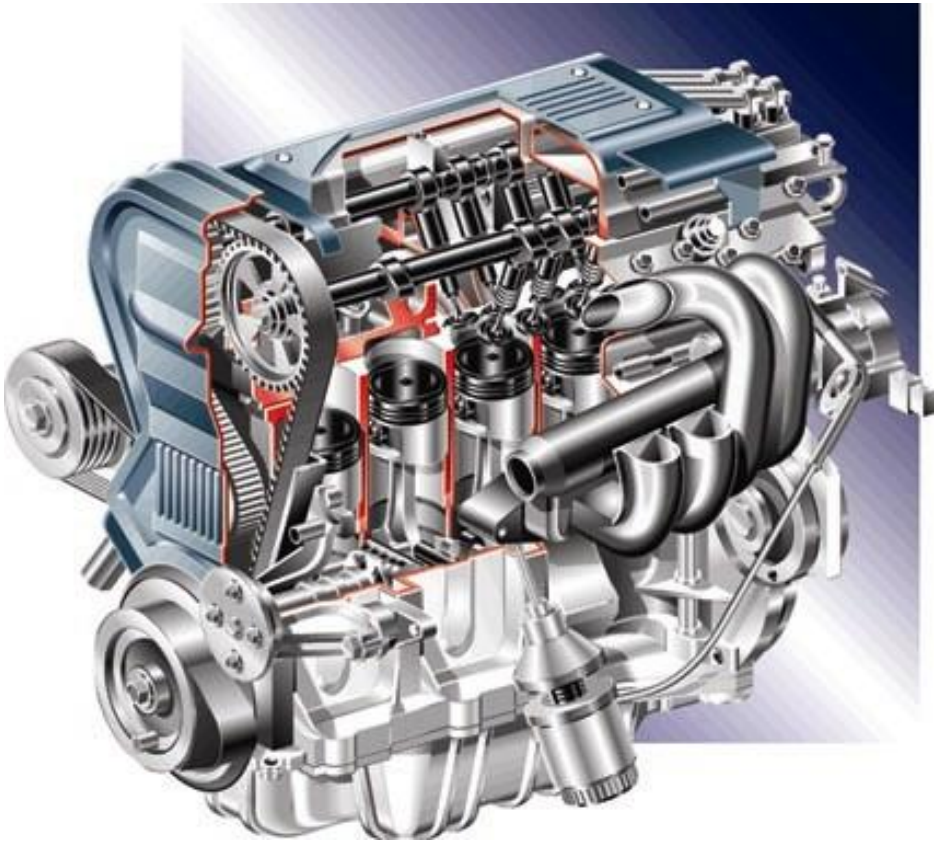
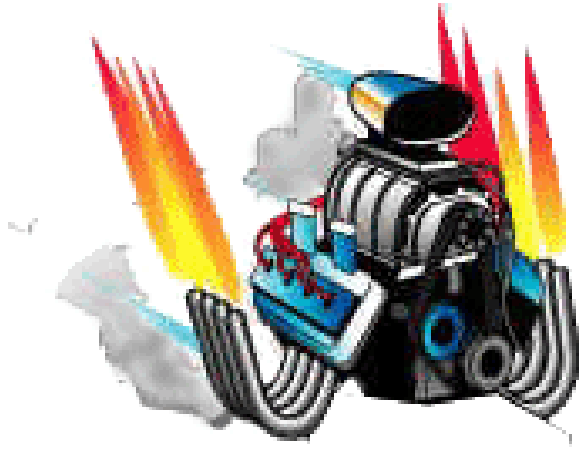
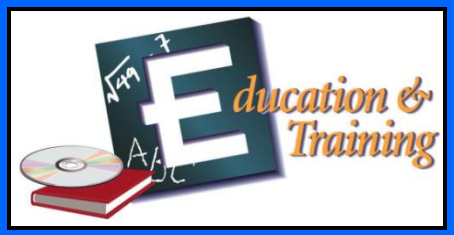
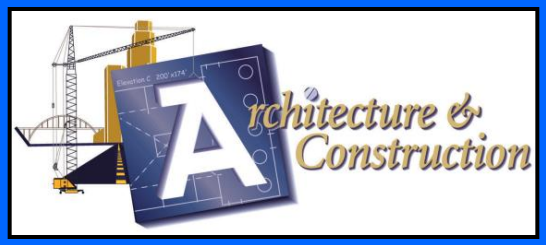
ATASA 5TH Study Guide
Chapter 9 Pages 220-254
Engine Design & Diagnosis
90 Points

Please Read The Summary





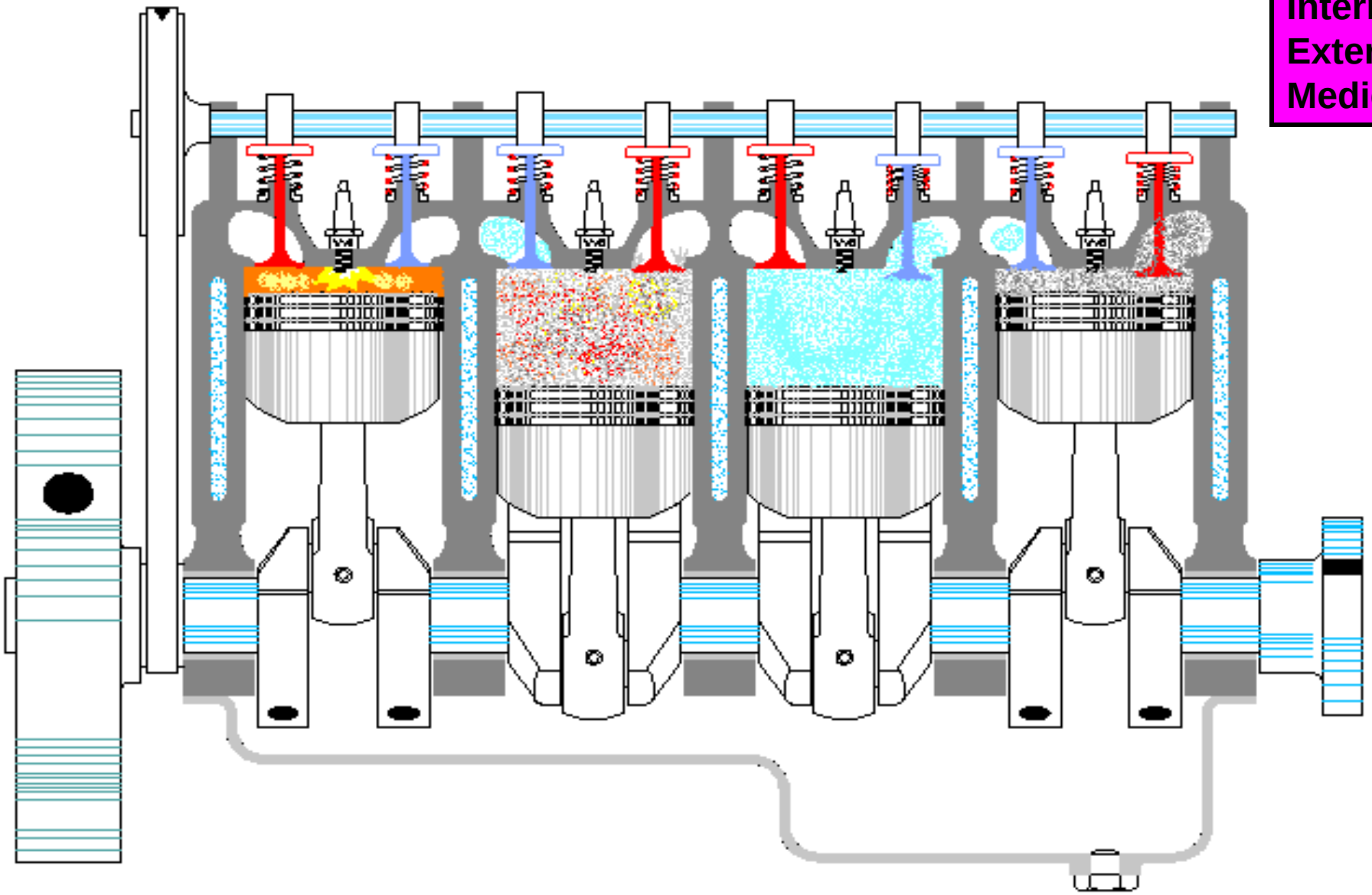




Is there a career for me that melds 2 or more of my favorite clusters?

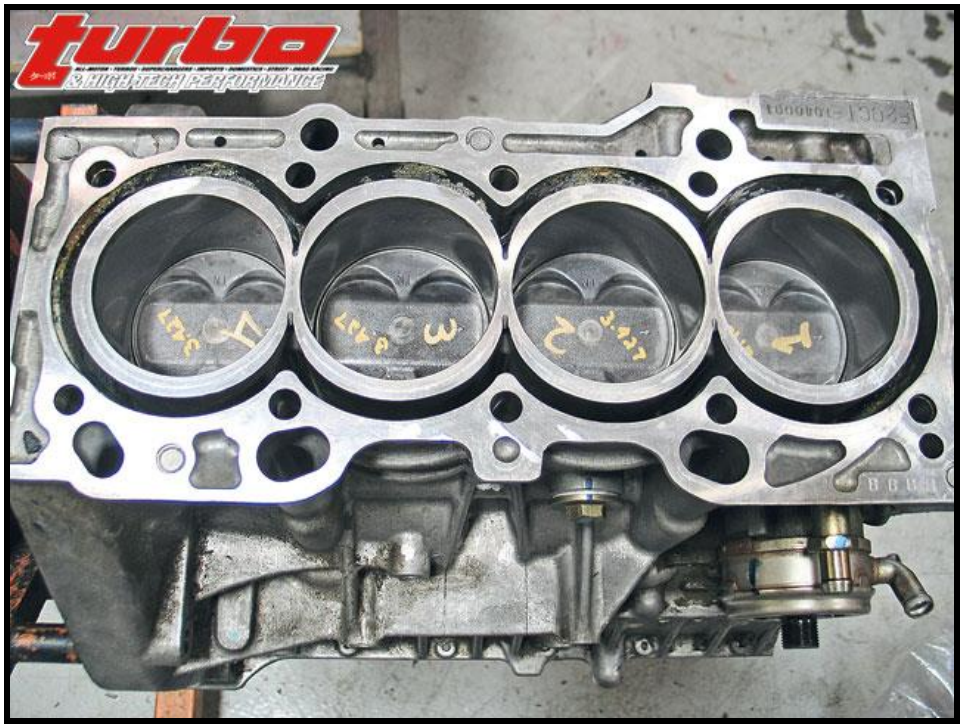
1. All auto engines, both gas & diesel are classified as _____combustion.

Internal
External
Medieval



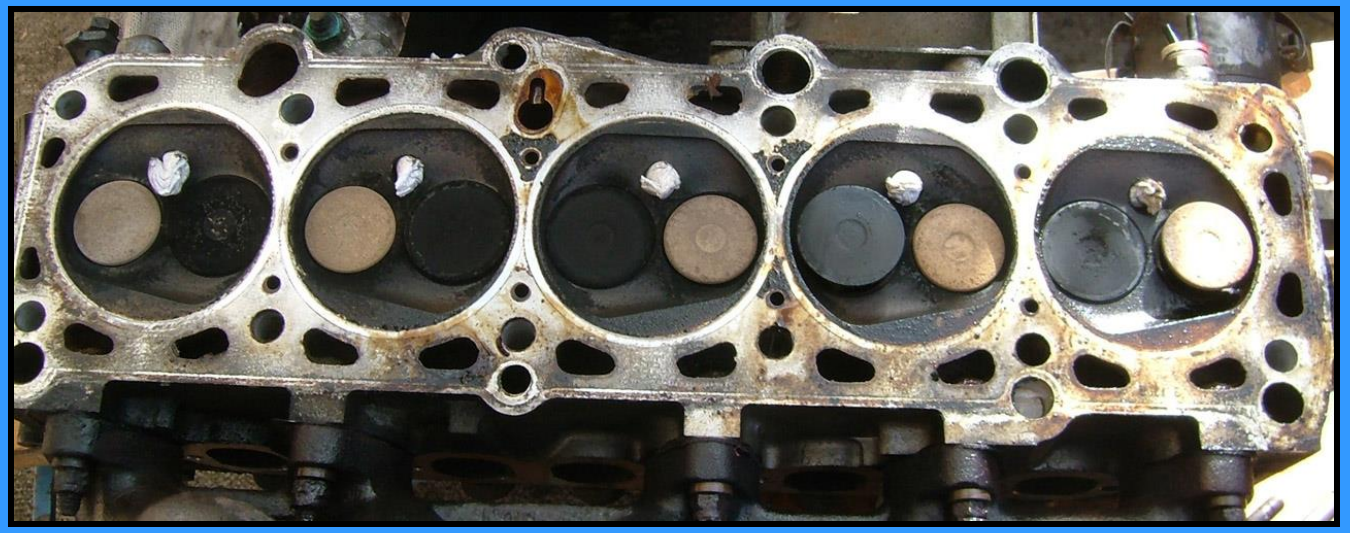
2. The engine _____ contains the cylinders through which the _____ reciprocate.

Block, Heads
Block, Pistons
Block, Valves

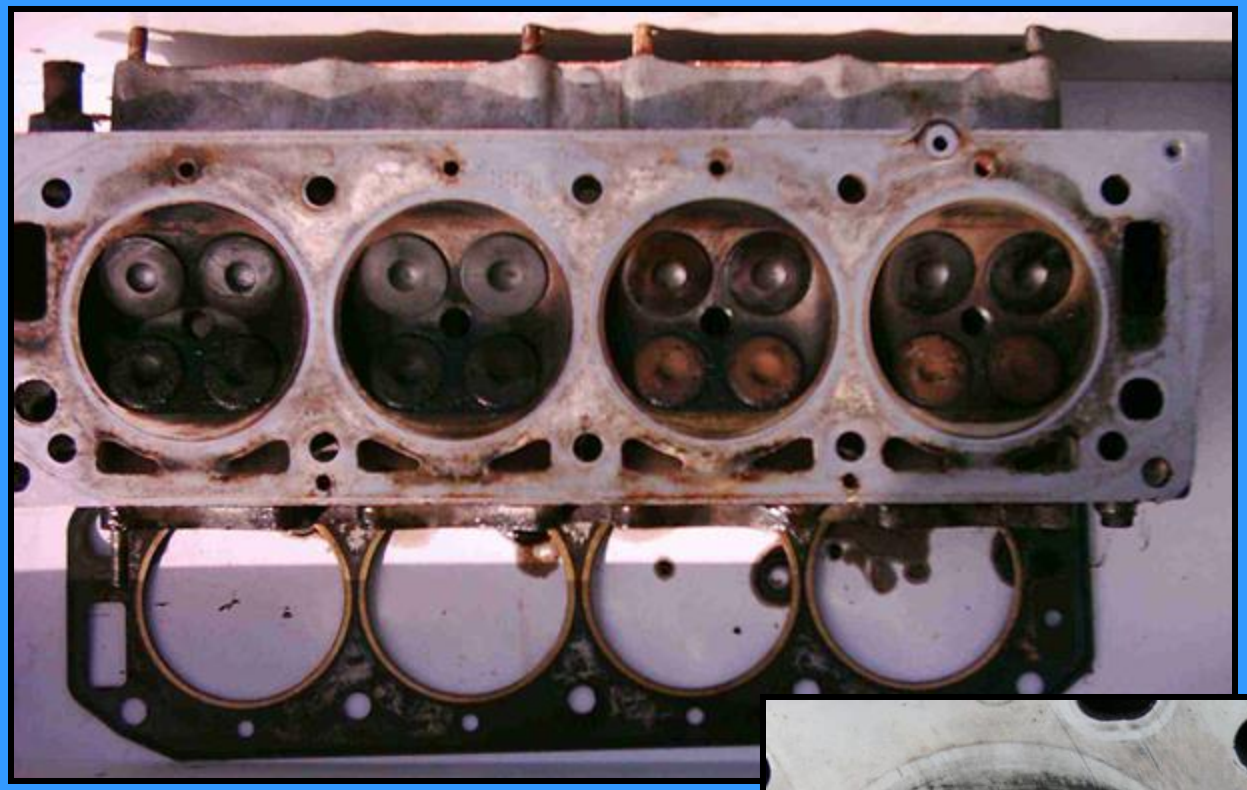


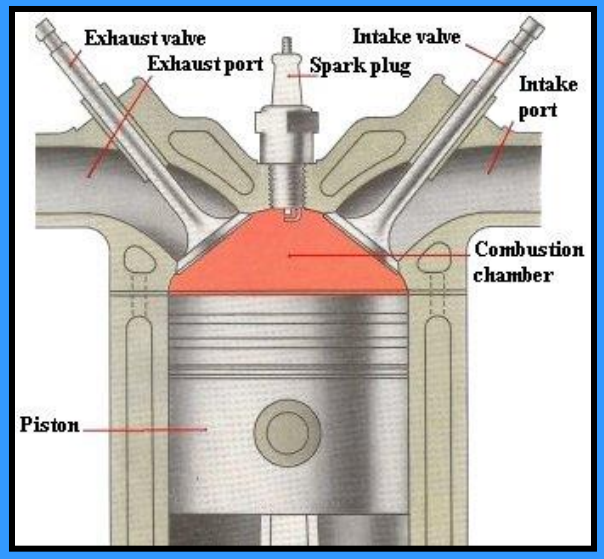
3. The cylinder _____ holds the valves, has the intake & exhaust ports & seals off the top of the block.

Block
Heads
Manifolds



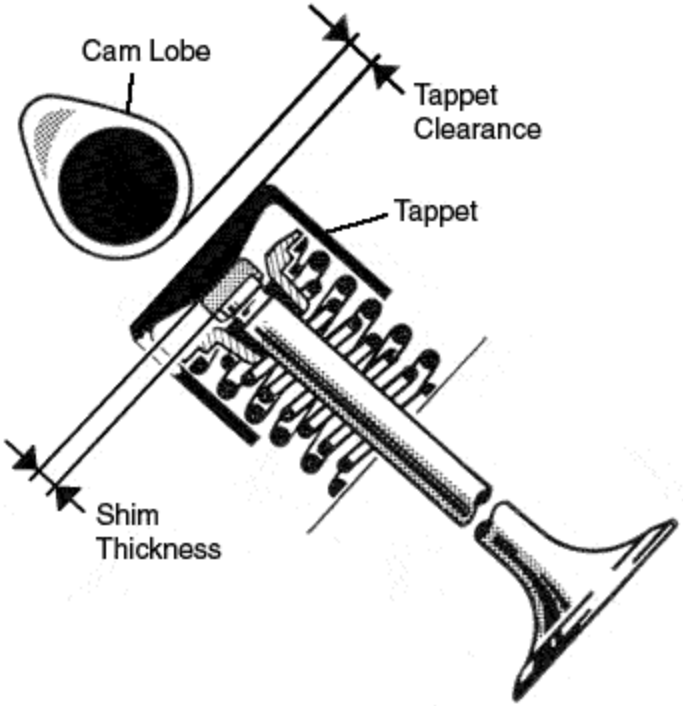
4. The A/F mixture burns in the combustion _____ area above the pistons & under the head.



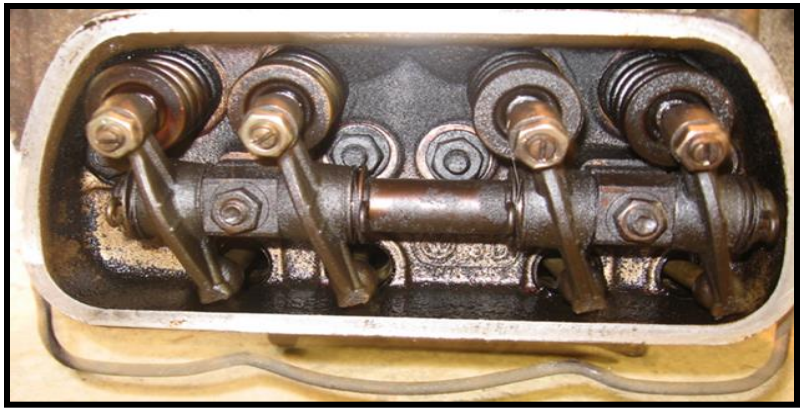


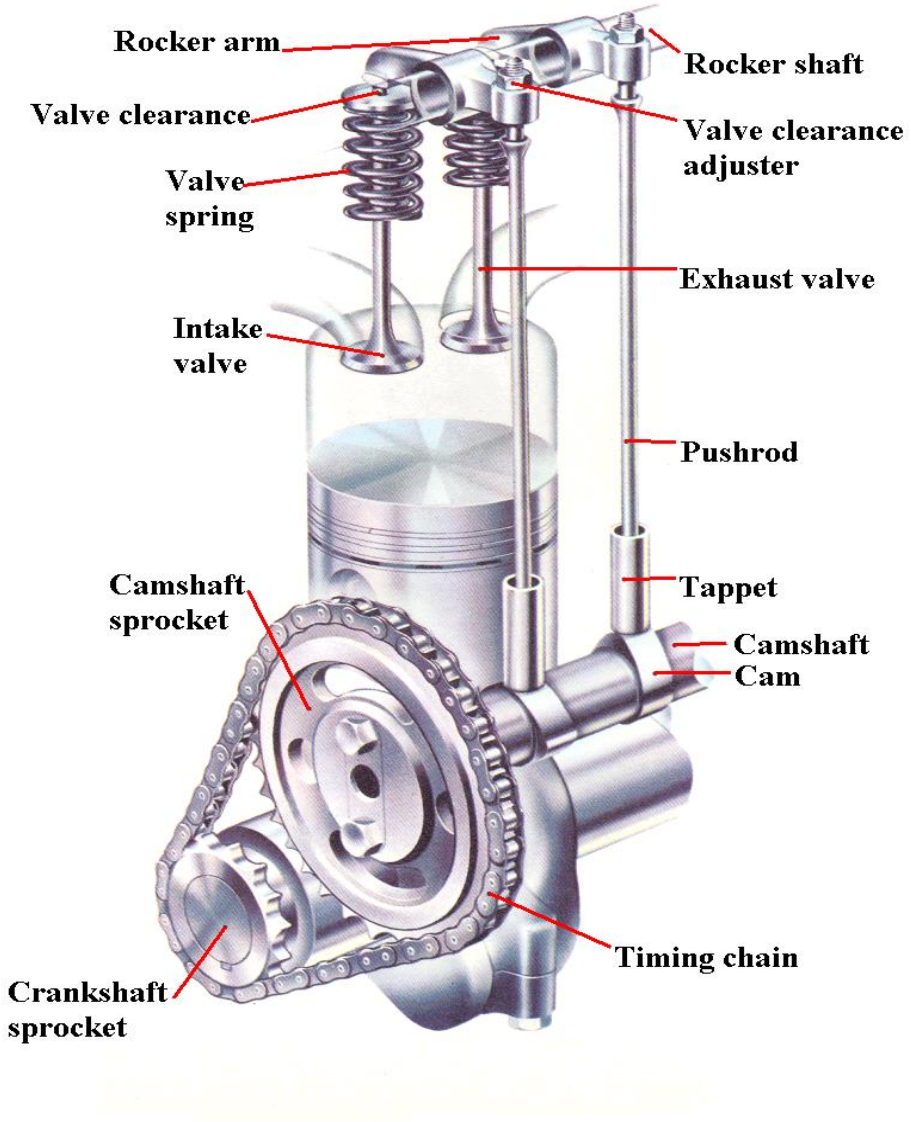
Chamber
Cavity
Compartment

5. The valve _____, controlled by the camshaft, is the series of parts used to open & close the valve ports.

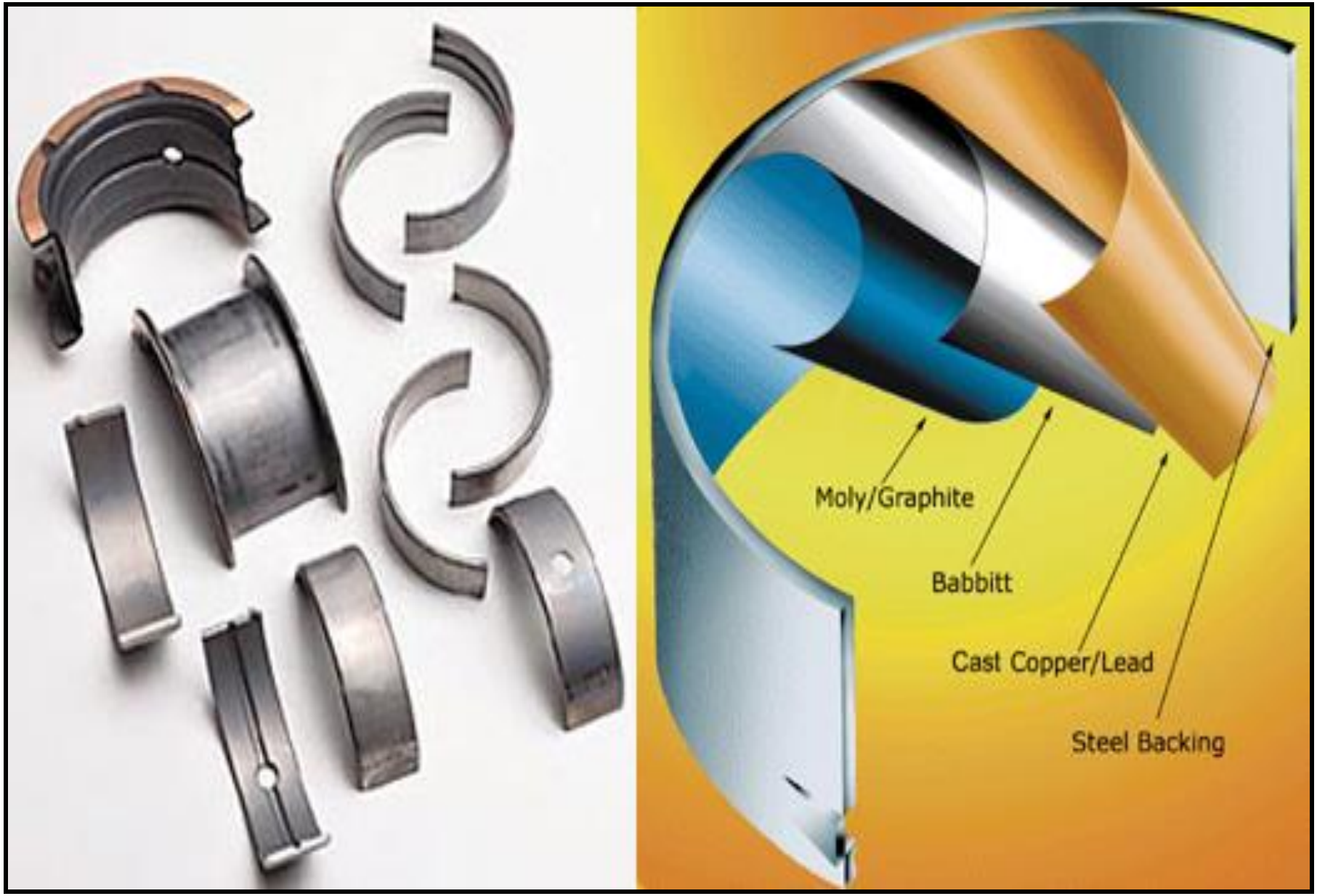


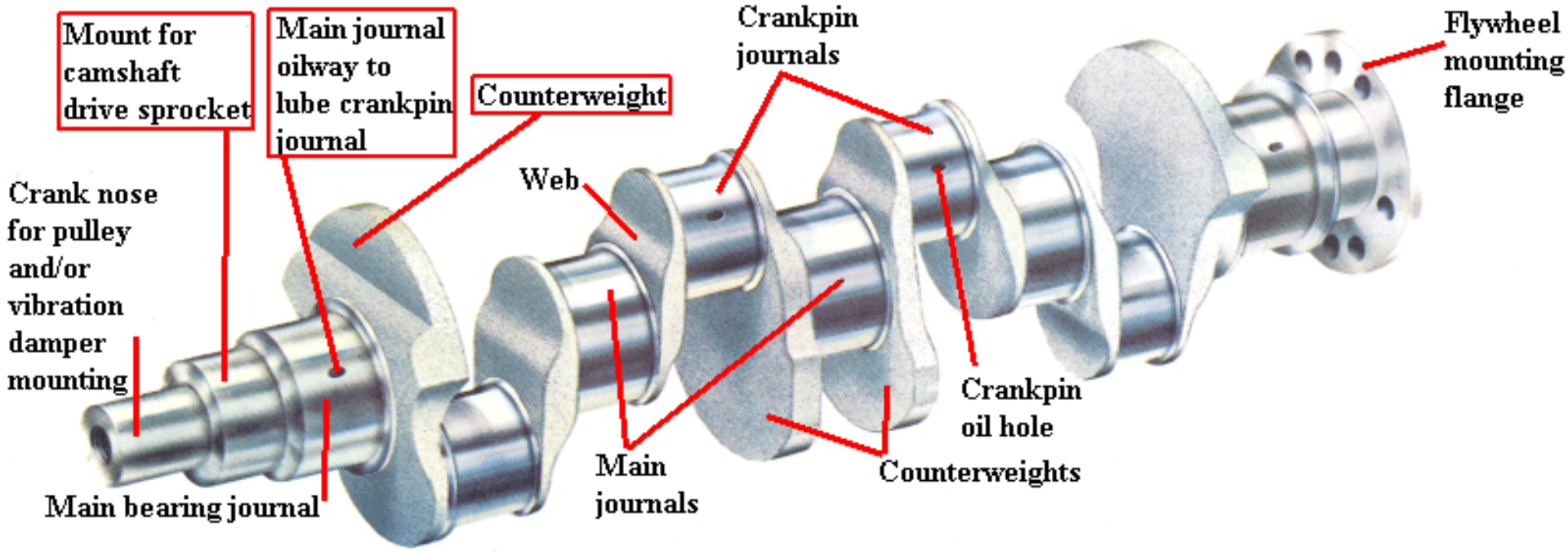
Brain Train Strain





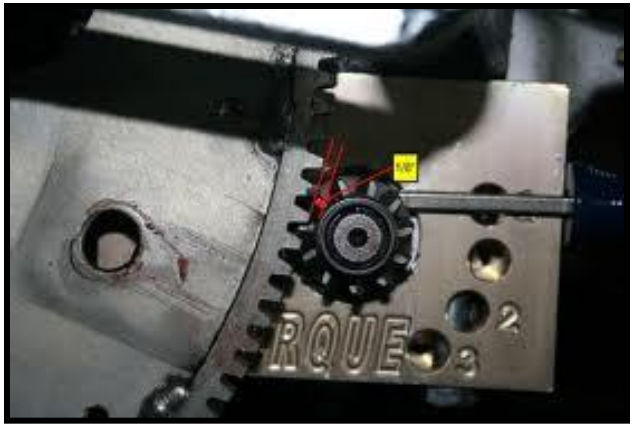
6. The _____ is linked to the pistons by the _____ rods. These parts working together change the reciprocating motion of the pistons into useful rotary motion.


