What's Going on Inside My Engine?

An Overview of Engine Assessment and Leakdown Testing

By

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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

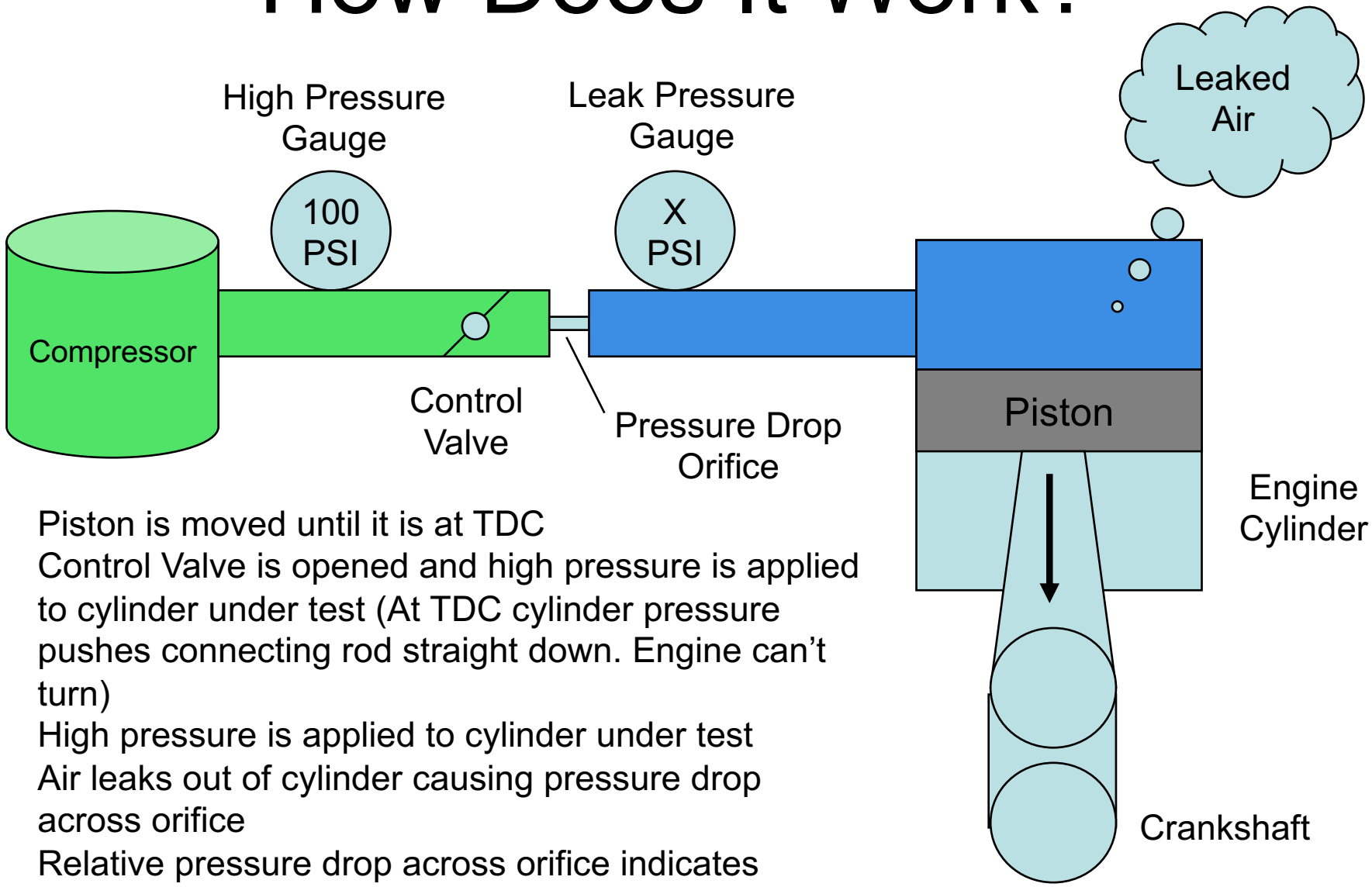
So What is a Leakdown Test?

- 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?

