Testing Compression

There are two kinds of compression tests you can run on your engine. The "Static" test and the "Dynamic" or "Running" test. If you know how to do these tests right, and how to interpret the results, they can tell you a great deal about the health of your engine.

- **Static compression** can tell you about the health of your piston rings, cylinder walls, and valves.
- **Dynamic compression** reveals problems in the intake and exhaust systems of the engine.

To perform these tests, you will need some basic tools.

- A socket set with spark plug socket and extensions.
- A compression gauge. There are two types. One is the press-in type that has a pointed rubber boot that you press into the spark plug hole. You can use this type for static compression only, and you'll have to have a helper. The other screws in the spark plug hole. The screw-in type is better. You will definitely NEED the screw-in type if you're going to do a dynamic compression test, preferably one with an external pressure release valve.

Other helpful tools:

- Spark plug boot puller, to help prevent damage to the spark plugs wires when you pull them off
- Remote starter switch
- Mechanic’s gloves

Combine the compression tests with other tests to pinpoint the source of a problem.

Static compression Test

To perform a static compression test:

Left Bank Compression		Right Bank Compression	
Dry	Wet	Dry	Wet

1. Start the engine and warm it up to normal operating temperature.
2. While the engine is warming up, make a chart on a piece of paper, like the one to the right. It doesn't have to be fancy. Just draw it out with a pencil. This chart is for a V-8. A 4-cylinder engine will have only 1 column, as will an inline 6. Adjust your chart to match your engine.
3. Now that the engine is warmed up, remove all the spark plugs. Yeah, I know the exhaust system is hot. That's what Mechanics Gloves are made for.
4. Block the throttle wide open.
5. On a fuel-injected engine, disconnect the fuel injectors from the wiring harness.
6. Install the compression gauge in cylinder #1.
7. If you have a remote starter switch, crank the engine. If you don't have a remote switch, then have a helper crank the engine from inside the vehicle.
8. The compression gauge will come up in puffs. Crank the engine until the needle doesn't climb anymore.
9. Record the gauge reading in your chart, in the space that represents the cylinder you just tested, and in the "Dry" column. (The top of the chart represents the front of the engine.)
10. Remove the compression gauge, and squirt about 2 tablespoons of motor oil into the cylinder.
11. Crank the engine over a few turns, and reinstall the compression gauge.
12. Repeat step 7, and record the result in the "Wet" column for that cylinder.
13. Repeat steps 6-12 for each cylinder.

Interpreting the Static Compression Test

What you want to see is all the DRY tests giving nearly equal readings. Readings should be within 10% of the highest reading. For example, if the highest reading of all the cylinders is 160 psi, then the lowest reading should be no less than 144 psi.

Readings less than that indicate problems with that cylinder's rings, valves, cylinder walls, head gasket, or combustion chamber.

Left Bank Compression		Right Bank Compression	
Dry	Wet	Dry	Wet
150	152	159	160
155	157	157	157
152	153	155	157
160	160	158	161
A Healthy Engine			

The WET readings help you to narrow down the problem. This is because the oil you shot into the cylinder will collect at the top of the piston, lubricating the piston rings and increasing their seal.

If the **wet reading is significantly higher than the dry reading,** then the problem lies in the rings or cylinder walls. The problem is weak or worn piston rings, or a scored cylinder wall, or both. It does not, however, rule out leaking or burnt valves.

If the **wet reading and dry reading are nearly equal,** then the problem is in the head, valves, or head gasket. The problem lies in a burnt or leaking valve or seat, leaking head gasket, or cracked combustion chamber. It can also indicate a cracked cylinder wall.

You can compare your compression readings with other symptoms, too, to help narrow down the problem even further. For instance, if the head gasket is leaking, it may show up as a low dry test, low wet test, overheating, and air bubbles in the radiator while the engine is running.

A **zero pressure** reading on a cylinder indicates something is broken or badly cracked, like a piston, cylinder wall, or combustion chamber. In can also indicate a severely burned-out head gasket or a valve partially burned away.

Two adjacent cylinders with low readings usually indicate a bad head gasket, rather than mechanical damage to other parts. Usually. Not always.

Left Bank Compression		Right Bank Compression	
Dry	Wet	Dry	Wet
140	140	165	165
154	156	157	170
152	153	160	175
170	172	158	178

Probably needs a valve job and rings. Note readings not within 10%, and wet vs. dry on right bank.

