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## **The Engine Explained**

**By Kevin Schappell**

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The engine is the heart of your car, but instead of pumping blood, the engine pumps air and fuel. The engine's main function is to convert air and fuel into rotary motion so it can drive the wheels of the car. How does it do that ??.... Well let's start with a cutaway of the engine and see all the major parts then we will get into the actual mechanics.

**Pistons:** Most common engines have 4, 6, or 8 pistons, which move up and down in the cylinders. On the upper side of the piston is what is called the combustion chamber where the fuel and air mix before ignited. On the other side is the crankcase, which is full of oil. Pistons have rings which serve to keep the oil out of the combustion chamber and the fuel and air out of the oil.

**Crankshaft:** The crankshaft is connected to the pistons via a connecting rod. As the piston moves up and down in the cylinder it rotates the crankshaft and converts the straight line motion into rotary motion.

**Valve train:** The valve train consists of valves, rocker arms, pushrods, lifters, and the camshaft. (shown in above picture in blue, yellow, and green) The valve train's only job is that of a traffic cop. It lets air and fuel in and out of the engine at the proper time. The timing is controlled by the camshaft, which is synchronized to the crankshaft by a chain or belt.

Now that we have a general overview of the parts involved let's talk about what happens. Most automotive engine today are 4-stroke (or 4-cycle) engines, meaning they have four distinct events which make up the cycle.

**Intake stroke:** The camshaft opens the intake valve and the piston moves down the cylinder. This creates vacuum and sucks in air and fuel into the combustion chamber above the piston.

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**Compression stroke:** As the piston starts moving back up the cylinder the intake valve closes and seals off the combustion chamber. This causes the air and fuel to compress.

**Power stroke:** As the fuel is compressed and the piston nears the top of the cylinder the spark plug fires and ignites the fuel and air. This explosion pushes the piston back down the cylinder and drives the crankshaft.

**Exhaust stroke:** After the piston reaches the bottom of the cylinder, the exhaust valve opens and the gasses left over from the fuel and air are sent out to the exhaust system.

Put these four events together in the above order and you have a complete cycle. Are you asleep yet? That's enough theory, let's talk about the real world and problems you might encounter with the above mentioned parts.

**Pistons:** Remember I talked about the rings, which seal the combustion chamber from the crankcase.

The rings over time tend to wear out. When they wear they allow the fuel and air to enter into the oil and dilute it. This dilution reduces the oil's ability to lubricate your engine and can cause premature wear. Also if the rings wear down they can allow oil from the crankcase to enter the combustion chambers. This will result in oil being burned and exiting your tailpipe as grayish/white smoke. If your car spews grayish white smoke and it does not go away in the first few minutes after start-up you might have worn rings. If the smoke goes away after start-up look to the valve train section.

**Crankshaft:** The crankshaft rides on bearings, which can wear down over time. The bearings support the crankshaft and also the rods, which connect the pistons to the crankshaft. A loud medium pitched knocking noise in the engine points to worn bearings most of the time. This is usually a costly repair and involves removing the crankshaft and either machining the surface where the bearings ride, or replacing the entire crankshaft. To prevent this type of problem, use a high quality oil, change your oil at suggested intervals (3 months or 3000 miles is a safe number) and always maintain your oil level between oil changes.

**Valve train:** Remember the oil smoke problem mentioned above in the piston sections. If your car only smokes grayish/white smoke at start-up you may have leaking valve seals. Valve seals keep oil from above the valve from leaking into the combustion chamber. When they wear, they can allow oil to seep into the combustion chamber and collect there until you start the engine again. You generally do not get oil leaking past the valve seals while the engine is running since the seals expand with the heat of the engine and plug the leak.

Another common problem is the timing chain or belt will slip or even break causing the cam shaft to stop rotating. Remember the camshaft tells the valves when to open and if it stops spinning then the valves stop opening and closing. No valve moving, no engine running :-)

A term you will hear when talking about timing chains and belts is "interference engine". When an engine is an "interference engine" the pistons and valves are so close together that if the valves were to stop moving (broken belt or chain) and the crankshaft kept spinning they would crash into the piston.

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(that's the interference) This crash tends to do bad things to an engine, breaking valve, bending pushrods, and even cracking pistons. This is why most manufacturers recommend changing the timing chain or belt every 60,000 miles. Timing belts dry out, stretch and deteriorate over time so even if you do not have 60,000 miles on the car think about changing the belt after it's 6 years old.

Preventive Maintenance:

Change your oil regularly.

Give your engine a chance to warm up before driving if possible. Let the oil get into all parts of the engine before driving. This is even more critical in cooler temperatures when the oil is cold and sluggish.

Change your timing belt or chain at your manufacturer's recommended interval.

void "snake oil" additives advertised on late night TV. Regular oil changes and good maintenance habits will keep your engine running it's best.

If you have a turbo charged engine, give the engine a minute or two cool down before turning it off. This cool down period allows oil to circulate and cool down the bearings. If you shut off the engine

immediately after hard driving, the oil can gum up around the hot bearings and create problems down the road.

What to discuss with your mechanic:

If you have to replace your engine, discuss the benefits of buying used versus new. If you plan on keeping your car for some time, a new engine might be the best bet. Sometimes new engines are not much more expensive than rebuilt ones, and offer the best solution.

When trying to diagnose engine noises, be as descriptive as possible. Take note to when the noise occurs; at what throttle position, and when the noise started occurring. Sometimes changing the weight of oil being used can cause a new noise to crop up. Make sure you mechanic knows if you changed oil brands or weight recently.

Kevin Schappell maintains

where he gives advice on buying, selling,

insurance, and financing. A mechanical engineer and car guy, Kevin has decided to spend his online time helping others learn about automobiles. To learn more about how your car works, Kevin has created

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## **RF Engineering for 802.11 WLAN**

**By Joe Bardwell**

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The article describes electromagnetic propagation and how RF engineering concepts can be applied specifically to 802.11 Wi-Fi WLANs. The popular formulae often applied to wireless networking are explained in clear, concise terms, with the math and physics being included. These include free space path loss, Fresnel zone calculation, and even an introduction to the Maxwell wave equations. The official title of the paper is, "I'm Going to Let My Chauffeur Answer That.", an allusion to a humorous story explained in the paper. The full text of the paper is available on the Connect802 website, in the Literature section at: [www.Connect802.com/literature](http://www.Connect802.com/literature)

Mr. Bardwell is a recognized technical expert and speaker and is co-author of the book, "Troubleshooting Campus Networks" (Wiley). He is Chief Scientist and President of Connect802 Corporation, a Wi-Fi design and systems integration company in California. ([www.Connect802.com](http://www.Connect802.com))

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