



SIDEWINDER COURSE PREREQUISITE MANUAL

The S&S engine class is designed for the seasoned tech or shop owner. A certain level of knowledge and understanding is required for your success. We will be covering basic four stroke theory as well as component identification. For many, this is going to be a review and refresher. However it is necessary to help insure that all students are on a more even level.

Part Identification

CYLINDER HEAD

- “ The cylinder head sits on top of the cylinders and seals the combustion chamber. It holds the valves and rocker assemblies, has the ports for the intake and exhaust to enter and exit the cylinder.
- “ Cylinder Heads come in different shapes and sizes depending on the application. Several finishes are available as well.



- “ Combustion chambers change drastically with application.





Valves

- “ Valves are in the cylinder head and open and close allowing the air/fuel charge to enter the cylinder and to let the spent exhaust gasses out of the cylinder and into the exhaust system.



Valve springs

- “ Valve springs provide preload to hold the valve stems to the rocker arms so that they close quickly and completely with the contour of the cam lobe.



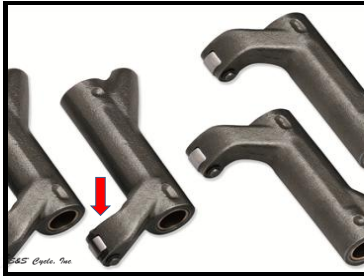
- “ It is sometimes necessary to use stronger or longer springs depending on the other changes or upgrades made to a motor.

Rocker Arms

- “ The rocker arms are located on the top of the head. They transfer the movement of the pushrods to the valves.
- “ Rocker arm ratio- The difference in lift caused by the lever of the rocker arms. For example a 1.5:1 rocker arm will lift the valve 1.5 times the lift of the pushrod.
 - “ Kn- 1:1
 - “ P- 1.5:1
 - “ HD Shovel- 1.425:1
 - “ SH- 1.5:1
 - “ Evo and TC 1.625:1
- “ Standard Rocker arms act directly on the end of the valve stem.



- “ Roller Rockers have small rollers on the end that act on the end of the valve stem. The rollers help to eliminate shear forces.

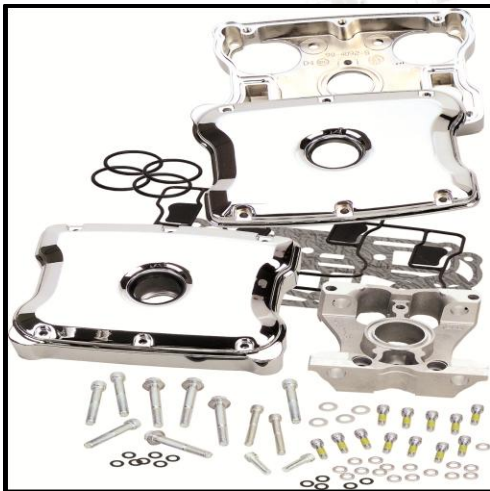


- “ The rocker arms pivot on rocker arm shafts.



Rocker Boxes

- “ The rocker arms are housed within the rocker boxes.



Compression Release

- “ A compression release is activated to let a small amount of air/fuel leave the combustion chamber on the compression stroke of the motor. The purpose is to let large displacement, high compression engines turn over more easily for starting.
- “ An electronic compression release is triggered when the start button is pushed.



- “ EZ Start Cams have a mechanism that bumps the exhaust valve open when the engine is turning at very low RPMs.



Tappets

- “ The tappets ride on the camshaft. By following the contours of the lobes they transfer the camshafts rotating motion into the reciprocating motion needed for the rockers to operate the valves.



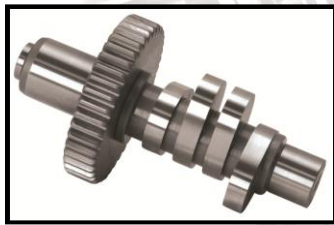
Pushrods

- “ The pushrods are actuated by the tappets and transfer the reciprocating motion up to the rocker arms. This is a set of standard S&S adjustable pushrods.