Left Bank Compression		Right Bank Compression	
Dry	Wet	Dry	Wet
120	122	159	160
125	125	157	157
152	153	155	157
160	160	0	0

Probably a head gasket leak in the left bank. Something seriously broken at the back of the right bank.

Dynamic or Running Compression Test

The tools needed for the dynamic test are the same as for the static test, but you MUST have a screw-in type compression gauge, preferably one with an external pressure release valve.

The engine should still be warm.

Do a static compression test first. You need the results from the static test to interpret the dynamic test.

Left Bank		Right Bank	
Idle	Open	Idle	Open

1. Make a new chart like the one on the right.
2. Remove the block holding the throttle wide open from the static test.
3. Install all the spark plugs except for cylinder #1, and connect the plug wires.
4. Ground plug wire #1 to the engine block. This is to protect the ignition system, and is absolutely necessary if your vehicle has a DIS ignition system (uses a pack of coils rather than a distributor).
5. Reconnect the fuel injectors. On a multi-port injection system, leave the #1 injector disconnected from the wiring harness.
6. Install the compression gauge in cylinder #1.
7. Start the engine and let it idle.
8. Release the pressure from the compression gauge, and let it pump up.
9. Record the compression reading for the appropriate cylinder in your chart, under the "Idle" column.
10. Reach over to the throttle linkage, and "BLIP" the throttle open and closed. The idea here is NOT to rev the engine. Just pop the throttle open to wide-open and drop it back, very quickly. What you're doing is letting the engine take a big gulp of air. But don't let it rev up!
11. Take the reading that now shows on the gauge, and enter it in the "Open" column.
12. Shut off the engine.
13. Reinstall #1 spark plug and plug wire. On multi-port injection, reconnect the #1 injector.
14. Repeat steps 3-13 for each cylinder.

Interpreting the Dynamic (Running) Compression Test

At idle, the dynamic compression readings should be APPROXIMATELY half of the "Dry" static compression readings, usually 50-75 psi. See the "What's happening" section below.

The "Open" readings (after you blipped the throttle), should be around 80% of the "Dry" static compression readings.

"Open" compression much less than 80% of static compression on one cylinder indicates restriction in the intake side of the engine, somewhere between the combustion chamber and the intake manifold's plenum. Look for a flat camshaft lobe, collapsed hydraulic lifter, heavy deposits on the back of the intake valve, problems with the intake rocker arm. Some manifolds, like Vortec's, have dividers or shutters that could be out of place.

Left Bank		Right Bank	
Idle	Open	Idle	Open
50	70	51	118
55	122	56	120
52	122	52	160
50	121	54	123

Front cylinder, left bank has an intake restriction. Third cylinder, right bank, probably has a crushed header tube.

If all cylinders are much less than 80%, then look for a plugged induction system, like a really bad air filter or a crushed inlet tube.

"Open" compression much higher than 80% indicates a restriction in the exhaust side of the engine. Look for a flat camshaft lobe, a collapsed lifter, or a crushed header tube.

If all cylinders, or all cylinders on one bank, are much higher than 80%, then look farther downstream in the exhaust. Look for a heat riser valve stuck in the closed position, plugged catalytic converter, crushed exhaust or tail pipes.

What's happening with this test is that at idle, the throttle plates are closed, and the engine is not pulling all the air it can. The "Idle" readings should compare to the static "Dry" readings, adjusted by how much vacuum the engine is pulling.

The atmosphere produces about 30 inches of air pressure. If you engine is idling at 20 inches on a vacuum gauge, then the air pressure inside the intake runners is at about 10 inches, or 1/3 of atmospheric pressure. In this case, if the "Dry" static compression for a cylinder was 150 psi, then the dynamic compression for that cylinder should be about 1/3, or around 50 psi.

When you blip open the throttle, you're letting atmospheric pressure dump into the intake. Manifold vacuum drops as air pressure in the manifold increases. The cylinder gets a load of air, and the compression reading jumps up for several rotations of the engine.

Restrictions in the intake don't let that gulp of air reach the cylinder properly, and the compression won't rise much.

Restrictions in the exhaust don't let the exhaust out properly, and compression jumps higher as the cylinder doesn't get all the exhaust pushed out.