

Using a Compression Gauge

These simple devices can tell you a great deal about the health of your engine. In fact, when used properly and interpreted correctly, a compression tester will reveal just about all you could want to know about your vehicle.

Here is how to use a compression gauge.

Make sure your car is in good tune and the battery is fully charged. Also make sure the valves are properly adjusted if your engine has mechanical (solid) lifters. Now take your car out for at least a 20-minute drive to get it up to operating temperature. This is an important step, because valves will be too loose and piston clearances will be too great if your engine is cold. For what we are about to do, you can't just rely on your temperature gauge alone. It only accurately measures head temperature.

As most of us know, metal expands as it heats up, and aluminum expands at a greater rate than iron. Pistons, which are most often made of aluminum, will be quite loose when an engine is cold but will expand to fit their cast iron cylinder bores as they warm up. In order for valve mechanisms to have sufficient clearance when they are hot, they too must be quite loose when cold. So for a compression check to be accurate, all of the engine components must be up to full operating temperature.

Check a shop manual to determine what the compression should be on your car's engine. Then shut it off and block the choke and throttle wide open. Remove all of the spark plugs. Now use a remote starter button, or have someone turn your engine over while you check the compression.

Write down the compression indicated by the gauge for each cylinder. Push the rubber nipple of the compression gauge into each spark plug hole in turn and crank the engine over several times. Write down the readings each time. Make sure to set the gauge back to zero before going on to the next cylinder.

A difference of up to 6 psi is acceptable from one cylinder to another on most old car engines. If any of the cylinders are 10 psi (or more) below the others, you have problems. If all of your cylinders are 10 pounds or more below specs your engine is probably in need of an overhaul. If the engine compression is even a couple of pounds low, there is nothing to worry about. Your engine is just aging.

As you can see, the initial compression data from your engine will tell you if you have a problem, but it won't tell you what the problem is without further testing to pinpoint what is wrong. For example, if your compression is down in one cylinder, it could be because of worn or broken rings, bad valves or a combination of both.

Squirt a little oil into the cylinder and test the compression again. If it comes up normal, worn piston rings are the problem. If it does not come up at all, leaking valves or a blown head gasket is the problem. On the other hand, if the compression comes up a little, but not enough, the problem may be both rings and valves.

It is not as common today with our clean burning fuels and high compression engines, but on low revving, low compression cars made 50 years ago and earlier, piston rings can occasionally become so carboned up that they stick in their grooves. If you suspect this problem, shoot a little solvent or kerosene in each cylinder. Let it soak in for a minute, then retest. If the compression comes up, the top end of your engine may just need a good cleaning to remove carbon deposits.

If your compression is down in two adjacent cylinders, you probably have a leaking head gasket. Try torquing the head bolts to specs and then retest. If you don't get results, take the head off and check for a cracked block. If the block appears sound, install a new head gasket.

If you determine that the problem is valves, it may be because they are burned and need regrinding or replacing. If you hear a lot of clatter, it may be due to a stuck hydraulic lifter or a broken or sagging valve spring. There are various liquid "miracle solutions" sold in auto parts stores that are supposed to free stuck lifters. I've never had much luck with them, but they may work on your car. There is no harm in trying them. Usually it is necessary to remove worn lifters and replace or rebuild them.

If you suspect a bad valve spring, remove the valve covers and test each spring with a screwdriver. If you discover you need to replace a valve spring, it is a good idea to check all of them for proper tension and at least replace the weak ones.

As you might have deduced from your compression test, an internal combustion engine is really little more than an air pump. Just as there is a lot to be learned by testing the pressure in the cylinders when the valves are closed and the piston is at the top of the bore, there is also much to be learned from measurements of the vacuum caused by air being sucked into your engine during operation. To test it, you use a vacuum gauge, which tells you the difference between the pressure inside the intake manifold and the atmospheric pressure outside it.

A vacuum gauge can be used to find intake manifold gasket leaks, burned valves, weak valve springs, ignition problems, a blocked exhaust system and an out of adjustment carburetor, as well as several other things, provided you know how to interpret what it is telling you. Before we get started, there are some things you should keep in mind.

