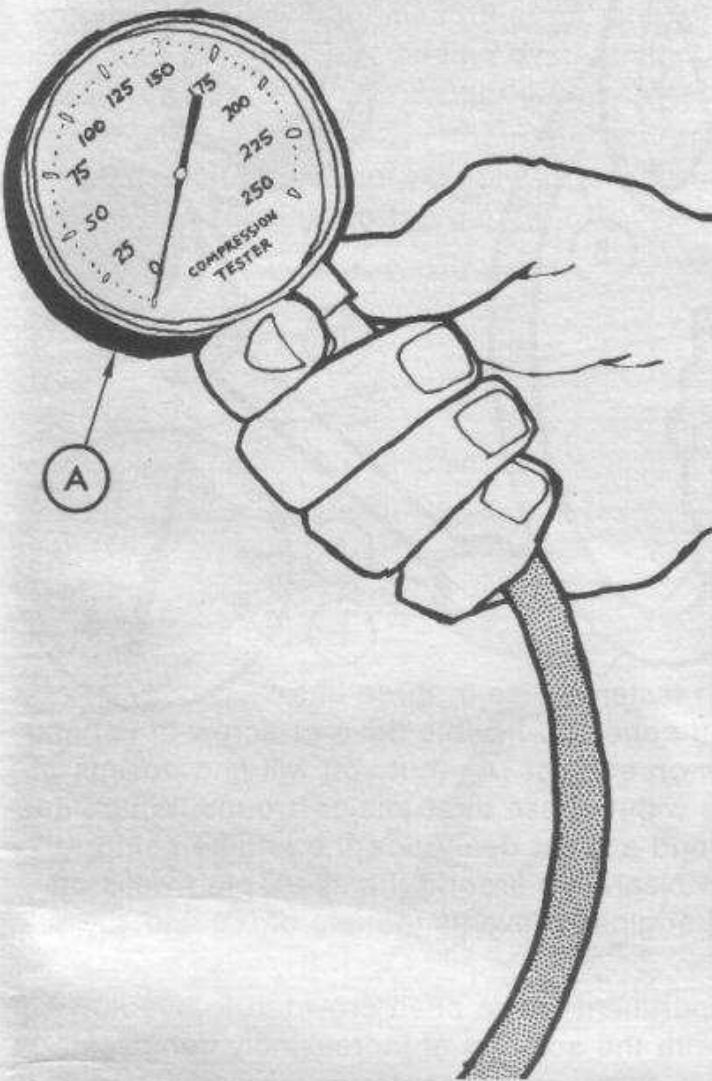


# COMPRESSION TESTER

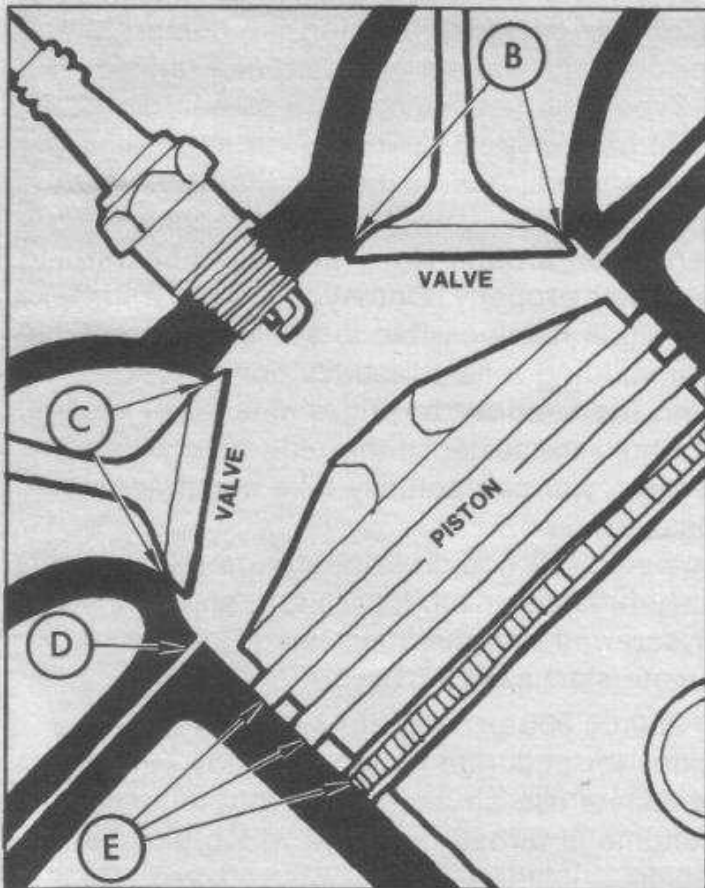


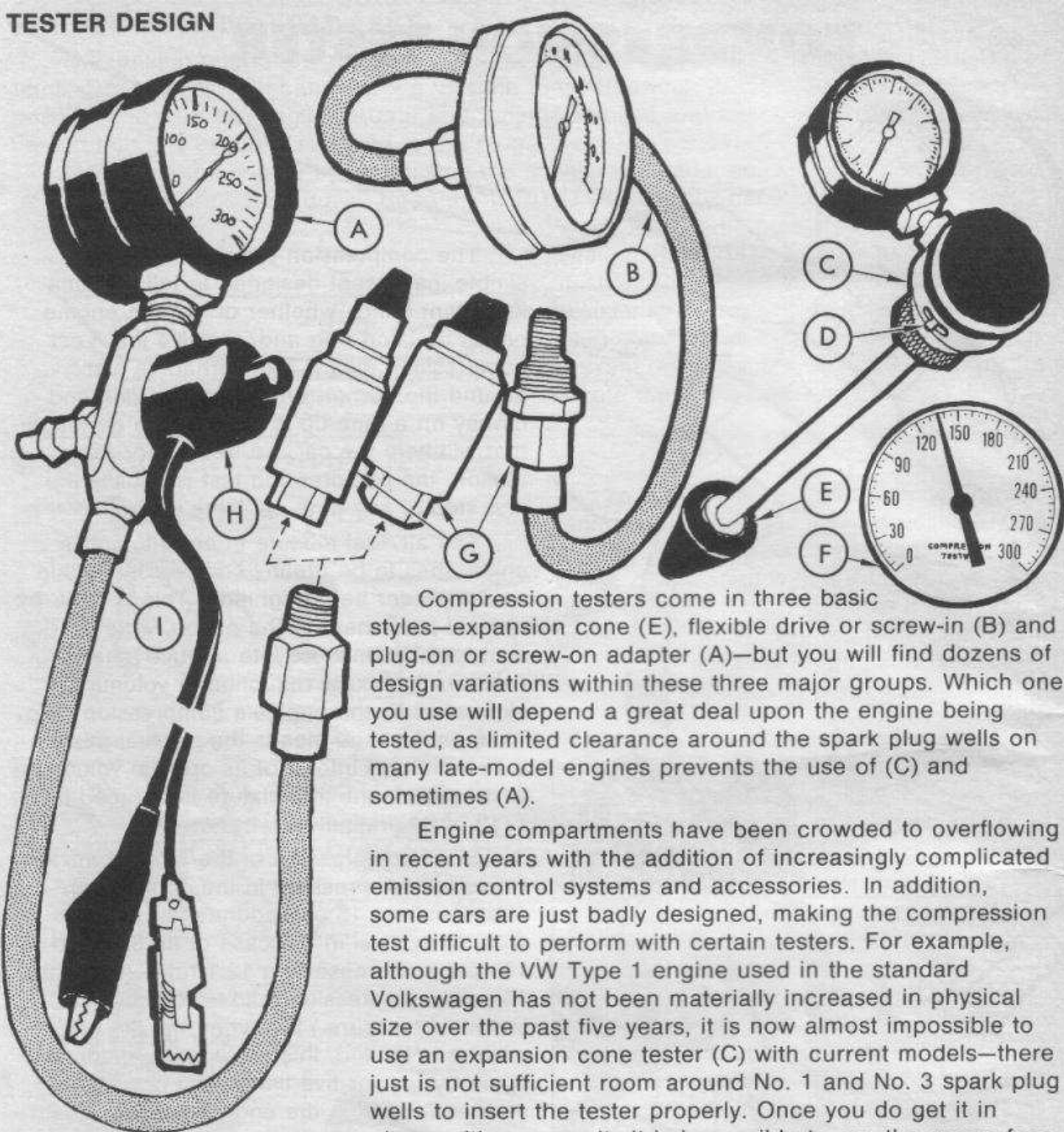
The compression tester (A) is a very simple instrument designed to tell you one important thing—whether or not the engine needs a piston ring and/or valve job. Lost compression means an overhaul is just around the corner, and spending time and money on a tune-up is not likely to do much that will help the car run better. For that reason, the compression test is usually the first step in any tune-up. Here's why.

The air/fuel mixture in an automotive engine has to be greatly compressed within each cylinder before ignition. This is done by upward movement of the piston, which squeezes the mixture into a much smaller volume. The exact reduction in volume is expressed as the engine's compression ratio. Thus an 8:1 ratio means the air/fuel mixture is compressed into  $\frac{1}{8}$  of its original volume; a 12:1 ratio means the mixture is reduced to  $\frac{1}{12}$  of its original volume.

Such compression of the air/fuel mixture increases the pressure in the combustion chamber from 15 psi (pounds per square inch) to 120 psi in the case of an 8:1 ratio, or 180 psi in the case of a 12:1 ratio. (Example:  $15 \text{ psi} \times \text{compression ratio} = \text{combustion chamber pressure}$ .) But when the air/fuel mixture is ignited, this pressure is multiplied again by four or five times. Full power and performance from the engine are dependent upon effective sealing of both compression and combustion pressure by the piston rings (E), intake and exhaust valves (B, C) and cylinder head gasket (D).

