

What's Going on Inside My Engine?

An Overview of Engine Assessment
and Leakdown Testing

By

Scott Andrews and Bob Szilasio

Do I Need to Rebuild My
Engine?

What Exactly IS A “Rebuild”?

- Replace head gasket (\$)
- Valve job (\$\$)
- Rings (\$\$\$)
- Rebore (\$\$\$\$)
- Comprehensive (\$\$\$\$\$\$\$)

How do I know what needs rebuilding???

Some Problems Are Easier Than Others To Diagnose

- Easy to diagnose
 - Oil Burning
 - Blue smoke on startup=Valve seals and guides
 - Blue smoke all the time=Rings (or really bad valve seals)
 - Overheating
 - White smoke=Head gasket or cracked head
 - Oil in coolant=Cracked head or block, or head gasket
 - Exhaust in coolant=Head gasket or cracked head
- Hard to diagnose
 - Poor Power, Rough Running, “Hard to Tune”
 - Poor valve sealing
 - Poor piston sealing
 - Cylinder to cylinder head gasket leaks

Compression Test

- Test of peak pressure in cylinder during cranking
- Simple test
 - Remove fuel pump fuse
 - Screw compression tester into spark plug hole
 - Open throttle butterfly
 - Crank engine until gauge peaks
- Can assess obvious issues in engine
 - Compression test with, and without oil in cylinder can identify ring issues

Isn't a Compression Test Enough?

- NO!!!!
- Compression test is a gross indicator of engine issues
- Aggregates all the leaks together
- Doesn't identify the source of the leak
- Only gives rough idea of the size of the leak
- Many engines will test OK for compression, but still have issues

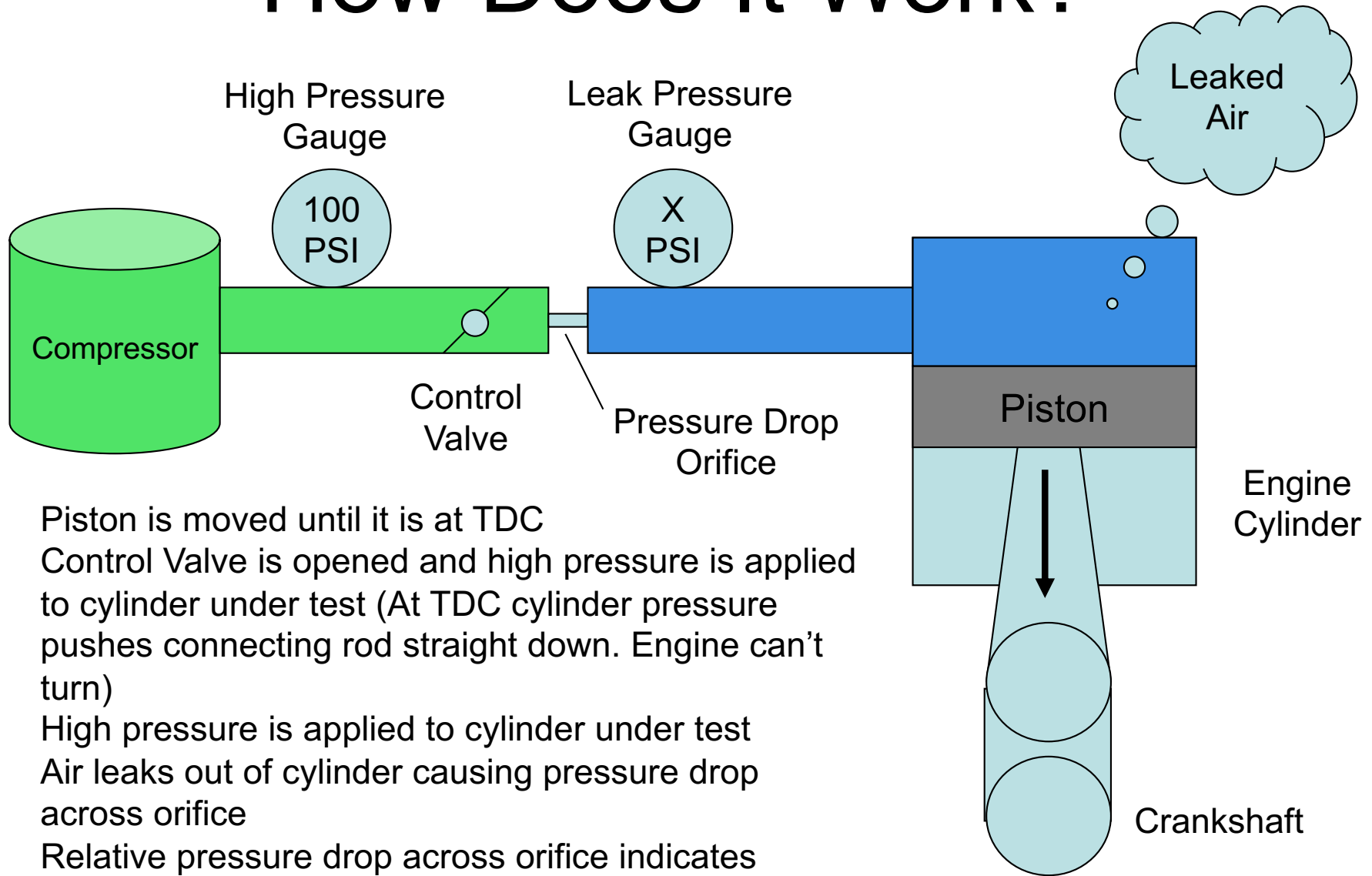
So What is a Leakdown Test?

