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Engine Diagnosis

Subject **Page**

Initial Print Date: 03/05 Revision Date: 04/11

Engine Diagnosis

Model: All

Production: All

OBJECTIVES

After completion of this module you will be able to:

- Understand the Operation of New Generation Engines
- Utilize BMW Diagnostic Equipment to Diagnose Engine Related Complaints
- Understand Engine Diagnosis Using Basic Hand Tools

Engine Diagnosis

When attempting to diagnose driveability complaints, always consider the basics. Regardless of the level of technology employed on an engine, it still needs a few basic things to occur in order to run properly. Whether the engine employs the latest technology or not, always refer to the basic principles first.

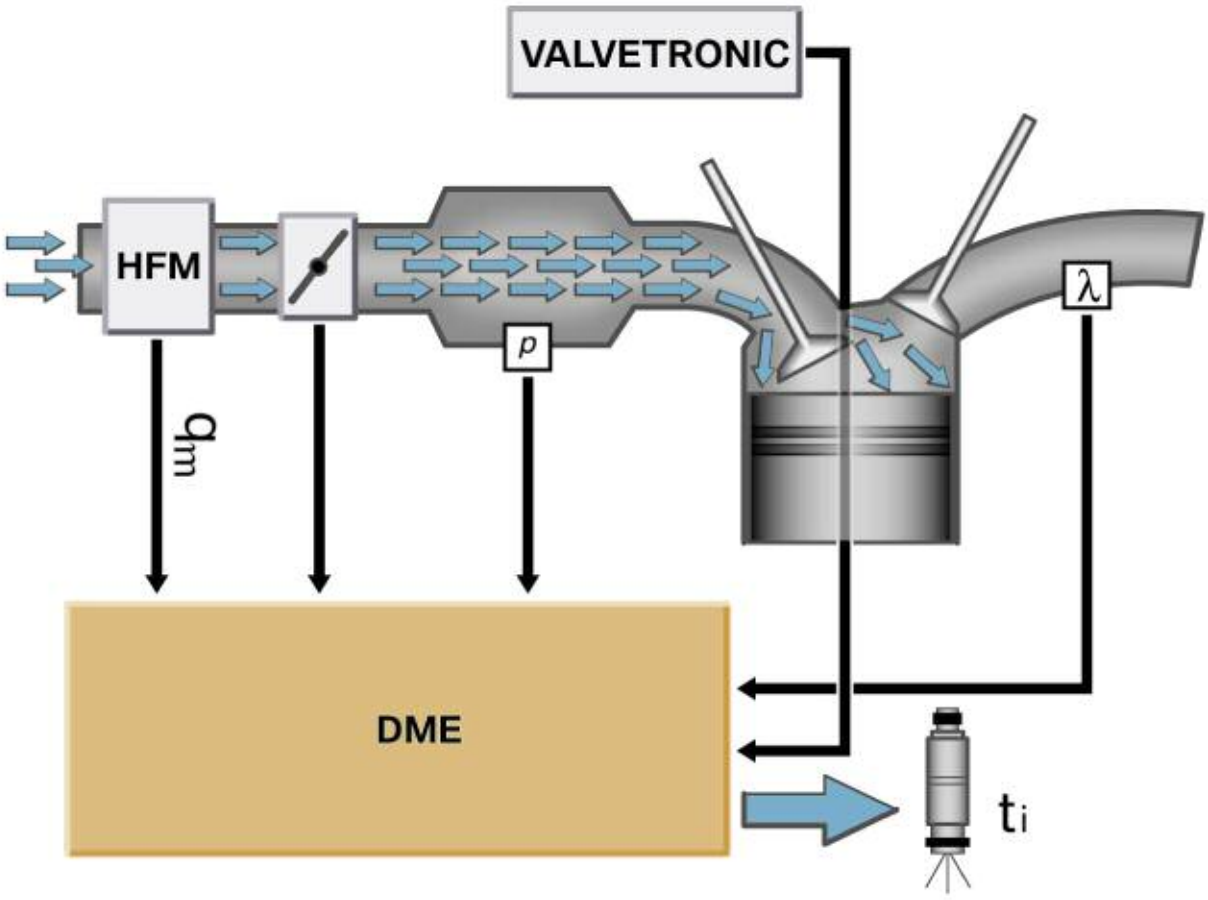
Any engine using **four-cycle spark-ignition** (Otto cycle) principles must meet the same fundamental conditions to run properly. Most engine related driveability problems fall into a few basic categories:

