

The Vacuum Gauge as a Diagnostic Tool

by Ken McNeil

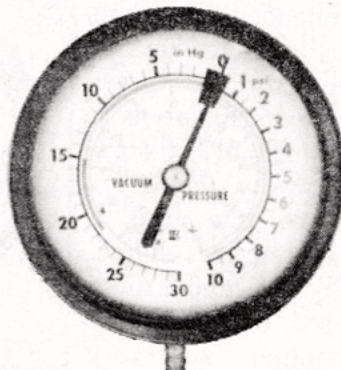


Several months ago there was an article in *Skinny Knuckles* on evaluating engine condition and problems through the sparkplugs. The plugs are an excellent indicator of internal problems, but there is an additional tool which definitely should be part of your tool box: the vacuum gauge.

You realize, of course, that your automobile engine is a four-stroke engine. Of the four strokes - intake, compression, power and exhaust - two are actually creating a vacuum in the engine - the intake stroke and the power stroke. In both cases, as the pistons descend from top dead center to the bottom of the stroke, a vacuum is created. In the intake stroke, of course, the intake valve is open and the air/gas mixture in the intake manifold rushes in to fill the vacuum. The exhaust valve should be tightly closed. On the power stroke, both the intake and exhaust valves should be closed. The vacuum gauge measures the vacuum and indicates the condition of the engine. This includes the valves, of course, the timing, the piston rings, the valve guides and valve springs.

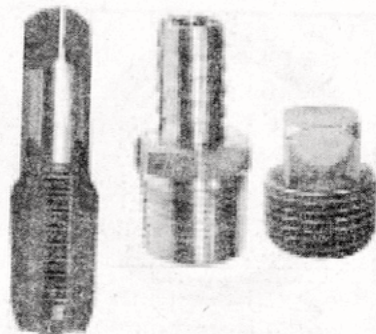
The vacuum gauge will only set you back a few dollars, but it can pay major dividends in results. It is easy to use, and, despite all the numbers on the face of the gauge, is easy to read. The numbers on the face of the gauge, ranging from '0' to '30' relate to inches of Mercury, the standard method of measuring vacuum. No vacuum at all will be indicated by a '0' reading. It means that the vacuum equals ambient atmospheric pressure and the column of Mercury does not rise. A near-perfect vacuum will approach '30' or 30 inches of Mercury, the maximum that can be achieved. With the engine off and not running, the internal vacuum should be '0'. In a running engine, the vacuum might approach '25', but will almost certainly never indi-

cate a perfect vacuum. Please keep in mind though, that as altitude increases, atmospheric pressure decreases. Roughly figure about one point for each 1,000 feet of increased altitude. Weather conditions might also affect the readings - a weather 'high' or 'low' might account for minor variations, but generally not enough to radically alter the readings for our use. Many vacuum gauges also double as a fuel pressure gauge so that you can easily measure the output of your fuel pump. The needle swings in one direction for vacuum and in the opposite direction for pressure.



Many vacuum gauges also double as a fuel pressure gauge. The left side of this gauge indicates vacuum, while the right side indicates pressure.

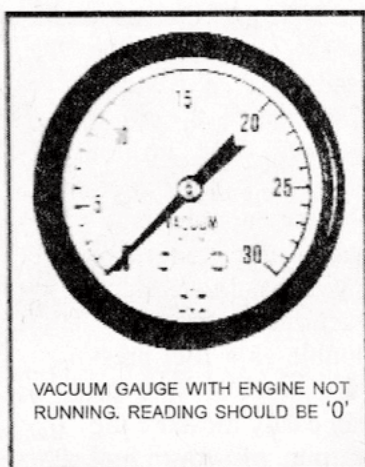
Most engines have some kind of port in the intake manifold that can be used for connecting a vacuum gauge. If the car is equipped with a vacuum windshield wiper, the connection is simple. Merely connect the gauge in place of the windshield wiper. If the car utilizes a vacuum tank (rather than gravity feed or a fuel pump), you can connect a 'T' fitting into the vacuum line with which to connect the gauge. Often an intake manifold will have a screw-in plug that can be removed and a fitting installed. If no other option exists, you may have to drill a hole in the intake manifold for a fitting. If the carburetor is below the intake manifold, remove it to prevent metal chips from falling into the carb. Drill the hole 11/32" (optionally a size 'R' drill bit) and use a 1/8" pipe thread tap. Fittings for a 1/8" pipe thread are readily available, and if you wish to remove the vacuum connection afterward, a 1/8" pipe thread plug will fit the hole. DO NOT confuse a 1/8" pipe thread with the standard 1/8" meas-



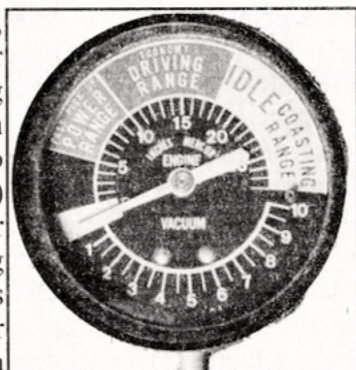
Left to right: a 1/8" tapered pipe tap, a 1/8" pipe fitting with a hose barb, a 1/8" pipe plug.

urement. A 1/8" pipe thread measures approximately 13/32" (0.406") whereas 1/8" equals 0.125".

