

COMPRESSION & LEAK-DOWN TESTING OF ENGINES

Scenario: You have your Ferrari advertised for sale and someone has developed a lot of interest in it, but before he will buy it he wants to have it checked over and a compression test done. Sounds reasonable, so you agree on a shop that you both trust to do the test and the car flunks! What went wrong, and what do you do now?

Most enthusiasts know that a compression test is a valuable tool to help determine the relative health of an engine, but few seem to be aware of the several factors that can significantly affect the test's outcome and lead to inaccurate conclusions, especially when comparing one car's results with those of a similar car being considered, these variables must be controlled and the findings given appropriate interpretation.

One important factor is engine temperature. Was the test performed on a stone cold engine or one that had just been driven across town to the shop? Most engines will produce ten to twenty pounds additional compression when warm, especially all-alloy units like a Ferrari. Another variable is throttle position. Most technicians will correctly lock the throttles wide open during testing, but if one man didn't, that car's test will show reduced readings.

Frequently, valuable cars that are being considered for purchase have not been driven regularly and a compression test done on one of these "hangar queens" is not necessarily valid. A car that has been stored for an appreciable period should be given a good run prior to testing to reduce the chance of sticking piston rings, which would lead to low readings. Also, such cars may have a deteriorated battery that will hold down cranking speeds and skew results. A booster/charger should be hooked up or a fresh battery substituted to insure meaningful figures.

Another factor easy to overlook is that of altitude. I once had a man in California who lost interest in a car I was selling because, according to his local expert, my car's compression readings were all 10-20# too low. Since these readings were taken in a Denver suburb nearly 6,000 feet above sea level, they were naturally below what would have been expected in L.A.

This last example illustrates another truism about compression readings: *variance* between cylinders is of much greater importance than absolute values. As I have discussed, altitude, temperature, etc., can all affect absolute readings, not to mention potential gauge variance. If you have ten cylinders at 130-135# and two at 25#, that indicates a problem, while a ten-pound variance from some arbitrary standard probably doesn't.

When a compression test shows that cylinders are significantly lower than the norm, a second test should be run after squirting a bit of oil into each cylinder through the sparkplug hole. The oil will provide a temporary seal around the piston rings and if the retest shows markedly improved compression one can suspect piston or ring problems. However, if this "wet" test does *not* produce normal readings, there are other likely problems such as a burned valve or leaking head gasket, since the compression loss is evidently not going past the rings. In order to more accurately diagnose the problem a second procedure should be run, a cylinder leak-down test.

The cylinder leakage test is at least as important a diagnostic tool as a compression test in evaluating an engine, and should be performed as a matter of course. It consists of bringing each cylinder in turn to top dead center, assuring that both valves are completely closed, and introducing pressurized air into the plug hole through a sealed fitting and a device that measures the rate - expressed as a percentage - at which the air must be replenished. If absolutely no air escaped past rings, valves, etc.

you would have 0% leak-down. In fact, the freshest engine will have 3-4% leakage; 6-10% is fine, but cylinders with problems can read up to 20-30% leakage or more.

This test will also help pinpoint the probable cause of a weak cylinder. For example, if the technician can hear air escaping through the carburetors, the likely culprit is the intake valve. A poorly-seated exhaust valve will ventilate out through the exhaust and a bad head gasket may bubble the coolant in the radiator.

Getting back to our original premise, what is the proper response when your car, or one that you are thinking of buying, turns up with a weak cylinder reading? It is considered normal for an engine to have a 10-15% variance between its highest-compression cylinder and the lowest, and as discussed, a moderate variance in these values from that of a published standard for that car should not be cause for alarm. But if you have one hole 100# lower than the rest there is definitely a problem - but it *could* be benign! Let's look a little further:

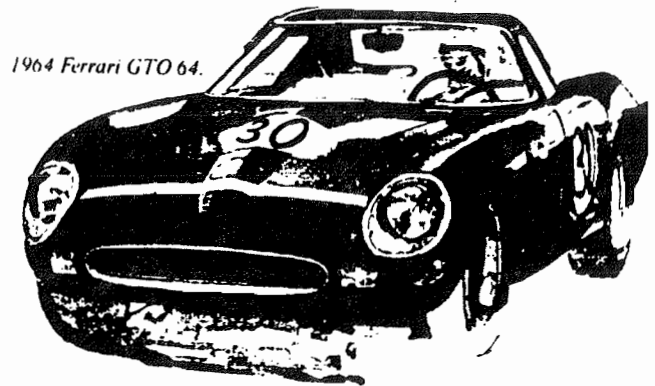
If the leakdown test showed passage by the exhaust valve, you might have gotten lucky. Its not unheard of for a flake of carbon, dislodged when the sparkplugs were removed, to stick on the exhaust valve seat. This will create quite a compression leak and a frightening test reading, but driving the car a bit will usually dislodge it and a retest may show a normal compression.

Another potential simple solution that should be looked for if either valve showed leakage and the carbon-flake theory didn't help, is to check the adjustment of the offending valves. They may have been misadjusted or tightened up and a loose setting will often restore their seating. Sometimes, if improvement isn't found immediately, several hundred miles of driving will help to reseal valves that were run too snug. If this cure fails to help, a burned valve or defective seat is pretty well assured.

Unfortunately, if the leakage seems to be going past the head gasket you've rolled snake eyes and the only real fix will be to remove the head and address whatever problem you find in a professional manner. Of course, if none of the valve seating tricks mentioned helps either, decapitization is called for as well.

Just to put this worst-case alternative into perspective, don't lose sight of why you had the car checked to begin with: to find out if there was anything major wrong with it. Problems that you know about are much preferable to those that come as a surprise! If a \$100,000 car proves to be exceptional in every other aspect but needs a \$3,000 repair to be perfect, that's a very negotiable sum relative to the transaction's value to both buyer and seller.

- Bill Orth, Technical Committee



1964 Ferrari GTO 64.