- Leakdown test applies high pressure air to a cylinder to find and measure leaks
 - Air applied through spark plug hole
 - Piston at TDC
- Air pressure is applied through a small orifice to create measurable pressure drop from the leak
- Pressure drop indicates extent of leakage
- Leakage exit indicates the type of leak

What Do I Need To Do The Test?

- Moderately large compressor
 - 30 gal, 150 PSI
- Leakdown apparatus
 - Can buy or make from hardware store parts
- Compression tester hose and plug fitting
- Clipboard, data table and a pencil
- A Helper

How Does It Work?



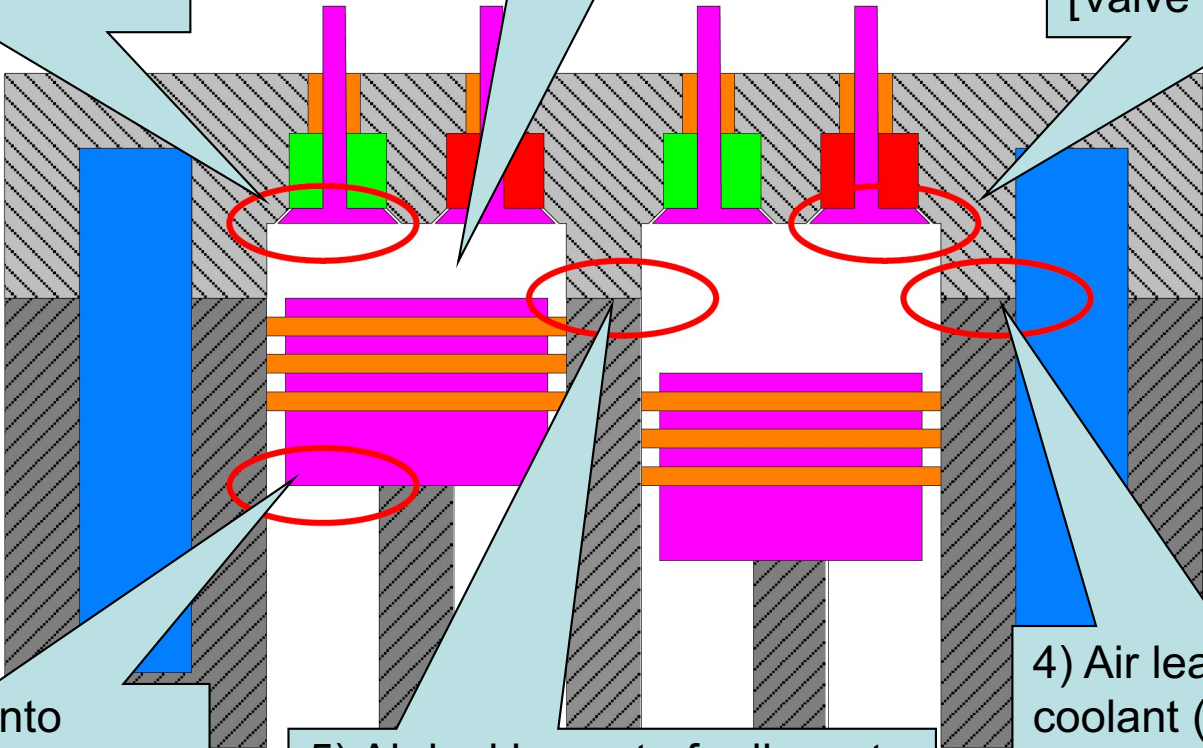
- 1) Piston is moved until it is at TDC
- 2) Control Valve is opened and high pressure is applied to cylinder under test (At TDC cylinder pressure pushes connecting rod straight down. Engine can't turn)
- 3) High pressure is applied to cylinder under test
- 4) Air leaks out of cylinder causing pressure drop across orifice
- 5) Relative pressure drop across orifice indicates extent of leaks
- 6) Location of exiting air indicates causes of leaks