- No Start/No Crank
- Extending cranking before engine start
- Rough Running Cold Idle
- Rough Running Warm Idle
- Rough Running Under Load
- Lack of Power
- Check Engine Light (MIL)

N63 engine cut-away

When referring to engine basics, all engines need fuel, air and spark to run. However, in order for a spark-ignition engine to run properly, a few things must be taken into consideration. The fuel, air , spark principle can be broken down further into the following categories:

- Sufficient engine compression with a leak-free combustion chamber.
- Sufficient amount of ignition voltage (spark) at the correct time.
- Proper fuel pressure and volume.
- Properly functioning fuel injection system (Engine management).
- Properly functioning air management system (Electronic throttle systems).
- Correct valve timing (VVT and VANOS).



Compression Testing

In order for an engine to run smoothly and efficiently, the combustion chamber must be free of leakage. An engine with low compression in one or more cylinders is inefficient and will run rough or lack in performance. Low compression may or may not cause the MIL to illuminate.

Low compression can be caused by the following:

- Leaking valves caused by burned valves or seats. The valve guide can also be worn causing the valve not to seat properly. Valves can also be bent from piston contact (from over-rev).
- Piston Rings which can be worn from high mileage or poor maintenance. Also, the rings can be damaged from foreign material or improper installation.
- Cracks in cylinder head or engine block. Cracks can be caused by overheating resulting in misfires or rough running.
- Defective cylinder head gasket. The cylinder head gasket can fail due to overheating which can cause cylinder leakage resulting in misfire, low compression and rough running.
- Bent connecting rod. A connecting rod can be bent from a defective fuel injector or water ingress into the combustion chamber causing hydrostatic lock.

Compression testing can be performed using a conventional compression gauge. There are some preliminary tasks and safety precautions that must be carried out before starting the compression test:

- Remove the fuel pump fuse and or relay, start the vehicle and allow vehicle to stall out on residual fuel.
- Disable ignition by unplugging all ignition coils and remove **ALL** sparkplugs.
- Connect battery charger to vehicle.
- Ensure that the throttle is wide open during cranking (see special note for VALVETRONIC equipped vehicles).
- Crank engine until compression gauge stops increasing. Be sure to crank engine equally between cylinders.
- Continue compression test on ALL cylinders so comparisons can be done.

* Record readings

- If necessary, re-check cylinders with suspect readings.
- If some cylinder readings come up low, add a few drops of oil and re-check. This can differentiate between valves/rings.

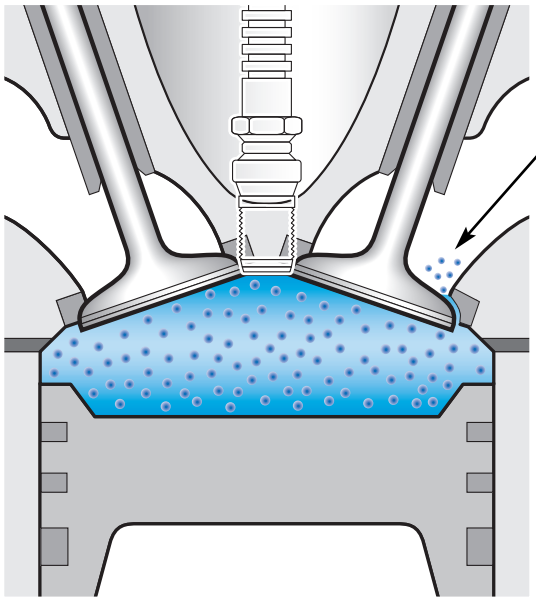
Cylinder Leakage Testing

Once a problem cylinder is detected via a compression test or by other means, a cylinder leakage test is used to pinpoint the problem area.