Moly/Graphite
Babbitt
Cast Copper/Lead
Steel Backing

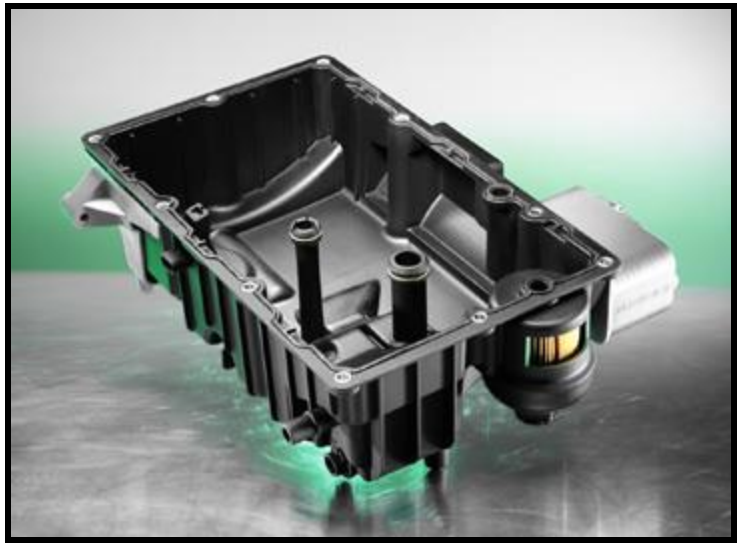

Mount for camshaft drive sprocket
Main journal oilway to lube crankpin journal
Counterweight
Crankpin journals
Flywheel mounting flange
Crank nose for pulley and/or vibration damper mounting
Web
Crankpin oil hole
Main journals
Counterweights
Main bearing journal

7. The drive end of the crankshaft is connected to the _____ *(manual)* or _____ *(auto)*.

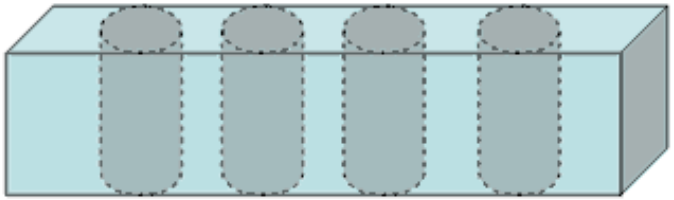
Flywheel, Flex Plate
Flex Plate, Flywheel
Drive Shaft, Cam



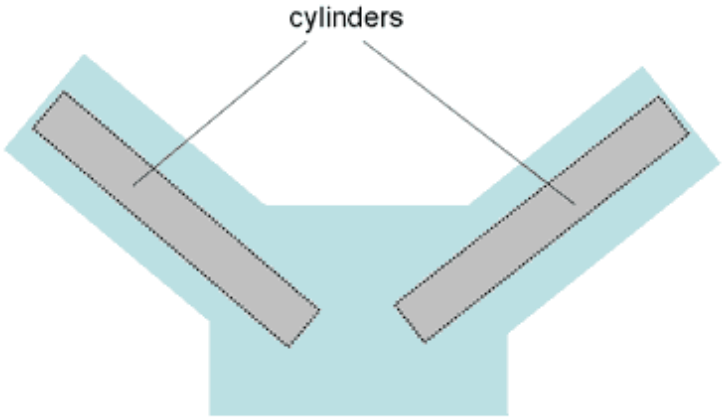
8. **Many of today's engine castings & stampings are lightweight non-iron materials like _____, _____, and fiber-reinforced _____. *(composites) Fasteners are also fewer & smaller.***



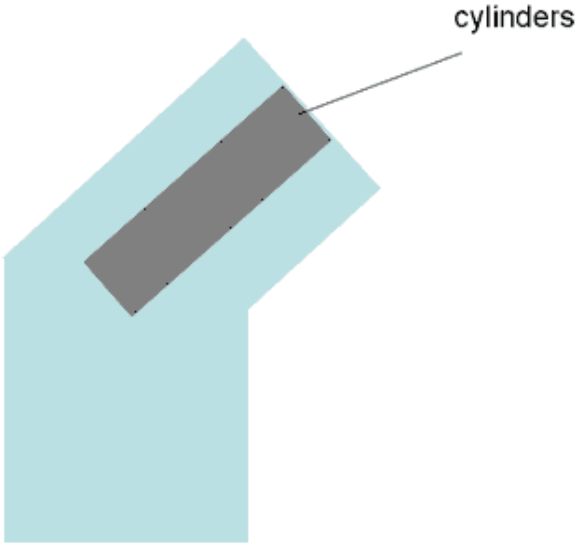
9. Engines can be classified by their operational _____, # and arrangement of _____, type of valve train options, spark or compression _____, cooling system & _____ type.



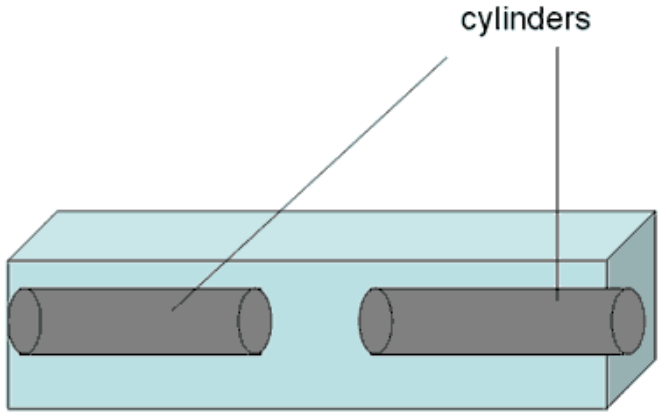
inline cylinder arrangement



V-type cylinder arrangement



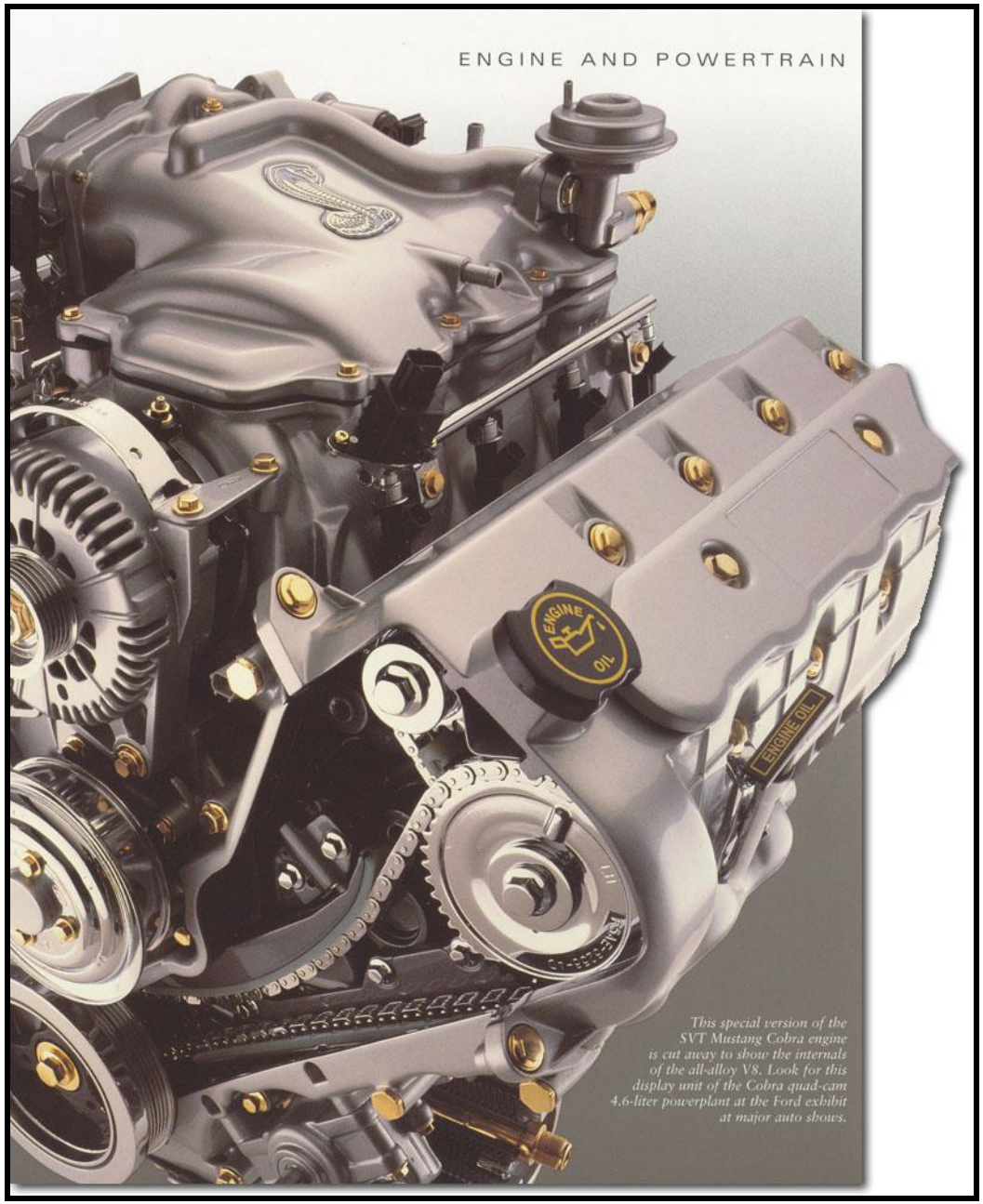
slanted cylinder arrangement



opposed cylinder arrangement

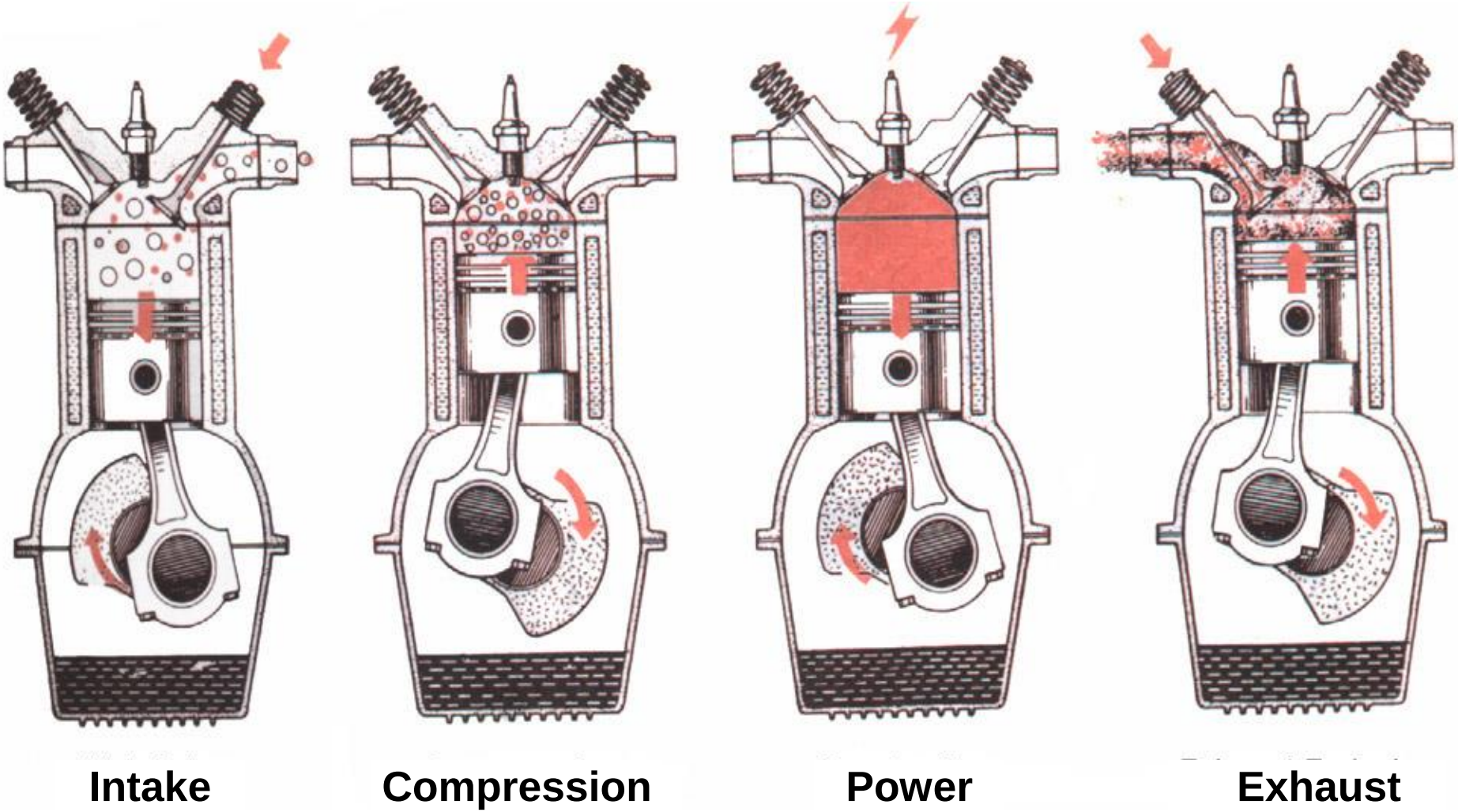
Cycle
Cylinders
Ignition
Fuel

10. V-block, dual overhead camshaft engines actually have ____ camshafts total.
(2 per cylinder head)



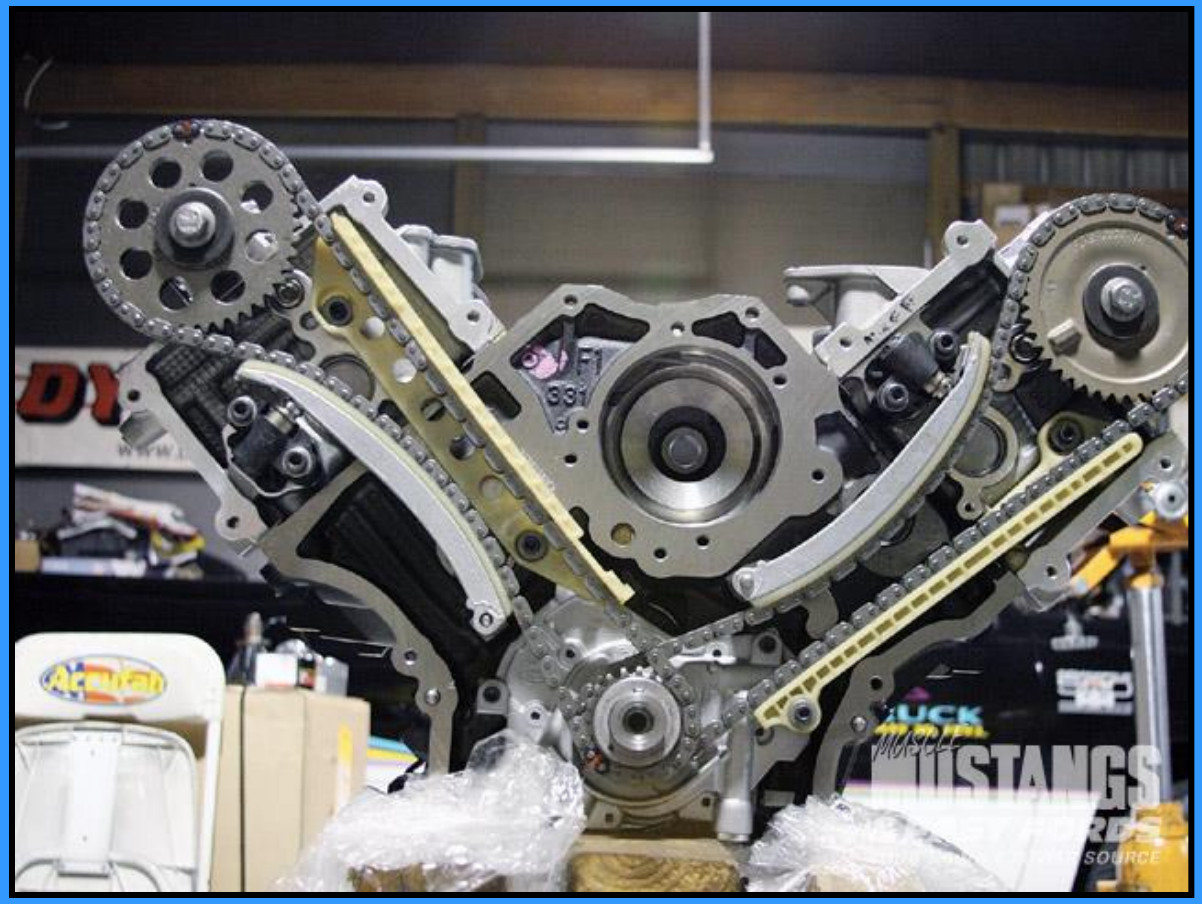
Two
Three
Four

11. Most engines still function with the basic _____ - _____ cycle of operation. I > C > P > E

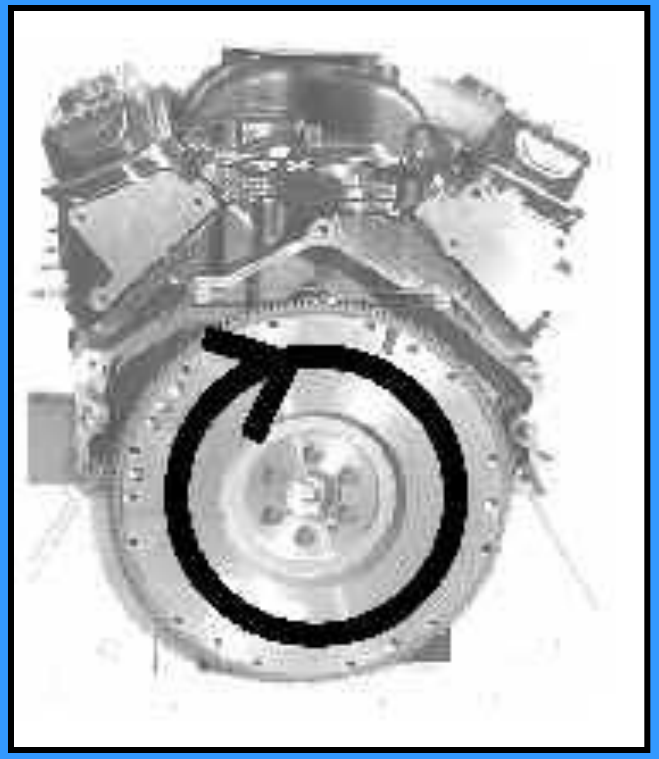


Intake Compression Power Exhaust

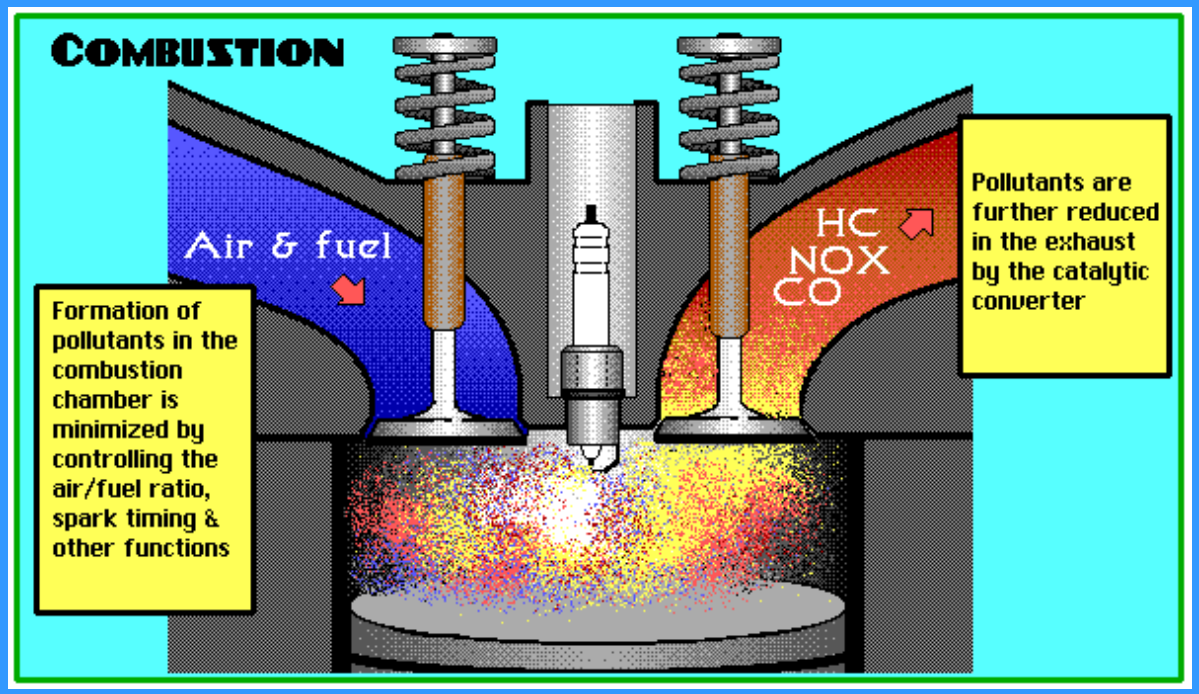
12. By SAE standards, all engines rotate *clockwise* as viewed from the _____.
CCW from output end



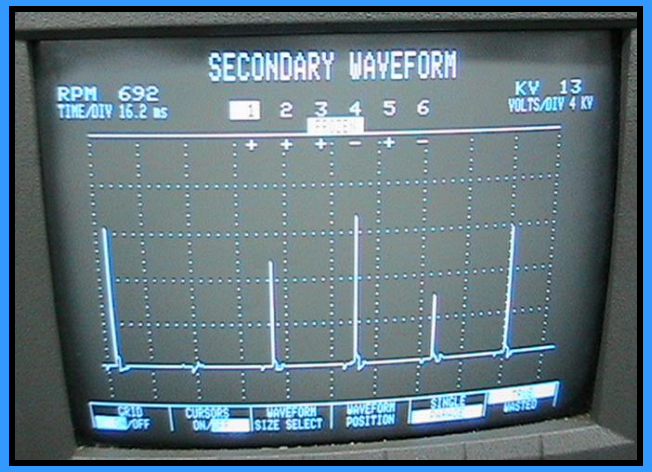
Front
Back
Side

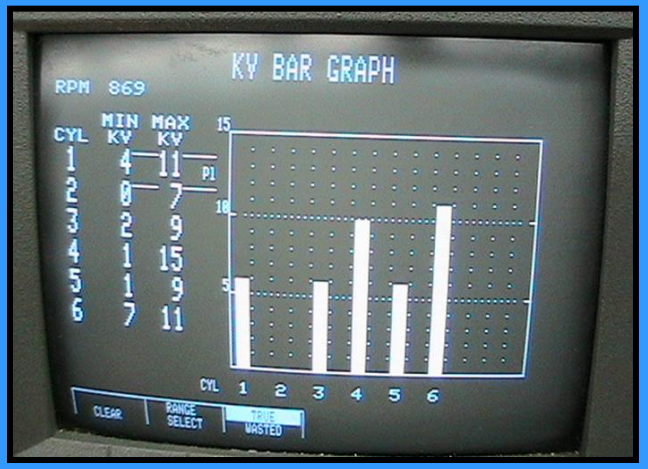


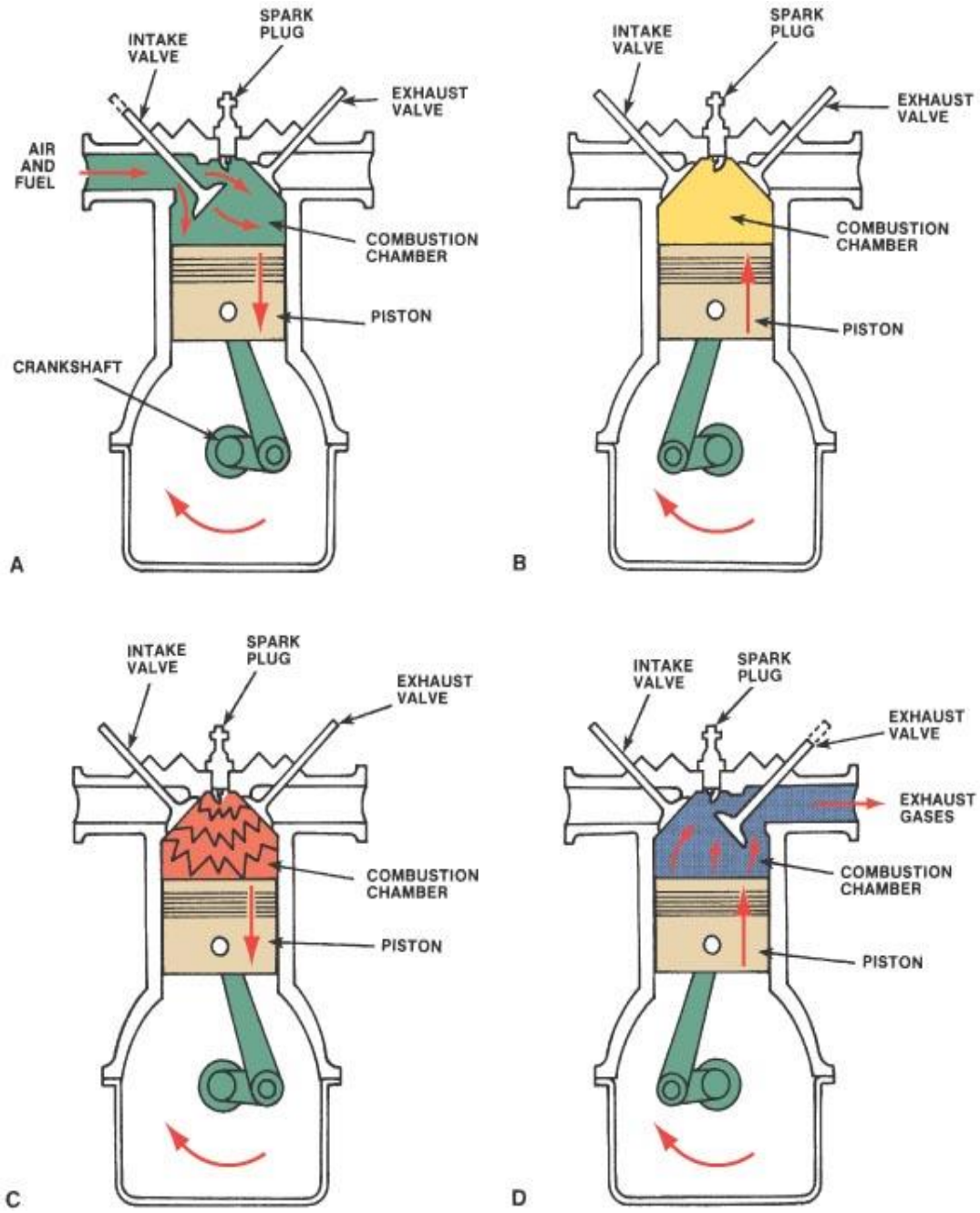
13. Complete combustion is burning all of the A/F mixture. _____ is the term for incomplete burn.



Re-fire
Misfire
Desire







Intake

½ Rev Crank & ¼ Rev Cam
180° 90°

Compression

½ Rev Crank & ¼ Rev Cam
180° 90°

Power

½ Rev Crank & ¼ Rev Cam
180° 90°

Exhaust

½ Rev Crank & ¼ Rev Cam
180° 90°

720º Crank = 2 Revolutions
360º Cam = 1 Revolution

3.000” stroke

2 piston strokes = 1 revolution

1000 revolutions per minute

1000 x 6.000” = 6000” of piston travel per minute at idle

2000 revolutions per minute

2000 x 6.000” = 12,000” of piston travel per minute at highway speeds

1 hour = 60 minutes

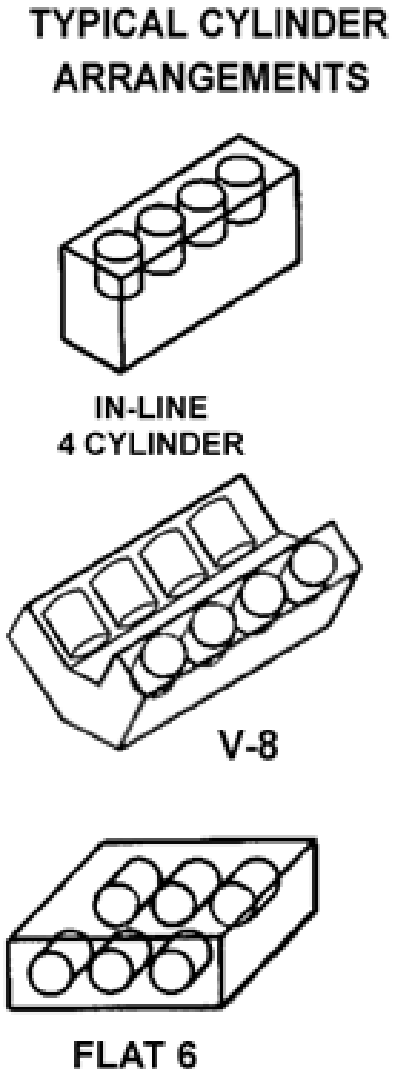
60 x 12,000” = 720,000” of piston travel per hour of driving

5,280 ft = 1 mile

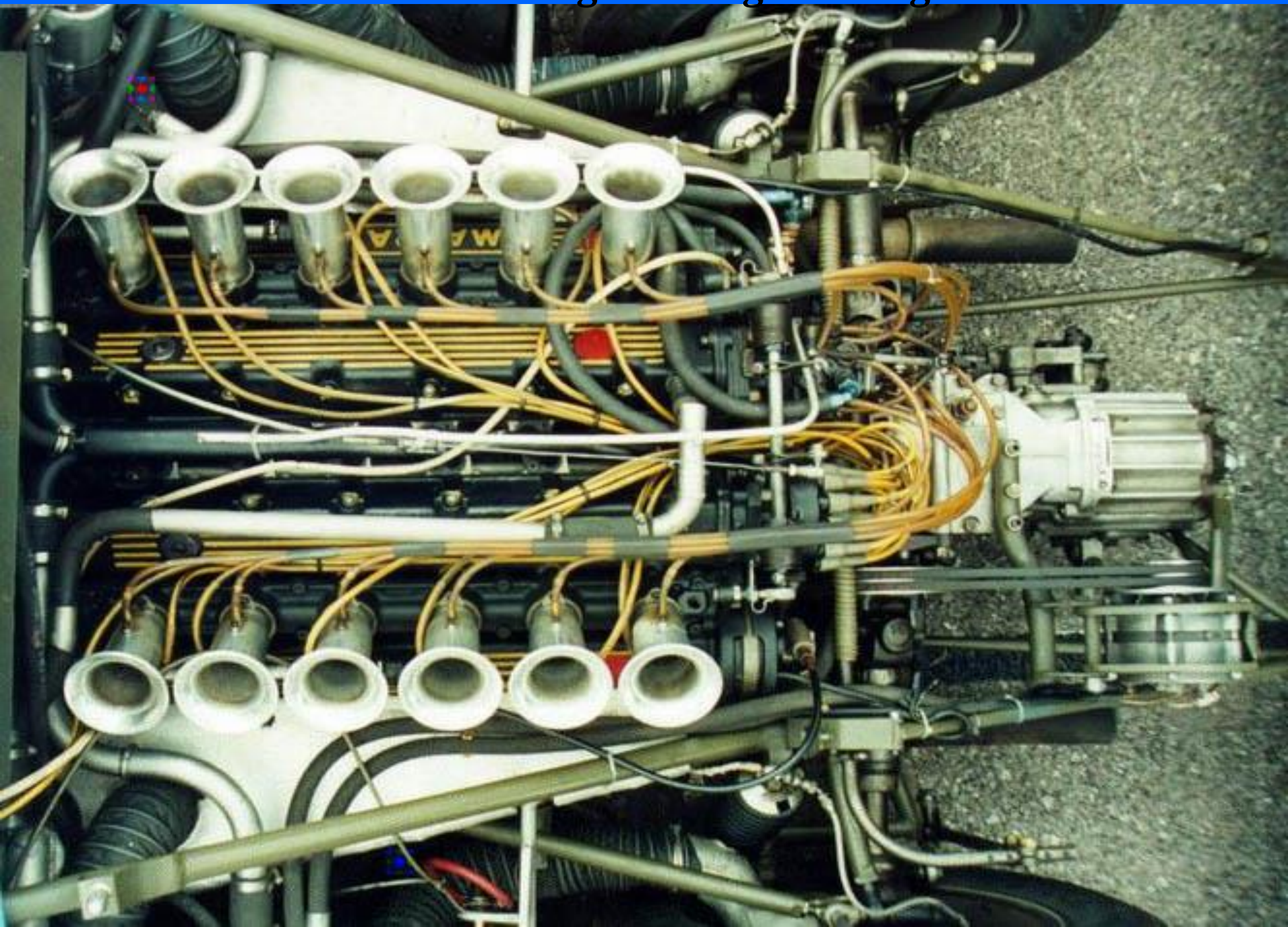
772,000” ÷ 12 = 60,000’

60,000’ ÷ 5280 = 11.36 miles per hour piston movement metal against metal

14. ___ - _____, slant, V, and the opposed or _____ *(flat)* cylinder arrangements are most popular.