The compression test tells us when there is a loss of sealing in these areas and helps locate such a loss exactly. Because such mechanical defects cannot be remedied by adjustments of the engine or its accessory systems, we use the compression test to determine the state of the engine and whether it will respond to a tune-up. To do so, we connect a gauge in such a way as to measure the amount of compression in the cylinders.





Compression testers come in three basic styles—expansion cone (E), flexible drive or screw-in (B) and plug-on or screw-on adapter (A)—but you will find dozens of design variations within these three major groups. Which one you use will depend a great deal upon the engine being tested, as limited clearance around the spark plug wells on many late-model engines prevents the use of (C) and sometimes (A).

Engine compartments have been crowded to overflowing in recent years with the addition of increasingly complicated emission control systems and accessories. In addition, some cars are just badly designed, making the compression test difficult to perform with certain testers. For example, although the VW Type 1 engine used in the standard Volkswagen has not been materially increased in physical size over the past five years, it is now almost impossible to use an expansion cone tester (C) with current models—there just is not sufficient room around No. 1 and No. 3 spark plug wells to insert the tester properly. Once you do get it in place, with many units it is impossible to see the gauge face.

Those who own or work on more than one car will find a flexible drive compression tester (B) the most convenient, as it does away with the need for buying a new tester each time cars are traded. It also eliminates the need to hold the tester in the plug hole with a lot of force. With a flexible drive or other screw-in testers, you can actually take compression tests without using a remote start switch if necessary.

All compression testers consist of three basic parts: the compression gauge (F), which is fitted with a check valve or release button (D); a shaft, hose or tubing (I) and an expansion cone, plug fitting or adapter (G,E) that is fitted or screwed into the spark plug hole for an airtight connection. Some even have a built-in remote start switch (H).

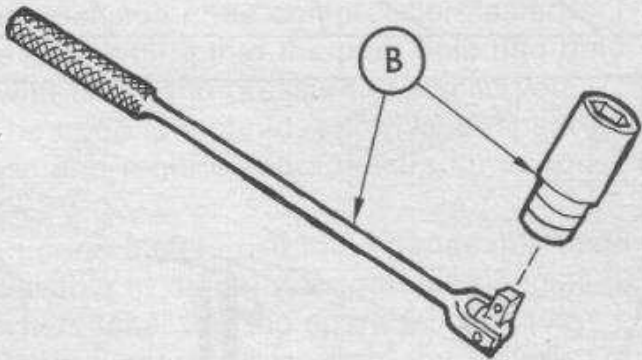
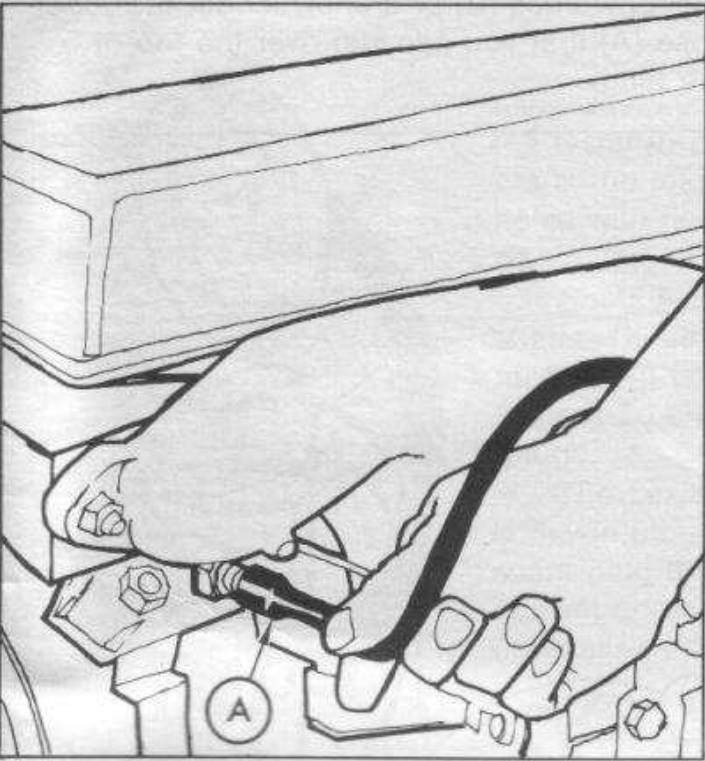
The compression gauge face (F) reads up to 250 or 300 psi, depending upon the manufacturer, and is marked in 5- or 10-psi divisions for accurate readings of any automotive engine you will need to test. The more expensive testers use an adapter tip that automatically seals itself in the plug hole by suction when the engine is turned over and which may be provided with a finger-grip handle for ease in holding.



## PREPARATIONS FOR USE

Check the engine oil for grade, amount and quality before making a compression test. Oil that is too thick may mean that an attempt has been made to compensate for piston ring or cylinder bore wear by adding overly thick oil. If the oil is extremely dirty, worn out or if the level is very low, the oil will not do its lubrication job properly and should be replaced.

