Understanding Overhead-Valve Engines

Once unheard of, these engines now supply the power for nearly all of your equipment.

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You've all heard about overhead valves when shopping for power equipment, but what do they mean to you? Do you need overhead valves? Do they cost more? What will they do for you? Twenty years ago, overhead valves were unheard of in any type of power equipment. Nowadays, it is difficult to find a small engine without them.

In an engine with overhead valves, the intake and exhaust valve(s) is located in the cylinder head, as opposed to being mounted in the engine block. Many of the larger engine manufacturers still offer "standard" engines that have the valves in the block. Their "deluxe" engines have overhead valves and stronger construction. Overhead valves give you longer engine life, better fuel economy and, in most cases, fewer engine repairs.

To understand overhead valves, you need a basic understanding of the workings of valves, cams, cranks and strokes.

Valve-Train Arrangement

Manufacturers configure camshafts and valves in engines in three basic ways-valve in block (VIB), overhead valve (OHV) and the overhead cam (OHC). In OHV and OHC designs, valves are mounted above the cylinders in the cylinder head. The distinction between these two engines lies in the location of the camshaft (which operates the valves). The engine is an overhead-cam design if the camshaft is located in the cylinder head. The engine is an overhead-valve design if the camshaft is located in the engine block. The VIB design is less expensive to produce and is typically found on lower-end engines.

System Operation

The camshaft is located in the engine block on an overhead-valve engine. The camshaft uses lifters, push rods and rocker arms to activate its valves. Its operation is fairly simple and is identical to an automotive engine. As the camshaft rotates, each off-center (eccentric) cam lobe pushes against a lifter or tappet. The upward motion of the lifter transfers through the push rod to the rocker arm.

This upward motion changes to downward motion as the rocker arm pivots. The downward motion opens the valve. As the camshaft continues to rotate, the lobe passes by the lifter and allows the valve to close. A spring (attached to the valve) returns the valve to its seated position. Every cylinder in an internal-combustion engine contains one intake valve and one exhaust valve. Both valves open and close internal passages in the cylinder head. The intake valve is the larger of the two valves. It controls the flow of fuel into the combustion chamber. The exhaust valve controls the flow of exhaust gases out of the cylinder.

Valve-Design Characteristics

The valves consist of a round head, a stem and a groove at the top of the valve. The head of the valve is the larger end that opens and closes the passageway to and from the combustion chamber. The stem guides the valve up and down and supports the valve spring. The groove at the top of the valve stem holds the valve spring in place with a retainer lock. The valves must open and close for the air-and-fuel mix to enter, then exit, the combustion chamber. Proper timing of the opening and closing of the valves is required for the engine to run smoothly. The camshaft controls valve sequence and timing.

The Camshaft

The camshaft consists of several camshaft journals and a

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set of cam lobes. The camshaft journals, like the crankshaft journals, hold the camshaft in place. A bearing, placed around each journal, allows it to rotate freely. The cam lobes open the intake and exhaust valves in each cylinder. The number of cam lobes equals the number of valves in an engine.

The angular positioning of the cam lobes on the shaft determines the sequence of the valves' opening and closing. The design of the lobes determines how high the valves will open (lift) and how long they will remain open (duration). These designs vary from one engine to another.

New Technology, Regulations And You

In the last few years, outdoor-power-equipment-engine technology has given us overhead cams, fuel injection and computer controls. Government regulations require you to be up-to-date in your knowledge of what types of engines you can use. If you have specific questions regarding government regulations, contact your local Environmental Protection Agency office.

The Four-Stroke Cycle

Controlling the combustion of the air-fuel mix is an important and complex process. Four essential steps take place at the correct time and in the correct sequence for proper combustion. This must happen in every cylinder of the engine. This process is the four-stroke cycle.

The term "four-stroke" comes from the number of piston strokes required to complete the combustion cycle. A stroke is the movement of the piston from its highest position in the cylinder (top-dead-center) to its lowest (bottom-dead-center) or from the lowest to highest position. The four strokes are intake, compression, power and exhaust.

* **Intake stroke.** The intake stroke is the first of the four strokes in the combustion cycle. As the piston moves away from the top of the cylinder, the intake valve opens. The downward movement of the piston creates a vacuum (negative pressure) in the cylinder. The relatively high pressure outside the cylinder (ambient pressure) pushes a mixture of air and fuel into the cylinder. Just after the piston reaches the bottom of the cylinder, the intake valve closes.

* **Compression stroke**. The second stroke of the combustion cycle is the compression stroke. The compression stroke begins as the piston starts to move upward in the cylinder. The intake valve closes, trapping the air-fuel mix in the cylinder. Upward movement of the piston compresses the mixture into a small volume.

Compressing or squeezing the air-fuel mix is important for developing maximum power. The higher the compression, the greater pressure exerted on the piston when the air-fuel mix ignites. Compression also pre-heats the mixture, which helps it burn efficiently.

* **Power stroke**. The third stroke is the power stroke. The power stroke begins as the compressed air-fuel mix ignites in the combustion chamber. A spark plug, located in the cylinder head, creates an electrical spark in the combustion chamber, which ignites the air-fuel mix. The burning fuel rapidly expands, creating high pressure against the top of the piston. This pressure drives the piston downward. The downward motion provides the power to turn the crankshaft that, in turn, drives the equipment. The crankshaft converts up and down movement (on all four strokes) of the piston to rotary motion.

* **Exhaust stroke**. The final stroke of the cycle is the exhaust stroke. As the piston approaches the end of the power stroke, the exhaust valve opens. Pressure in the cylinder causes the exhaust gases to rush past the valve and into the exhaust system. The piston moves the cylinder up, pushing most of the remaining exhaust gases from the chamber. As the piston nears the top of this stroke, the exhaust valve begins to close as the intake valve begins to open.

The exhaust stroke completes the combustion process. The opening of the intake valve signals the beginning of a new cycle. This cycle occurs in every cylinder and repeats as long as the engine is running.

(Editor's Note: Robert Sokol is associate editor of Intertec Publishing Corp.'s ABOS Outdoor Power Equipment Book in the company's Technical Manuals Division.)