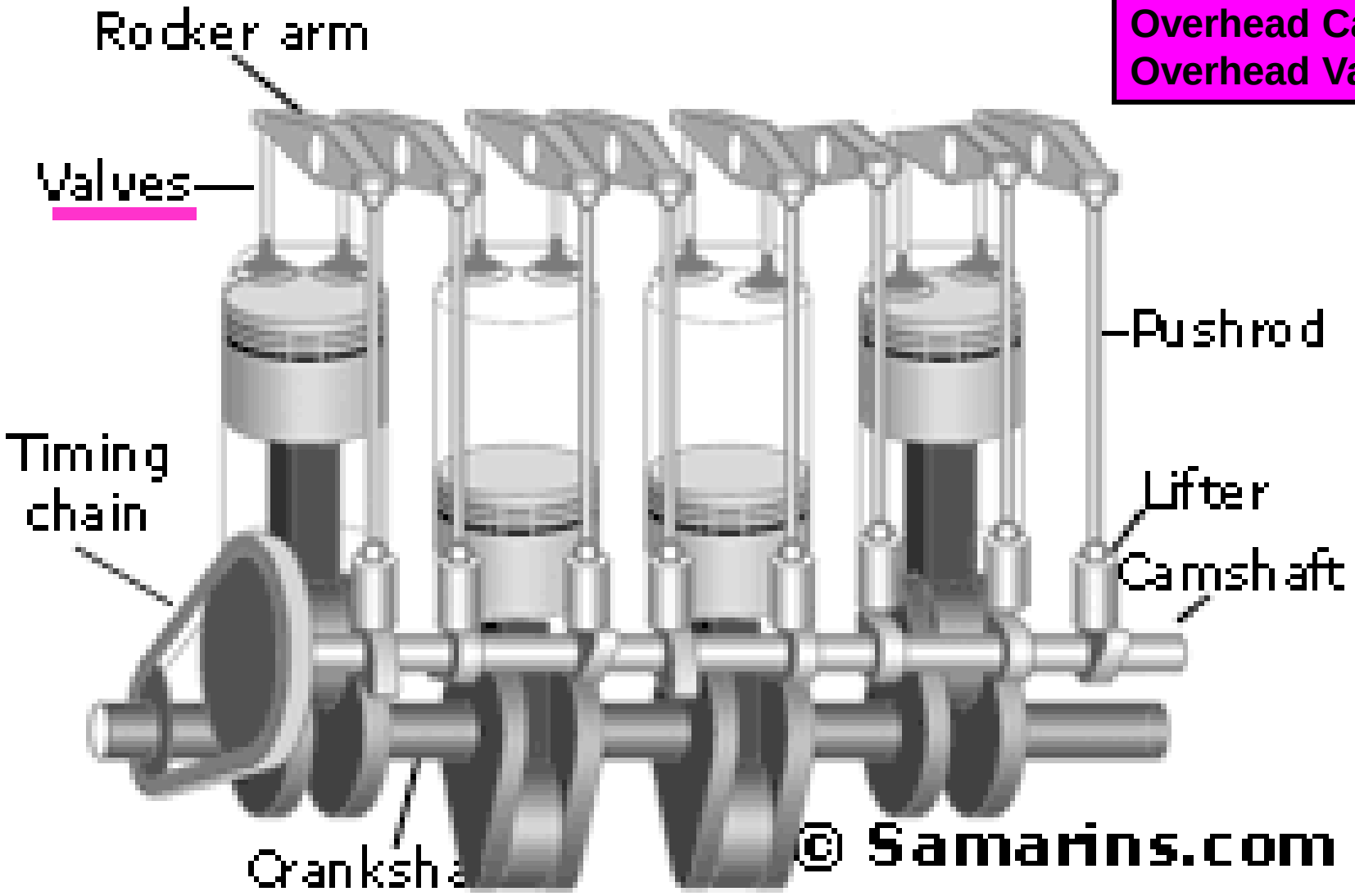


ATASA 5th Engine Design & Diagnosis



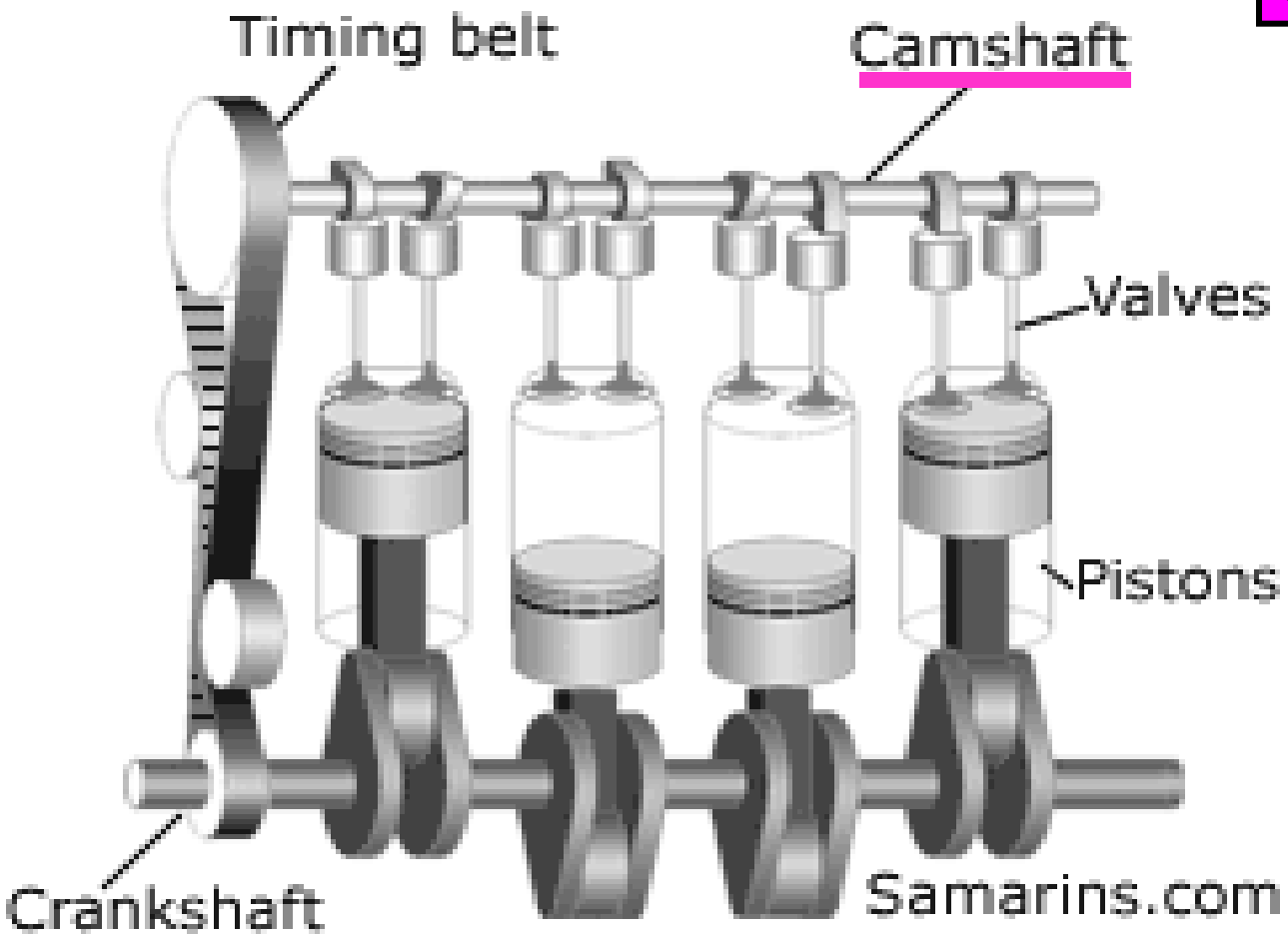
15. An _____ _____ engine is also known as a ***push rod style*** due to its valve train design.

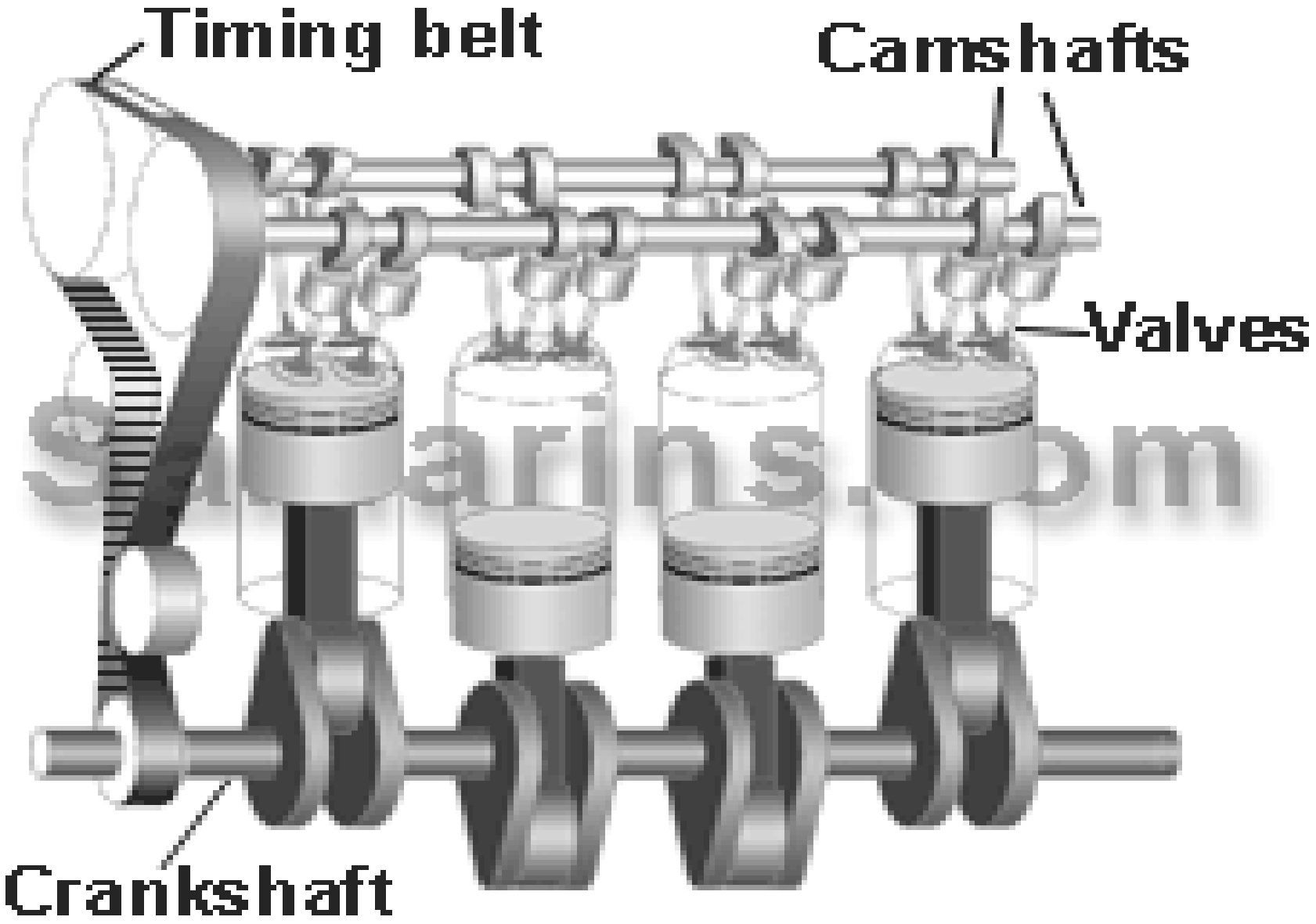
Overhead Cam
Overhead Valve



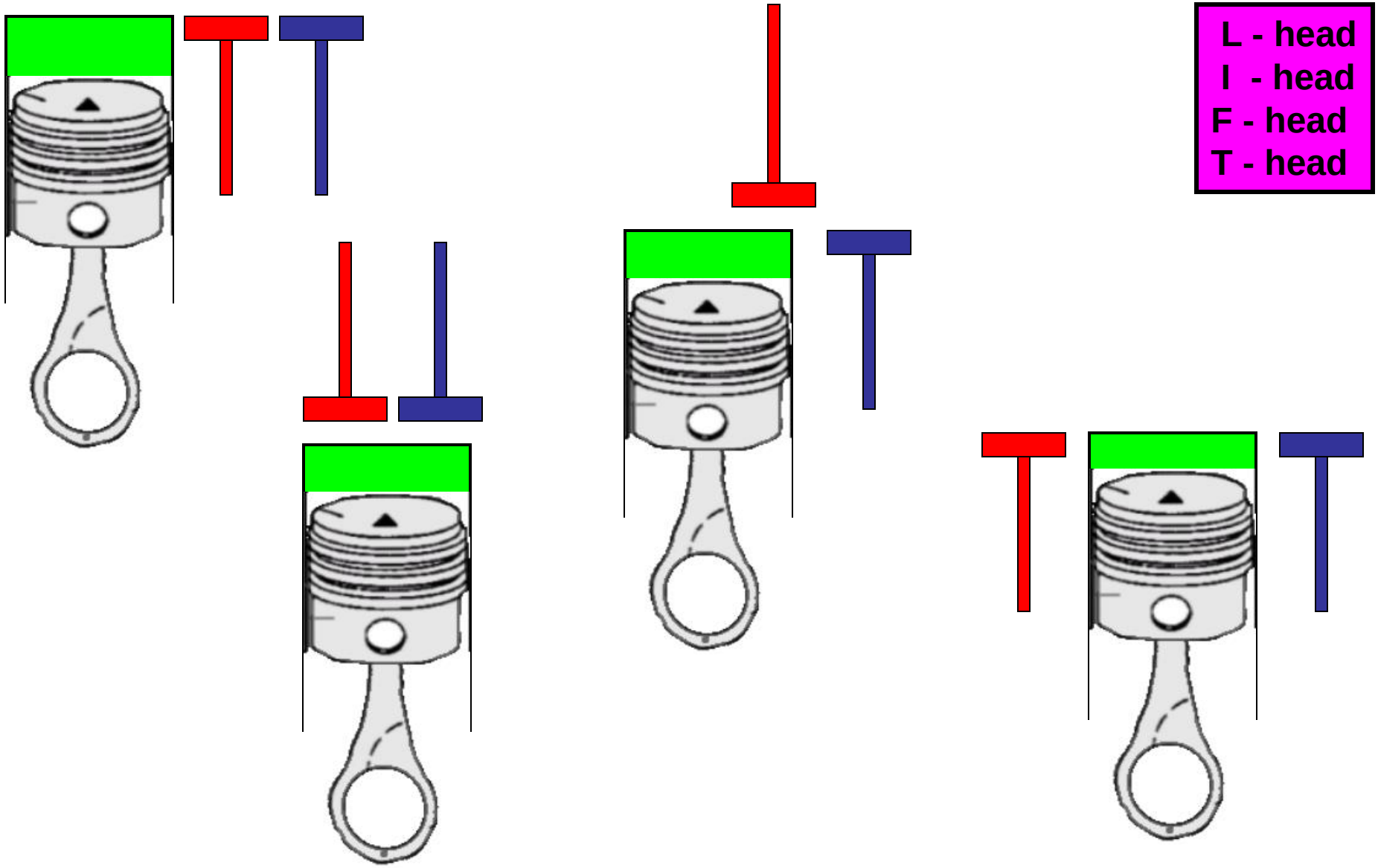
16. An _____ _____ engine may have rocker arms and tappets, but ***has no push rods***. ***(OHC)***

Overhead Cam
Overhead Valve



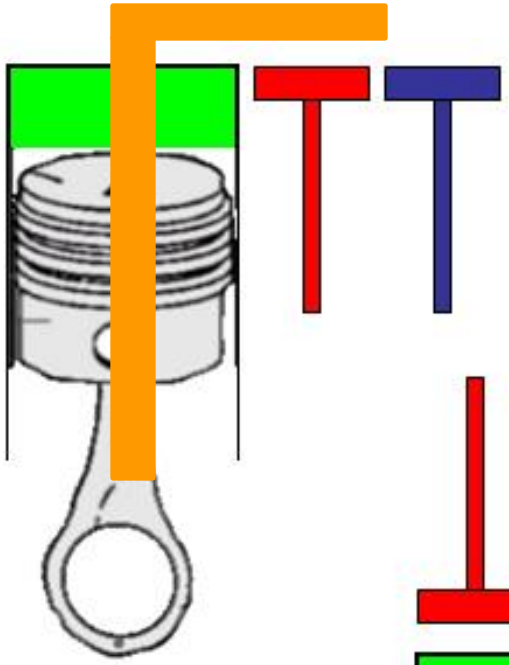

Timing belt
Camshafts
Valves
Crankshaft

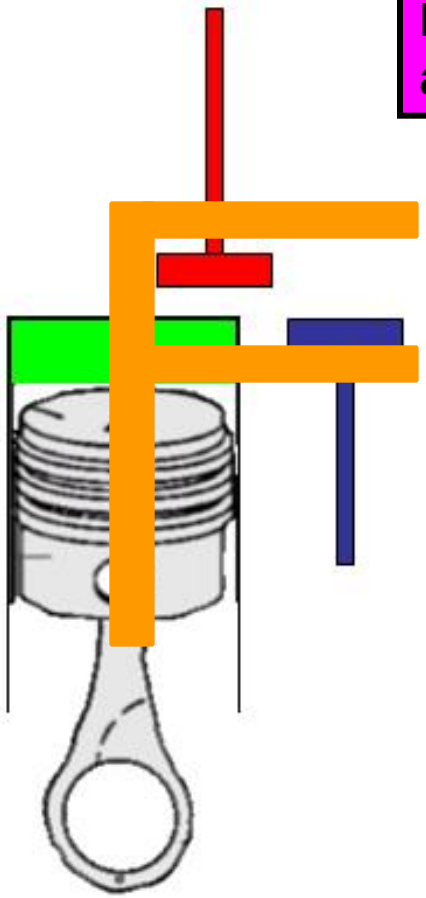
17. The 4 valve arrangements ever used are the ____, ____, ____, ____ head.
____*-head is OHV.*

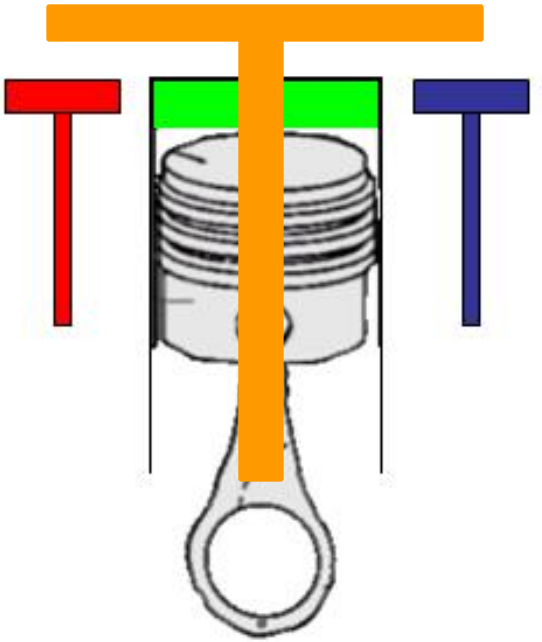


L - head
I - head
F - head
T - head

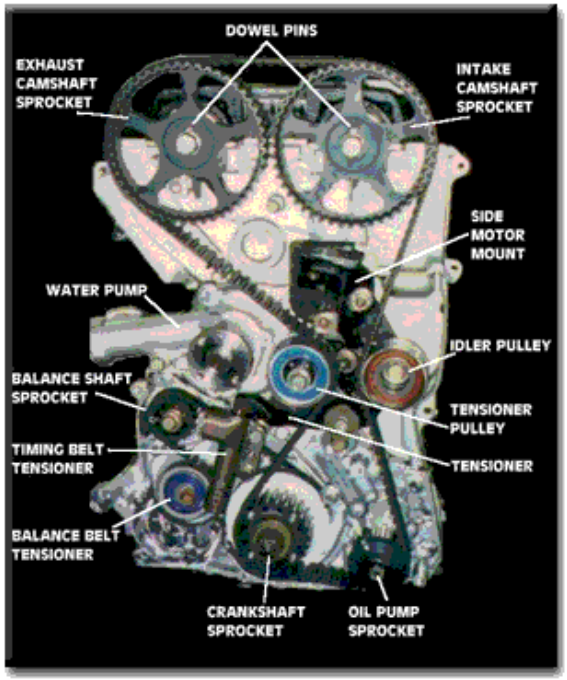
I – head is most common
a.k.a. Over Head Valve





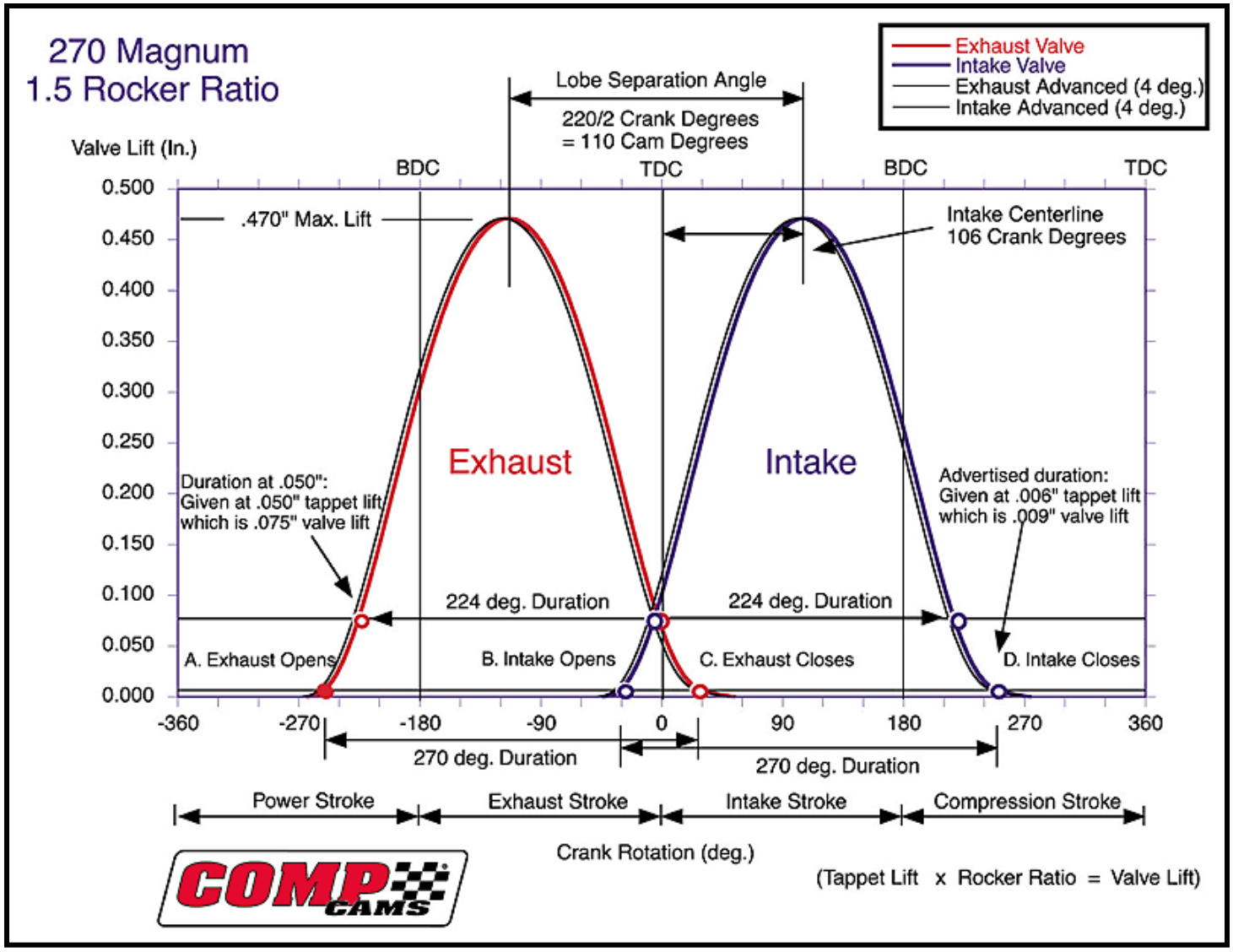


18. _____ drives can be gear-to-gear, timing chain & sprocket, or timing belt & sprocket.



Crankshaft
Camshaft
Balance shaft

19. Camshafts turn at _____ the speed of the crankshaft, rotating _____° for every *four-stroke cycle*.



½ crank speed

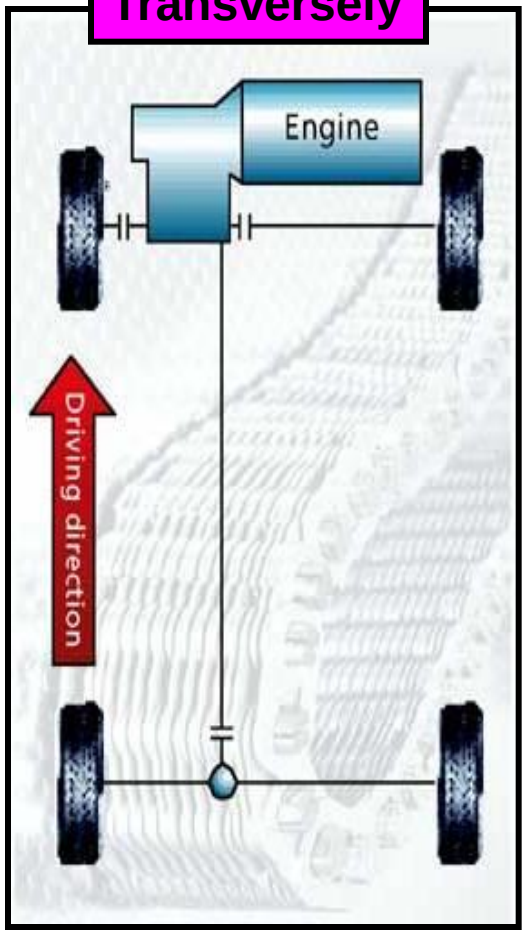
½ the distance

180°
360°
720°

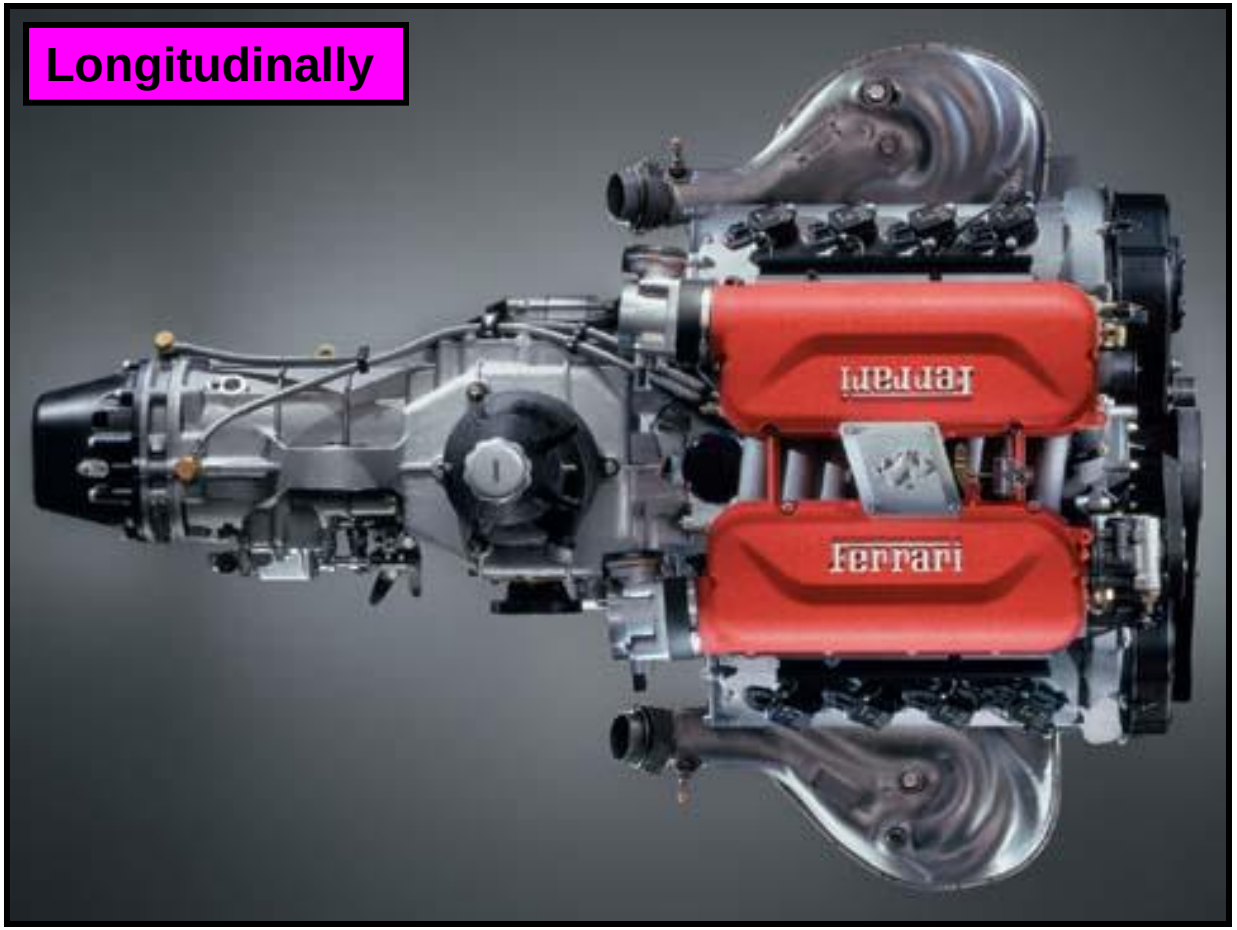
20. An engine *facing forward/backward* is said to be _____ mounted. _____ mounted engines *face sideways* in the engine compartment.

(Vehicles torque steer the way the engine faces.)

Transversely



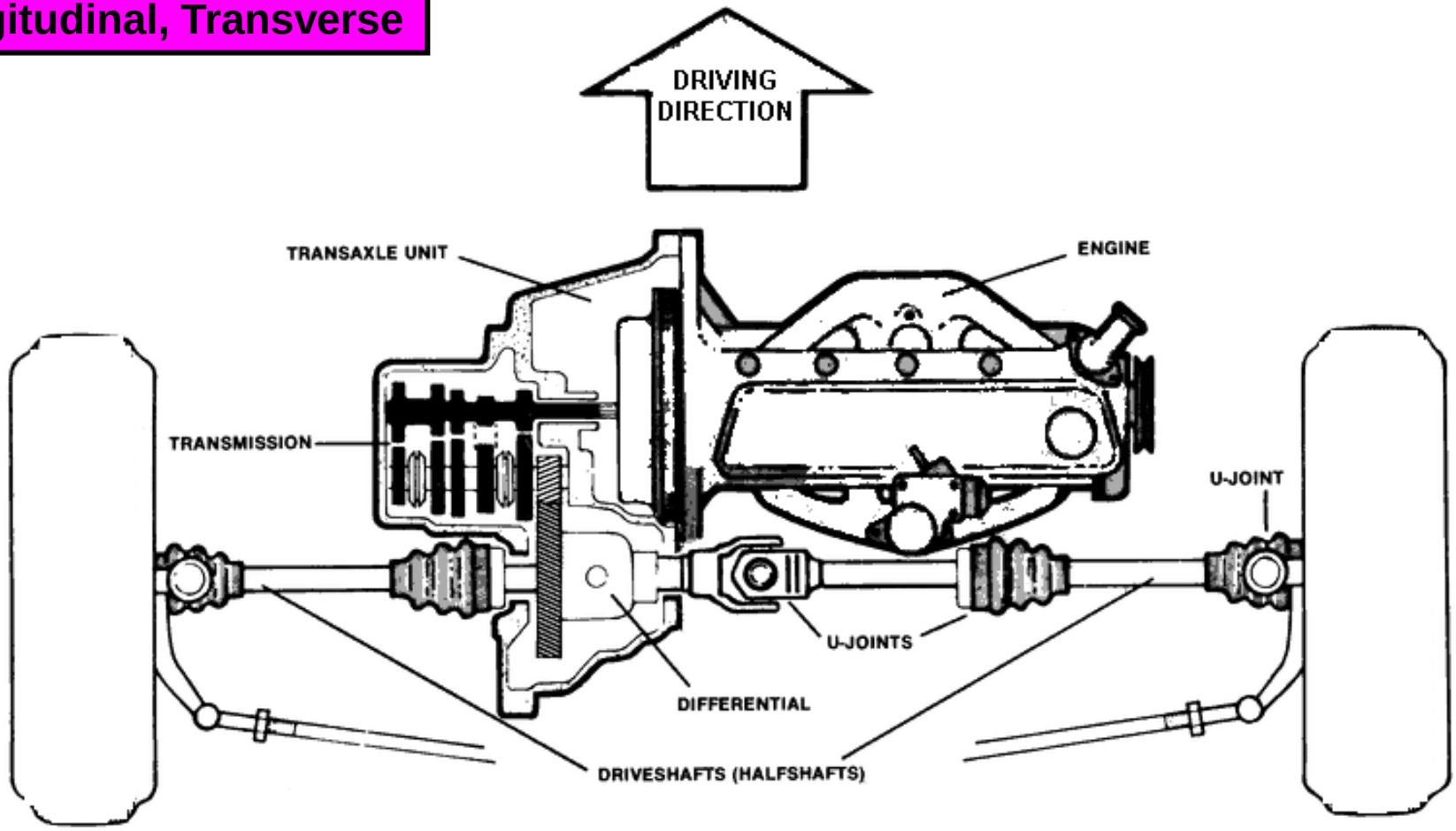
Longitudinally



20. An engine *facing forward/backward* is said to be _____ mounted. _____ mounted engines *face sideways* in the engine compartment.