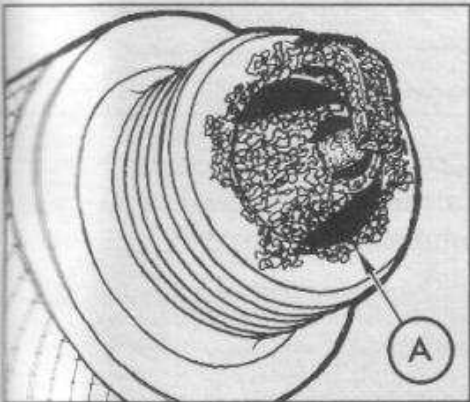
You should also make certain that the battery is up to at least 75% of full strength; if not, the starter motor may not be able to turn the engine over fast enough to give an accurate compression reading on the gauge.



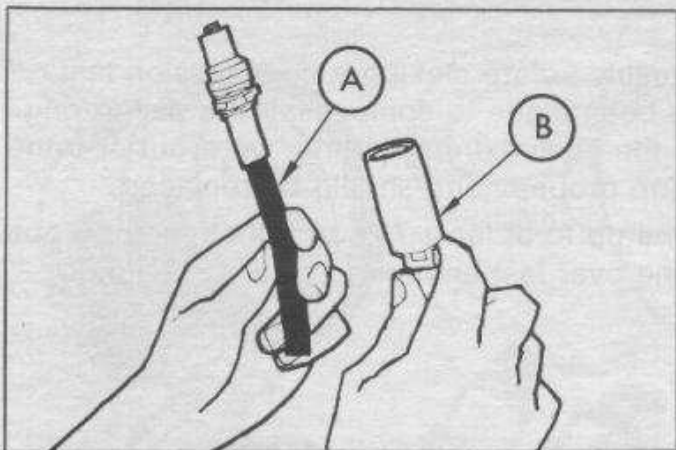
Run the engine until it reaches normal operating temperature, then shut it off. Mark and identify all spark plug wires (A) one at a time before disconnecting them, so that they can be replaced on the correct plug, then move them out of the way. Loosen each spark plug about one full turn with a spark plug socket and breaker bar (B)

**CAUTION:** BLOW THE SPARK PLUG WELLS CLEAN WITH COMPRESSED AIR. THIS PREVENTS ANY ACCUMULATED DIRT FROM FALLING INTO THE HOLES WHEN THE SPARK PLUGS ARE REMOVED. IF COMPRESSED AIR IS NOT AVAILABLE, USE A HAND TIRE PUMP OR WIPE WITH A CLEAN CLOTH. THIS IS ESPECIALLY IMPORTANT WHEN WORKING ON OLDER ENGINES THAT RECEIVED TUNE-UPS INFREQUENTLY AND WHERE DIRT AND GREASE BUILDUP MAY BE CONSIDERABLE.

Some auto manufacturers recommend loosening the plugs one turn, then starting the engine to blow out any carbon inside the cylinder that may have been dislodged by loosening the plug. Such carbon particles may lodge under a valve during the compression test, because there is no air flow through the combustion chamber to blow them into the exhaust as there is when the engine is running.