Interpreting The Test

3) Air leaking into intake manifold of cylinder under test indicates bad intake valve seal [Valve Job]

1) Pressure Drop Should be less Than 10%

2) Air leaking into exhaust manifold of cylinder under test indicates bad exhaust valve seal [Valve Job]



4) Air leaking into crankcase indicates leaking rings (usually observed by air escaping from dipstick tube or oil cap [Rings or Rebore])

5) Air leaking out of adjacent cylinder intake or exhaust manifold indicates cylinder to cylinder leak (common in M90/M88 Engine) [Headgasket]

4) Air leaking into coolant (observed by bubbles in coolant reservoir) indicates cylinder to water jacket leak [head gasket or cracked head]

A Tale of Three Engines

Scott Andrews' '80 Euro 635 (Before Valve Job)

Cylinder	Compression	Leakdown Pressure Drop	Primary Leak Source
1	190 PSI	10%	Exhaust
2	70 PSI	95% (!!)	Exhaust and #3 plug hole
3	160 PSI	82% (!!)	Exhaust and #2 & #4 plug holes
4	165 PSI	35%	Exhaust
5	182 PSI	25%	Exhaust
6	180 PSI	10%	Exhaust

Note high compression readings
And poor leak performance



Car actually ran well; Removed head. Had visible cylinder to cylinder leaks between 2 and 3, and 3 and 4; Replaced all exhaust valves, 2 intake valves and head gasket. Car now has 25-30% more power

Bob Szilasio's '80 633

Cylinder	Compression	Leakdown Pressure Drop	Leak Source
1	165 PSI	32%	Dipstick Tube
2	168 PSI	35%	Dipstick Tube
3	178 PSI	10%	Dipstick Tube
4	172 PSI	14%	Dipstick Tube + #5 plug hole
5	170 PSI	43%	Dipstick Tube
6	177 PSI	8%	Dipstick Tube

This car runs fine; It has good compression numbers, but clearly is in need of new piston rings and possibly a rebore (Depending on the state of the cylinder walls).

Bob Kuimelis' '85 635

Cylinder	Compression	Leakdown Pressure Drop	Primary Leak Source
1	185 PSI	5%	General
2	185PSI	10%	General
3	180 PSI	15%	Exhaust/General
4	185 PSI	6%	General
5	180 PSI	8%	General
6	185 PSI	8%	General

Nice Engine! Starting to show need for a valve job

Wrap Up/Questions

- Leakdown test identifies specific weaknesses in an engine
- Much more sensitive than a simple compression test
- Relatively easy and fast to perform
- Allows you to develop a solid rebuild plan