Because a vacuum gauge measures the difference between atmospheric pressure and the pressure in your intake manifold (as opposed to measuring pressure from some fixed figure), the higher you live above sea level, the lower the outside atmospheric pressure will be, so the lower the manifold pressure reading will be as well. To allow for any differences in altitude, find out your local elevation and interpolate from there. The reason the readings on the gauge are in inches is because pressure is still measured by how many inches a given pressure would cause mercury to move up a glass tube in an old style barometric gauge. Before attempting a vacuum test, make sure you adjust the engine idle to the correct RPMs as specified in your shop manual. Tachometers are the ideal tool for this purpose and are available at auto supply stores for a nominal price. On most old cars, the idle is about right if the car rolls along at 7 to 10 miles an hour on level ground in low gear with your foot off the gas.

Once again, make sure your engine is properly tuned, its valves correctly adjusted and that it is thoroughly warmed up before testing. Attach the gauge either to the vacuum tubing going to your car's windshield wiper motor, or install a tee at the opening on the throttle body of the carburetor where the vacuum advance ties in, or you can remove a small plug in the intake manifold. Many old cars are equipped with a plug, but if your car is not, you may want to remove the manifold, drill and tap a hole, then install one for future convenience.

If your car is equipped with a compound fuel pump that has a vacuum booster pump on top for the windshield wiper motor, you will need to disconnect the booster pump to allow the gauge to read properly. If you attach the gauge to your manifold, you will need to install a nipple, push a length of rubber tubing onto it and connect your gauge. Make sure all of your connections are air tight before running the tests.

At sea level, a well tuned healthy engine should idle at a steady reading of 18-22 inches.* Of course the needle will vibrate slightly even on a sound engine, but it should not show large fluctuations. If an engine reads at an excessively low but steady vacuum, there are several possible reasons for it. A low but steady vacuum gauge reading means that whatever is wrong is affecting all of the engine cylinders equally. The things to check for are as follows:

1. Leaky carburetor flange gasket
2. Worn carburetor throttle shaft
3. Leaking vacuum lines
4. Improper valve timing

If the gauge fluctuates or wanders around through several inches, it indicates a leaking condition affecting one or more, but not all cylinders. Again, keep in mind that a certain amount of needle pulsing is normal, especially on 4 and 6 cylinder engines. If you've never used a vacuum gauge before and you feel unsure of your results, get an experienced person to give you a second opinion before tearing your engine apart. Fluctuating can be caused by the following:

1. A burned or stuck valve
2. Intake manifold leak at one cylinder

3. Worn intake valve guide
4. Broken piston or piston rings

To help further isolate the problem, run the engine at about 2000 RPM. If the pointer steadies, inspect for the following:

1. Ignition or timing problems
2. Incorrect carburetor mixture adjustment at idle

If the pointer's sweeps get larger, check for weak or broken valve springs using a large screwdriver to tweak the springs. If the sweeps get shorter and more rapid check for the following:

1. Carburetor or intake manifold leaks
2. Sticking valves

If when you run the RPMs up to 2000, you see a gradual decrease in the vacuum reading, check for exhaust system restrictions such as a kinked tail pipe or partially blocked muffler.

*It should be noted that on some cars, particularly classic muscle cars, camshaft duration can affect manifold vacuum and idle quality. Many aftermarket cams will bring the compression down to 13-15 inches, depending on how radical it is.

Testing fuel pumps:

Another way most vacuum gauges can be used is to test fuel pump pressure. Of course, because of the volatility of gasoline, you must be very careful doing this. Work outdoors and have a fire extinguisher handy. Disconnect the fuel line where it goes into the carburetor and attach the vacuum gauge using one of the fittings that comes with the gauge or one from an auto parts store. Now start your engine. Most likely there will be enough fuel in the float bowl of the carburetor for the engine to run long enough for the pump to be tested. Compare the gauge reading to the specifications in your shop manual. If you are on the road and do not have this information at hand, you can assume your fuel pump is probably good if it tests between 4 and 6 pounds of pressure.