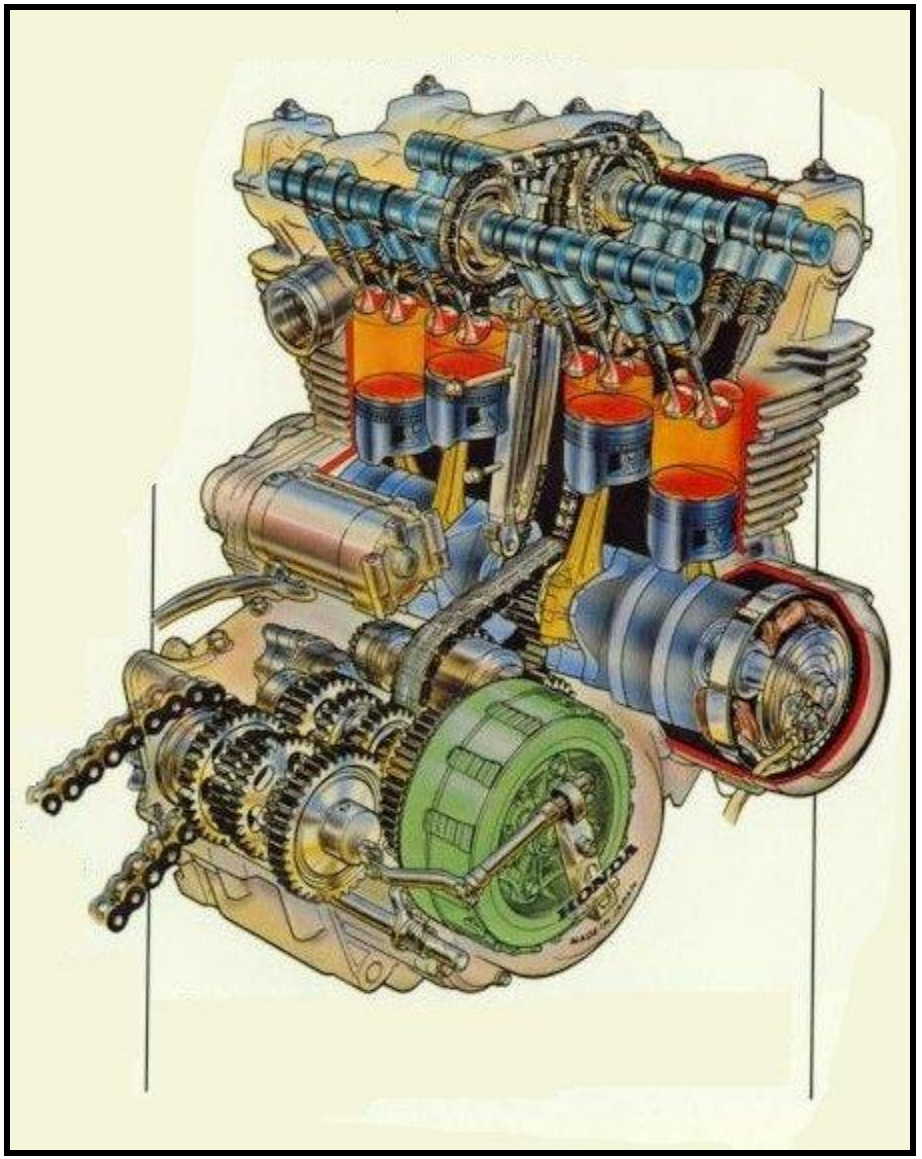
(Vehicles torque steer the way the engine faces.)

Longitudinal, Transverse

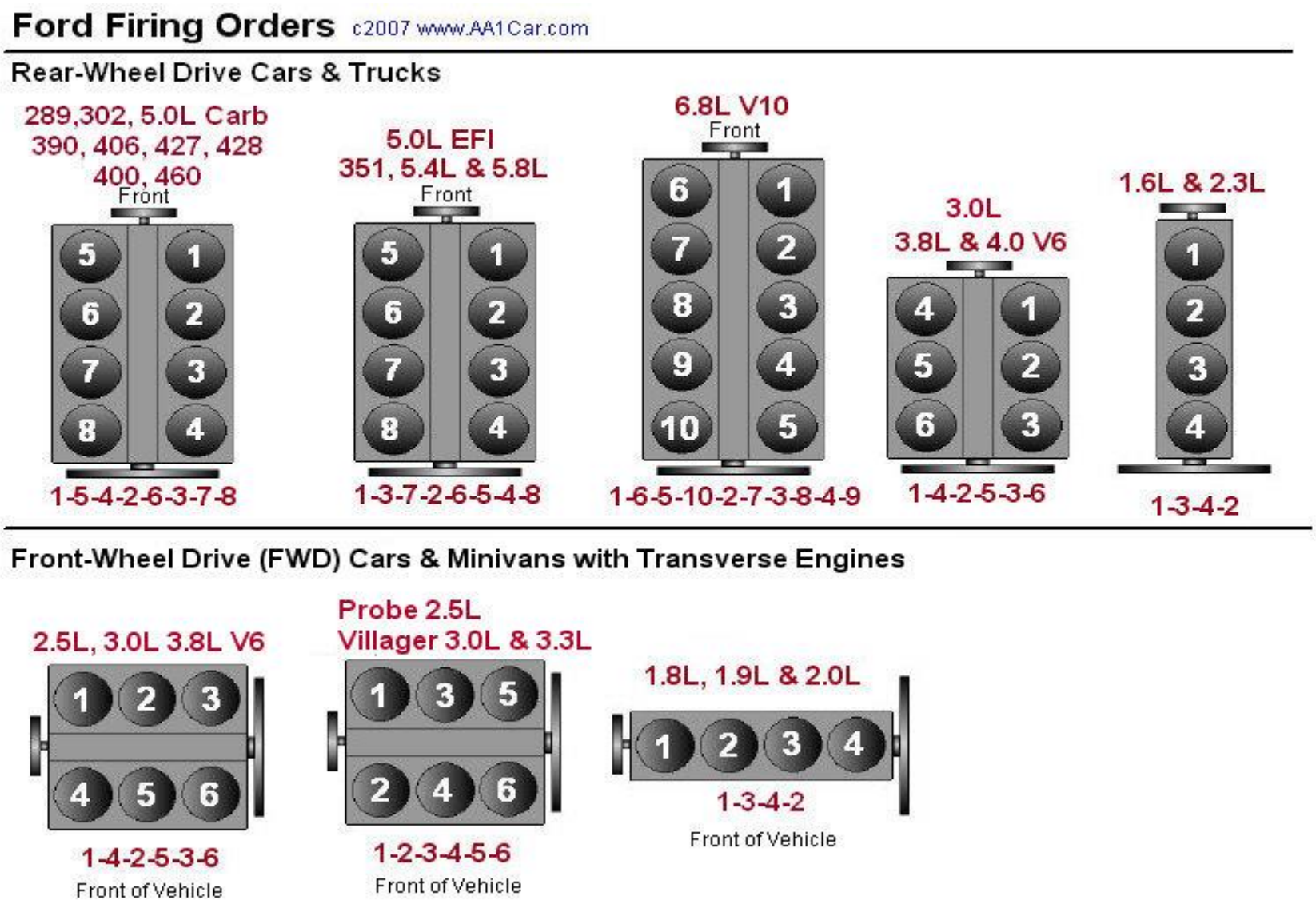


Name the systems of the engine that make the mnemonic
ME FEEL ICE

Mechanical
Exhaust
Fuel & Air Delivery
Electrical (Starting & Charging)
Emission Controls
Lubrication
Ignition
Cooling
Electronic Engine Management



21. _____ _____ is the sequence in which the air/fuel mixture is ignited in the cylinders.



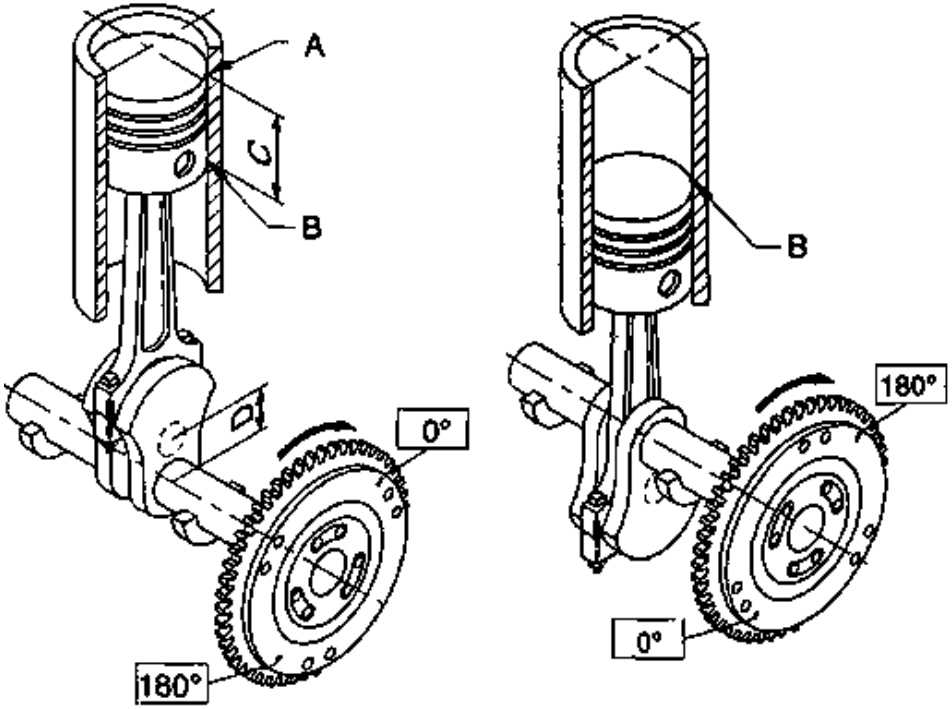
22. _____ is the *cylinder diameter* and _____ is the *distance the piston moves TDC to BDC.*

A Top Dead center (T.D.C)

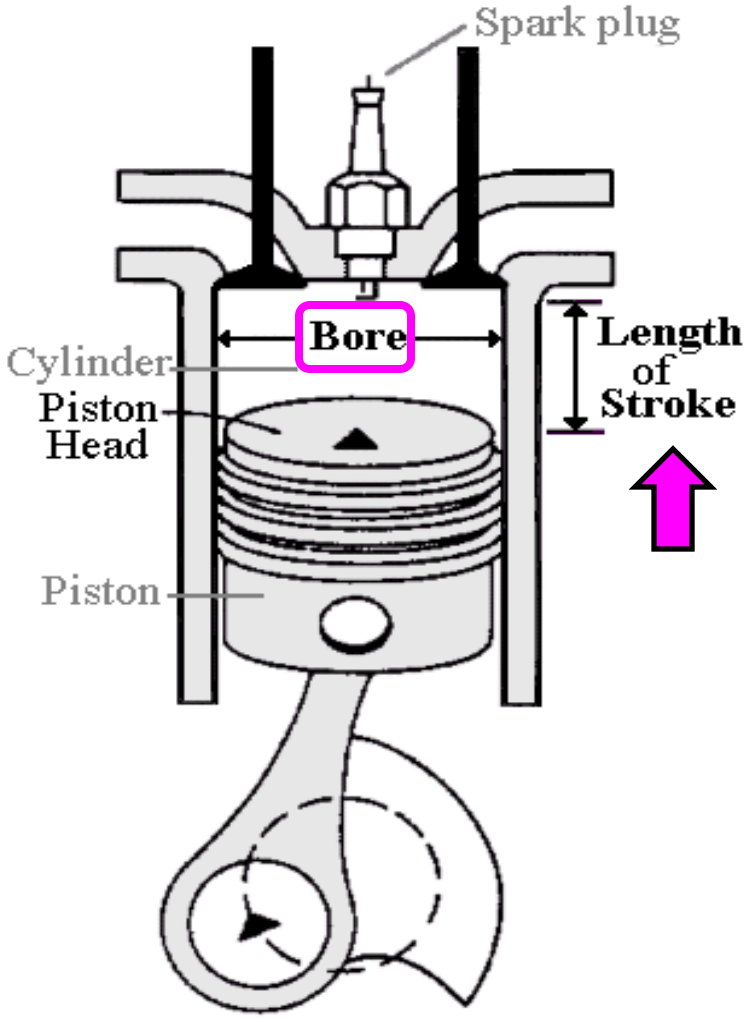
B Bottom Dead Center (B.D.C.)

C Stroke length

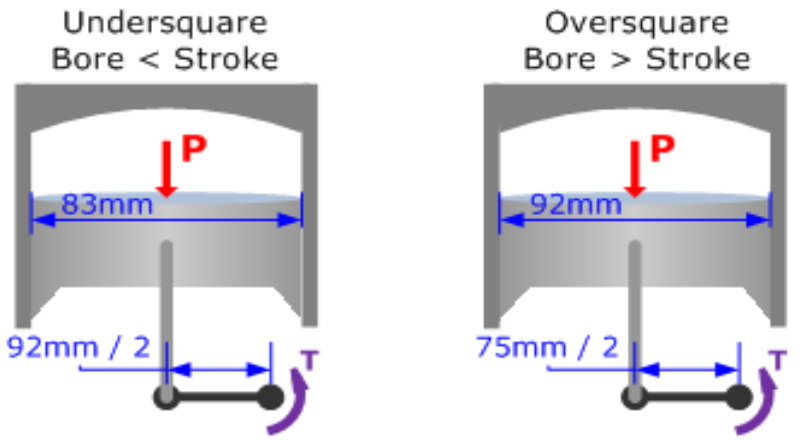
D Crank throw



Dx2 = Stroke length



23. Bore = Stroke the engine is "square". Bore > Stroke = _____
Bore < Stroke = _____



$$Torque \cong Cyl\ Pressure \times Piston\ Area \times Pin\ Offset$$

$$Torque_{Undersquare} = P \times \left(\frac{83^2 \cdot \pi}{4}\right) \times \frac{92}{2}$$

$$Torque_{Undersquare} = P \times (5411) \times 46$$

$$Torque_{Undersquare} = 2.5 \times 10^5 \times P$$

$$Torque_{Oversquare} = P \times \left(\frac{92^2 \cdot \pi}{4}\right) \times \frac{75}{2}$$

$$Torque_{Oversquare} = P \times (6648) \times 37.5$$

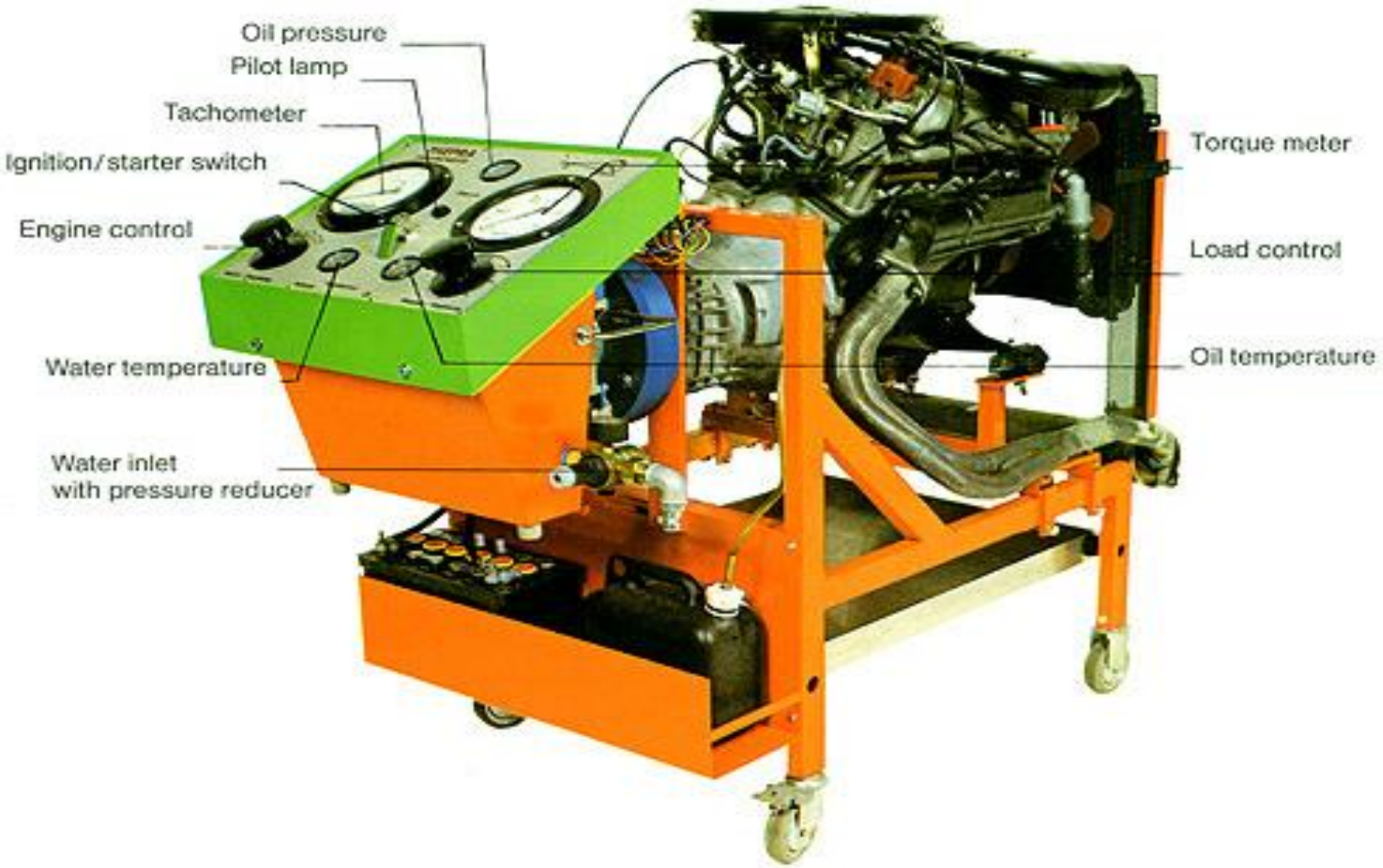
$$Torque_{Oversquare} = 2.5 \times 10^5 \times P$$

Square Engine: Bore" = Stroke"

Over Square Engine: Bore" Greater Than Stroke"

Under Square Engine: Bore" Less Than Stroke"

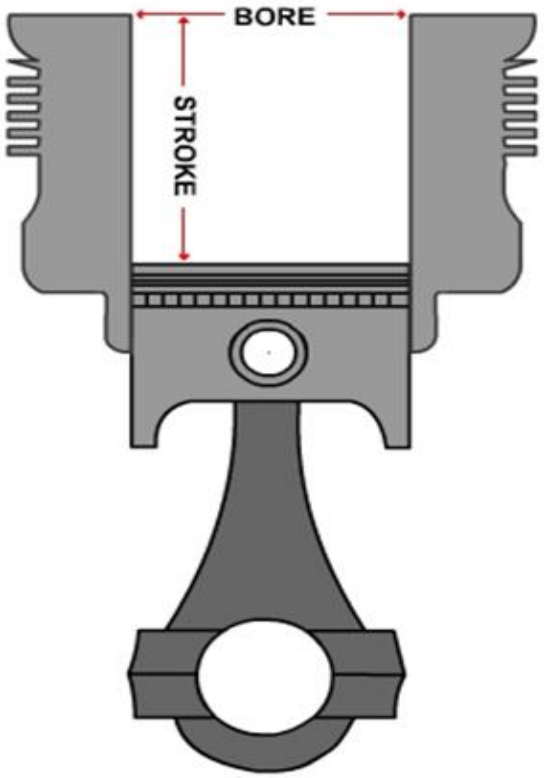
Engine performance is defined as the work that engines do & how well they do it.



Square Engine:

As a square has both the sides equal, here also the Bore and Stroke are of almost same size.

The engine tries to strike a balance between torque and top speed.

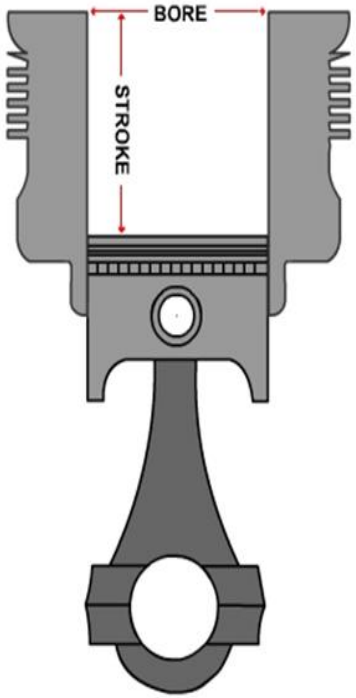


Long Stroke/ Under Square Engine:

As the name suggests the Stroke is longer than the Bore.

Due to the longer stroke, the engine makes good torque at relatively low rpms.

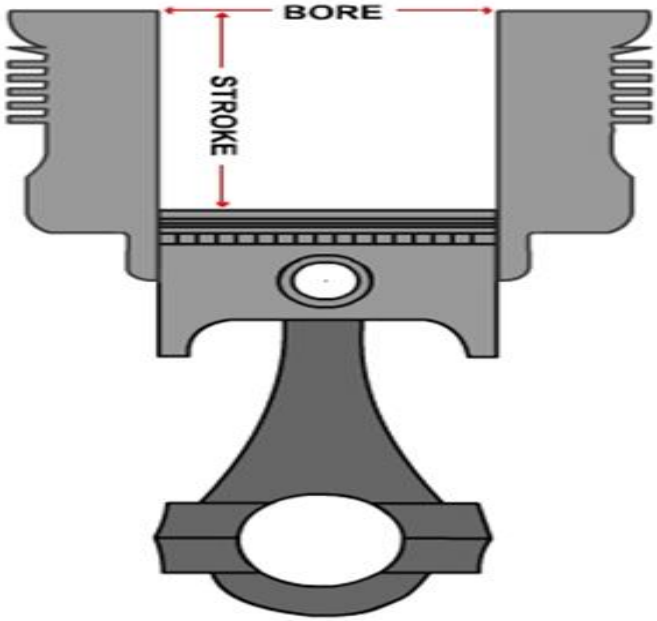
It is important where the bikes' pulling more (torque) at relatively low rpms is more important than the top speed.

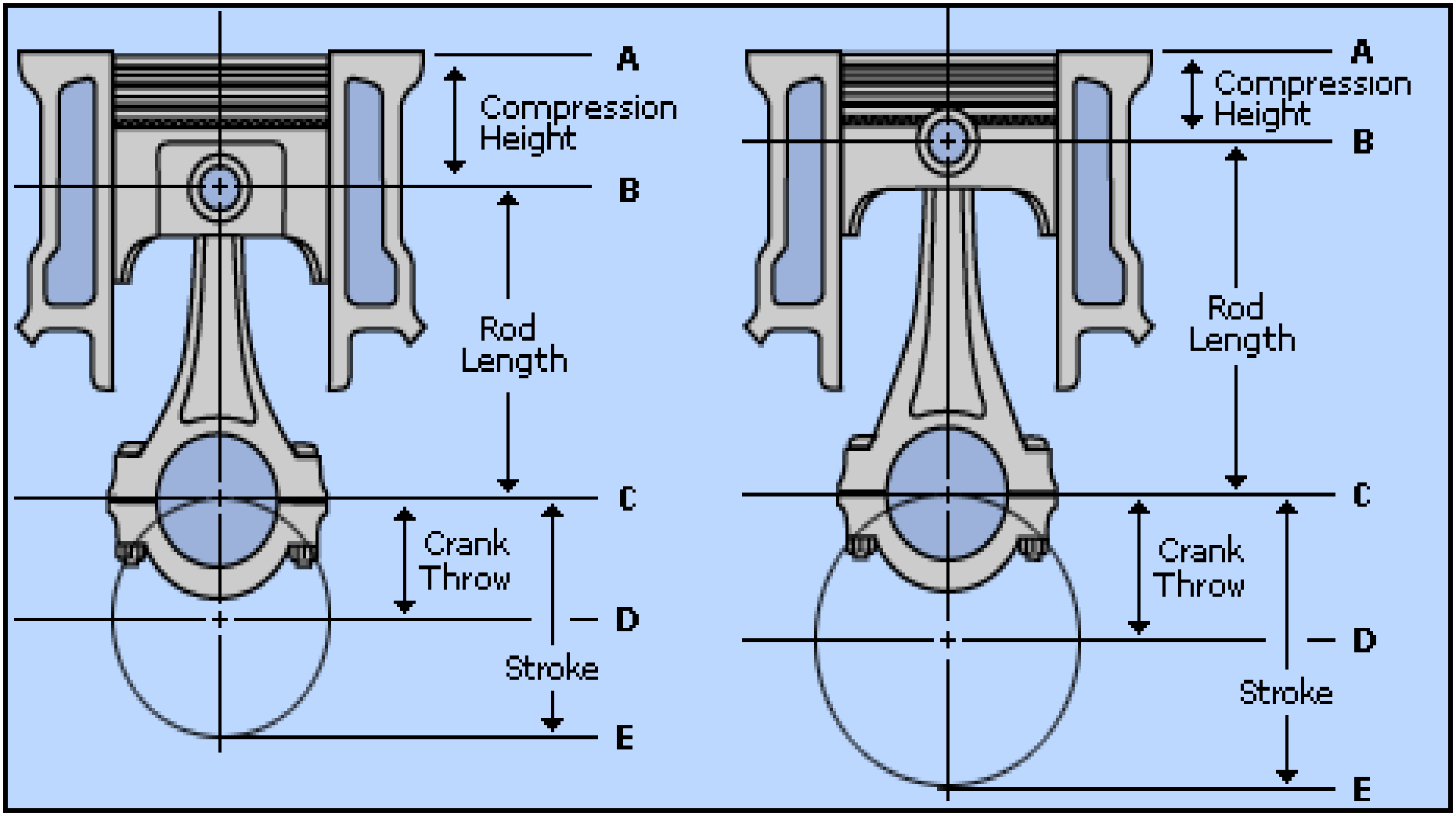


Short Stroke/Over Square Engine:

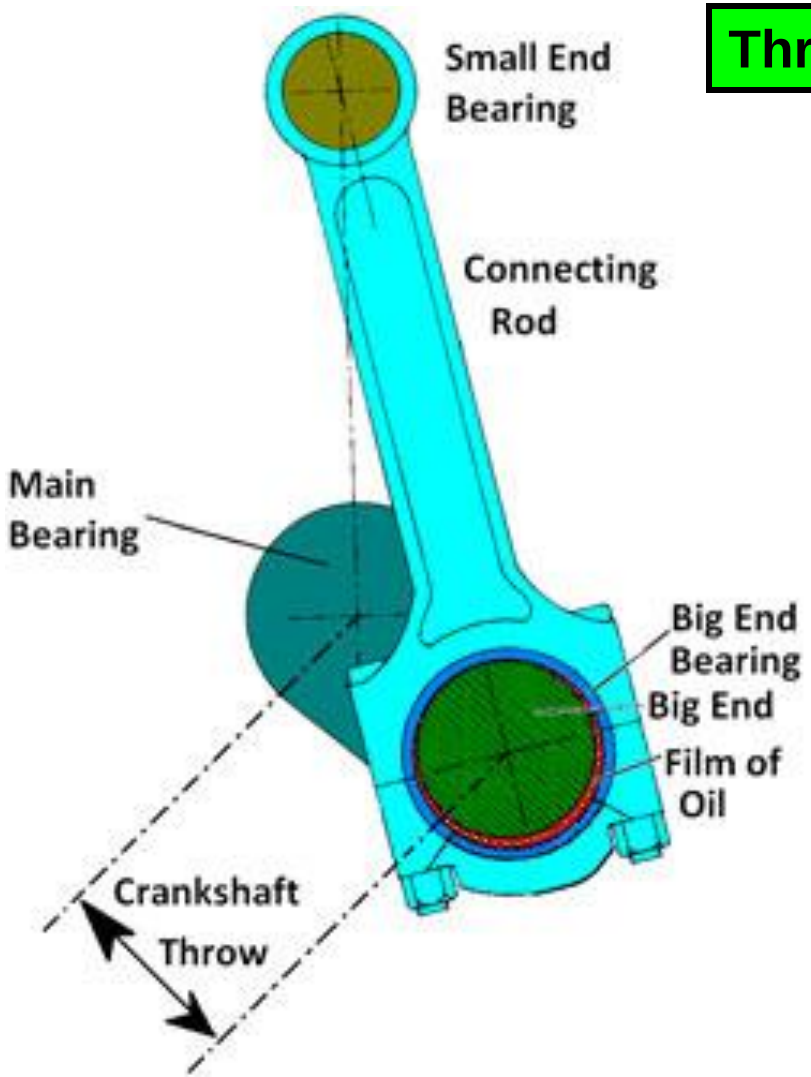
As the name signifies the Stroke is shorter than the Bore.

Due to the relatively shorter stroke, the engine revs fast and is more suitable where a quick build of power is important, more importantly where the bikes make power at higher rpms.




A
Compression Height
B
Rod Length
C
Crank Throw
D
Stroke
E
A
Compression Height
B
Rod Length
C
Crank Throw
D
Stroke
E

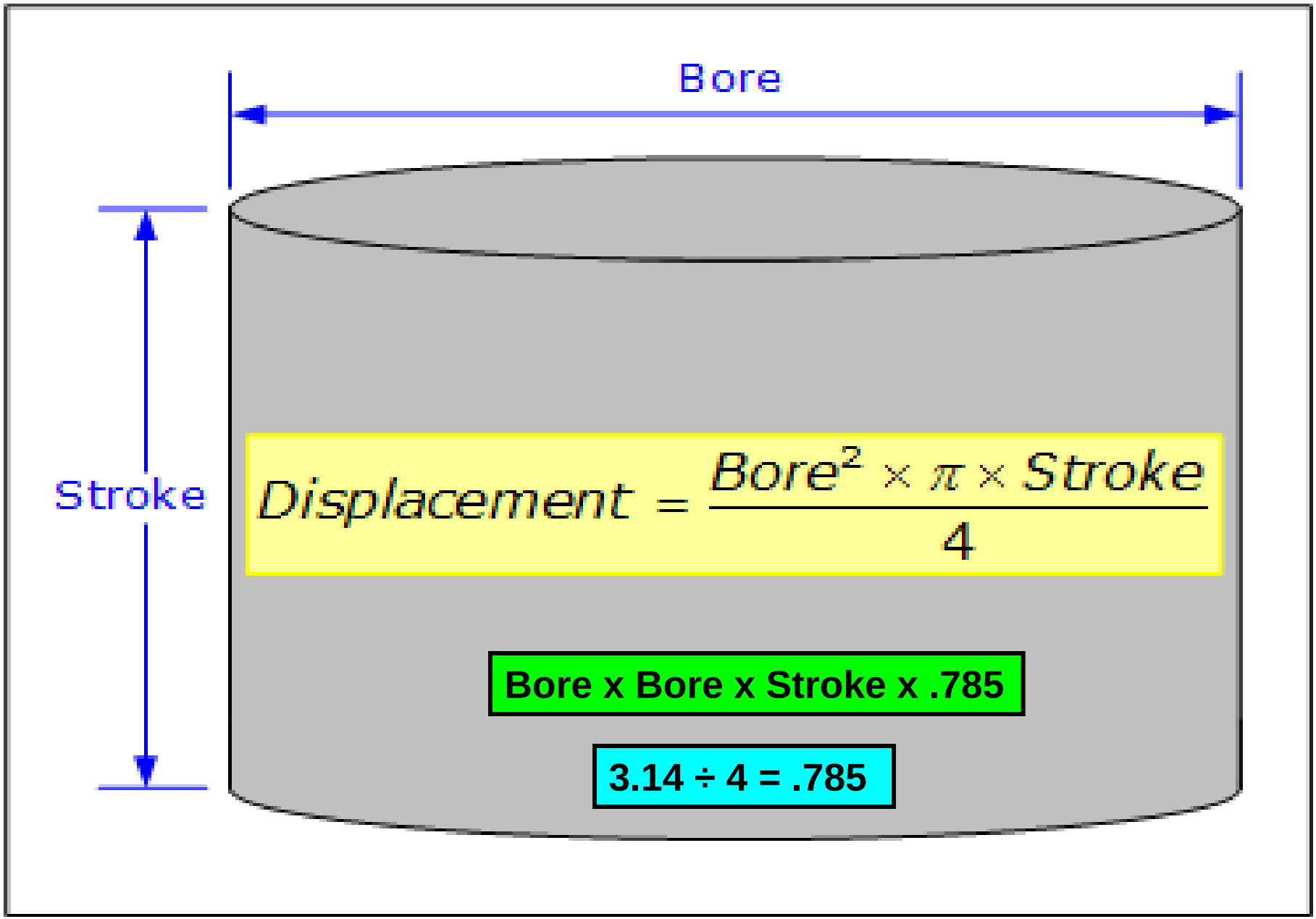
24. _____ is the distance measured from the main bearing centerline to the rod journal centerline.