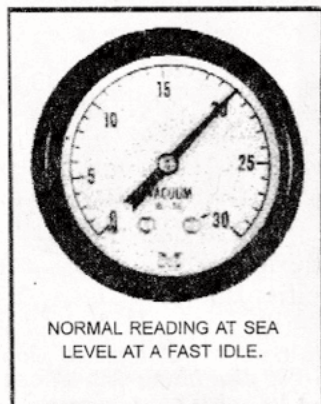
Once the connections are made, the gauge can be connected (either temporarily or as a permanent instrument on the dashboard) and used to monitor the engine. (Years ago there used to be a very popular accessory available called a 'Motor Minder.' It was nothing more than a vacuum gauge, but was made 'user friendly' by framing the different vacuum ranges in color. 10 to 18 (inches of Mercury) was the green, or Economy Driving Range; 5-10 - red - was Fast Pickup Power Range and there was a range for Idle/Coasting. Different brands used similar color ranges with varying range titles.)



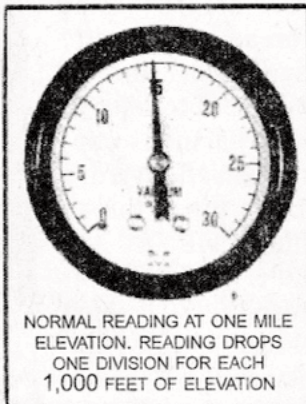
VACUUM GAUGE WITH ENGINE NOT RUNNING. READING SHOULD BE '0'



As indicated earlier, with the engine 'off', the reading on the gauge should be '0.' Allow the engine to warm to normal operating temperature. At sea level and with the engine in good condition, the reading at a fast idle should be approximately '19' or '20.'

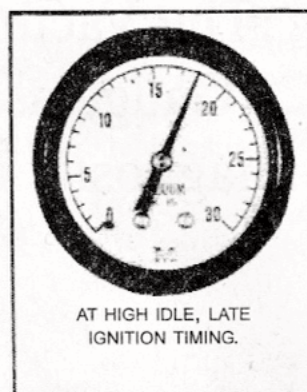


NORMAL READING AT SEA LEVEL AT A FAST IDLE.



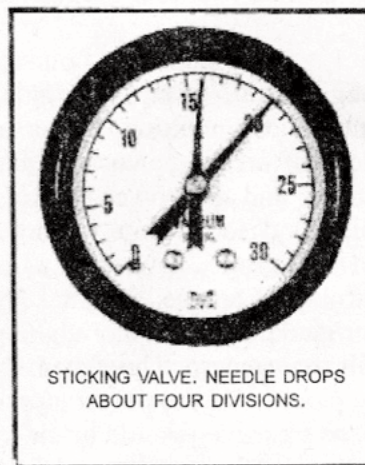
NORMAL READING AT ONE MILE ELEVATION. READING DROPS ONE DIVISION FOR EACH 1,000 FEET OF ELEVATION

A lower reading, say, about '16,' could indicate a retarded spark. Before going any further, check that the plugs are gaped properly, breaker points are properly adjusted and that the timing is set with a timing light. If after making ignition adjustments the reading is still low, adjust the carburetor. Set the idle for the highest possible reading on the vacuum gauge.



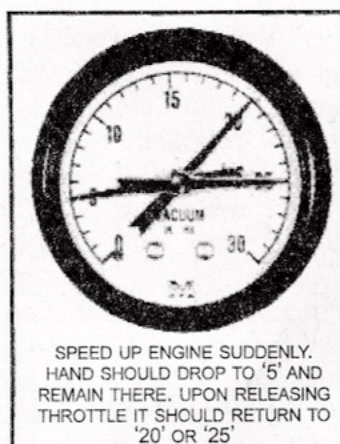
AT HIGH IDLE, LATE IGNITION TIMING.

A gauge reading, fluctuating between about '16' and '20' might indicate a sticking valve. Try this: remove the hose from the fitting on the intake manifold and squirt a little light oil into the vacuum gauge fitting hole. Reconnect the vacuum gauge. If the reading seems to smooth out near '20,' it is a sticking valve.



STICKING VALVE. NEEDLE DROPS ABOUT FOUR DIVISIONS.

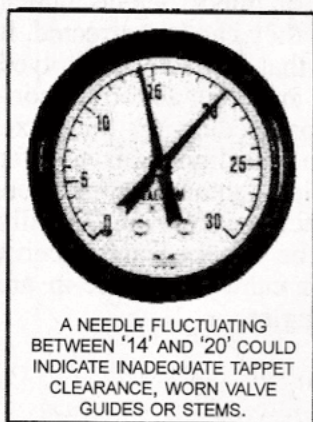
Next, with the engine running and the gauge reading '20,' or normal, speed up the engine suddenly, and hold the throttle down. The gauge needle should drop to about '5' and remain there.