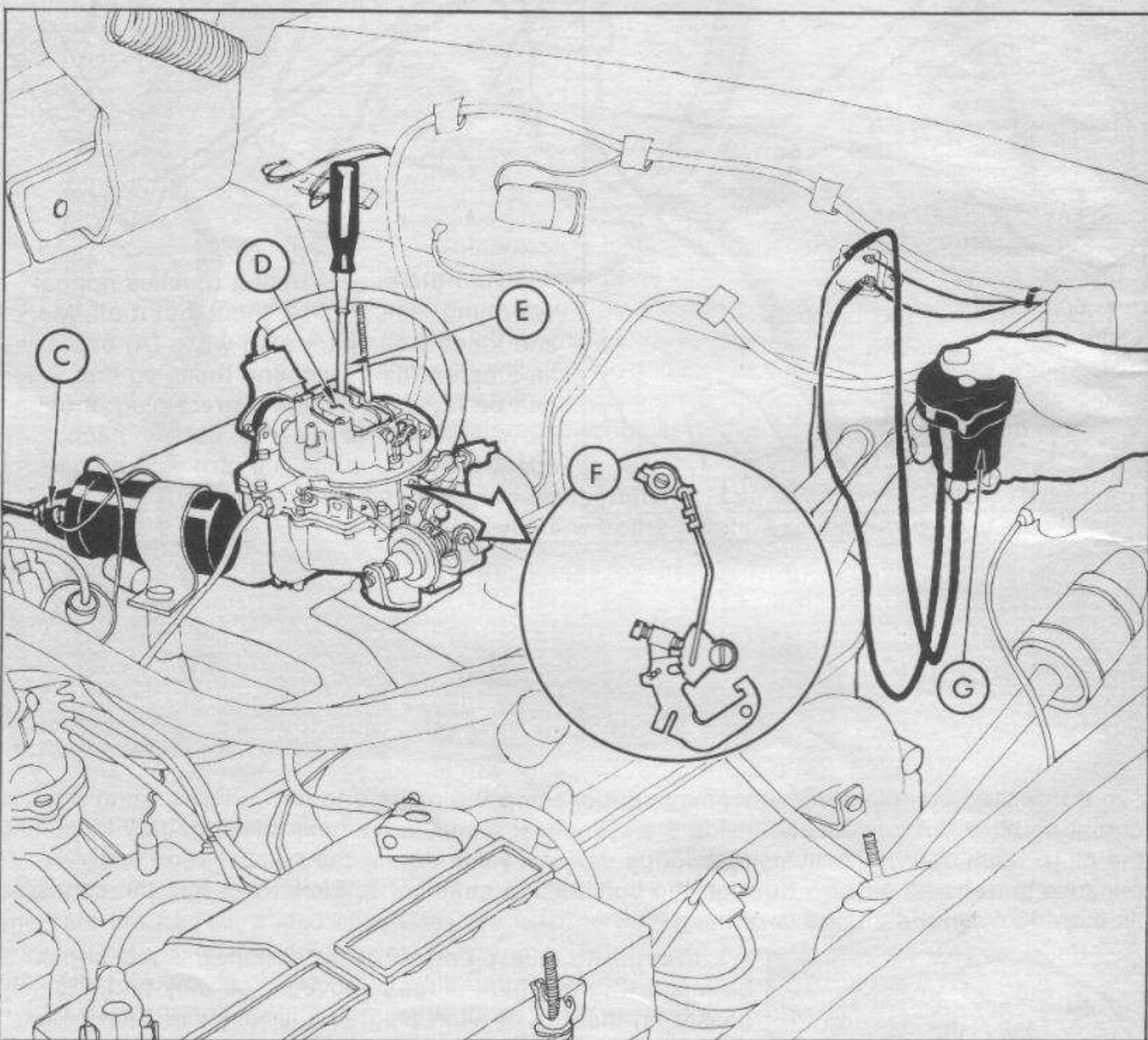


In order to relieve engine compression, this test should be made with all spark plugs removed. You *may* find a small gasket on the end of each plug as it is removed. *Don't lose them*; reuse is necessary for proper sealing. Many plugs do not use gaskets, however, so if they are not present, you are still okay. Check the electrodes and insulator at the tip of each plug for signs of excessive oil fouling (A). While oil-fouled plugs can be caused by a clogged PCV system, a leaking oil bath air cleaner element or just a simple case of too much oil in the crankcase, the odds are excellent that piston ring or valve problems are responsible.



**WARNING:** THE ENGINE WILL REMAIN CLOSE TO OPERATING TEMPERATURE WHILE YOU ARE WORKING ON IT. BE CAREFUL NOT TO TOUCH THE HOT EXHAUST MANIFOLD, ENGINE HEAD OR SPARK PLUGS.

Spark plugs should be removed with a socket wrench (B) or a short length of rubber hose (A) that you can slip over the top of the plug.



To prevent the automatic choke (D) from closing, insert a screwdriver in the carburetor air horn (E), then set the throttle valve (F) wide open. Connect a remote start switch (G—see that chapter) to let you turn the engine over from the engine compartment.

**CAUTION:** DISCONNECT AND GROUND THE IGNITION COIL HIGH-TENSION (SECONDARY) WIRE (C) TO PREVENT THE ENGINE FROM STARTING WHEN IT IS CRANKED.