Camshaft

- “ The camshaft rotates at half the speed of the crank shaft. It operates the valve train to insure even



Cylinder

- “ The cylinder is where the piston and connecting rod move.
- “ The piston travels up and down inside the cylinder. It is the bottom sealing surface of the combustion chamber.



Pistons



- “ PISTON RINGS
- “ WRISTPINS
- “ CIRCLIPS

Connecting rod

- “ The connecting rod connects the flywheel assembly at the crankpin to the pistons.
- “ The big rod end has the larger diameter bearing and connects to the crankpin.
- “ The small rod end connects to the wristpin of the piston.



Crankcase



Nose Cone

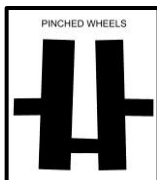
- “ The cam cover on an evolution style motor. It gets its name from the shape of the cover.



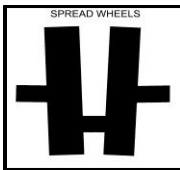
Flywheel Assembly



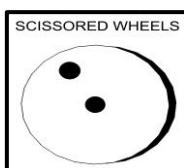
- “ Set of Wheels - Slang term for a flywheel assembly and connecting rods.
- “ Pinched wheels- Condition where the flywheels are out of alignment in such a way that the side opposite of the crankpin is narrower than the pin side.



- “ Spread wheels- Condition where the flywheels are out of alignment so that the side opposite of the crankpin is wider than the side adjacent to the pin.



- “ Scissored wheels (non concentric)- Condition when each of the flywheels is not concentric with the other, or one is twisted on the crank pin.



A four stroke motor has five major events..

“ INTAKE STROKE

- “ The piston moves from TDC to BDC.
- “ The intake valve is open.
- “ The new air/fuel charge is drawn into the cylinder.

“ COMPRESSION STROKE

- “ The piston moves from BDC to TDC.
- “ Both valves are closed.
- “ Air/ Fuel charge is compressed in preparation for combustion.

“ TIMED IGNITION

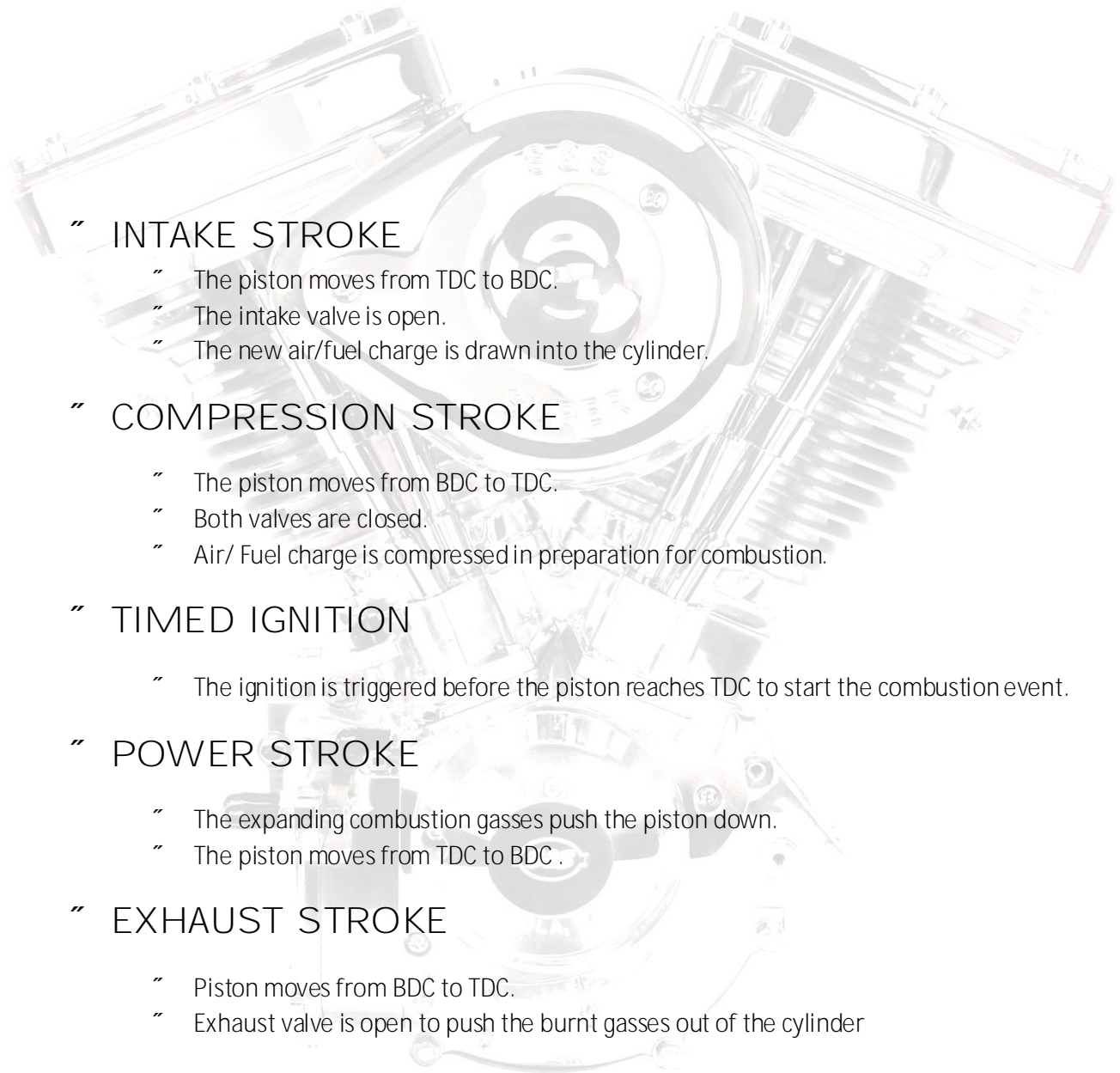
- “ The ignition is triggered before the piston reaches TDC to start the combustion event.