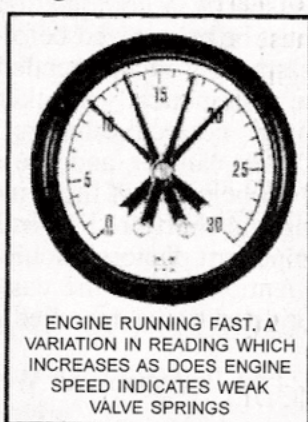
SPEED UP ENGINE SUDDENLY. HAND SHOULD DROP TO '5' AND REMAIN THERE. UPON RELEASING THROTTLE IT SHOULD RETURN TO '20' OR '25'

If the readings fluctuate, it is a good indication that the valve springs are weak. If the gauge needle slowly climbs back up, it is an indication that the valves are leaking. If the reading fluctuates

rapidly between '14' and '20' it is an indication that 1) there is insufficient tappet clearance, 2) valve guides are worn, or 3) valve stems are worn. A reading of about '12' indicates late valve timing. Early valve timing will cause backfiring, while late valve timing could cause overheating.



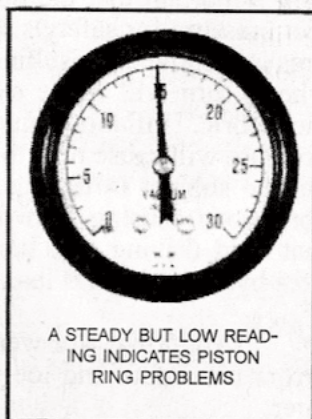
A NEEDLE FLUCTUATING BETWEEN '14' AND '20' COULD INDICATE INADEQUATE TAPPET CLEARANCE, WORN VALVE GUIDES OR STEMS.



ENGINE RUNNING FAST. A VARIATION IN READING WHICH INCREASES AS DOES ENGINE SPEED INDICATES WEAK VALVE SPRINGS

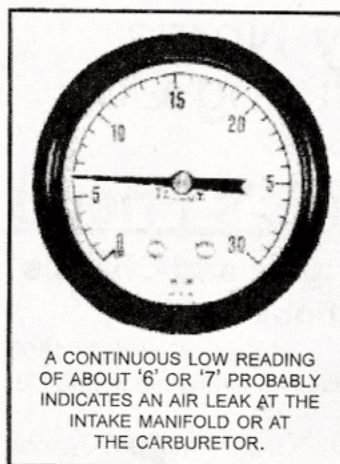
At idle, if there is a sudden drop in the vacuum reading, there may be a blown head gasket between two cylinders. You can generally locate the cylinder with the leak by touching the sparkplug terminals one by one with a screwdriver in order to see which one is firing as the reading on the gauge drops.

A steady reading, lower than normal - that is approximately '15' - probably indicates bad rings with a poor seal between the piston rings and the cylinder walls.



A STEADY BUT LOW READING INDICATES PISTON RING PROBLEMS

A continuously low reading - say '6' or '7' - tends to indicate an air leak in the system. It may be a leaking intake manifold gasket, a leaking carburetor gasket or a warped intake manifold. You can often locate such a leak by spraying around the intake manifold or the carburetor with a volatile spray. WD40, brake cleaner and starting fluid all



A CONTINUOUS LOW READING OF ABOUT '6' OR '7' PROBABLY INDICATES AN AIR LEAK AT THE INTAKE MANIFOLD OR AT THE CARBURETOR.

work. Do not spray too much, and spray just a small area each time to locate the leak. If a leak is located, you can tell by the needle on the gauge climbing and by the sound of the engine changing as the volatile spray replaces the air leak. A leaking or disconnected vacuum line will cause a similar problem. Early cars and trucks had very few vacuum lines to contend with. Generally the windshield wiper was the only 'vacuum line.' But newer vehicles use vacuum to operate a massive number of components, including - but certainly not limited to - transmission, heater, air conditioner, carburetor, and a variety of smog-reduction devices.

Other problems within a carburetor can also cause a poor reading. An air leak, at perhaps the throttle shaft due to a worn shaft or worn bearings, will allow too much air to enter. A defective idle adjusting screw could be the culprit. A poor reading at high engine speed could indicate partially blocked jets or jets which are too large. Replace the carburetor with a known good one to see if that clears up the problem.

Finally, if the vacuum windshield wiper is not operating and you are getting a good vacuum reading at the windshield wiper fitting, you may have a plugged hose to the wiper, or a leaking hose. Reconnect the windshield wiper hose to the intake manifold fitting and connect the vacuum gauge to the hose at the point that it connects to the wiper motor. If you do not get a reading similar to the one which you had at the manifold, replace the hose. If the vacuum reading is good though, it is an indication of a defective wiper motor.

S.K.

Tired of searching eBay and getting all kinds of offerings that have little or nothing to do with your search requests? Try this: tighten your search parameters. Instead of searching, for example, for Chrysler 300, try 1968 Chrysler 300, or even 1968 Chrysler 300 convertible. The more specific you are, the better chance of cutting down unwanted results. And try this, too. Enclose your search parameters in quotation marks. By specifying "1968 Chrysler 300" within quotes, you should eliminate a lot of extraneous garbage in your search results.