Throw x 2 = Stroke

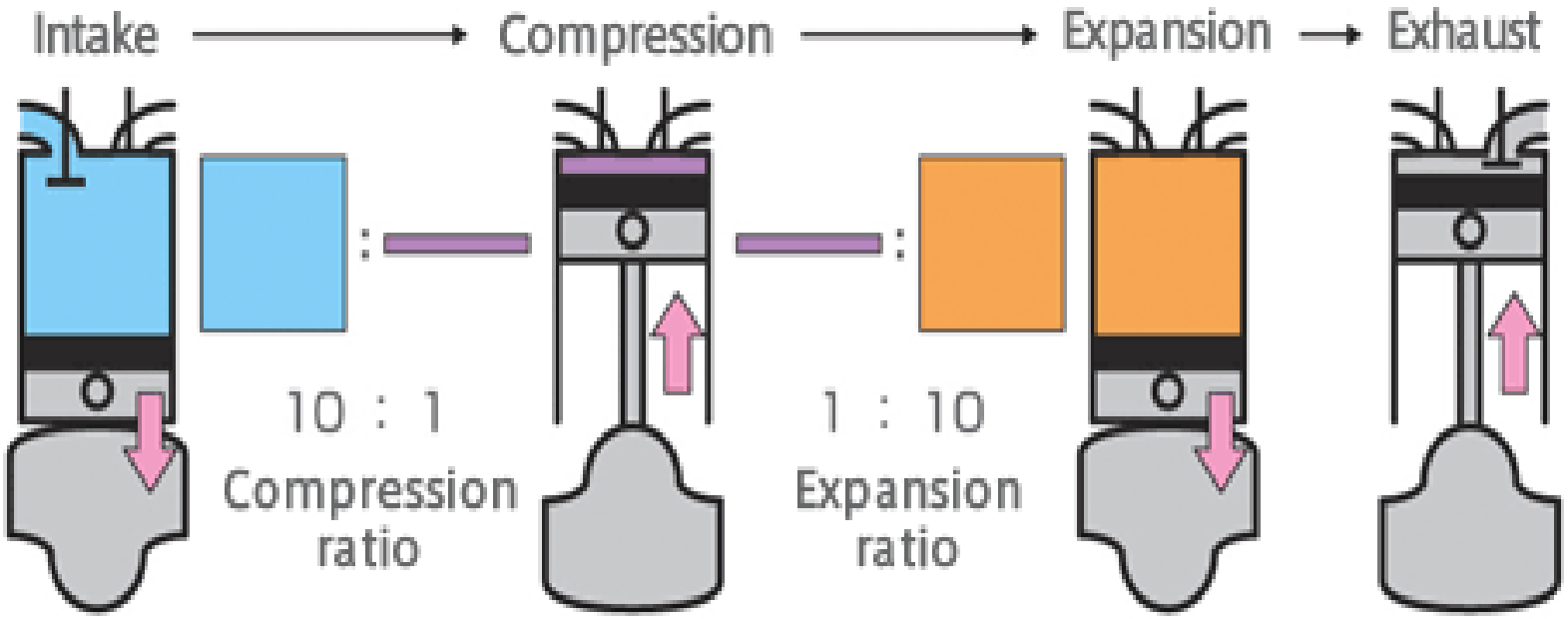
1.750” x 2 = 3.500”

Crank Throw or Offset


Bore
Stroke
$Displacement = \frac{Bore^2 \times \pi \times Stroke}{4}$
Bore x Bore x Stroke x .785
3.14 ÷ 4 = .785

Here's why compression ratio is so important!

■Compression ratio and expansion ratio

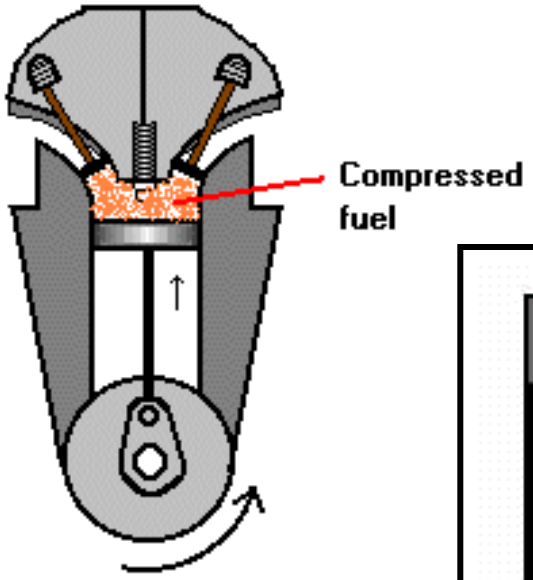


In most engines compression ratio = expansion ratio

Compression ratio : The ratio of the volume of the air-fuel mixture in the cylinder before and after a compression stroke.

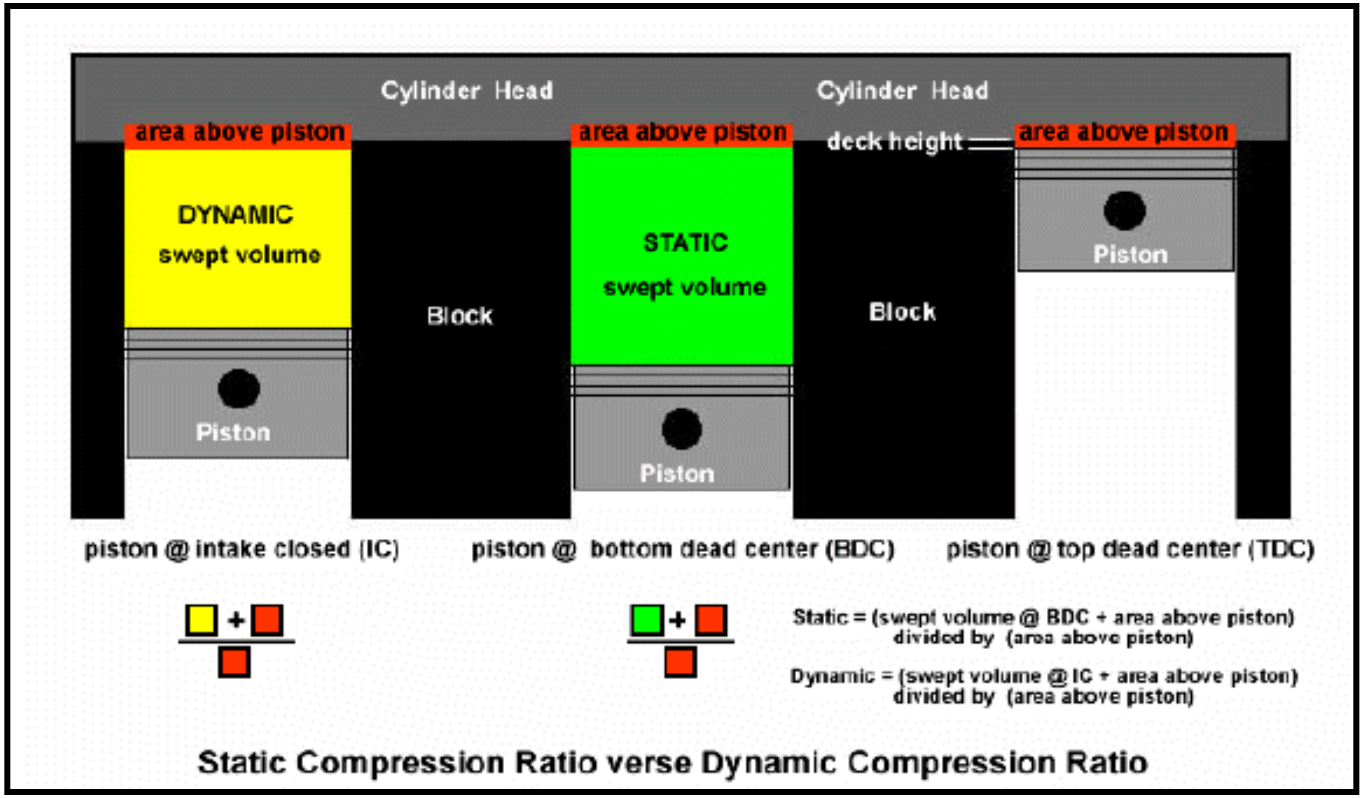
Expansion ratio : The ratio of the volume of the detonated fuel before and after an expansion stroke.

If Displacement = 500 cc's & Combustion Chamber Volume is 50 cc's
Compression Ratio = _____



500 ÷ 25 = 20:1 Compression Ratio (diesel)

500 ÷ 50 = 10:1 Compression Ratio (gasoline)

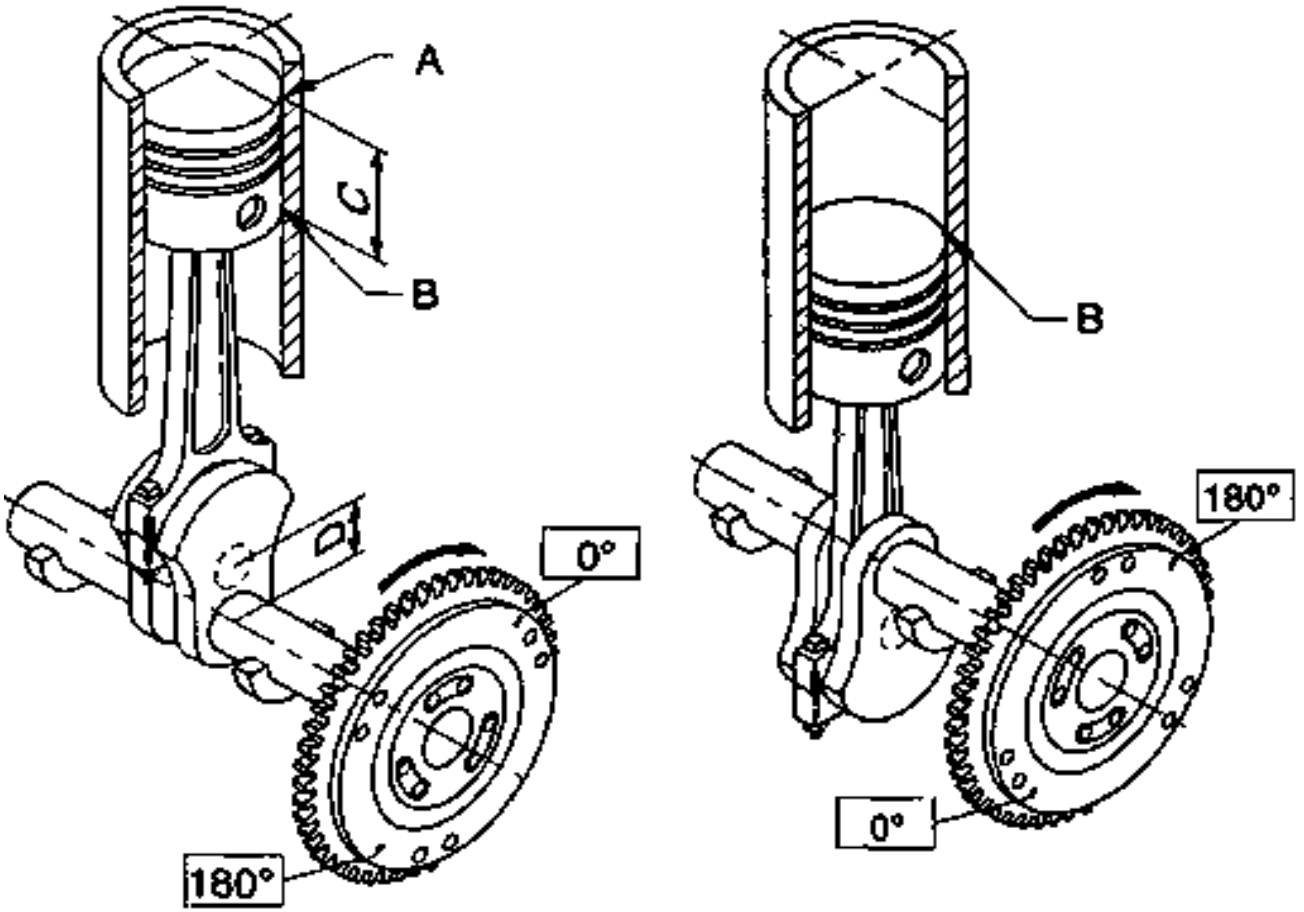


A Top Dead center (T.D.C)

B Bottom Dead Center (B.D.C.)

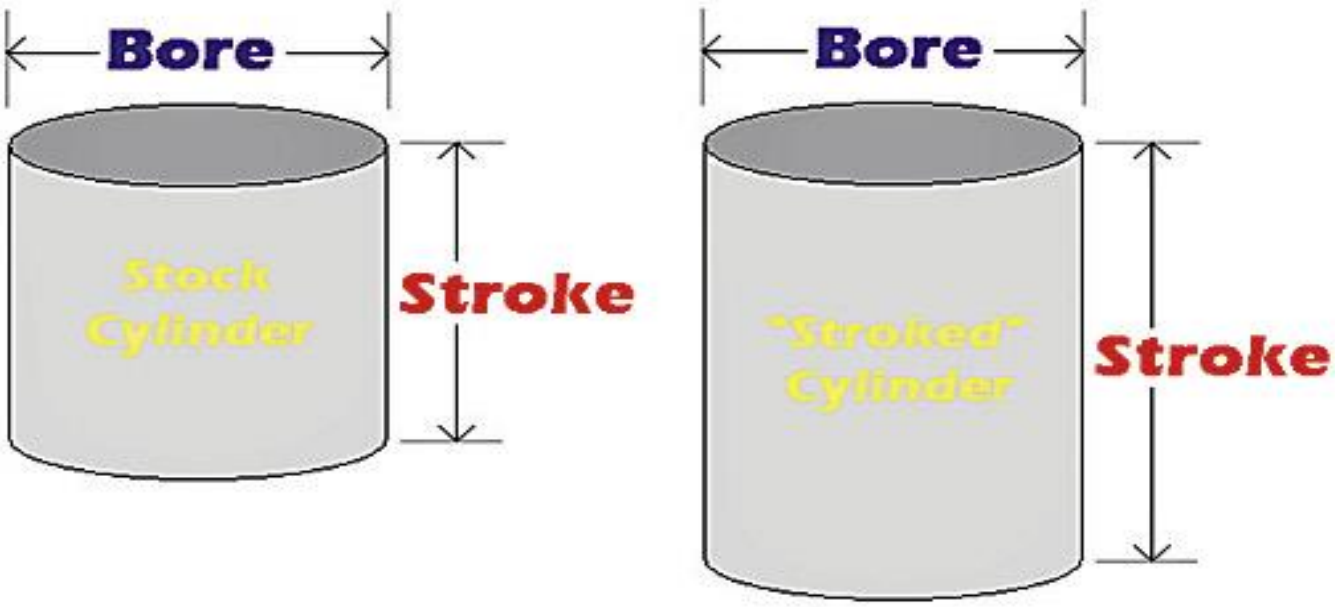
C Stroke length

D Crank throw



Dx2 = Stroke length

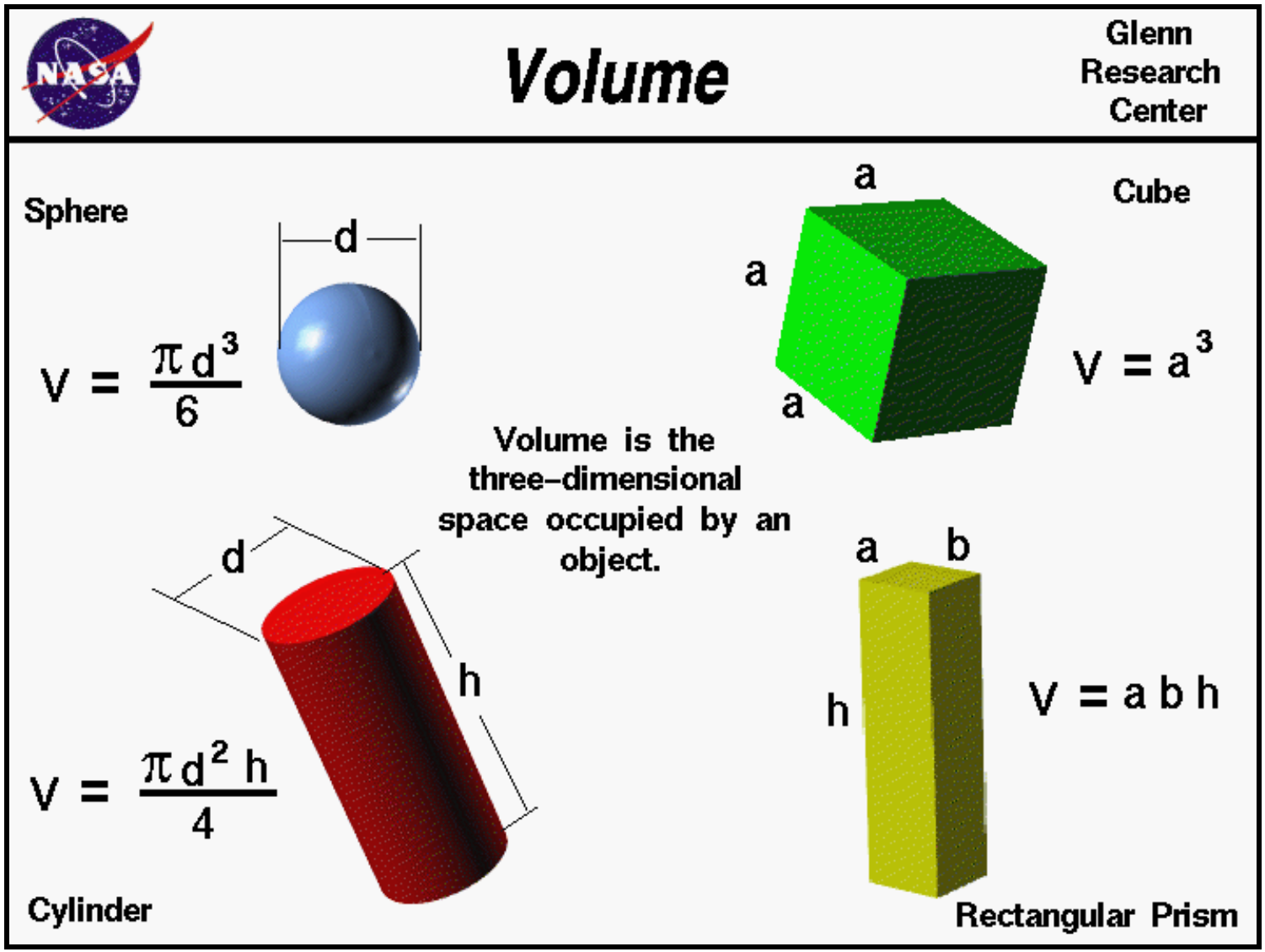
25. _____ is the term for *total cylinder volume*.
(Either metric or standard units of measure)



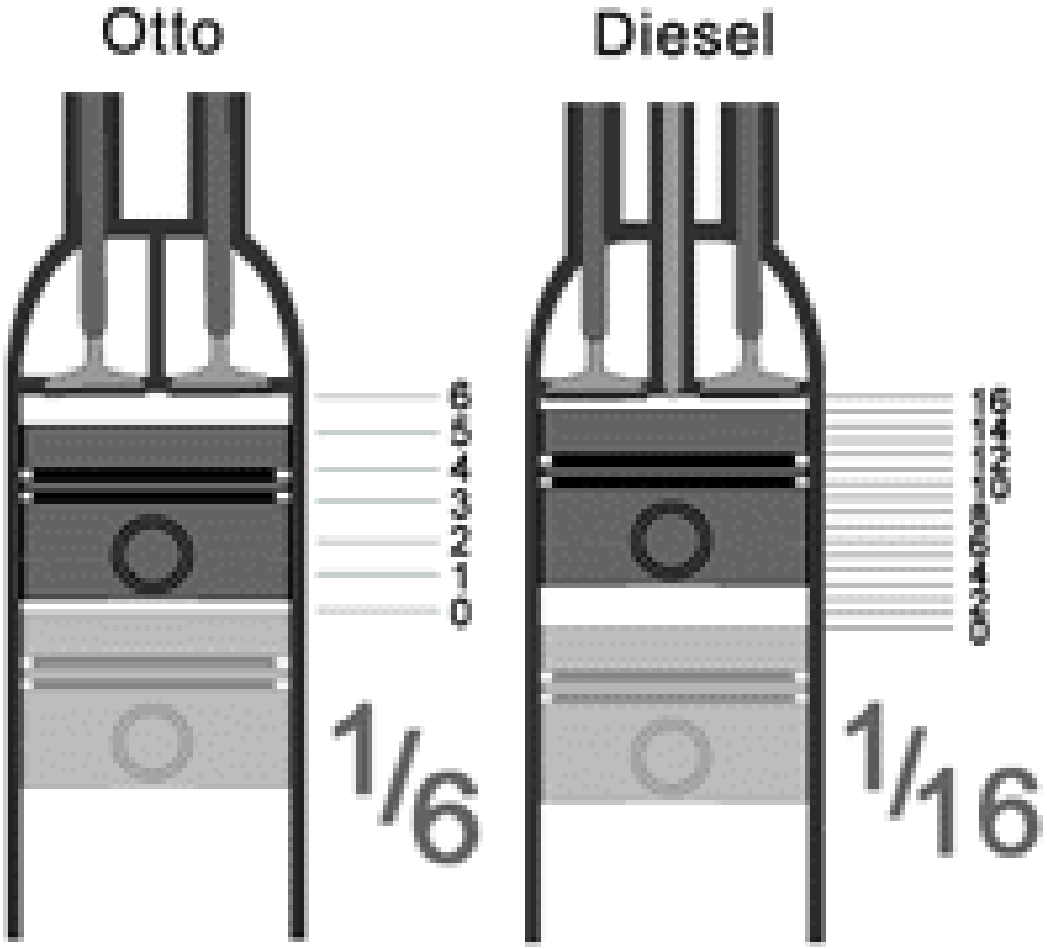
$$\text{Engine Displacement} = 8\pi \frac{\text{Bore}^2}{4} \text{Stroke}$$

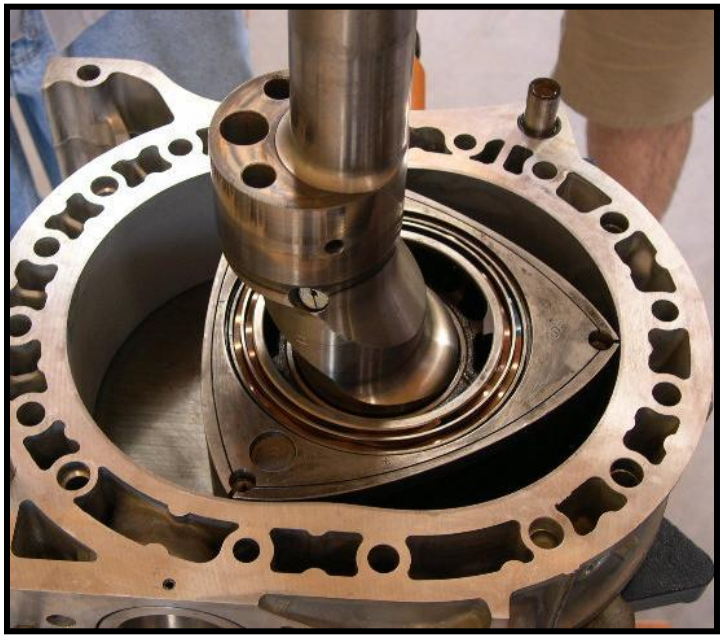
Bore x Bore x Stroke x .785 x # of Cylinders = Displacement

26. _____ x _____ x _____ x .785 x # of cylinders = Displacement
(either metric or standard) ***It's Always Cubic Something!***

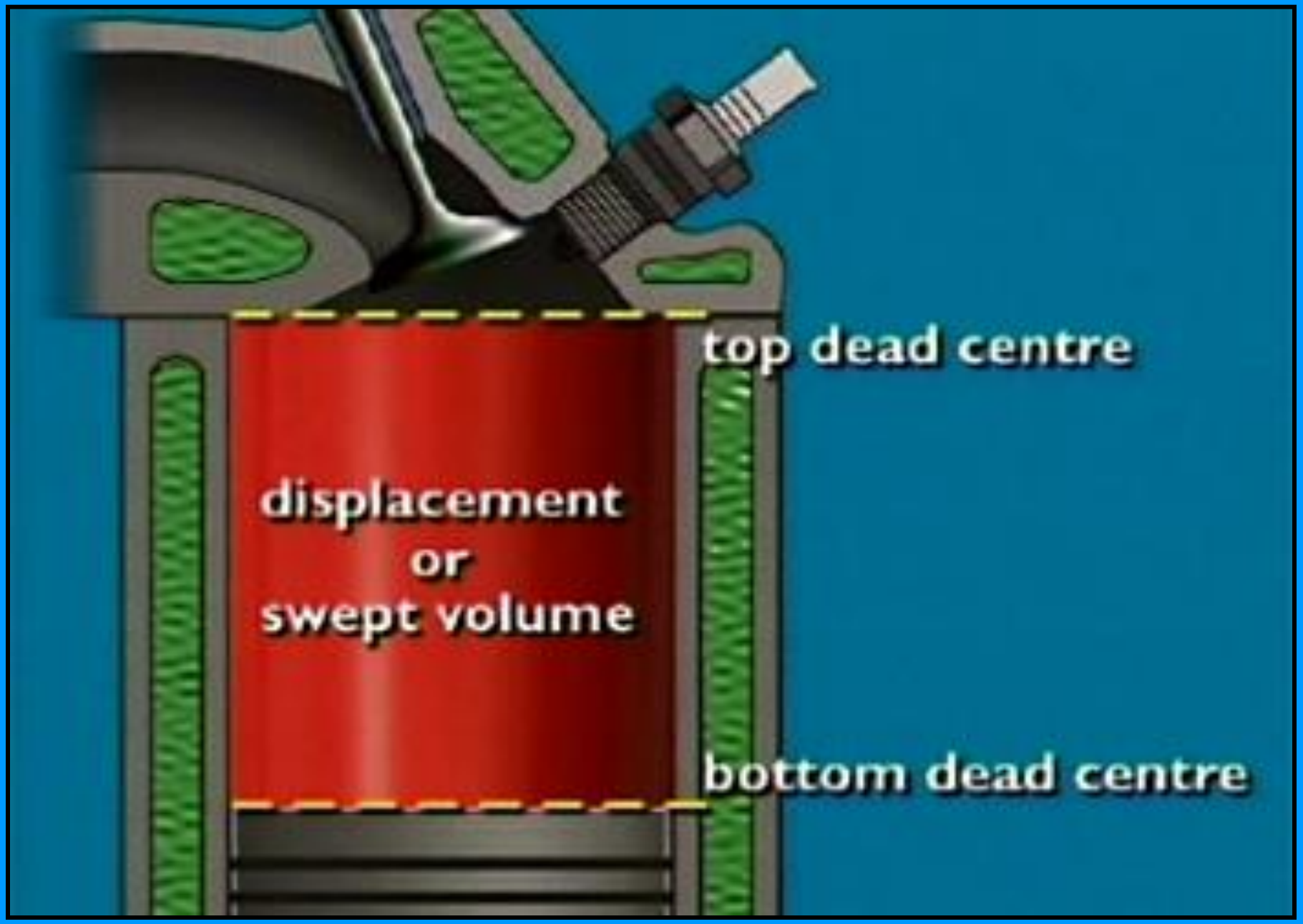


27. _____ _____ is found by dividing cylinder volume w/piston @BDC by cylinder volume w/piston@ TDC.
More Correctly, Cylinder Volume divided by Combustion Chamber Volume.

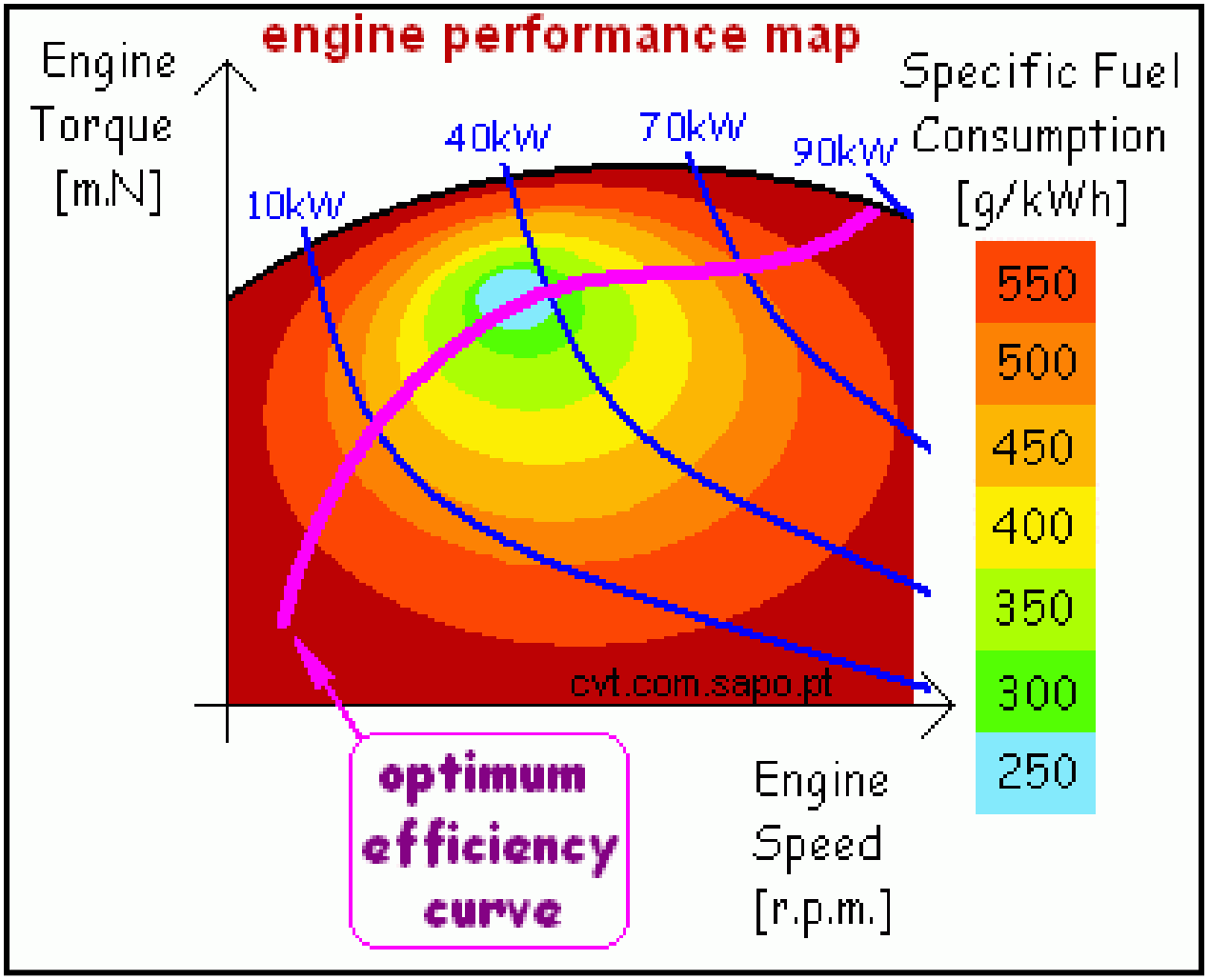




Compression Pressure
Compression Ratio
Mechanical Efficiency

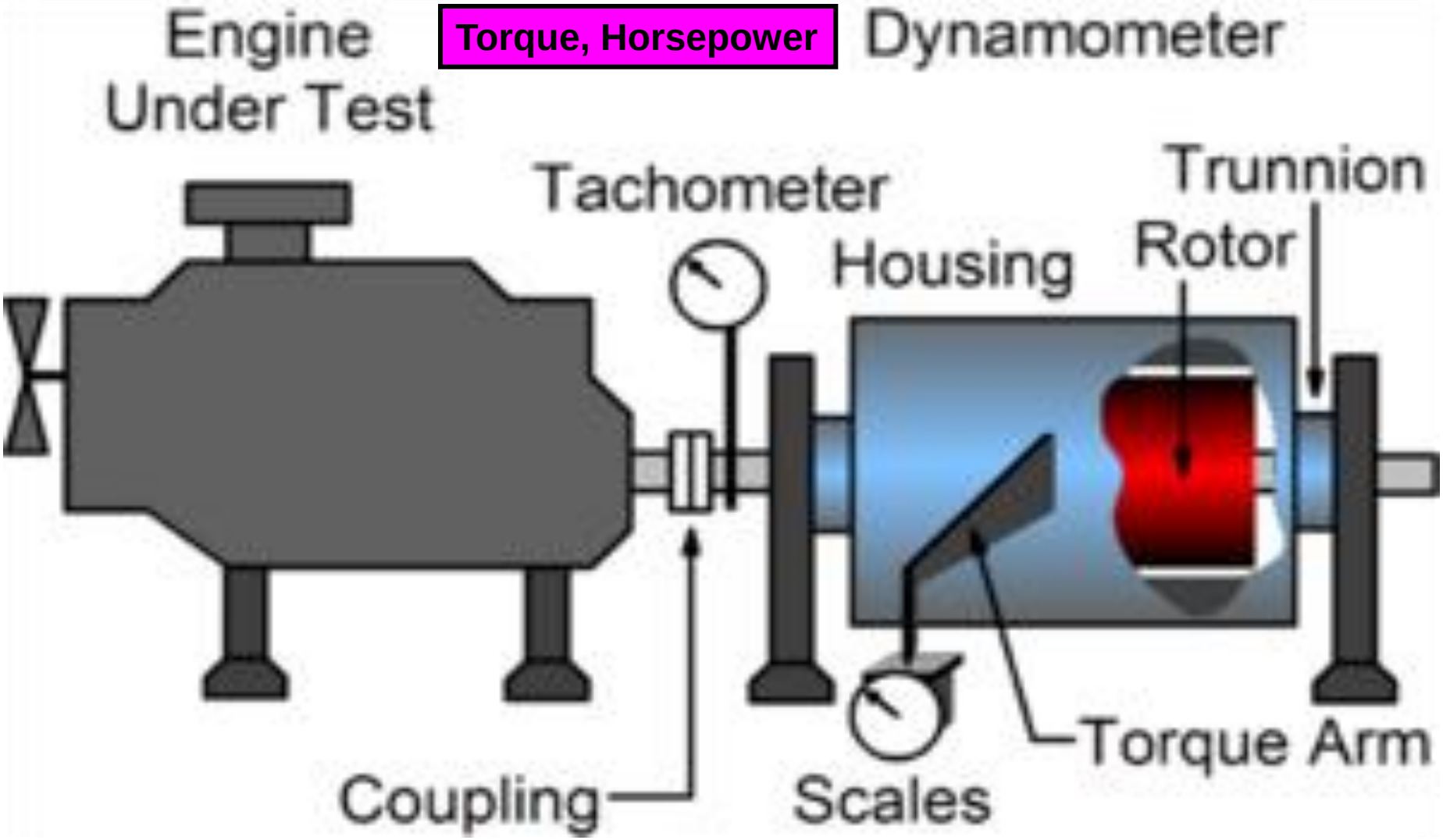

top dead centre
displacement
or
swept volume
bottom dead centre

28. Engine _____ is found by dividing output energy by input energy.
(always less than 100%)



Horsepower
Torque
Efficiency

29. _____ is *twisting or turning force*, expressed in pound-feet.
_____ is the rate at which torque is produced.
(1 HP is the ability to lift 33,000 pounds 1 foot in 1 minute or 550# 1ft/sec)



