Back to the Basics

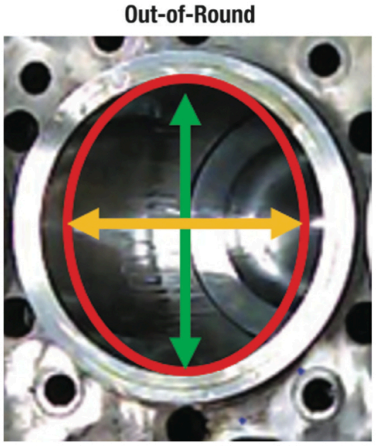
Seven commonly used engine terms

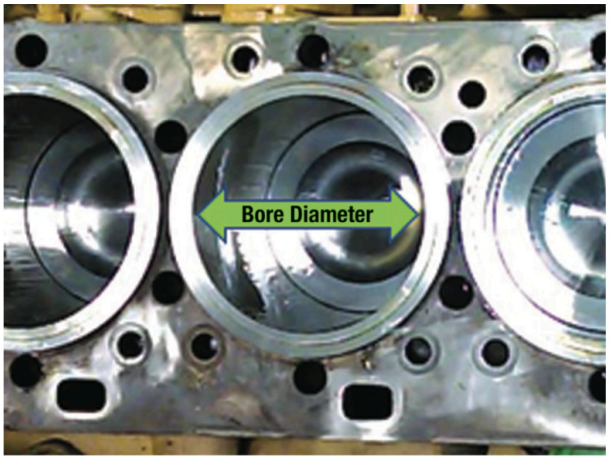
BY **STEVE SCOTT**

It is almost a sure bet that the first two terms that comes to mind when talking about engines are Horsepower and Torque. From garden equipment to garage door openers and even vacuum cleaners, Horsepower is proudly promoted, and Torque is often a close second. Some of the terms used to describe an engine are self-explanatory, but others can get lost in the technical engineering lingo to the point that the value or practical meaning of the term is not very clear. Here are the top seven:

Bore

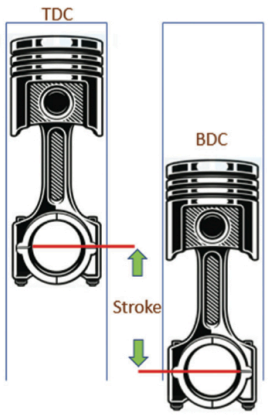
Bore is simply the diameter of the cylinder. Measuring the bore considers three factors: taper, out-of-round and oversize. Boring subject – let's move on before you lose interest.

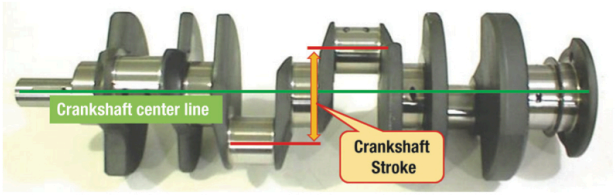




Stroke (per cylinder)

The crankshaft determines the Cylinder Stroke of the engine. Stroke is the distance the piston travels from top dead center (TDC) to bottom dead center (BDT) as the crankshaft rotates. Long stroke engines are typically lower RPM and higher torque than short stroke engine. Short stroke engines can run at higher RPM and are faster. Long stroke engines produce more power.

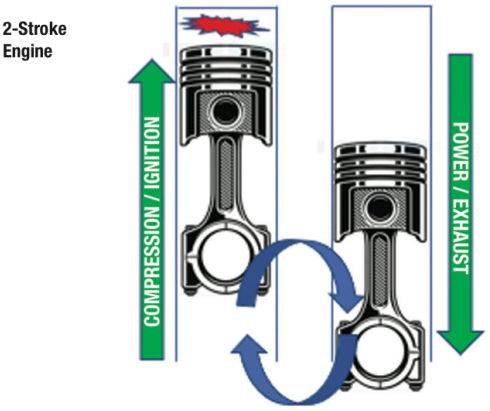




Stroke Design (2-Stroke vs. 4-Stroke)

This refers to the sequences or strokes that occur throughout a single combustion cycle. Each full rotation of the crankshaft moves the piston two strokes (one up and one down). The industrial engines you will most likely encounter today are called 4-Stroke engines.

In a 2-Stroke engine, one revolution of the crankshaft completes the combustion process. By design, the compression/ignition happens on the upstroke and the power/exhaust happens on the downstroke. Each time the piston comes up the cylinder combusts (fires). These engines are less fuel efficient than 4-stroke engines.