“ POWER STROKE

- “ The expanding combustion gasses push the piston down.
- “ The piston moves from TDC to BDC .

“ EXHAUST STROKE

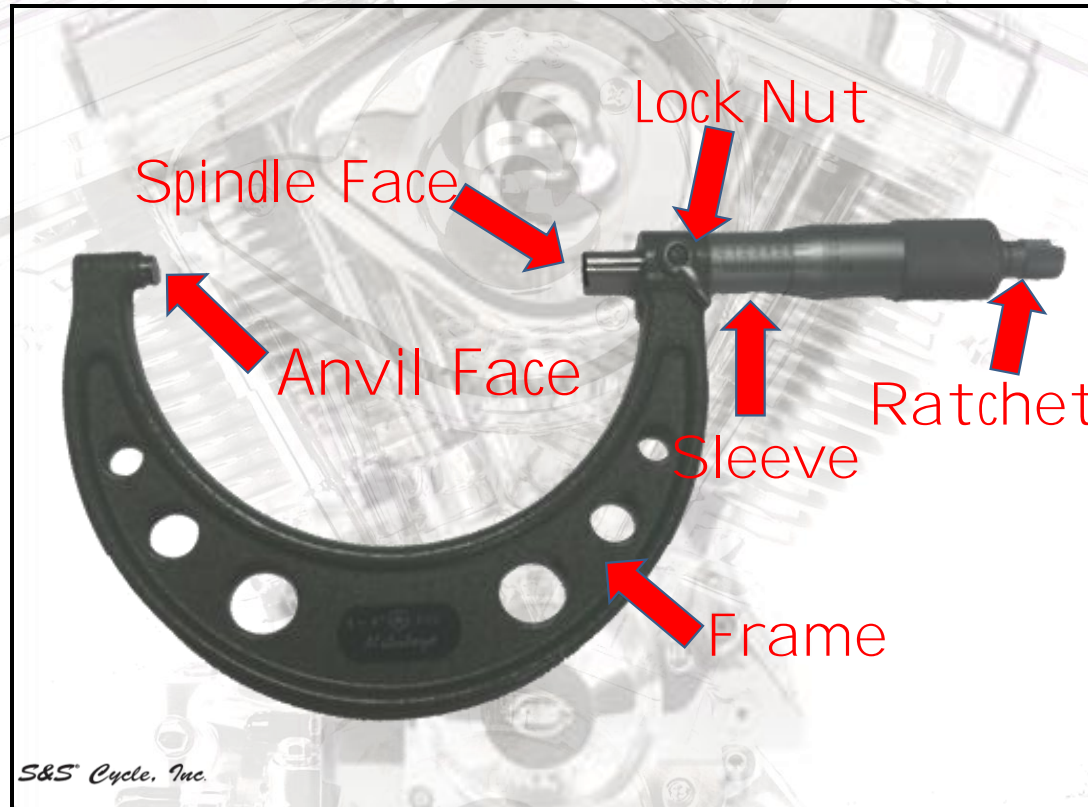
- “ Piston moves from BDC to TDC.
- “ Exhaust valve is open to push the burnt gasses out of the cylinder