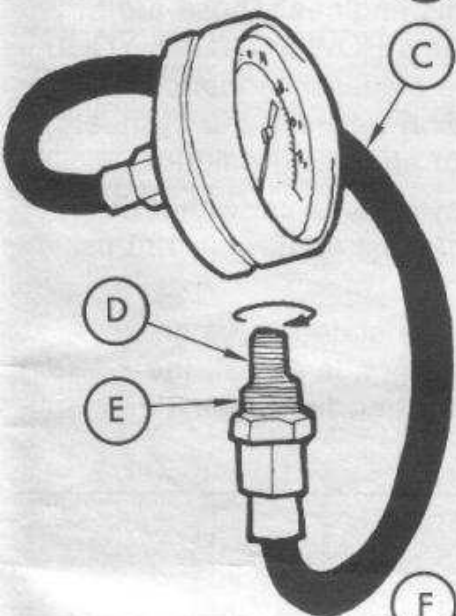


# ATTACHING THE COMPRESSION TESTER

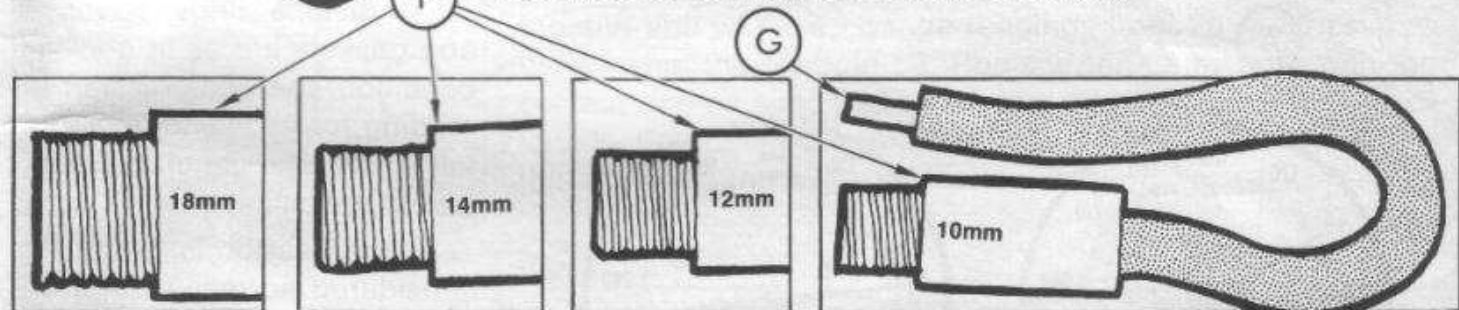


Connecting the expansion cone compression tester is easy. Just insert the cone fitting into the plug hole and hold the tester in place with firm hand pressure (A) while you crank the engine. The cone is tapered, so it fits all spark plug holes with equal ease and requires no adapters for various size plugs.

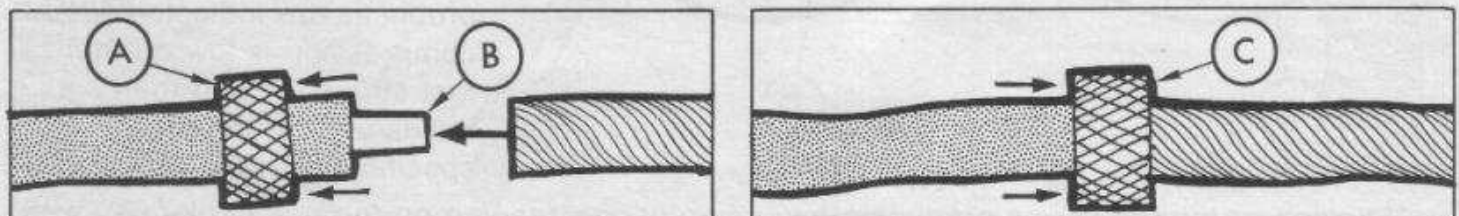
Some expansion cone testers use interchangeable cone shafts. These are available in different lengths and angles (B) for ease in testing when access to the spark plug well is limited. To change them, unscrew them from the tester gauge.



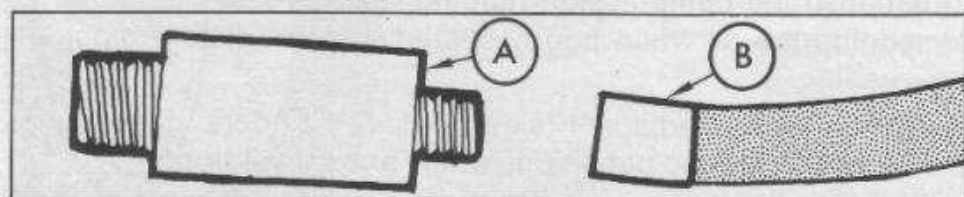
The flexible drive tester is equipped with a two-stage, screw-in plug fitting for use with 14mm (D) or 18mm (E) spark plug thread diameters. This will fit the majority of current engines. Simply screw it into the plug hole to finger tightness by turning the flexible hose (C).



The plug-on adapter tester is the most versatile, because adapters (F) can be obtained for 18mm, 14mm, 12mm and 10mm thread diameters, allowing you to test *any* engine, old or new. Attached to the plug adapter is a length of hose with a fitting (G) that couples with the gauge hose.



To use, screw the correct adapter size into the spark plug hole finger-tight. Pull back the sleeve (A) on the adapter hose end and push the gauge hose all the way onto the fitting (B). Then slide the sleeve (C) forward to make the connection airtight.



The screw-on adapter (A) is threaded on both ends. One end screws into the plug hole. The other end screws into a metal fitting on the end of the gauge hose (B).

## COMPRESSION TESTING

All cylinders should be tested for compression. Turn on the ignition switch and use the remote start switch to crank the engine with the compression tester in place. Turn the engine over for at least four and preferably six to eight compression strokes. You should record the reading obtained on the first stroke as well as the final stroke. Remove the compression tester and clear its gauge of the remaining air by depressing the release valve or button (if it is so equipped). Attach the tester to the plug hole next in line to test that cylinder. Repeat for each cylinder.