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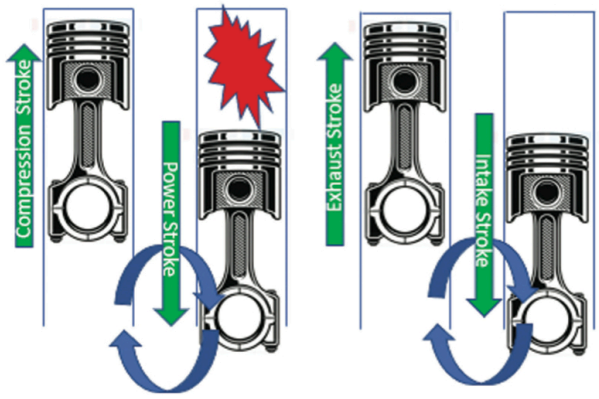
4-Stroke engines require two full revolutions of the crankshaft to complete one combustion cycle. The piston must travel up once for the compression stroke, down once for the power stroke, up again for the exhaust stroke and down once more on an intake stroke. This completes one full combustion cycle. 4-Stroke engines produce higher levels of torque at lower RPM than 2-Stroke engines.

4-Stroke Engine



Displacement

This term is commonly thought of as an indicator of power and fuel economy, higher displacement engines equal more power, but are thirsty on fuel. This is not necessarily true as there are many other factors involved. Displacement is usually stated in Liters (L) or Cubic Inches (CI). Displacement in common reciprocating piston engines is the cylinder volume times the number of cylinders. To be more precise it is found by multiplying three variables: Stroke, Bore Area and the Number of Cylinders. There are several displacement calculators available on the internet, but if you are into mathematics, the formula for displacement is:

$$\frac{\pi}{4} \times \text{bore}^2 \times \text{stroke} \times \text{number of cylinders} = \text{displacement}$$

Compression Ratio

This is where things can start to get blurry. Static Compression Ratio is commonly known as Compression Ratio (CR). It is the difference in the Cylinder Volume when the piston is at bottom dead center (BDC) versus that of the volume when the piston is at top dead center (TDC). In other words, the actual dimensional size of the Cylinder Volume at TDC and BDC. Dynamic Compression Ratio considers the closing point of the intake valves. At the closing point of the intake valves the piston is no longer at BDT so the Cylinder Volume has changed. Adding a turbocharger or blower increases the cylinder pressure, but does not change the CR.

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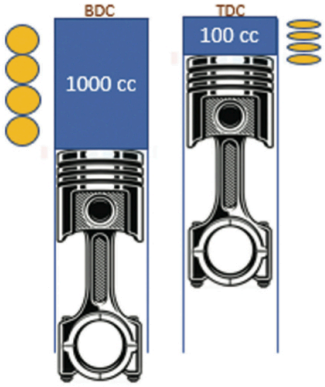
The example below is a 10:1 compression ratio. 1000/100, which is 10:1.



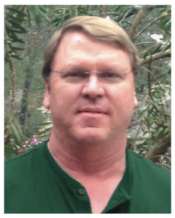
Horsepower

Okay, now we are getting into a more interesting topic. Horsepower is a term coined by James Watts in the late 1770s. Mr. Watt is credited with improving the performance of steam engines but faced a challenge in how to sell steam engines into industries literally driven by horses. He needed a method to measure horse against machine. The 200+ year old stories differ on how Mr. Watt arrived at his formula. One account shows a horse pulling a 33-pound bucket of water up from the bottom of a 1000 foot well in a minute. Another shows raising 330 pounds of coal 100 feet in one minute. Weight and distance can change as long as they equal 33,000 pounds in one minute. This gave Mr. Watt his sales pitch and the term has stuck with us ever since. Horsepower is the rate at which work is done: speed. Speed gets you down the road, Torque takes you over the mountain.

Torque

Horsepower and Torque are soulmates. Speed gets you down the track, but Torque is what slams you back in the seat when you dump the clutch. Torque is the turning force applied to do the work. In a good stereo system, you might consider Horsepower as the volume and Torque as the bass. Torque packs the punch. Torque is the product of the power stroke of the piston.

That is my list of the seven wonders in engine terms: Bore, Stroke, Stroke Design, Displacement, Compression Ratio, Horsepower and Torque. Each could be a topic of its own. Of the seven wonders, Compression, Horsepower and Torque are the trinity, but Horsepower and Torque are the dynamic duo of the group. The best combination of these all depends on the purpose of the engine. For a Semi truck pulling 40,000 pounds of freight, Horsepower and Torque are key. For a daily driver, economy may be the goal, but the rumbling sound of an old big block still has that WOW factor and makes smiles per gallon so much fun.■



Steve Scott joined the service department at IPD in 1982, working with parts, service and sales for a variety of equipment, diesel, and natural gas engines. Since 2004, he has been the director of product development and technical support for IPD. For more information, email sscott@ipdparts.com.