Precision Measuring

Precision measuring is an important part of engine building. We will have a brief review of reading an inch micrometer.

Micrometer

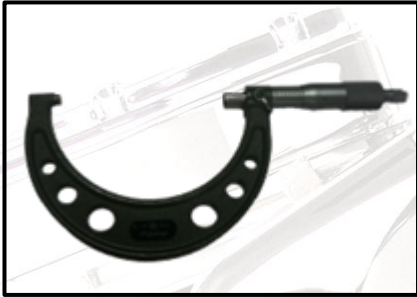


" Inch micrometers only measure a range of one inch. They will often come in a set with a different micrometer to measure:

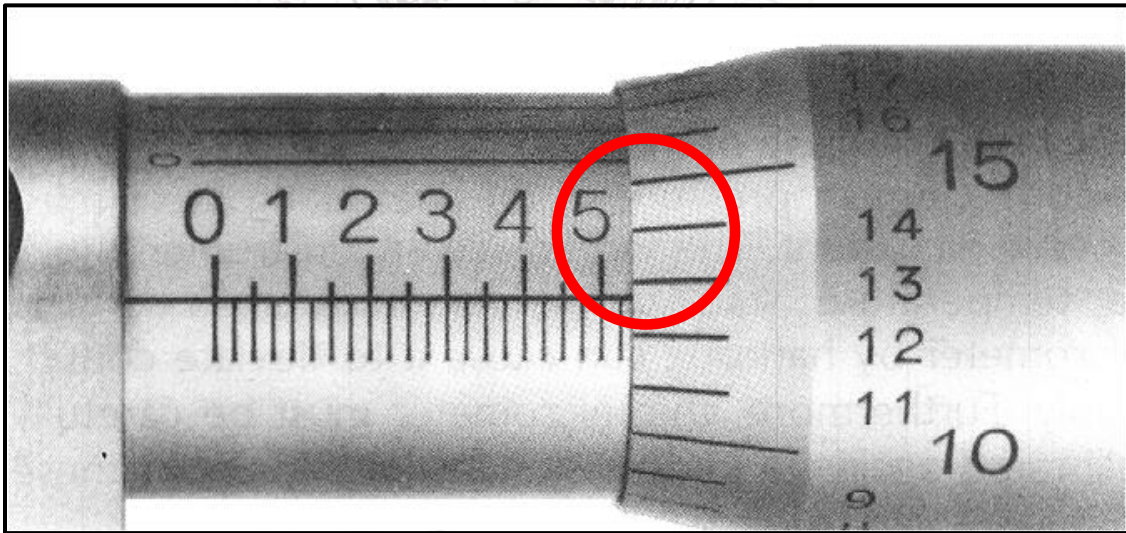
- " 0-1 inch
- " 1-2 inches
- " 2-3 inches
- " 3-4 inches
- " 4-5 inches

Reading the Micrometer

- “ The first digit is determined by the size of the micrometer. For instance, this is a 3-micrometer so the first digit is 3.