The leakage test uses an air pressure gauge and compressed air to indicate the percentage of air loss. By listening and observing at key points, the problem can be narrowed down before the engine is disassembled.

The first step is to bring the piston to TDC (compression stroke). Then compressed air is introduced into the cylinder using the cylinder leakage tester. Be sure the engine does NOT rotate, if the engine rotates, the engine was not at true TDC.

Check the gauge on the tester, it should read in percentage of leakage. Check the engine specification for permissible leakdown. A general rule of thumb is 15% or less for a good cylinder. However, some engine have a tighter tolerance.
Most BMW engines should be at 8% or less.



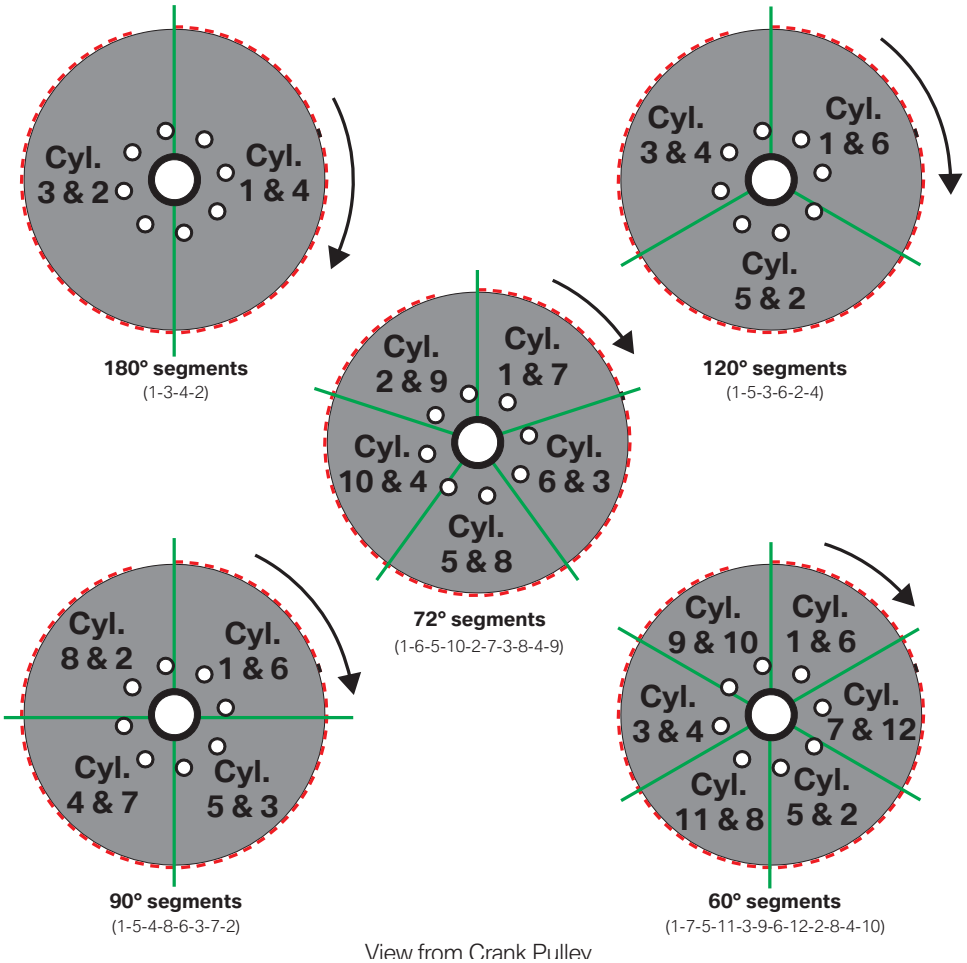
If any cylinder shows excessive leakdown, check for leakage by listening or observing the following points:

- Listen for air (hissing) at the tailpipe. This would indicate leakage at the exhaust valves on that cylinder.
- Listen for air (hissing) at the throttle. This would indicate leakage at the intake valves on that cylinder. (Be sure throttle is wide open and listen at throttle opening)
- Open the oil cap and listen for air. This would indicate air leakage into the crankcase. This would be piston rings or cylinder bore concerns.
- Observe the coolant reservoir and or remove the radiator cap. Bubbles in the coolant would most likely indicate head gasket leakage or cracked block/head.