You can hear dynamometers all around in Charlotte, NC


88
IMPALA SS
amp
MAHLE
COMP CAMS
Raybestos
Edelbrock
Stant
WIX

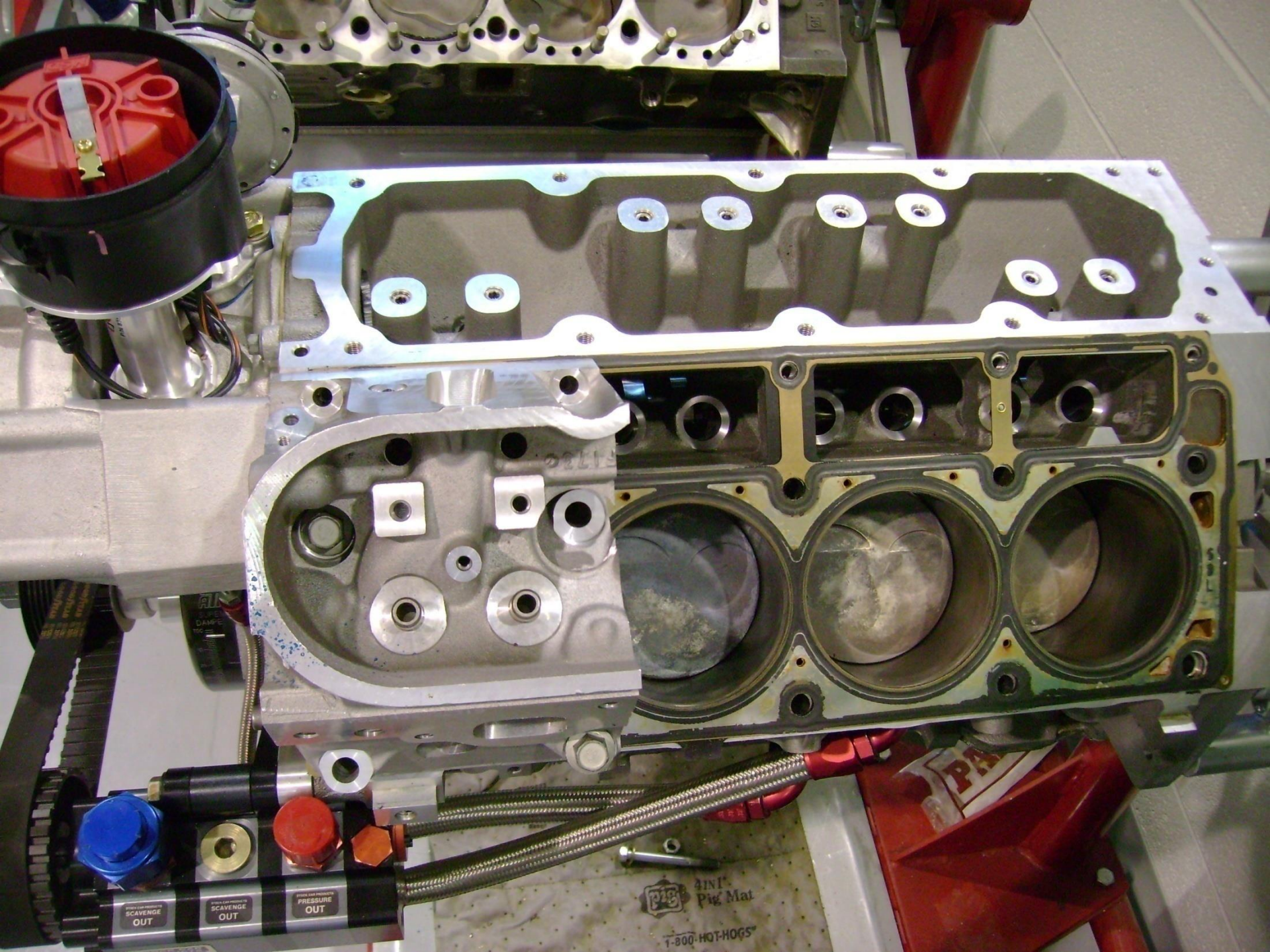

ROUSH FENWAY

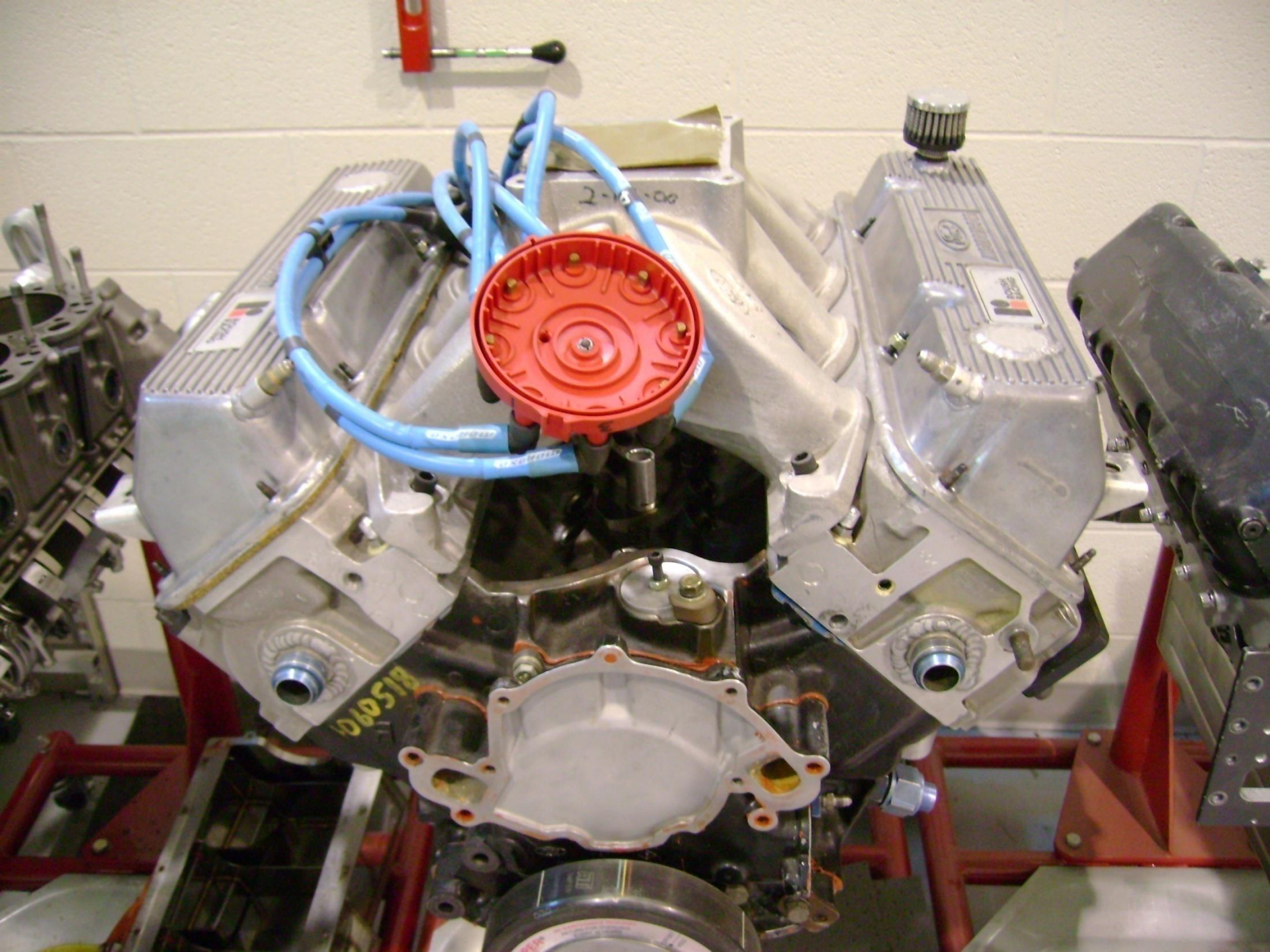

GUARANTEED TOUGH.
FUSION
FUSION
FUSION


MSD
ROUSH


NASCAR

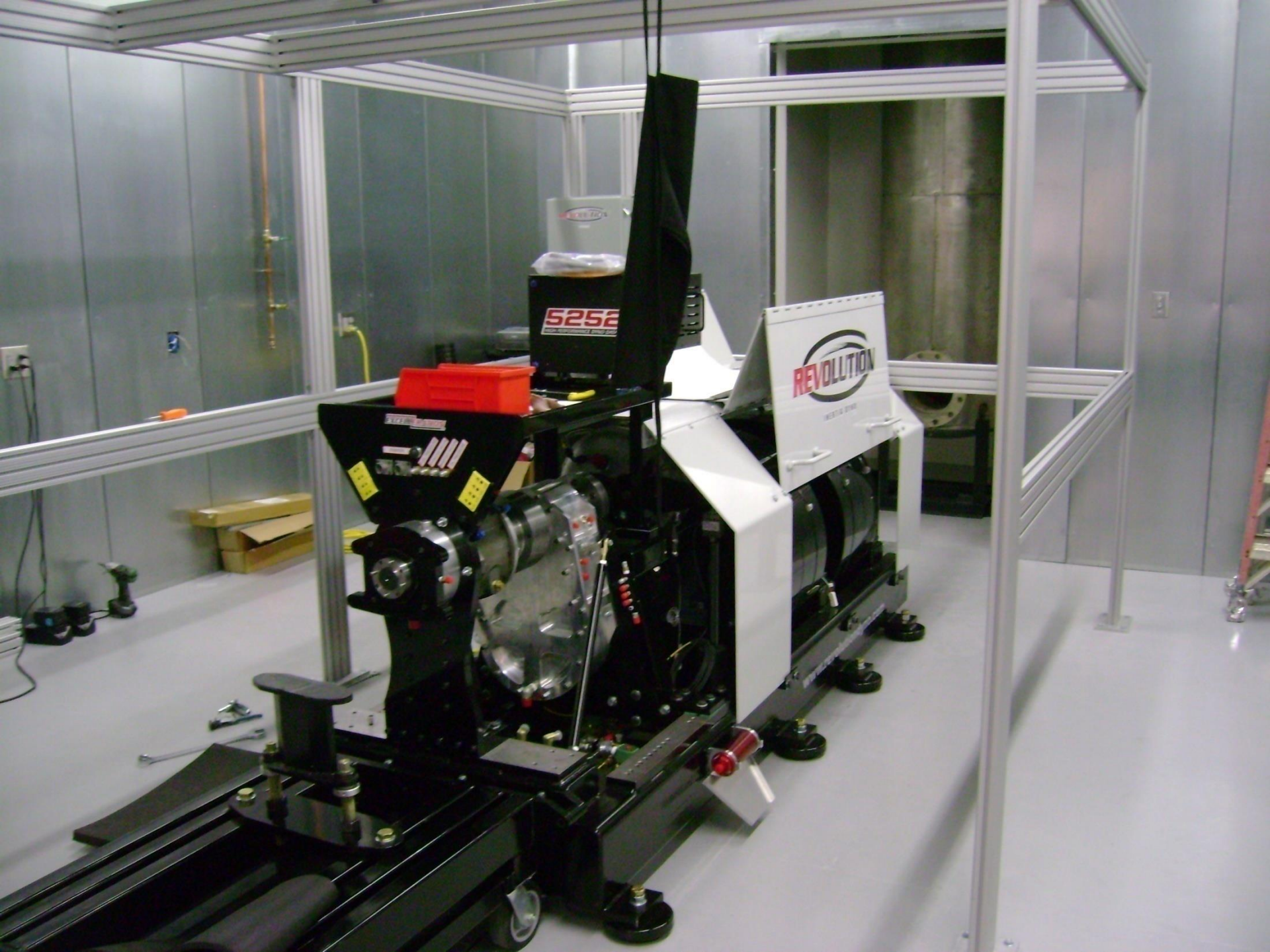

Solid Modeling
Lab

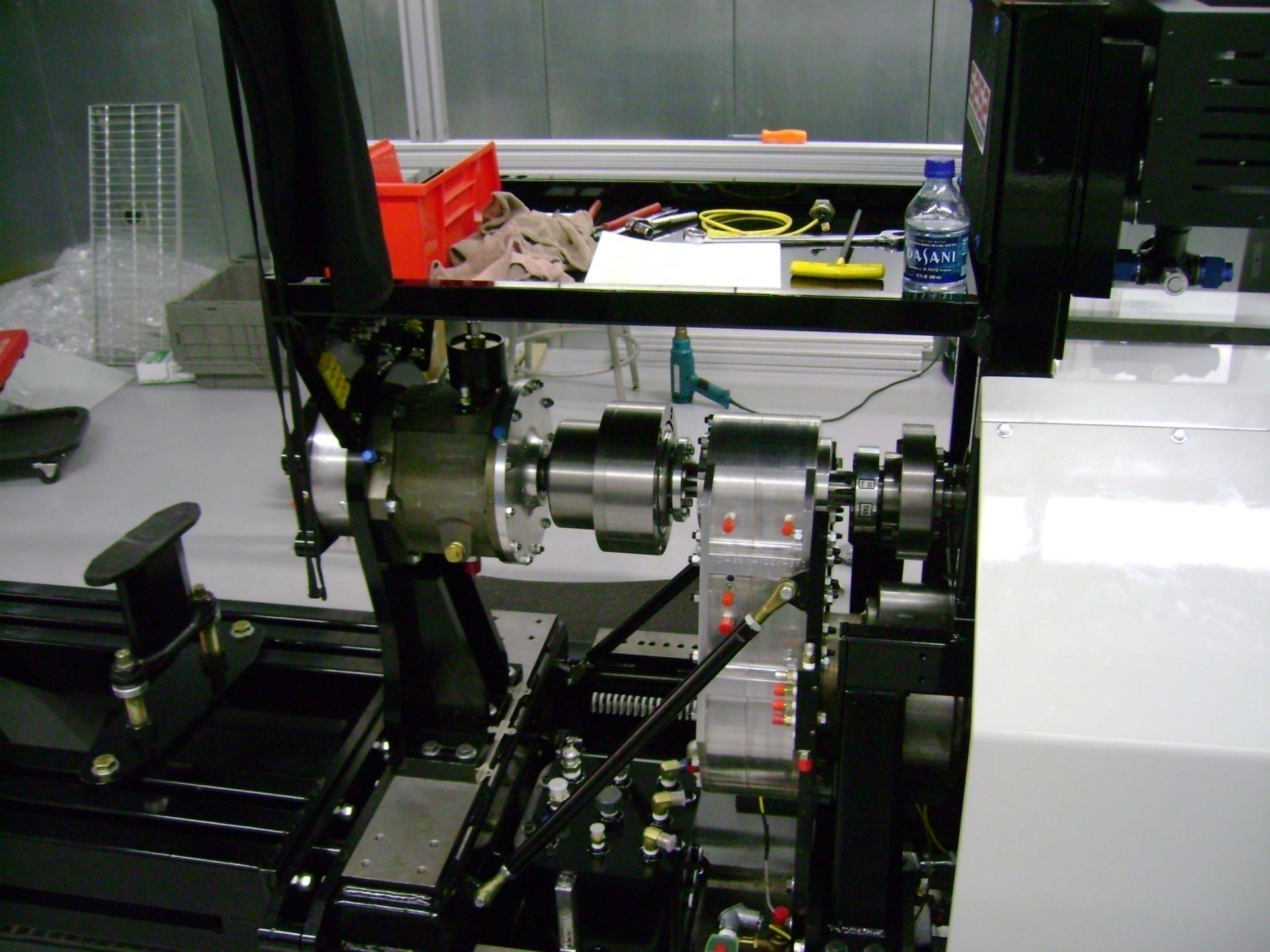

SCAVENGE
OUT
SCAVENGE
OUT
PRESSURE
OUT
4IN1
Pig Mat
1-800-HOT-HOGS

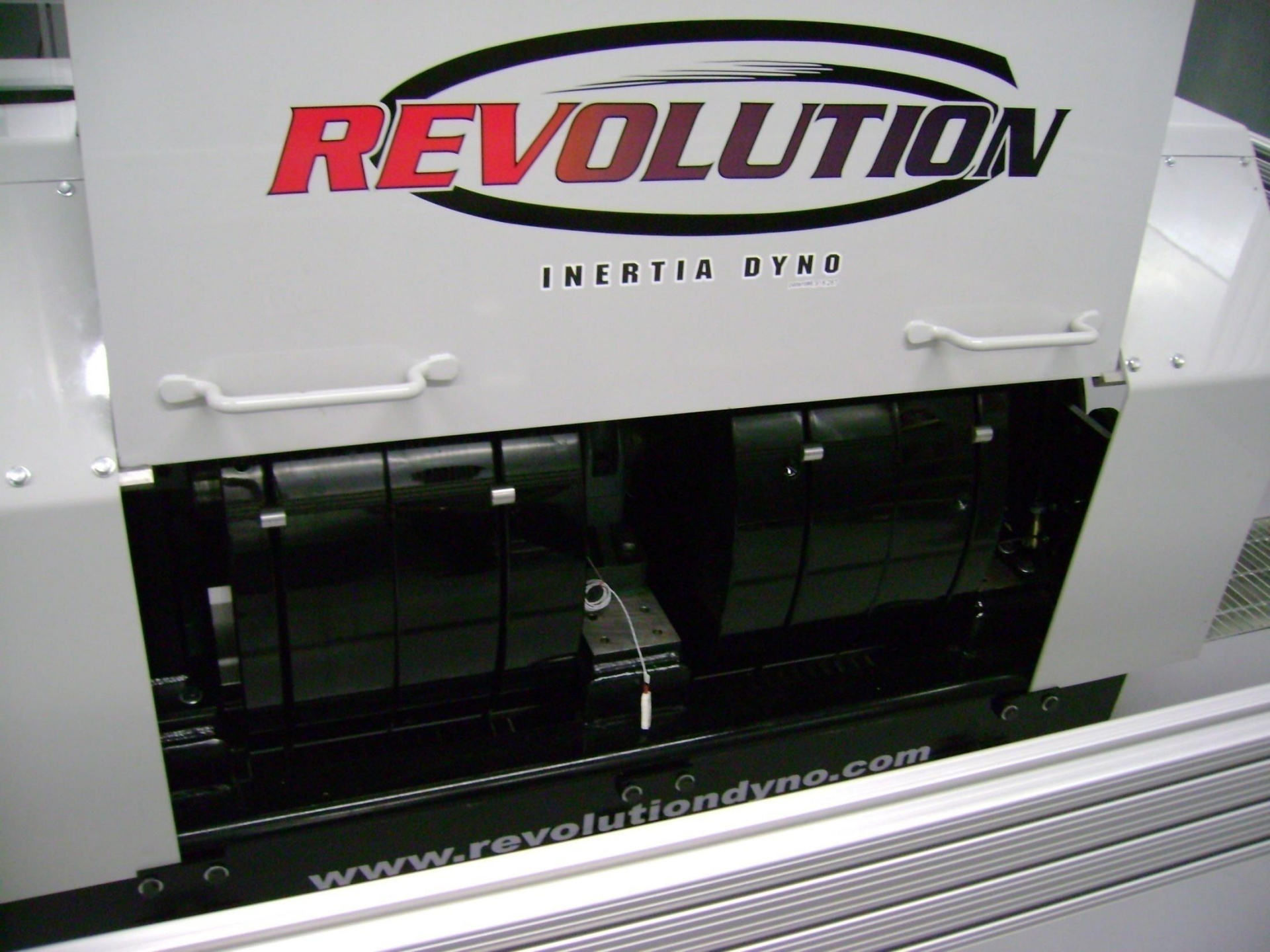


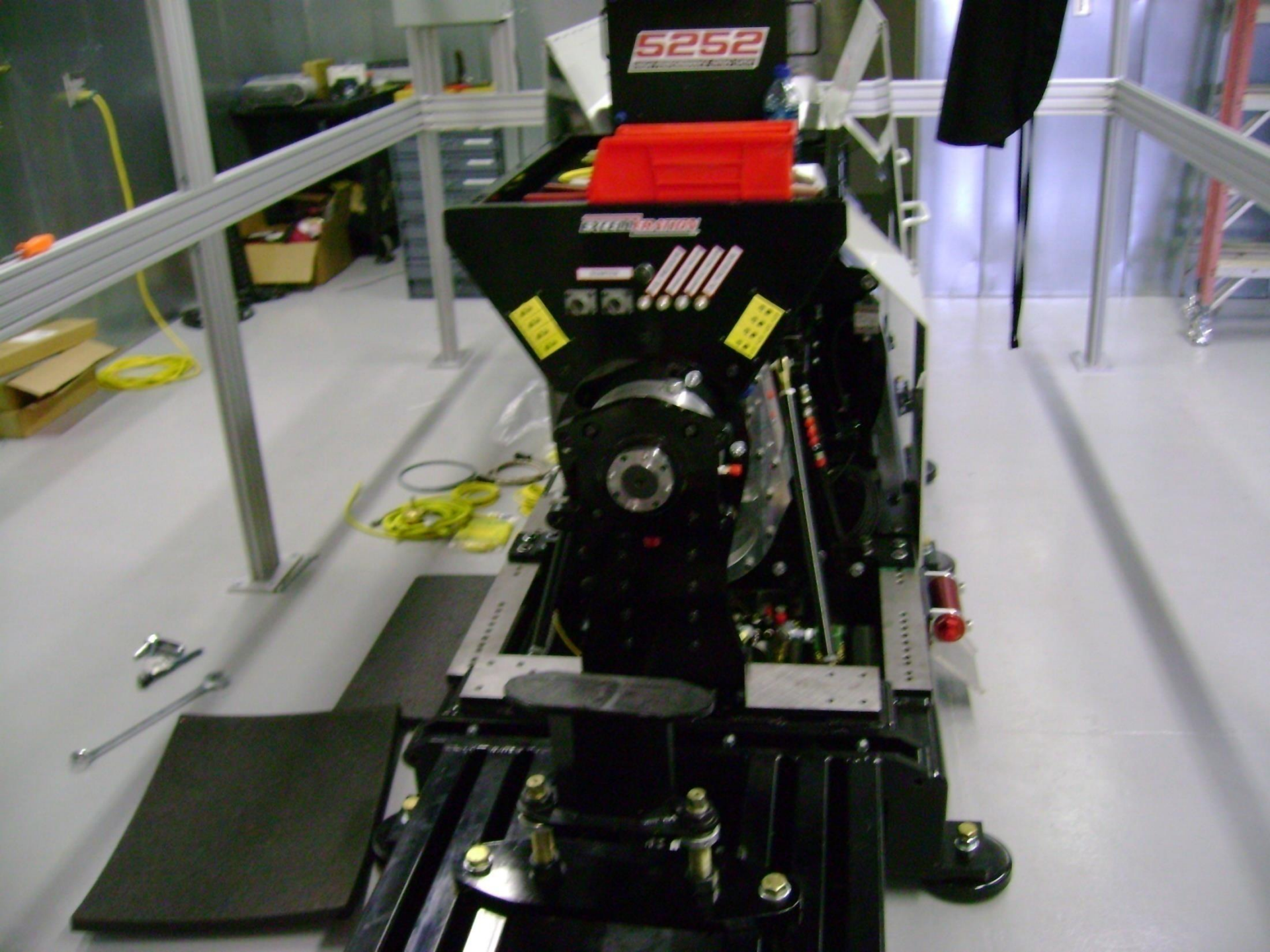
OFF
LOW
HIGH
kwalbox IV

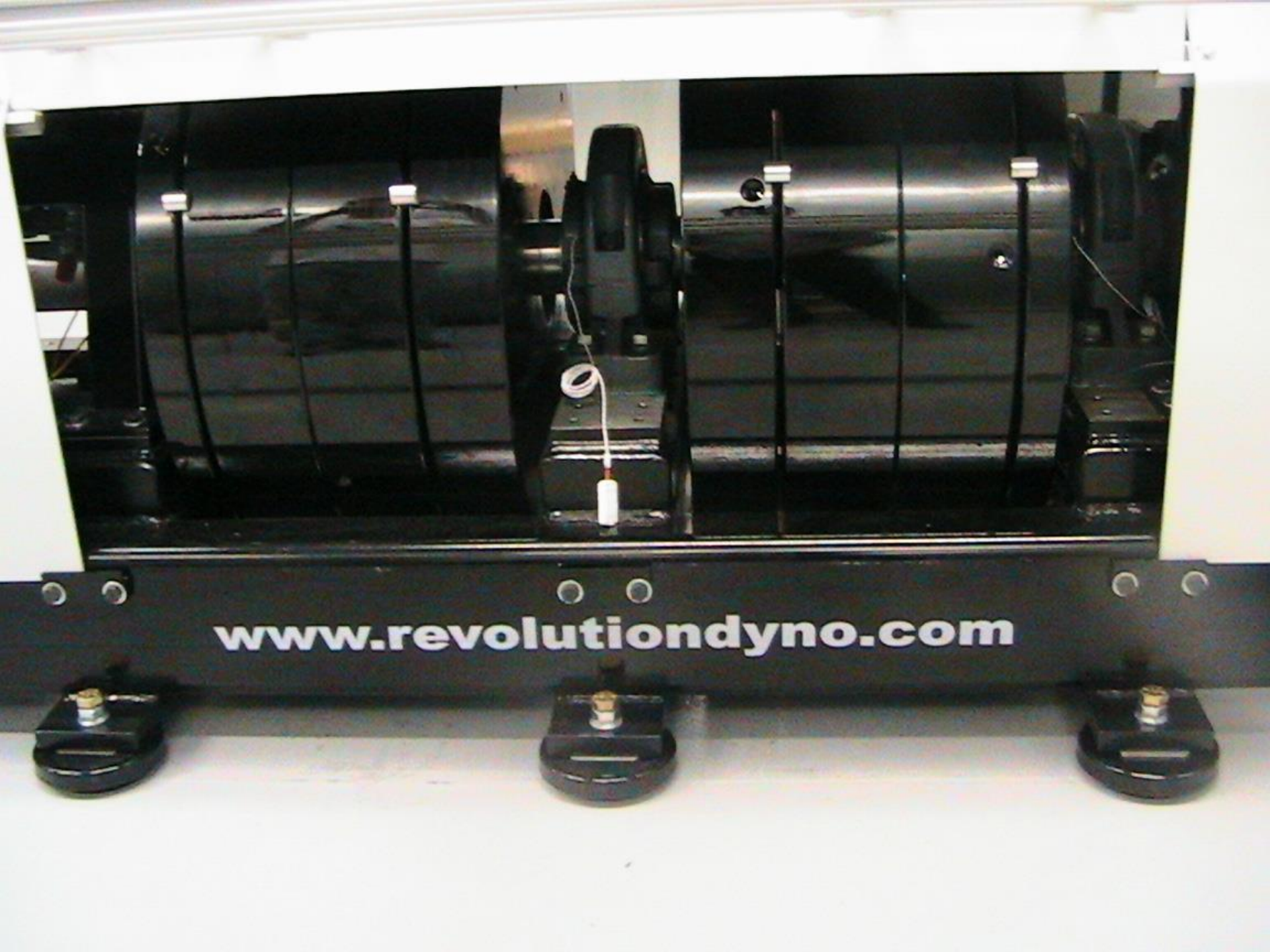

CRAFTSMAN
PROFESSIONAL
CHALLENGER
R/T

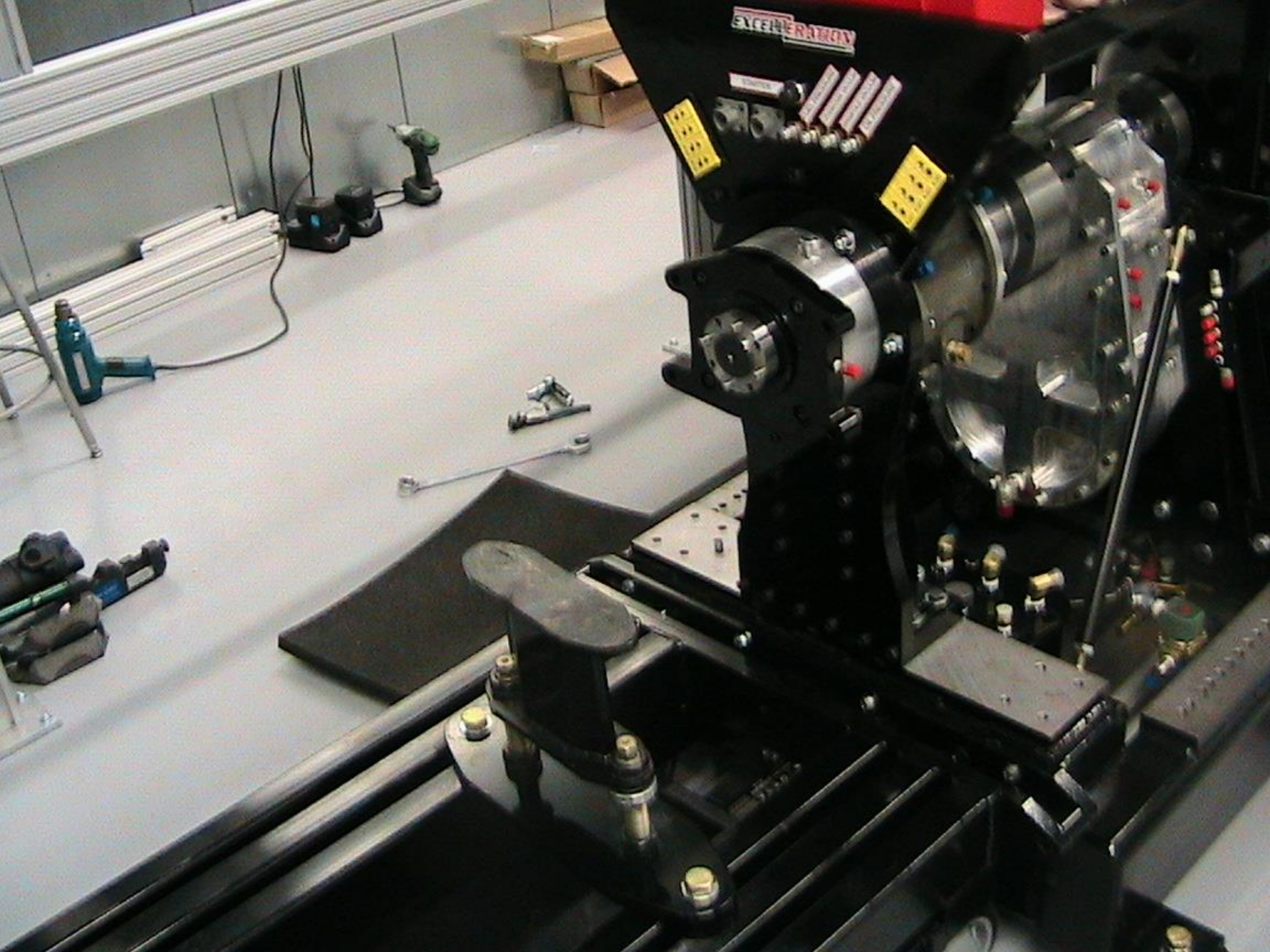

5252
REVOLUTION

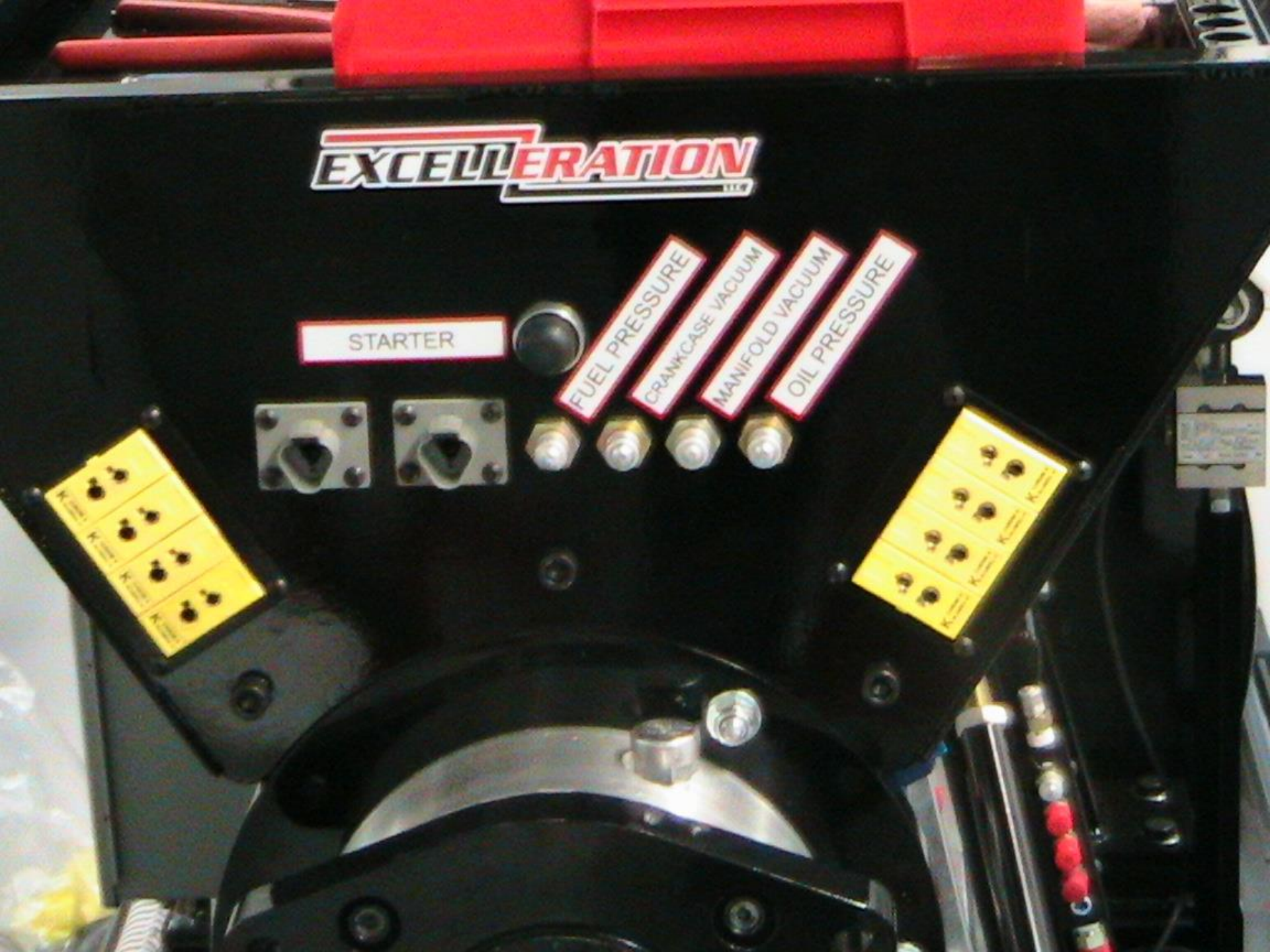

DASANI


REVOLUTION
INERTIA DYNO
www.revolutiondyno.com

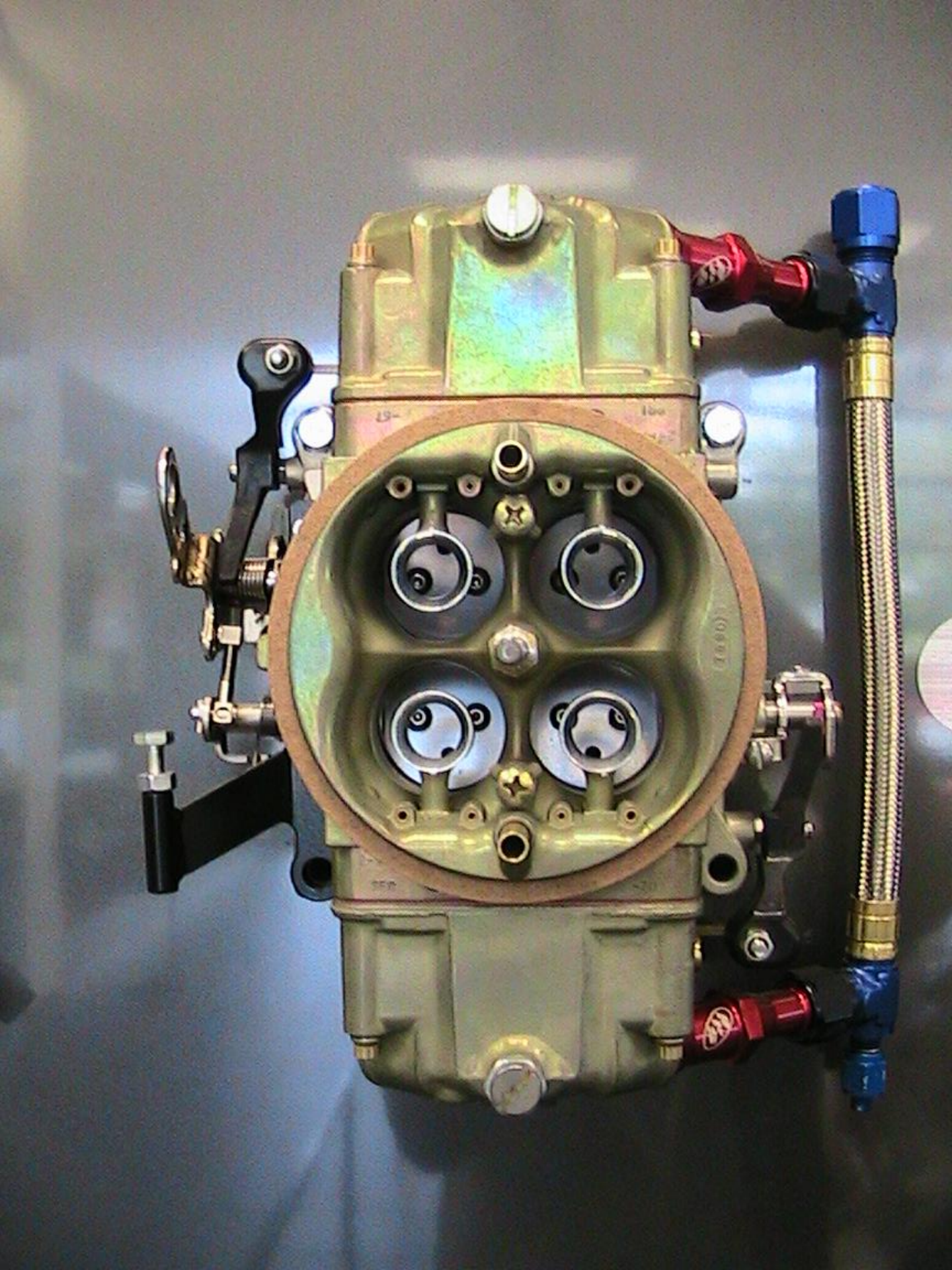

5252

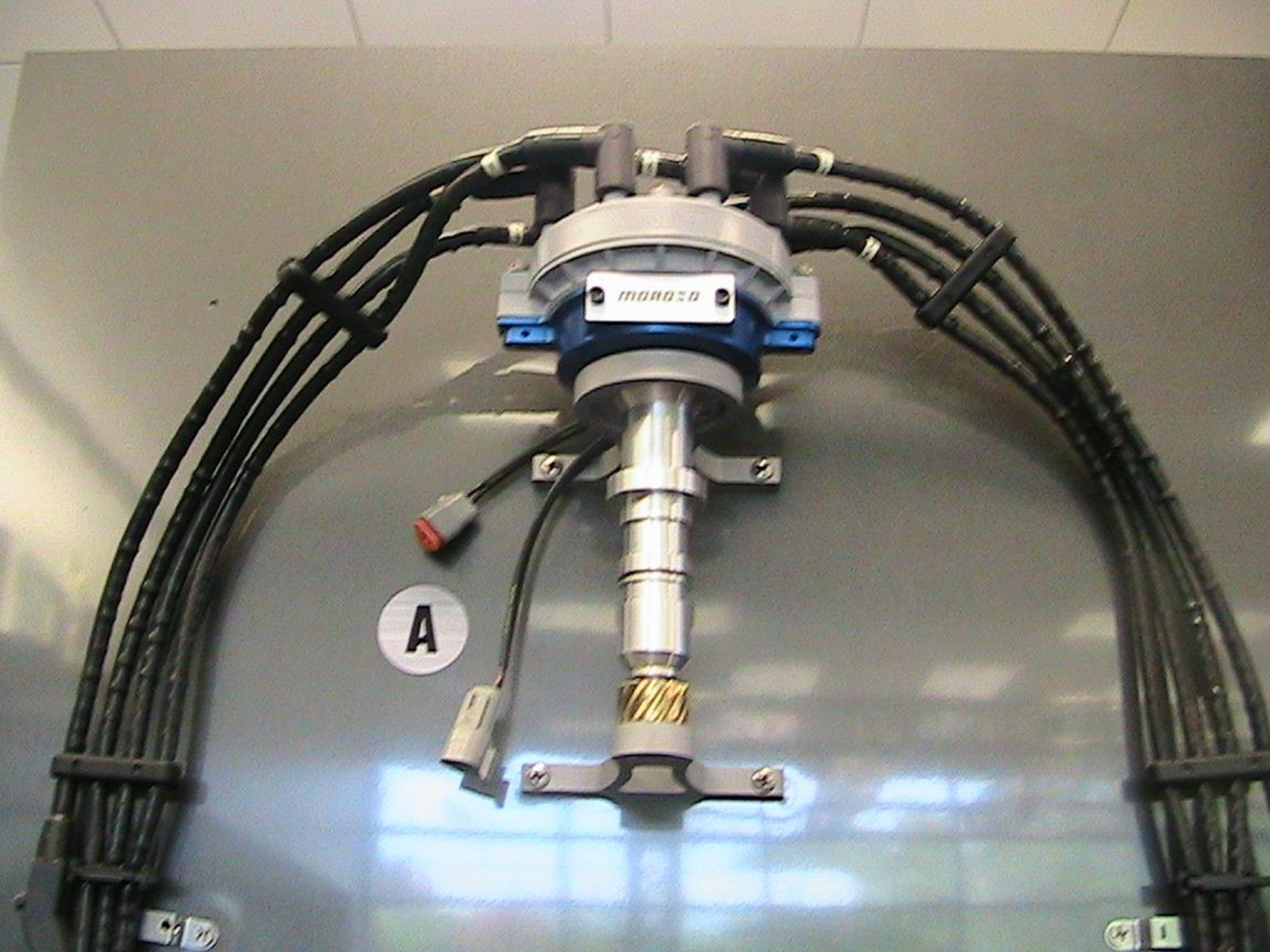

www.revolutiondyno.com

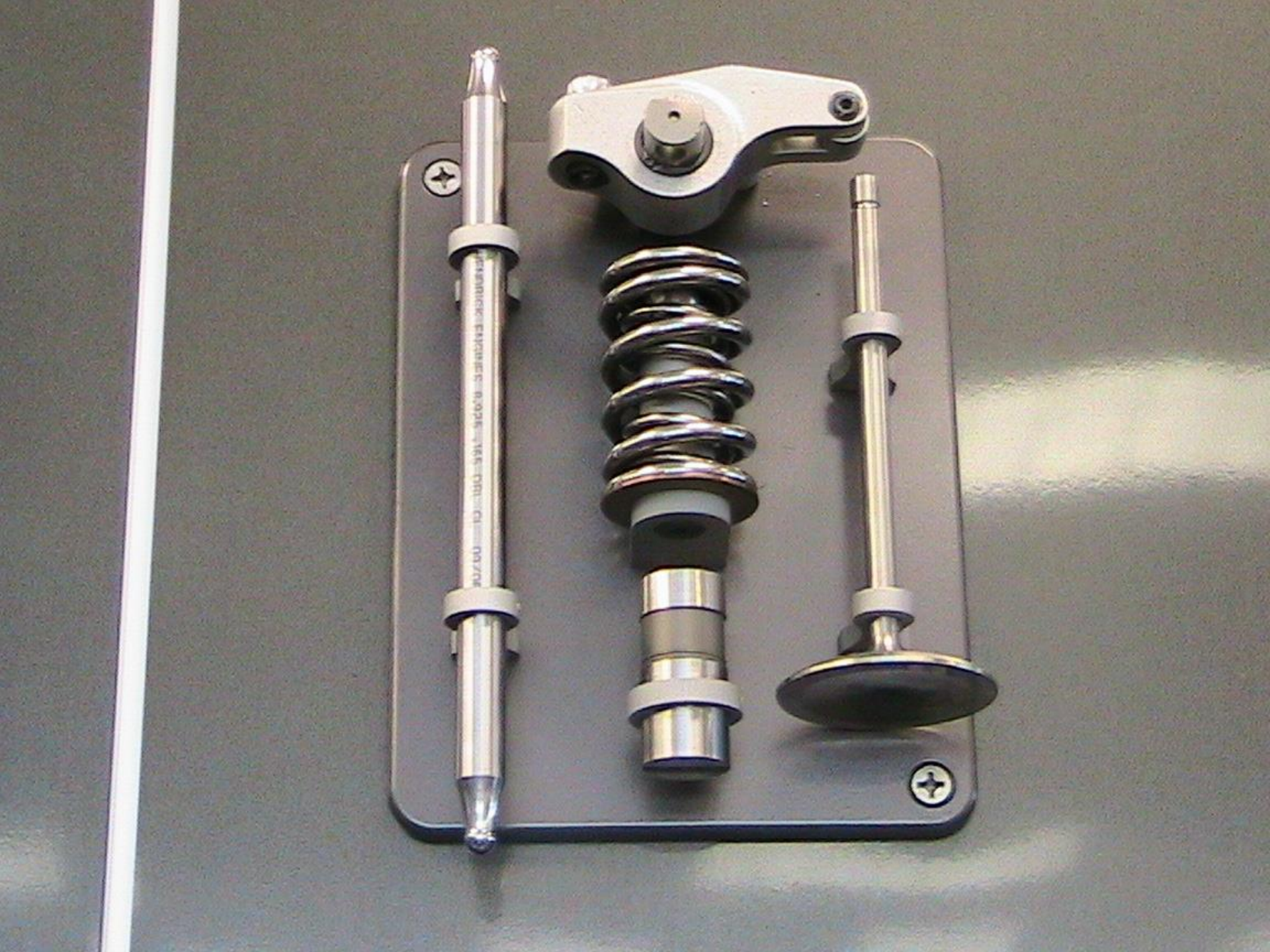


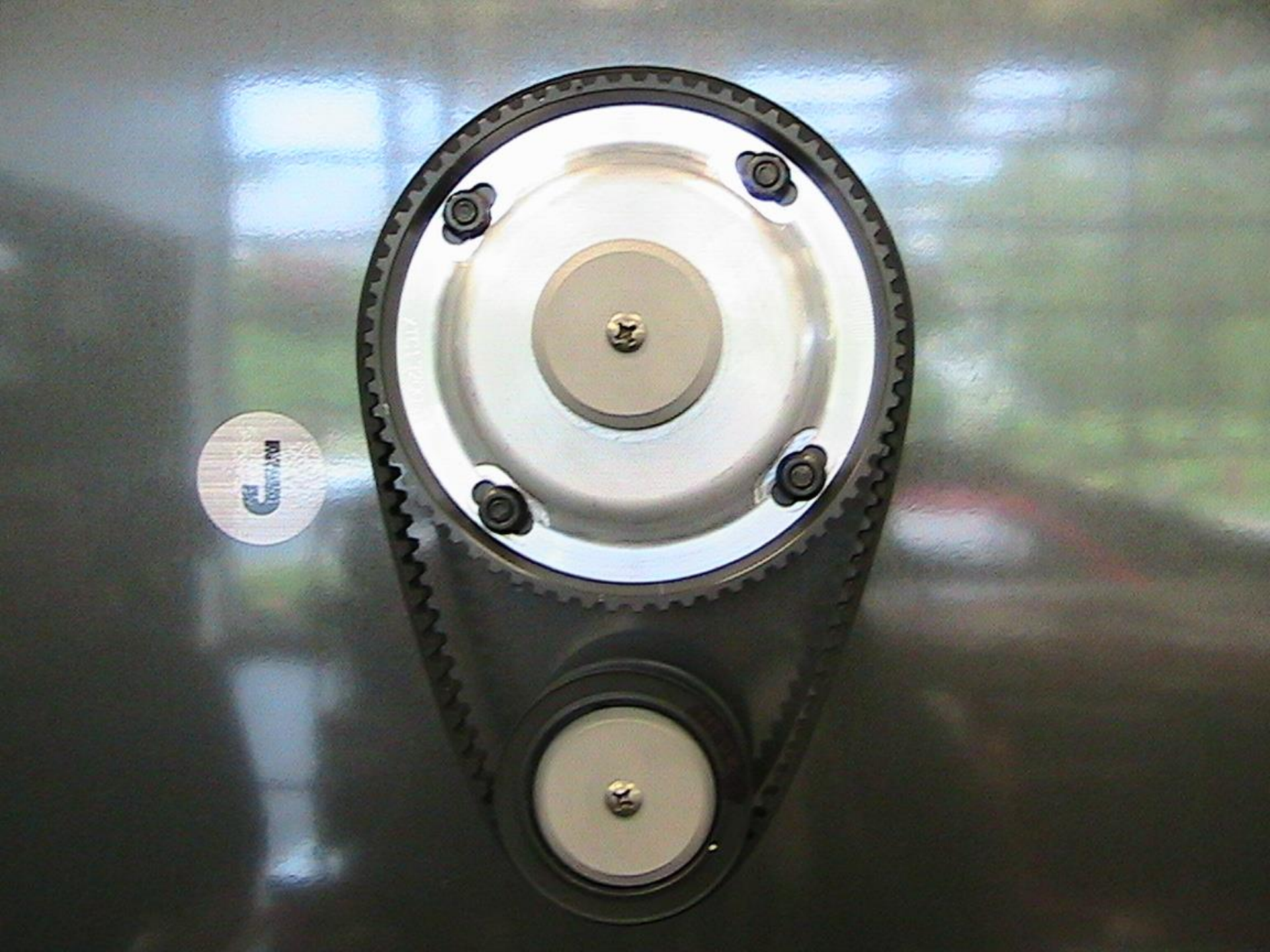

EXCELLERATION
STARTER
FUEL PRESSURE
CRANKCASE VACUUM
MANIFOLD VACUUM
OIL PRESSURE

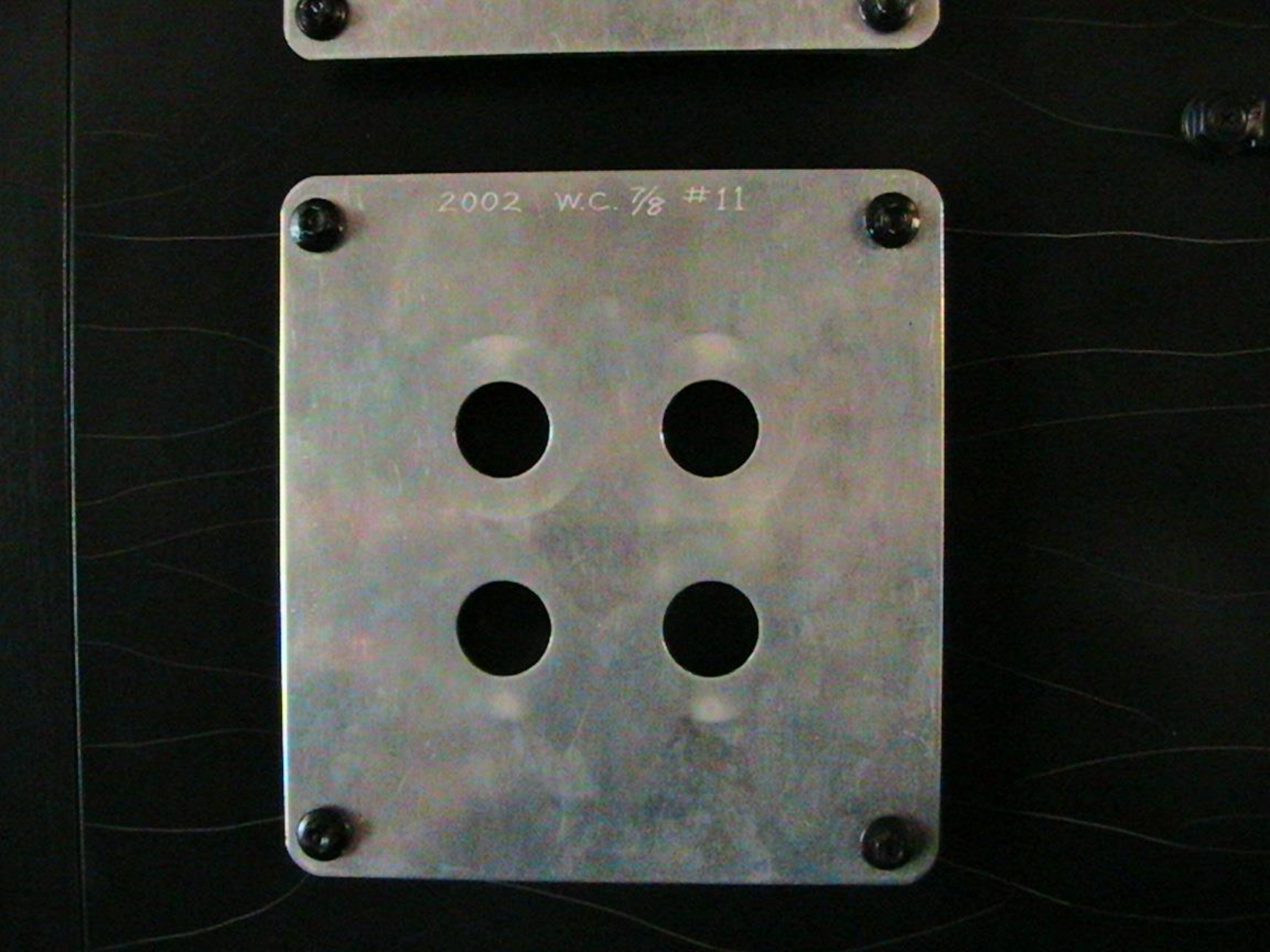

Windshear
180 MPH ROLLING ROAD WIND TUNNEL
WINDSHEAR

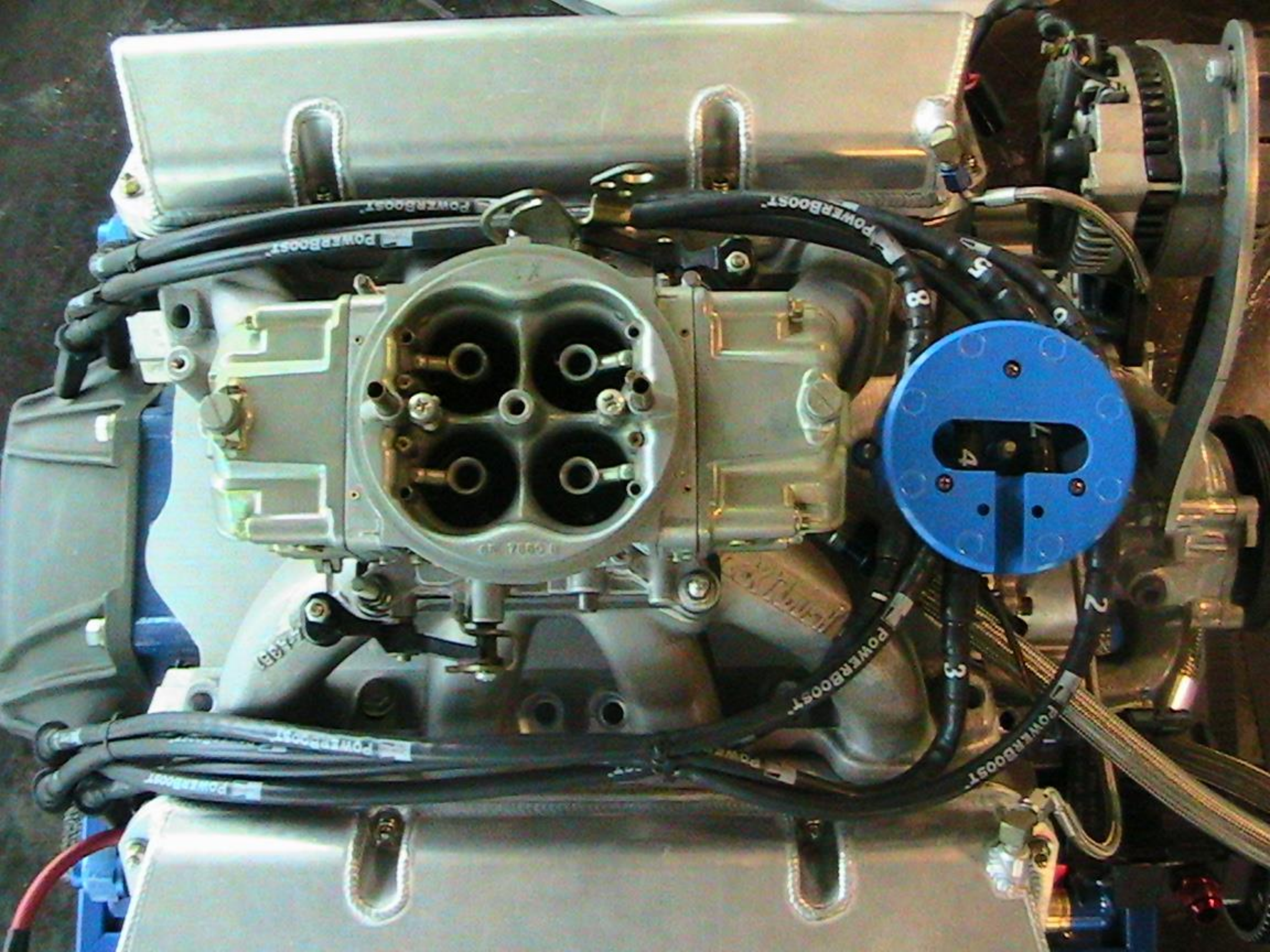



MOMOZO
A






2002 W.C. 7/8 #11