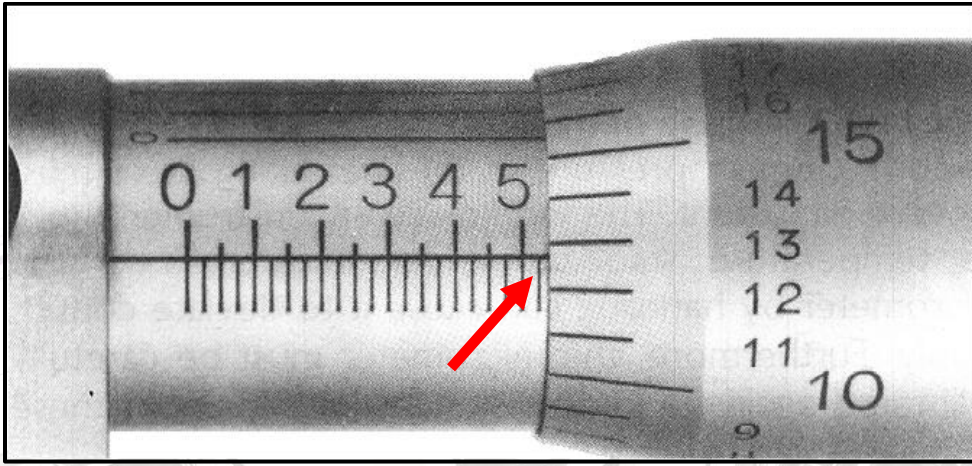
- “ The inch of measurement for the micrometer is divided into 10 equal segments. This is the next digit.
- “ In this case the tenth spot is .5
- “ The line for the .6 is not yet visible.



- “ So far we have:

$$\begin{array}{r} 3.000'' \\ + 0.500'' \\ \hline 3.500'' \end{array}$$

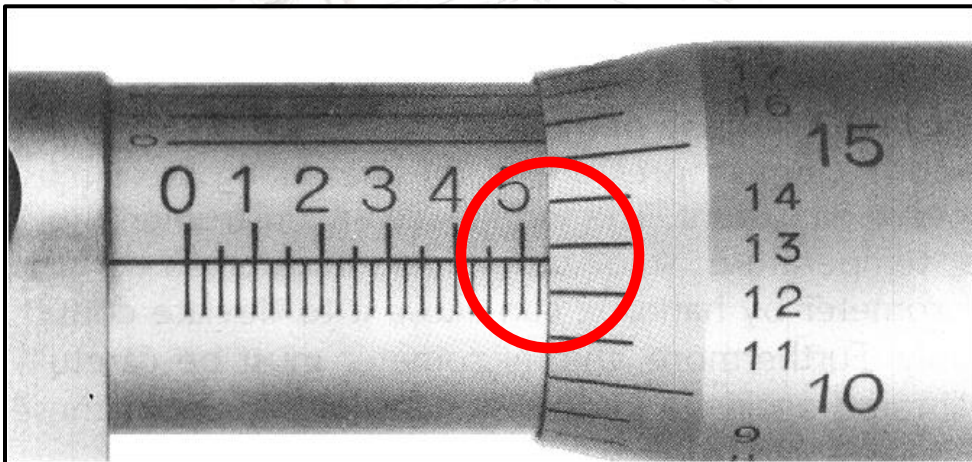
Each tenth increment is divided into four equal increments of .025 each.



Our reading here so far is:

$$\begin{array}{r} 3.000'' \\ 0.500'' \\ + 0.025'' \\ \hline 3.525'' \end{array}$$

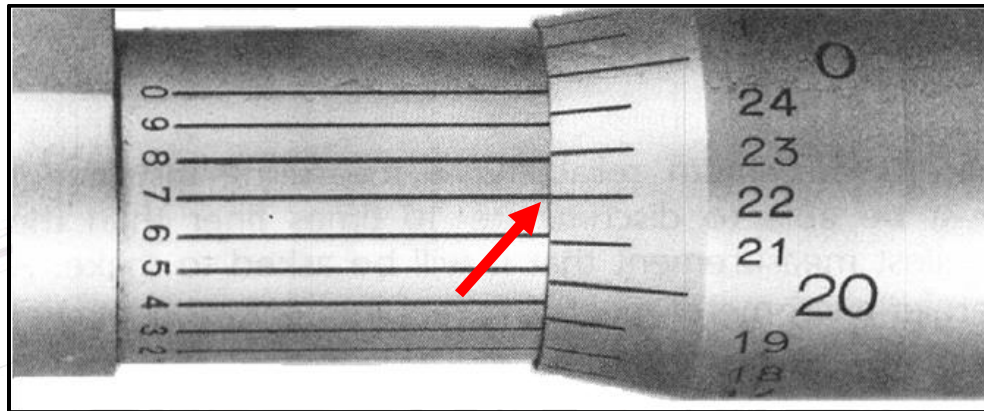
The partial increment of .025 is divided into individual increments of .001 on the barrel.



