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| Station | | Task | |
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| Static 1503 & 903 | | | |
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# 1503 Engine Leak-Down Test

## Task Objective

At the completion of this task the technician will be able to properly perform a 4-stroke engine leak-down test. The technician will be able to give a clear explanation of the results obtained, so that the mechanical condition of the engine can be determined.

#### Repair Order Information

The customer states there is a lack of engine power and the engine is running rough.

**Introduction**

**Compression and Leak-Down Tests**

In addition to a properly proportioned mixture of air and fuel and strong and properly timed ignition spark, the engine must produce enough compression to compress the air/fuel charge to a point where it is dense enough to be easily ignited. Anything that reduces an engine’s ability to adequately compress the air/fuel mixture will negatively affect engine performance.

There are two methods by which an engine’s mechanical integrity can be tested; a cranking compression test (dynamic compression testing), and a cylinder leak-down test (static compression testing).

A cranking compression test is performed using a compression tester (Gauge) which threads into the sparkplug hole. With the ignition disabled and the throttle wide open, the engine is then cranked, either manually with a kick or pull starter or with the engine’s electric starter, and a pressure reading is taken. The test reading is then compared to the engine’s cranking compression specification to determine if the compression is within specification.

A cranking compression test will tell you if an engine is actually providing compression. If compression is low or there is no compression at all, obviously there is a problem.

A cranking compression test will not, however, indicate where there is a loss of compression. A cylinder leak-down test is utilized to determine where the engine is losing compression.

A cylinder leak-down test is also performed to determine the percentage of loss in the cylinder.

The first test that should be performed is a compression test and if the compression is lower than the specification, a cylinder leak check should be performed.

On multiple cylinder engines only the cylinder or cylinders that showed less than specified compression should be tested. It is not necessary to perform a leak down test on an engine that the compression shows good.

**Compression Testing**

In order to obtain accurate compression pressure results the following steps must be taken:

* On electric start vehicles these tests must be performed with a fully charged and tested battery.

Slow cranking speeds affect compression pressure.

* On engines equipped with a decompressor lower than normal reading may be normal Comparison with a known good vehicle will give an indication of a normal reading
* The ignition system must be disabled. Ignition system damage may result.
* Sparks can ignite fumes in the engine compartment.
* Fuel injectors must be disabled.
* Fuel vapors can be pumped into engine compartment.
* All sparkplugs are to be removed. Spark plugs left in can slow the cranking speed.
* The throttle plate must be fully opened. This allows a full air charge to enter the engine.
* The compression gauge is inserted into the spark plug hole.
* The engine is cranked over four to five times.
* The reading from the gauge is recorded.
* The readings are compared to specification.

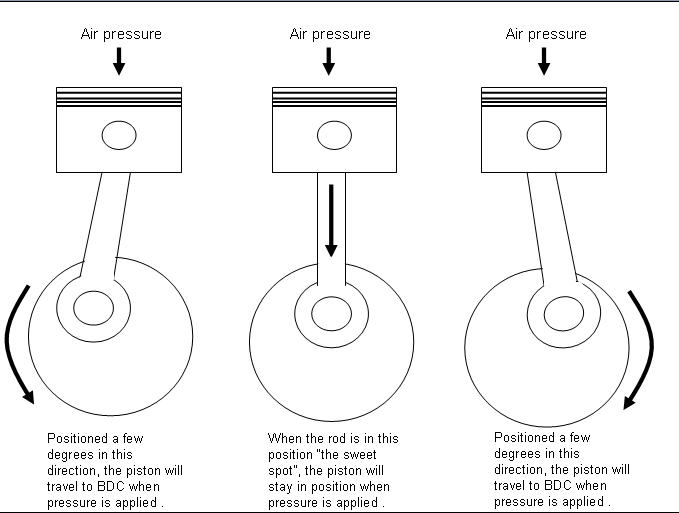
NOTE: If the compression is lower than specification, the problem may be the piston’s compression rings. This can be further confirmed by injecting a small quantity of oil into the cylinder, which will help the rings provide a better seal. If the compression reading increases considerably, the piston rings are likely worn beyond their service limit.

**Cylinder Leak-Down Test**

A cylinder leak-down test requires a pressure gauge, a hose and fitting assembly, one end of which threads into the sparkplug hole, the other end connects to a source of compressed air. The leak-down test tool also includes a regulator to control air pressure.

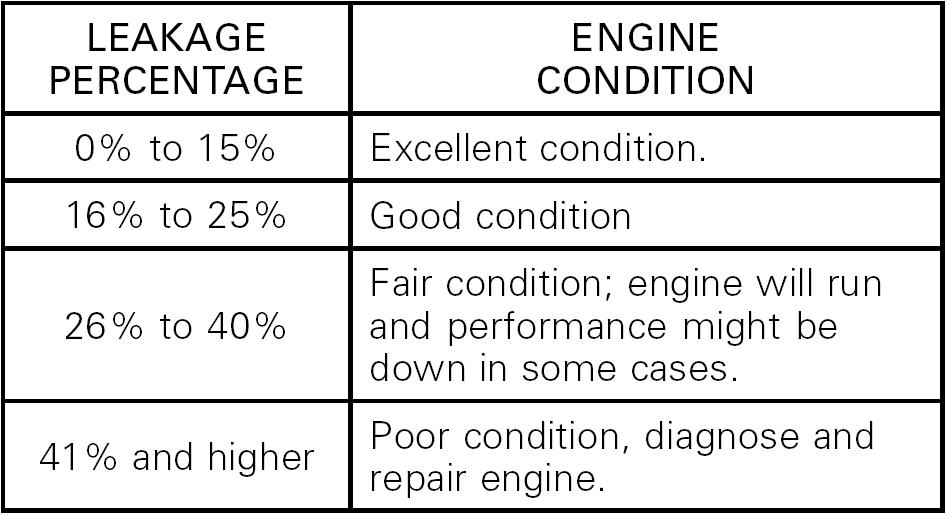
To perform a leak test first the piston must be positioned at TDC "Top Dead Center" of its compression stroke, when both intake and exhaust valves are fully closed. The crankshaft must then be rotated to "exactly" TDC, and in some cases secured so that it cannot rotate. If the engine cannot be secured at TDC compression stroke for each cylinder, then the piston and connecting rods exact TDC or "sweet spot" must be found. There can be several degrees of crankshaft rotation while the piston is at TDC, a few degrees before TDC and a few degrees after TDC, yet the piston is still at TDC. To determine exact TDC you must observe the piston when it first reaches TDC and then while continuing to turn the crankshaft, observe when the piston begins to leave TDC.