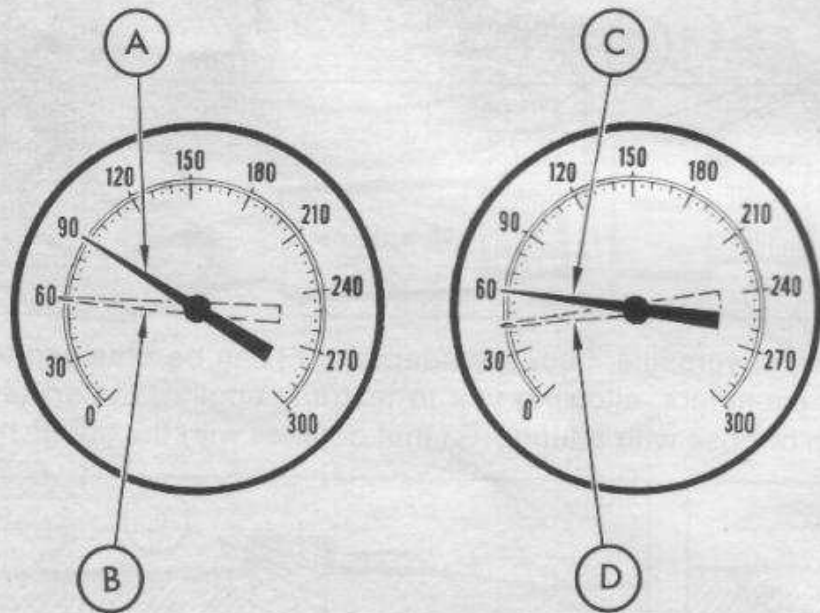
## COMPRESSION SPECIFICATIONS

Each manufacturer publishes compression specifications for his engines. These are usually found only in a factory shop manual or a book like Petersen's HOW TO TUNE YOUR CAR, although foreign car manufacturers often include them in the owner's handbook. As the value of a compression test is to determine variations in compression between the cylinders, these specifications are commonly expressed as a range instead of an absolute figure.

In many cases, the specifications require the lowest-reading cylinder to be within a percentage (usually 75%) of the highest reading. Example: If the highest reading is 120 psi, the lowest should be at least 90 psi.

Alternatively, the specifications may give a minimum figure with a stated variance or range between the cylinders. If the minimum is 110 psi and the variance is 40 psi, the compression in all cylinders is correct as long as the difference between the highest and lowest is 40 psi or less and none are below 110 psi.

## TEST INDICATIONS



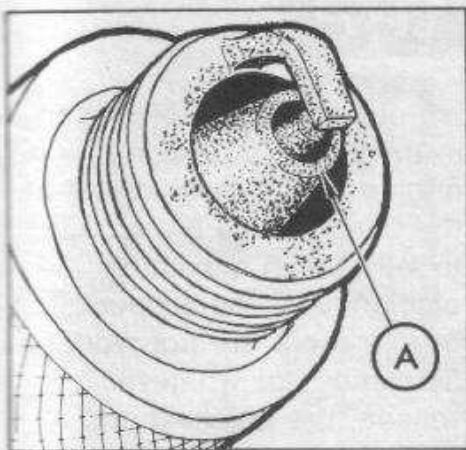
If pistons, rings, valves and gaskets are all in good condition, the compression test reading for all cylinders should fall within the manufacturer's stated specifications.

Compression is considered normal when the gauge reading builds up uniformly with each compression stroke to the specified figure. Piston ring problems are indicated when compression is low on the first stroke (B) and then builds up, but not up to specifications (A).

Sticking or burned valves produce a low compression reading on the first stroke (D), with little buildup on successive strokes (C). To accurately differentiate between ring and valve problems, pour a teaspoon of SAE 30 oil (engine off) into the spark plug hole of the low-reading cylinder to seal the rings and then retest. Little or no increase in the reading indicates that the valve is at fault, because the compression reading will increase considerably (10 psi or more) after adding the oil when poorly seated or worn piston rings are responsible for the original low reading.

If identical low readings are obtained on two adjacent (side-by-side) cylinders, gasket leakage between the cylinders is likely. Look for indications of water and/or oil in the cylinders.

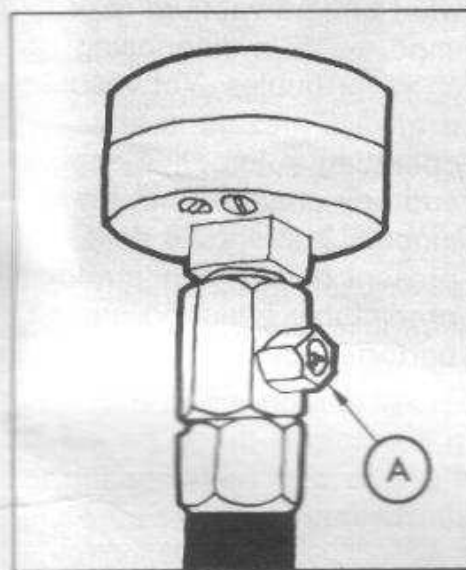




The accumulation of carbon deposits between the top of the piston and the cylinder head causes compression readings considerably higher than what the manufacturer specifies. One tip-off to this problem is a "pinging" sound when the engine accelerates under load (goes uphill or passes another car). Another is the presence of sooty, dry carbon covering the entire tip area of one or more spark plugs (A). It may be possible to correct this fault by using a plug with a higher heat range, but an excessively rich fuel mixture or a choke that is not opening fully might also be the cause. Check both possibilities before changing to a "hotter" spark plug.