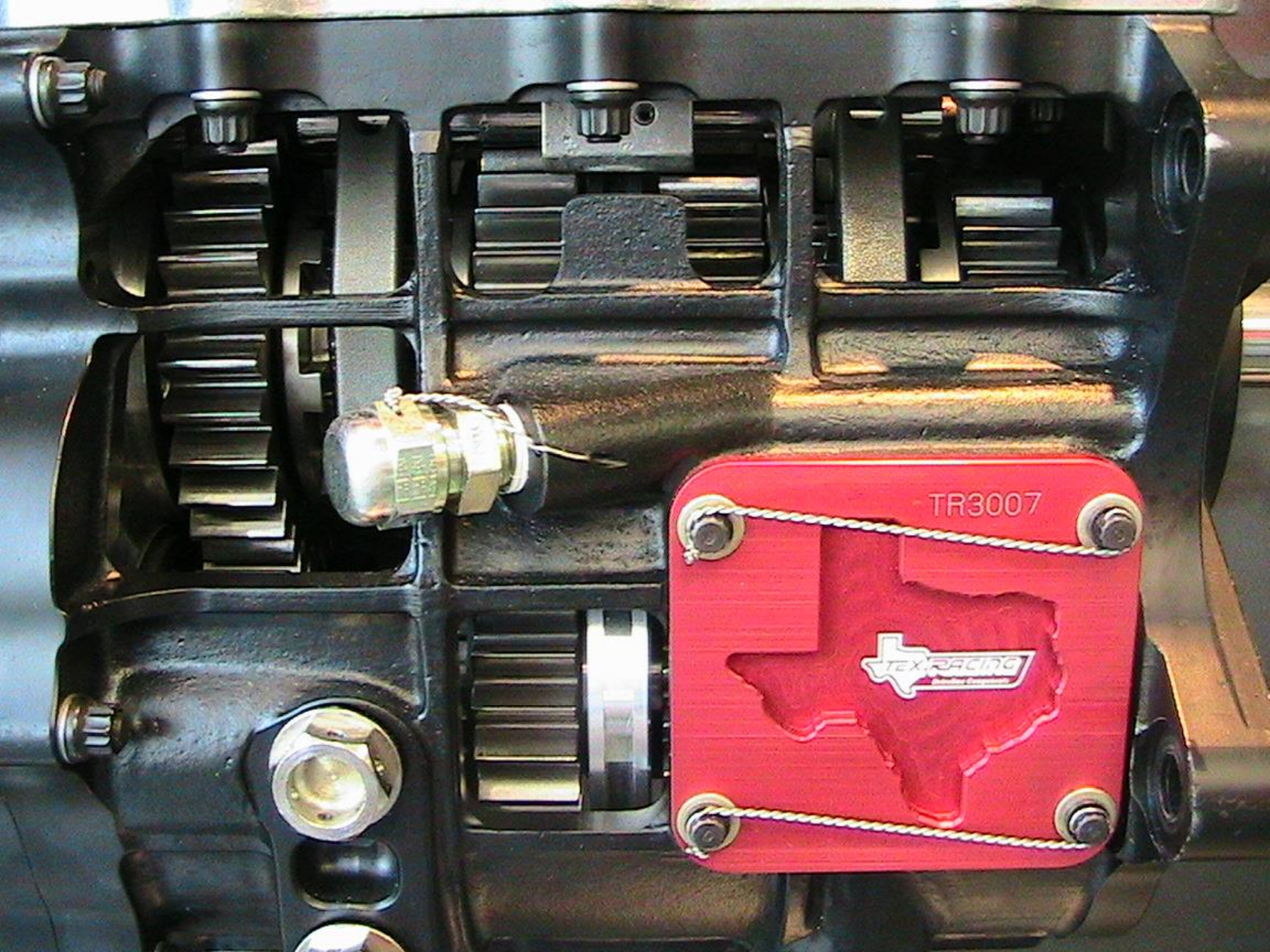

POWERBOOST

N

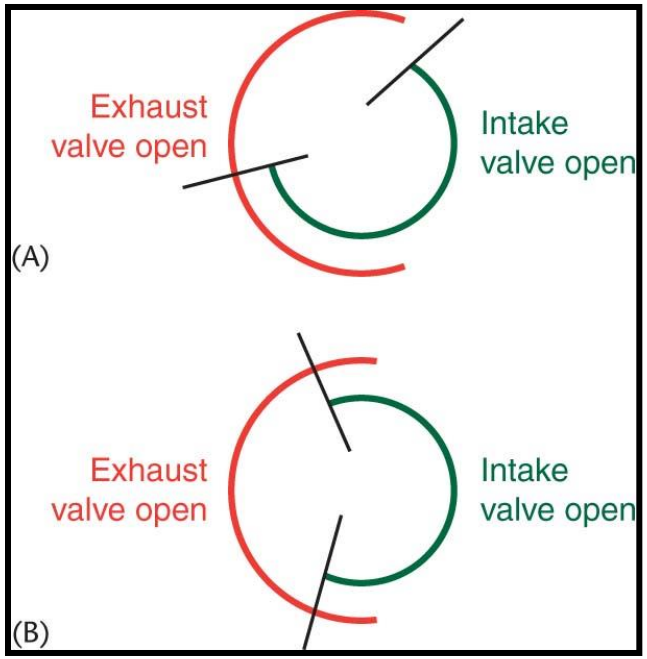
Wilwood
GT 6000
D

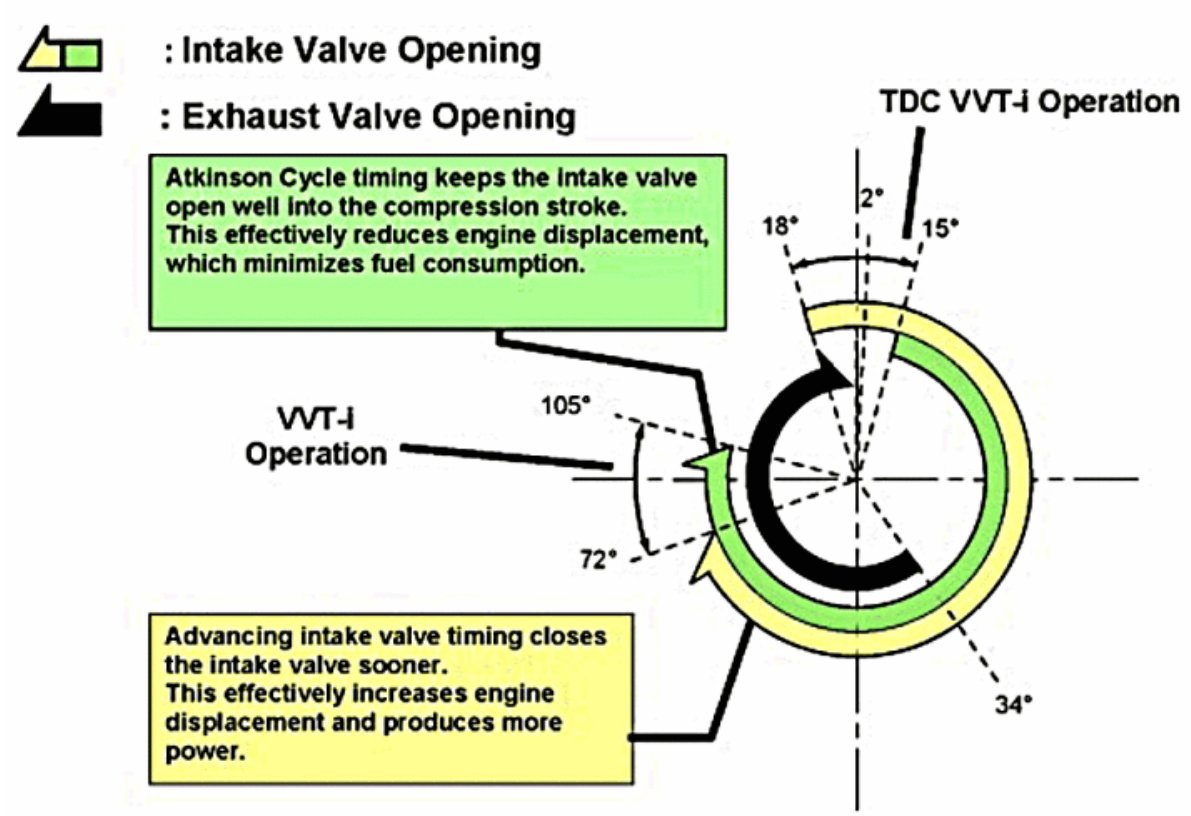
Ferrari

SRI
Racing


TR3007
TEX RACING

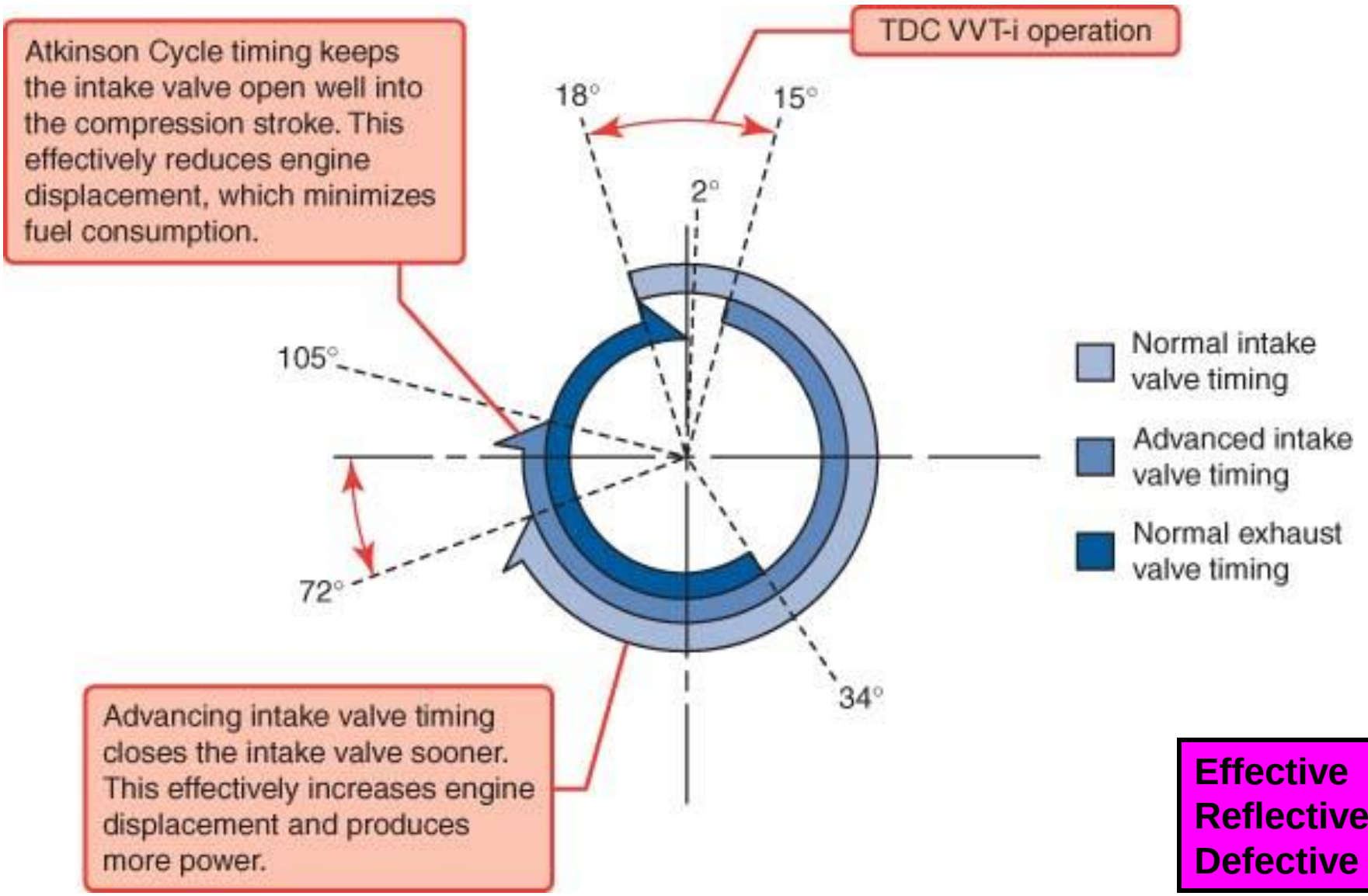
30. The _____ cycle engine holds the intake valve open longer during the compression stroke. This is done with variable valve timing & use the intake manifold as a "surge tank" for A/F mix…*or only air on direct injection.*





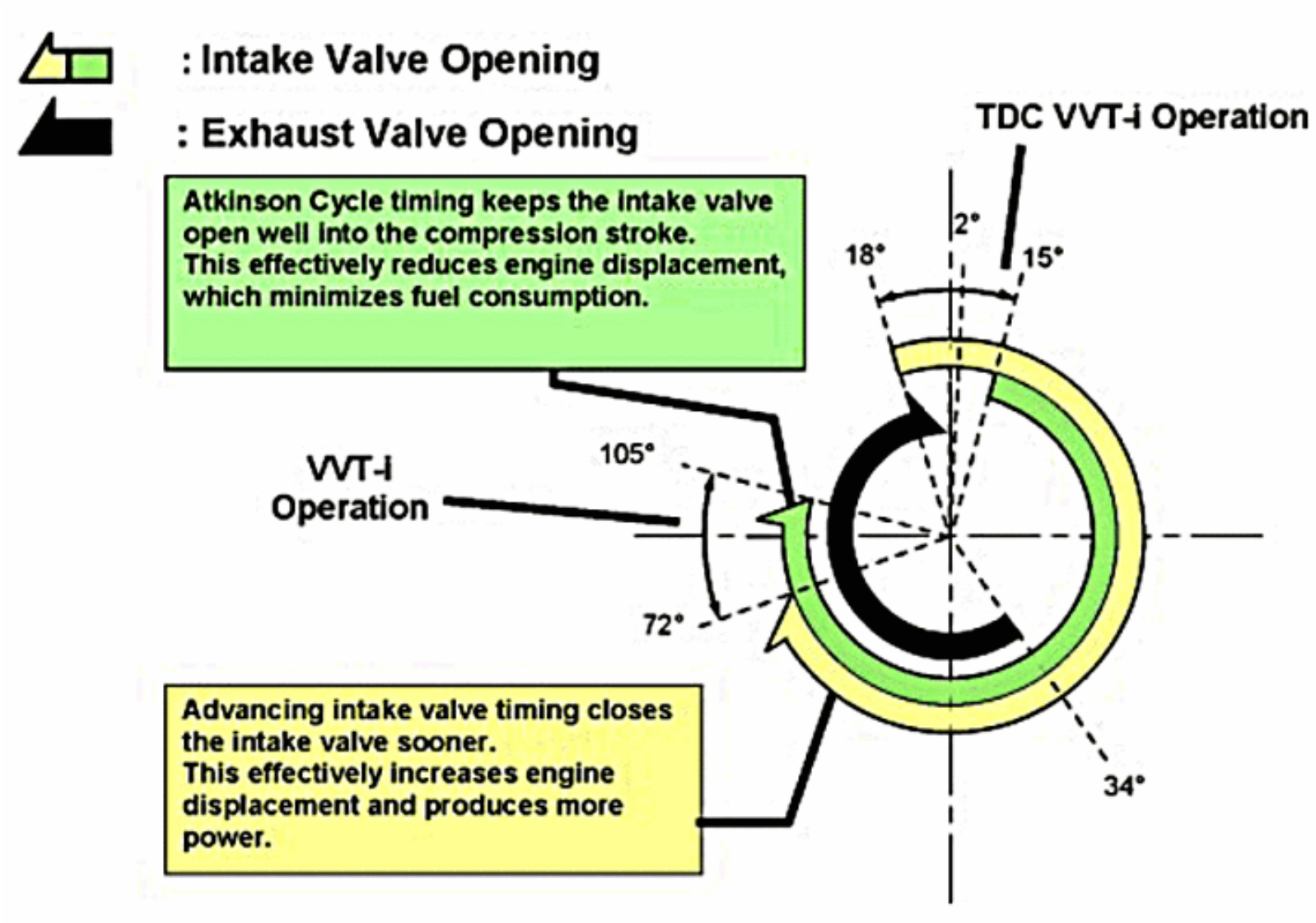
Miller
Otto
Atkinson

31. The actual piston stroke, in inches, is longer, but the "_____" compression stroke is shorter.



Effective
Reflective
Defective

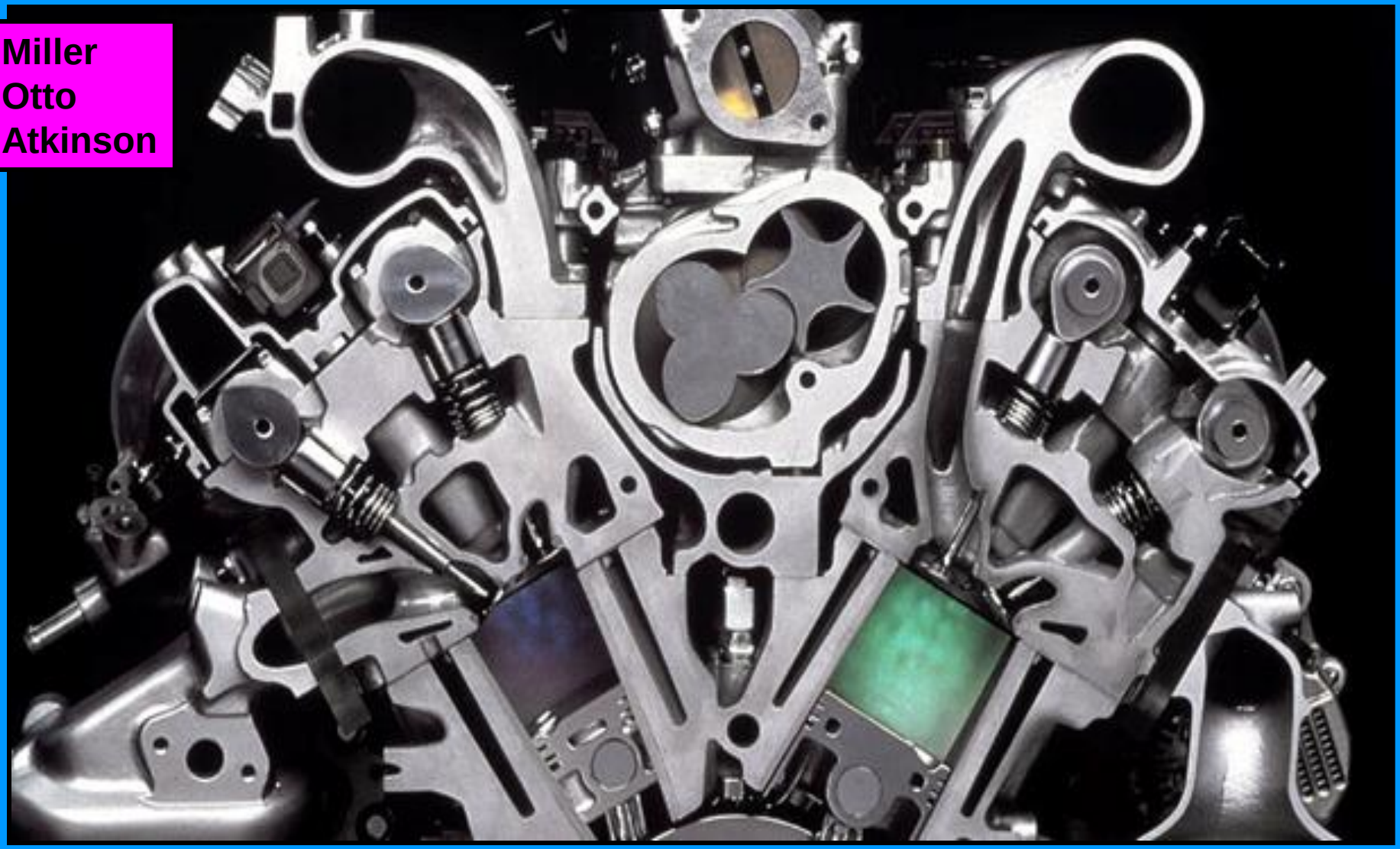
32. _____ vehicles use Atkinson cycle engines because of improved fuel economy & lower emissions, and because they have another source of power to add to the vehicle – the HV motor generator.



Diesel Hybrid Electric

33. An Atkinson cycle engine that has forced induction of a supercharger is called a _____ cycle.

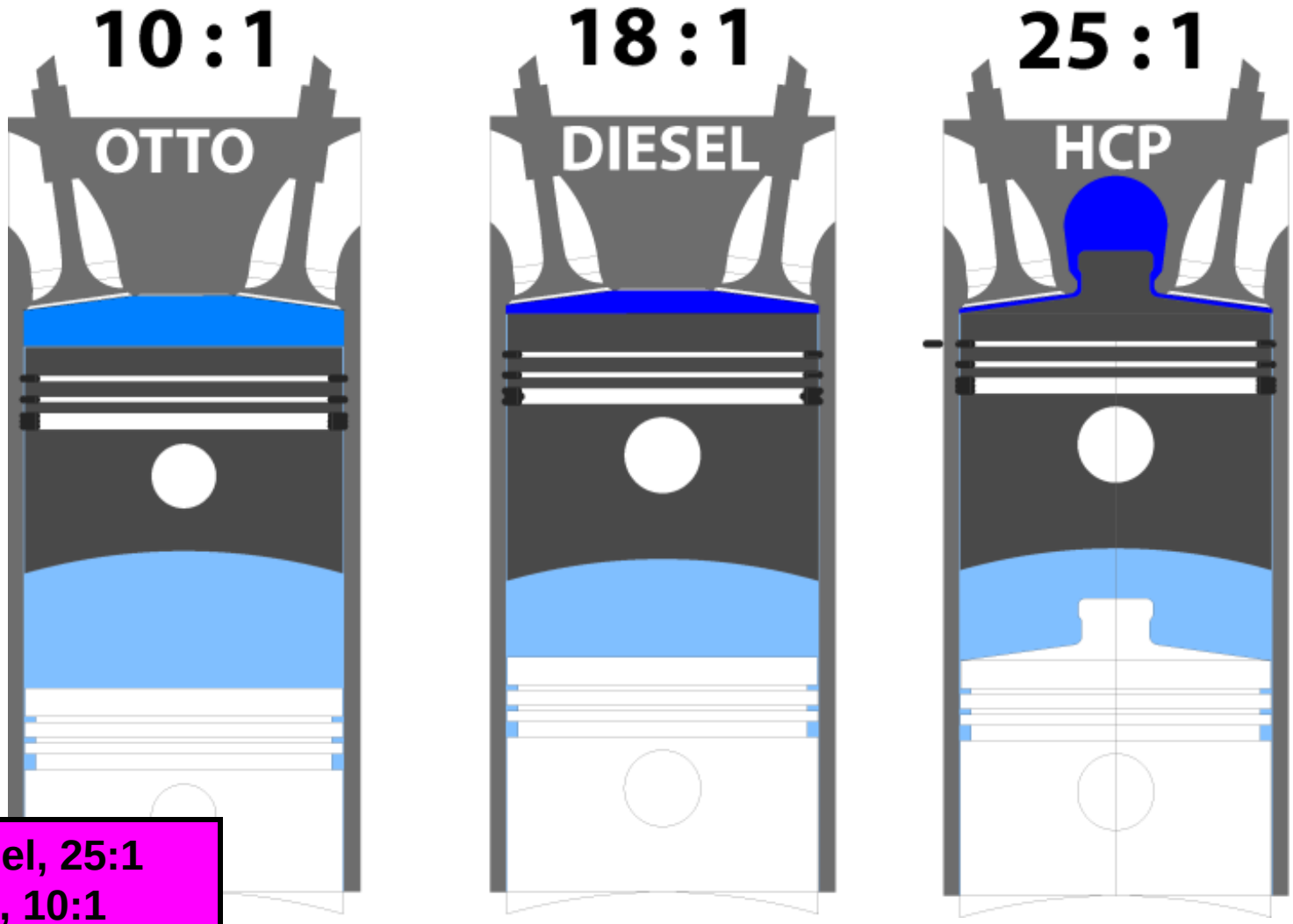
Miller
Otto
Atkinson



33. An Atkinson cycle engine that has forced induction of a supercharger is called a _____ cycle.

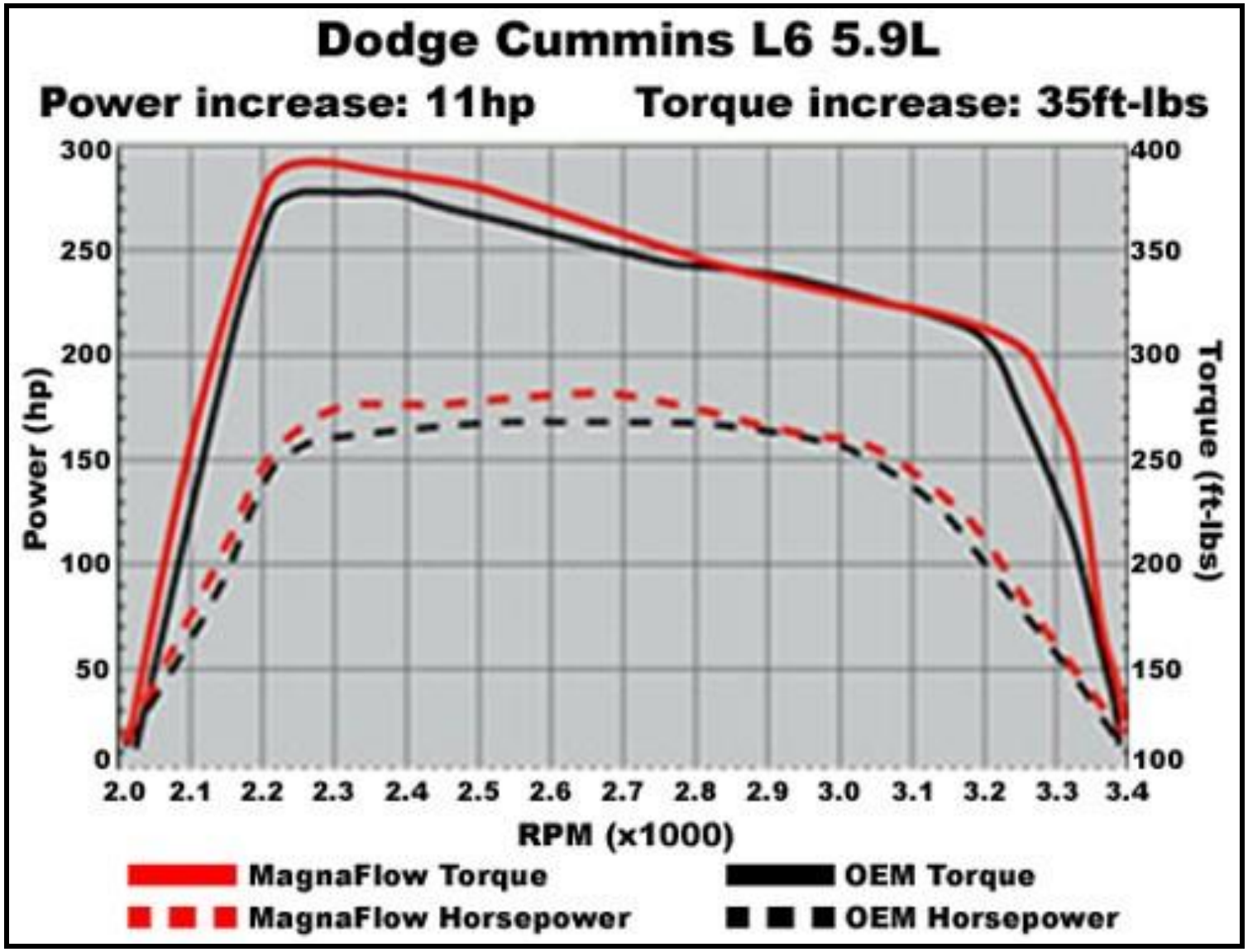
Miller
Otto
Atkinson

