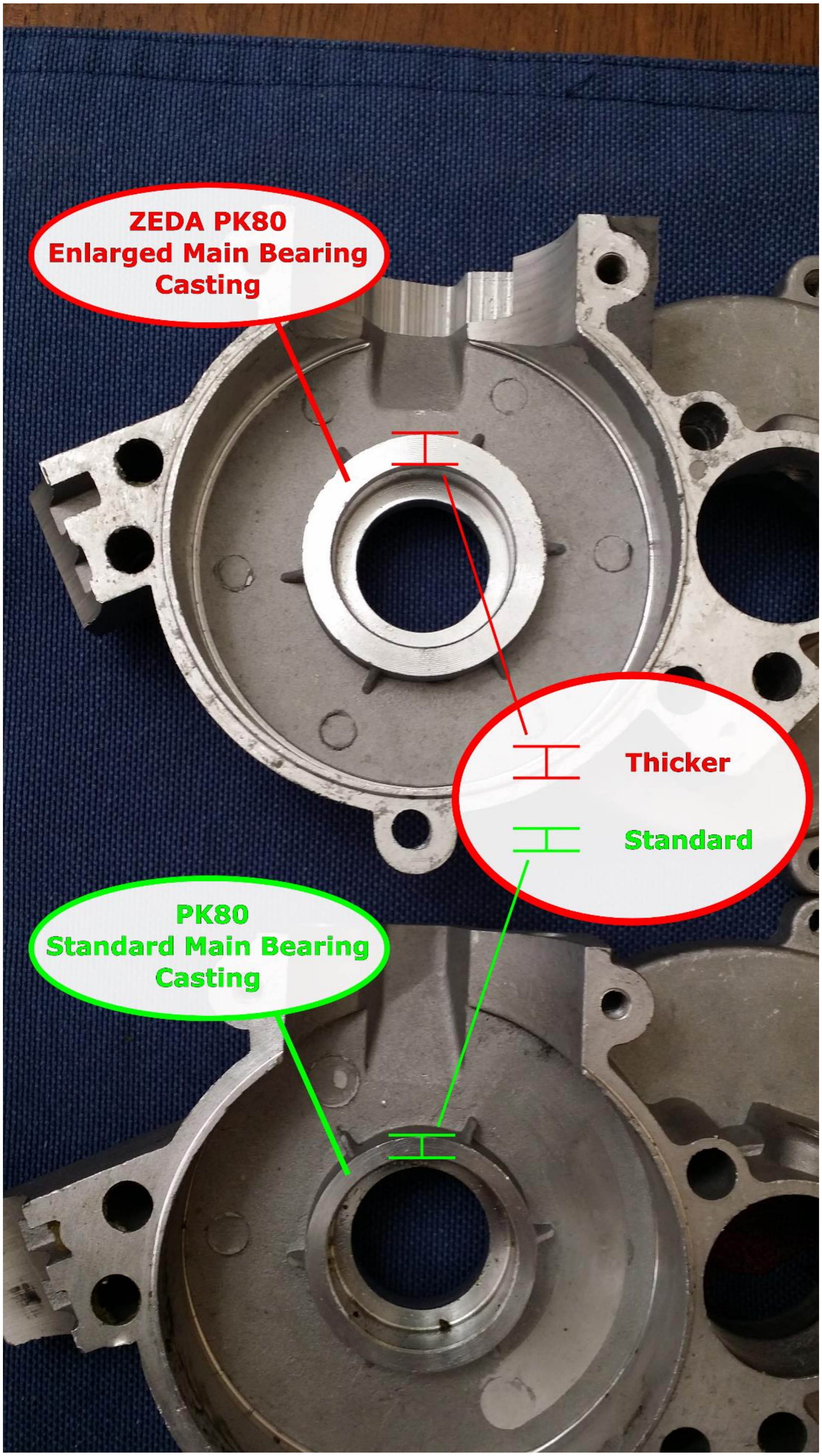
There are also two Exhaust Port Shapes to choose from; Rectangular, and Circular. Again, the obvious choice would be the Circular Exhaust Port Shape. The Circular Shape is inherently more efficient for the flow of gasses. More efficient gas flow will result in higher "Power Density".

For these reasons, it can be said Wide Intake Port Cylinders with Circular Exhaust Ports will have higher "Power Density" than Narrow Intake Port Cylinders with Rectangular Exhaust Ports.

All "Zeda80" Engines are sold with the more powerful Wide Intake Port, Rectangular Exhaust Port Cylinders.

Improved Case Casting – Main Bearings

I will start with a Picture, then an Explanation:



ZEDA PK80
Enlarged Main Bearing
Casting
Thicker
Standard
PK80
Standard Main Bearing
Casting

As you can clearly see, the Main Bearing Area of the Case Casting has been significantly enlarged.

Specifically:

- “PK80” / “GT5” Case: 0.160" Thick

- “Zeda80” Case: 0.255" Thick

- “Zeda80” Case = 60% Thicker

The “Zeda80” Cases are a whopping 60% thicker around the Main Bearing. This will result in a MUCH stiffer rotating assembly; improving performance, reducing engine vibration, and significantly improving reliability.

Zeda Technology Co. is the ONLY manufacturer -as of this writing- who is producing these improved cases. This shows the extreme dedication Zeda Technology Co. has to providing customers with the highest quality 2-Stroke Engine possible.

Finally, I hope this helps you, as the customer, come to a more informed buying decision. Apollo Moto Racing and Zeda Technology Co. is dedicated to providing you, the customer, with the most value for your money.

Thank you for reading!

Sean Davis

Owner – Apollo Motobecane, LLC

Director – AMR Zeda Racing