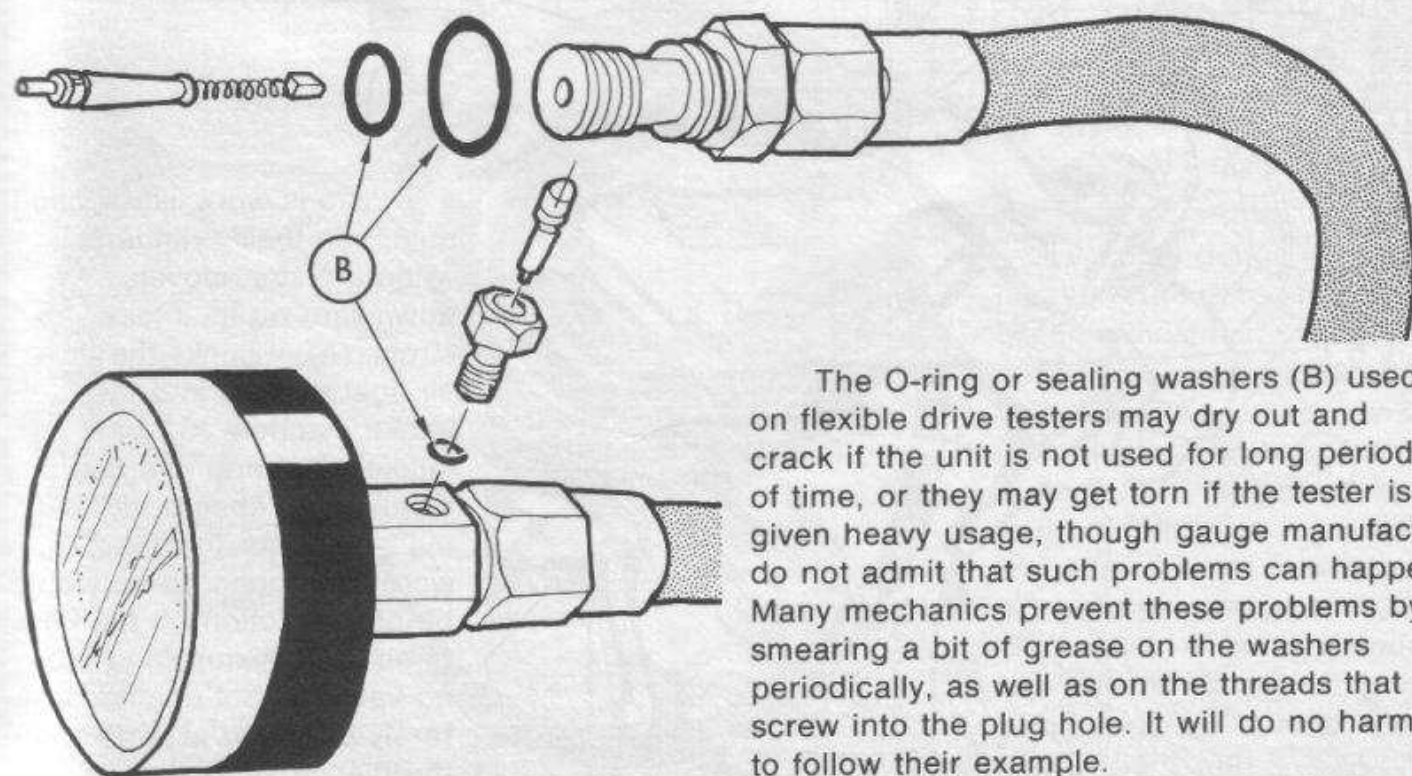
The use of high-compression heads on a performance option engine will also cause compression readings higher than specified.

## COMPRESSION TESTER MAINTENANCE



The major problem encountered with this simple test instrument is that of a leaking relief or check valve core (A). If the gauge does not seem to be working properly, remove the valve with a valve stem tool and look for dirt or contamination that may be interfering with its operation.

Cleaning the valve with solvent and compressed air and replacing it usually restores the compression gauge to proper operation, but if this does not stop the leak, it will have to be replaced. While any ordinary tire valve core will fit nicely in its place, avoid such a substitute. A tire valve core spring is too stiff and will keep gauge readings from 20 to 35 psi below what they should be. Replace the faulty core with the correct one as specified by the gauge manufacturer—this can usually be obtained from an auto supply store that handles the manufacturer's line of test equipment.



The O-ring or sealing washers (B) used on flexible drive testers may dry out and crack if the unit is not used for long periods of time, or they may get torn if the tester is given heavy usage, though gauge manufacturers do not admit that such problems can happen. Many mechanics prevent these problems by smearing a bit of grease on the washers periodically, as well as on the threads that screw into the plug hole. It will do no harm to follow their example.