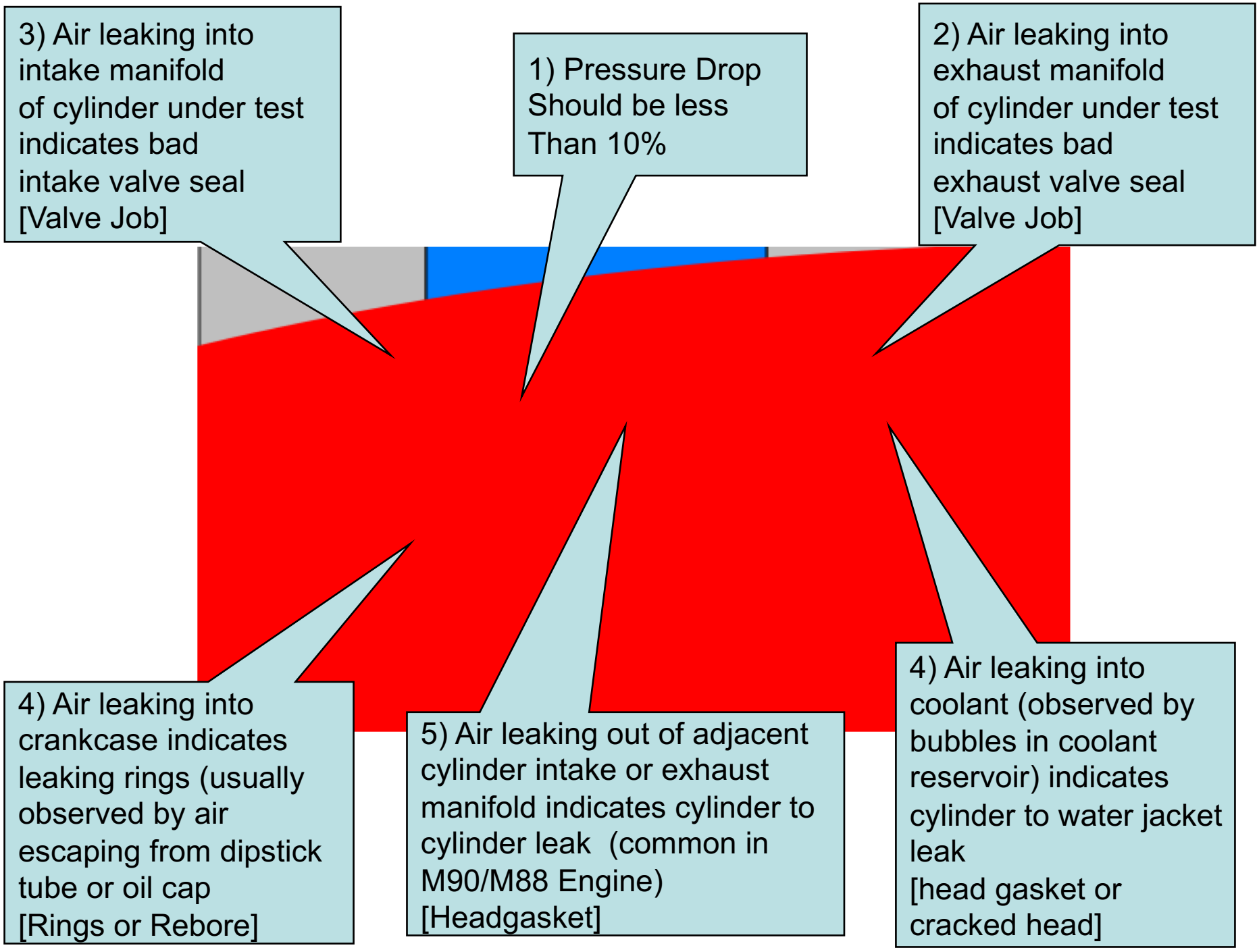
- Moderately large compressor
  - 30 gal, 150 PSI
- Leakdown apparatus
  - Can buy or make from hardware store parts
- Compression tester hose and plug fitting
- Clipboard, data table and a pencil
- A Helper

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

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 Szilasie'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