Our total now is:

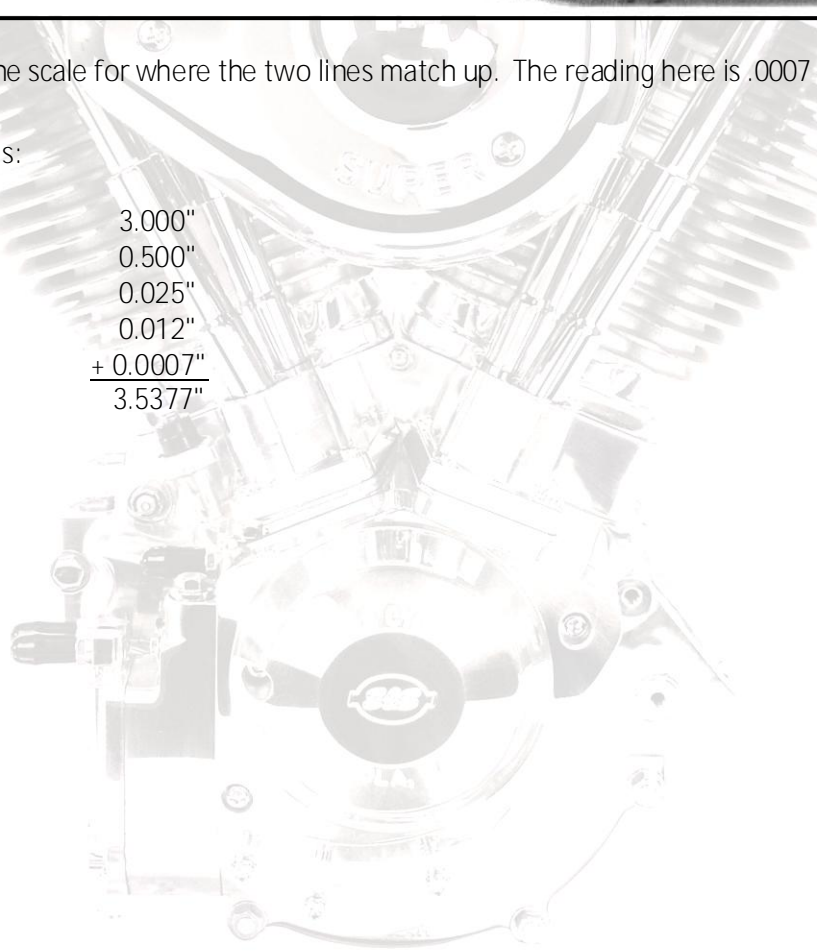
$$\begin{array}{r} 3.000'' \\ 0.500'' \\ 0.025'' \\ + 0.012'' \\ \hline 3.537'' \end{array}$$

- “ The .0001" increment is determined by using the vernier scale on the top of the barrel.