Hints on Cylinder Leakage Testing

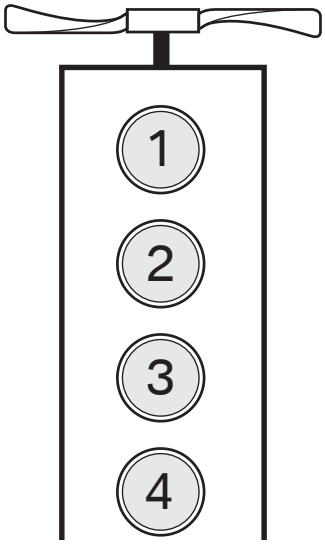
When performing cylinder leakage tests, the following tips might be helpful:

- Remove all spark plugs to allow easier rotation of the engine. (If this test is done after a compression test, the plugs should already be out).
- Perform the leakage test on all cylinders, not just the problem cylinder. This would indicate any other problems which can be rectified. This eliminates any repeat repairs and wasted diagnostic time.
- Perform the leakage test in cylinder firing order starting with cylinder #1. It takes two revolutions of the engine to complete the leakage test.
- Start at cylinder #1 and rotate the engine to the next cylinder in the firing order. Divide the number of cylinders into 720, the result is the number of degrees that each cylinder fires. For example, if you divide a 6 cylinder into 720, this equals 120 degrees. If you start at cylinder 1 and rotate the engine 120 degrees in the direction of rotation, you can check the next cylinder in the firing order.
- This process eliminates the need to rotate the engine an excessive amount.



Cylinder Arrangement and Firing Order

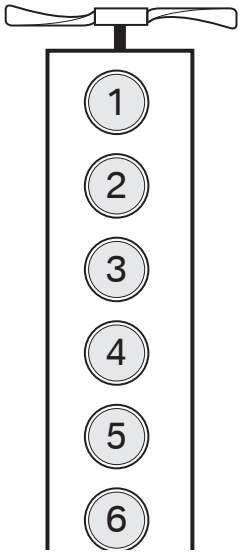
4-Cylinder



M10, M42, M44, S14, **N20**

Firing Order 1-3-4-2

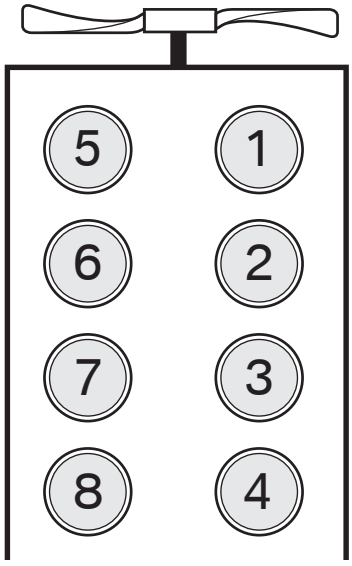
6-Cylinder



M20, M30, M50 (TU), M52 (TU), M54, **N52, N52KP, N51, N54, N55,** S38, S52, S54

Firing Order 1-5-3-6-2-4

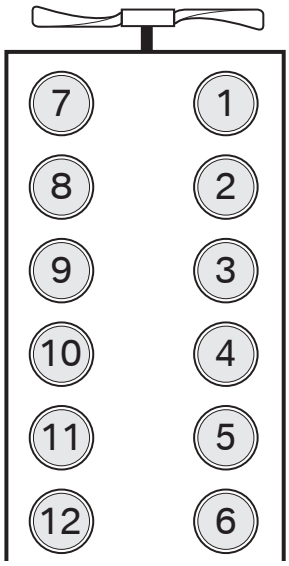
8-Cylinder



M60, M62, M62TU, N62, N62TU, **N63,S63, S65**

Firing Order 1-5-4-8-6-3-7-2

12-Cylinder



M70, M73, M73TU, N73**,** S70**, N74**

Firing Order 1-7-5-11-3-9-6-12-2-8-4-10