Mentally note how many degrees of crankshaft rotation the piston was at TDC and find the center point of rotation. This will be an estimated exact TDC and this is where the leak test is performed. If the engine rotates when air pressure is applied to the cylinder, estimate the position again and give it another try. The following illustration refers the exact TDC position in relation to the connecting rod.



# Once exact TDC has been positioned screw the leak test hose into the spark plug hole. Then install the leak-down test tool regulator on to the air supply hose, the regulator is used to set the gauge needle to 0% of leakage. The hose that is screwed into the cylinder is then connected to the regulator. This allows compressed air to fill the engine’s cylinder. The gauge is then observed to determine the percentage of leakage of the cylinder. The drop is compared to the allowable leakage as listed in the shop manual and repairs are made if appropriate. A cylinder leak-down test can identify leaking intake or exhaust valves and worn compression rings. If the percentage of leakage is excessive but there is no audible leak at either the intake or exhaust valves, the problem may be the piston’s compression rings. This can be further confirmed by injecting a small quantity of oil into the cylinder, which will help the rings provide a better seal. If the percentage of leakage then goes down, the piston rings are likely worn beyond their service limit. A leaking head gasket can also be at fault, removing the radiator cap and looking for bubbles inside will give a good indication if there is a leak into the cooling system.

**Cylinder leak-down test**

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Typical leakage percentage results

– Air escaping out intake ports means leaking intake valve(s)

– Air escaping out exhaust port means leaking exhaust valve(s)

– Air bubbles in coolant tank means leaking cylinder head gasket

– Air escaping into crankcase means excessively worn and/or broken piston rings.

# Cylinder Leak-Down Test

**Note:** Another important point when performing a cylinder leak-down test, or a compression test, is to make sure the engine is at normal operating temperature. This insures that all components have expanded, are properly coated with lubricant, and seal, the way they normally would. Obviously if the engine does not run or is new and not broken in, some allowance needs to be made in what is an acceptable leak-down %.

# Procedures

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| 1. Remove valve cover. | | | | | | | |
| 1. With an appropriate wrench rotate the engine using the drive shaft adapter. | | | | | | | |
| 1. Insert an appropriate TDC indicator tool into cylinder number 1. | | | | | | | |
| 1. Rotate the engine counterclockwise until cylinder number 1 is at Top Dead Center (TDC) of the compression stroke.   **NOTE:** The cylinder numbers are molded on the valve cover. | | | | | | | |
| 1. As the engine is turned over, observe the movement of intake rocker arm of the cylinder to be checked. After it completes the cycle and the intake valve closes, observe the piston. When it reaches its uppermost position that is TDC compression stroke. | | | | | | | |
| 1. Slightly move the engine crankshaft clockwise and counterclockwise a few degrees, until you find the approximate exact TDC "sweet spot" by observing the TDC indicator tool as it moves up and down. | | | | | | | |
| 1. Install gauge adapter from the leak down tester into spark plug hole. | | | | | | | |
| 1. Connect regulator to compressed air source and set gauge to zero.   **Warning: Before putting air to the cylinder being tested, remove the wrench!** | | | | | | | |
| 1. Supply combustion chamber with air from regulator. | | | | | | | |
| 1. Record the percentage of leakage of cylinder number 1. | | | | | | | |
| 1. Proceed the same way with remaining cylinders. | | | | | | | |
| CYL#1 | | | CYL#2 | | | CYL#3 |  |
| Do any of these readings indicate a required engine repair? | | | | | | | |
| YES |  | NO | |  |  | | |
| If so what needs to be repaired? | | | | | | | |
| What did you base your opinion on? | | | | | | | |

### Questions

1. What have you learned at this task? **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

2. A technician is performing a compression check on a three cylinder engine. The compression results are as follows --- Cyl # 1 = 150 PSI, Cyl # 2 = 70-PSI, Cyl# 3 = 145 PSI. Which cylinders should he follow up with a cylinder leak check?

A. All three cylinders should be checked.

1. Cyl# 2 and Cyl#3 should be checked.
2. Only Cyl# 2 needs to be checked.
3. All the cylinders should be checked any time a cylinder leak check is performed.

3. Explain why you answered the way you did to the preceding question.

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4. A technician is performing a leak-test on an engine with 200 hours and it shows 25 percent leakage through the valves. Would this indicate that the engine is in poor condition?

YES NO

5. Explain why an engine should have a leak check performed at operating temperature?

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6. Explain why an engine should have a compression check performed at with the throttle in the wide open position?

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8. Name four possible malfunctions that could cause excessive cylinder leakage to occur.

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**Instructor sign off-- Go \_\_\_\_\_\_\_\_\_\_**