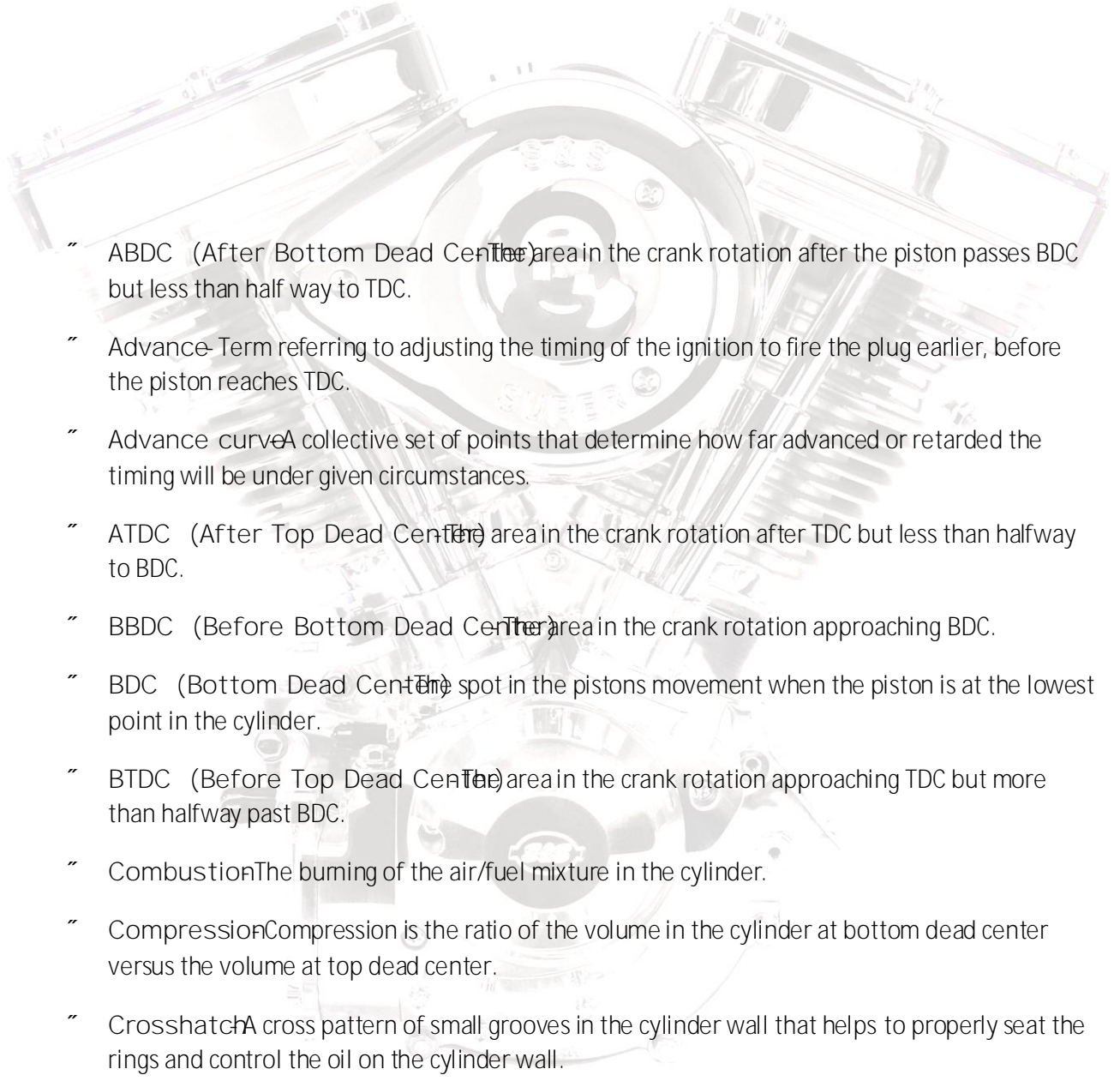


- “ Look on the scale for where the two lines match up. The reading here is .0007
- “ The total is:

$$\begin{array}{r} 3.000'' \\ 0.500'' \\ 0.025'' \\ 0.012'' \\ + 0.0007'' \\ \hline 3.5377'' \end{array}$$



Important Terms

- 
- “ ABDC (After Bottom Dead Center) The area in the crank rotation after the piston passes BDC but less than half way to TDC.
 - “ Advance - Term referring to adjusting the timing of the ignition to fire the plug earlier, before the piston reaches TDC.
 - “ Advance curve A collective set of points that determine how far advanced or retarded the timing will be under given circumstances.
 - “ ATDC (After Top Dead Center) The area in the crank rotation after TDC but less than halfway to BDC.
 - “ BBDC (Before Bottom Dead Center) The area in the crank rotation approaching BDC.
 - “ BDC (Bottom Dead Center) The spot in the pistons movement when the piston is at the lowest point in the cylinder.
 - “ BTDC (Before Top Dead Center) The area in the crank rotation approaching TDC but more than halfway past BDC.
 - “ Combustion The burning of the air/fuel mixture in the cylinder.
 - “ Compression Compression is the ratio of the volume in the cylinder at bottom dead center versus the volume at top dead center.
 - “ Crosshatch A cross pattern of small grooves in the cylinder wall that helps to properly seat the rings and control the oil on the cylinder wall.
 - “ Deck(Compression) Height The distance that the piston is positioned above or below the cylinder head gasket surface when the piston is at top dead center position
 - “ Degree Wheel A degree wheel is a tool that is attached to a crank to show when certain events happen throughout the rotation of the engine.

- “ Detonation Characterized by an instantaneous, explosive ignition of at least one pocket of fuel/air mixture outside of the flame front. A local shockwave is created around each pocket and the cylinder pressure may rise sharply beyond its design limits. ***If detonation is allowed to persist under extreme conditions or over many engine cycles, engine parts can be damaged or destroyed. The simplest deleterious effects are typically particle wear caused by moderate knocking, which may further ensue through the engine's oil system and cause wear on other parts before being trapped by the oil filter. Severe knocking can lead to catastrophic failure in the form of physical holes punched through the piston or head (i.e., rupture of the combustion chamber), either of which depressurizes the affected cylinder and introduces large metal fragments, fuel, and combustion products into the oil system.
- “ Dual fire Ignition system in which both spark plugs fire at the same time. Combustion will only does nothing. u) # # u
- “ Duration Duration is a measurement of how long a valve is open. It is measured in degrees of crank rotation.
- “ Effective Height Effective height is calculated by measuring the length of the cylinder from gasket surface to gasket surface + the thickness of the base gasket + the thickness of the head gasket
- “ Hemisphere Half or part of a sphere. It is circular in shape with a symmetrical dome
- “ Horsepower The simplest definition of horsepower is Dynamic force. Commonly a formula of work divided by time. Horsepower is what is responsible for keeping you moving.
- “ Inertia The tendency of the mass of an object to resist a change in motion. An item that is not moving will resist going into motion. An item that is in motion will resist stopping because the mass will want to continue.
- “ Knock- Another name for detonation
- “ Lapping - A process of using a mild abrasive compound to match the margin of a valve to the valve seat to insure that there is complete sealing.
- “ Lift- Lift is how far the valve raises off of its seat when opened.
- “ Overlap Overlap is the amount of time that both the intake and exhaust valves are open at the same time. It is measured in degrees of crank rotation.
- “ Reciprocating Motion that moves back and forth in a linear manner.
- “ Retard Term referring to timing the ignition to fire closer to the piston reaching TDC.

- “ **Rocker arm ratio** - The difference in lift caused by the lever of the rocker arms. For example a 1.5:1 rocker arm will lift the valve 1.5 times the lift of the pushrod.
- “ **Rotating Motion** - that moves around in a repetitive circular motion.
- “ **Set of Wheels** - Slang term for a flywheel assembly and connecting rods.
- “ **Single fire** - An ignition system in which the spark plug for each cylinder fires independently of the other.
- “ **Squish** - The squish zone is the area around the combustion chamber where the head overlaps the cylinder. It will ideally have a very small clearance to allow for the air/fuel charge to be squeezed into the combustion chamber. It helps to raise the compression and increase turbulence to allow for more complete combustion.
- “ **TDC (Top Dead Center)** - The time in a piston's movement when the piston is at the very top of its motion. Each cylinder has its own TDC within the rotation of the crank.
- “ **TDCC (Top Dead Center Compression)** - The top of the compression stroke for the cylinder.
- “ **TIMED IGNITION** - The ignition is triggered before the piston reaches TDC to start the combustion event.
- “ **Torque** - Torque is the turning or twisting motion, as when you turn a screw driver. Torque accomplished. The greater the torque, the faster the potential acceleration. Torque is mathematical constant used with all Hp and Torque calculations
- “ **Vacuum** - A vacuum is an area where the air pressure is less than atmospheric pressure. It can create a suction effect from an adjacent area of greater pressure. The air will move from the area of greater pressure to an area of lower pressure, trying to equalize pressures.
- “ **Valve Separation** - Valve separation is a condition where the cam is turning so fast that the lifter loses contact with the cam lobe as it passes the point of maximum lift. It makes contact again on the closing side of the lobe as the pressure from the valve springs catch up.