34. _____ engines are compression ignition engines with a compression ratio as high as ____:1.



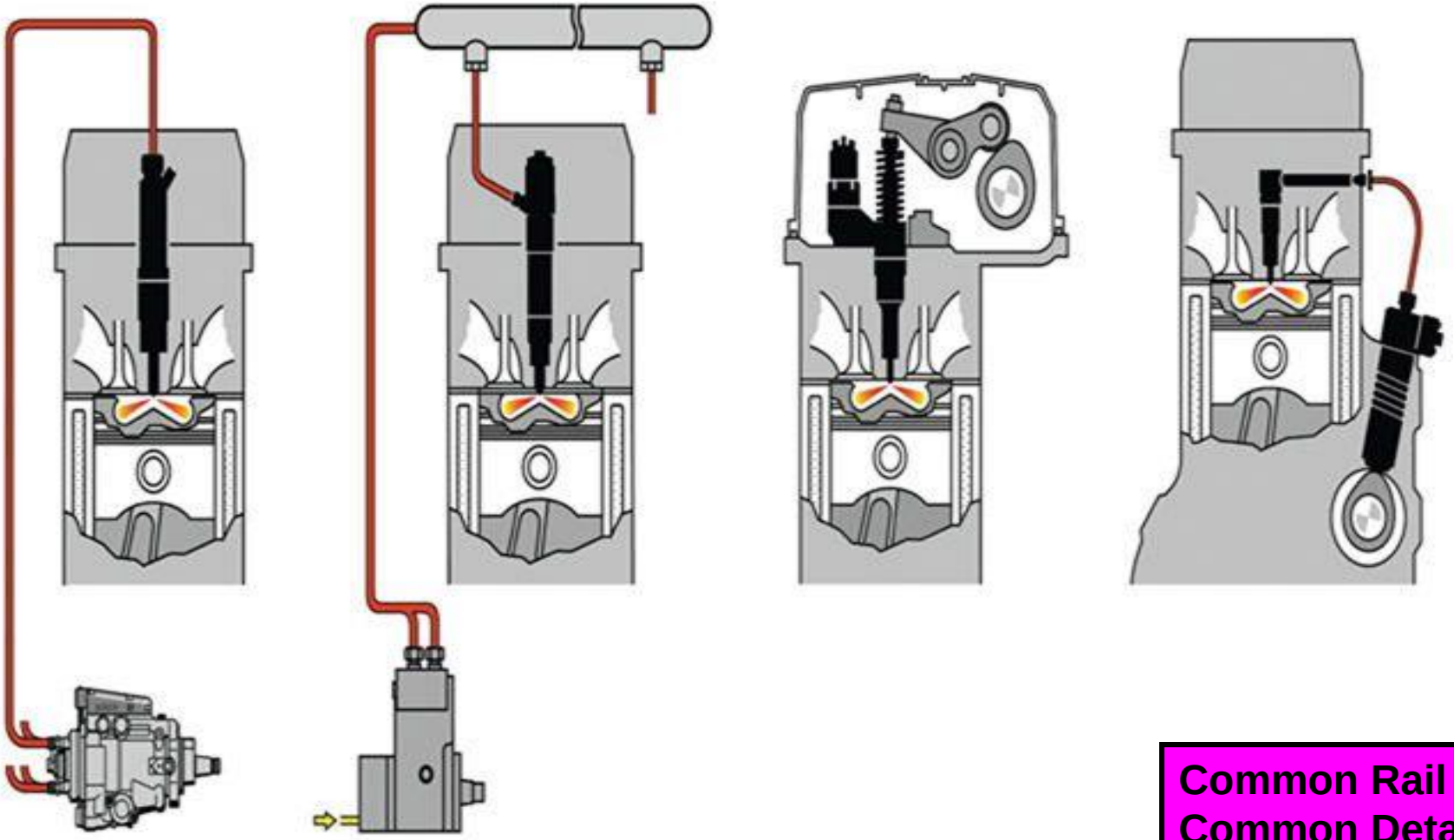
Diesel, 25:1
Otto, 10:1
Atkinson, 15:1

35. Diesel engines have high _____ output *at lower engine speeds* as compared to gasoline engines.



Torque
Mileage
Emissions

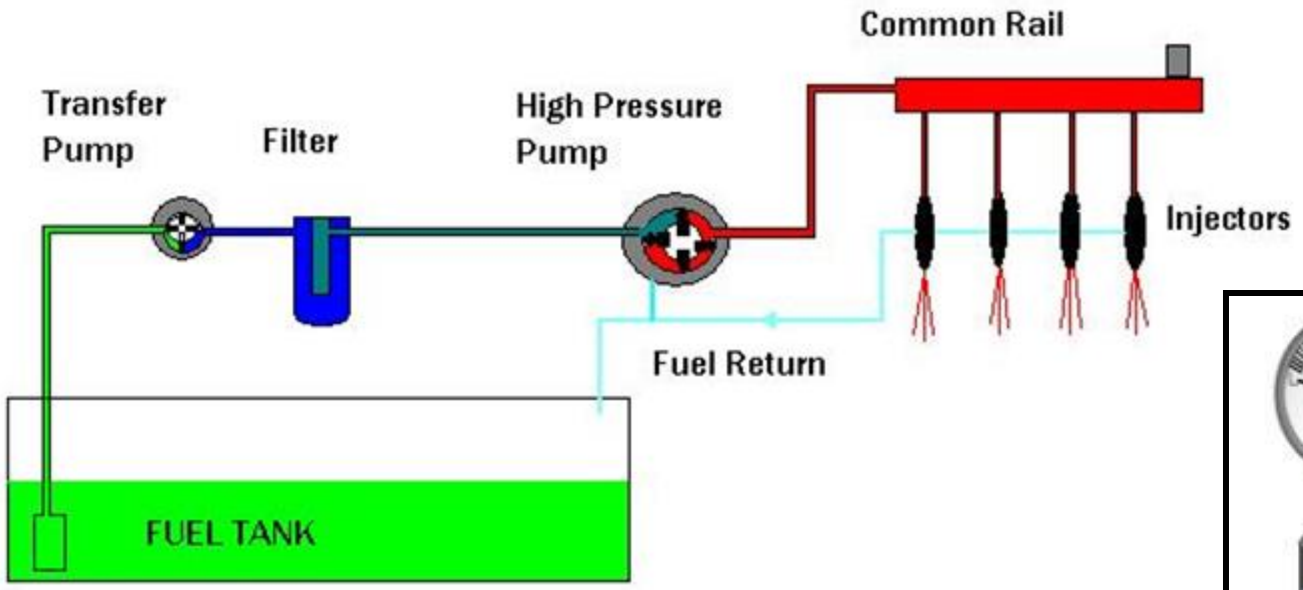
36. Old diesels had distributor-type injection. New diesels have _____ _____ direct injection.

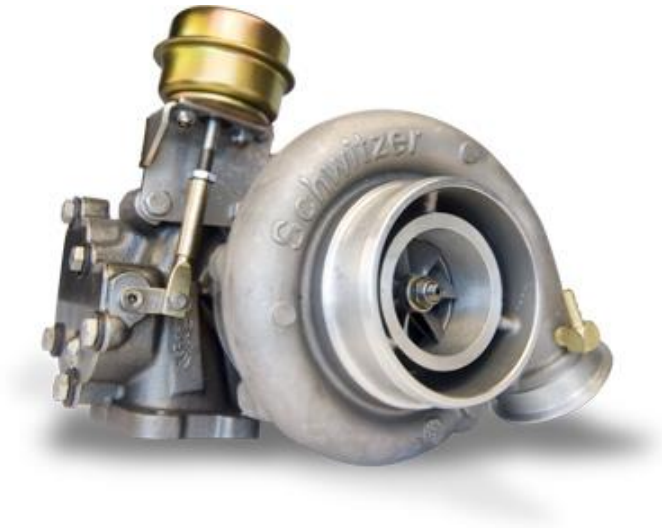


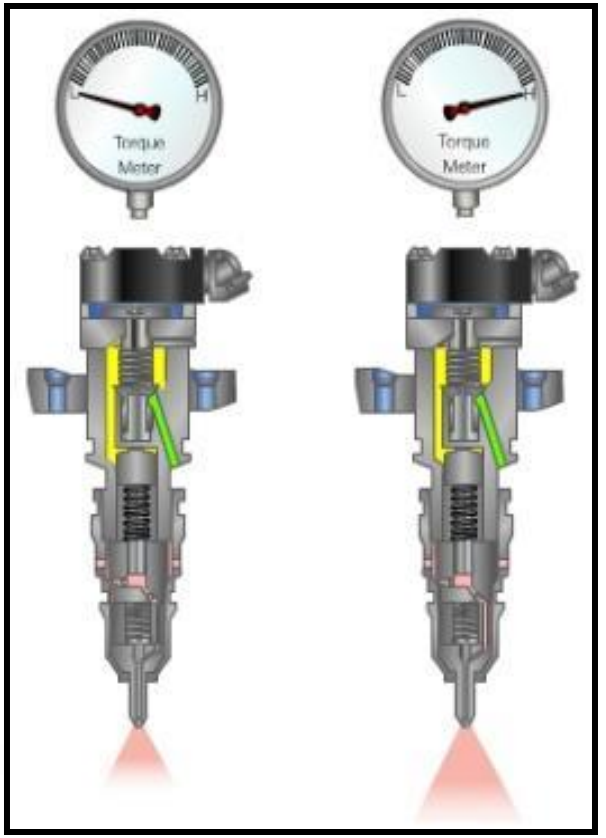
Common Rail
Common Detail
Common Sense

37. Combining common _____ DI with _____ can increase a diesel's horsepower.

Rail, Turbocharging







Air/Fuel Ratios

Diesel engines produce very little carbon monoxide, since combustion takes place in an oxygen-rich environment

Diesels do not run at the same stoichiometric ratio as gasoline engines (14.7:1)

Diesels run about 50% leaner than gas engine stoichiometric mixture.

Engine needs about 18 times more air by mass than fuel to maintain a smoke-free tailpipe.

Smoke-free operation is usually around 22:1 air-to-fuel ratio (AFR)

As additional fuel is added, more air is needed to stay smoke-free

Black smoke indicates we are producing particulate matter by not burning all the fuel

Even w/black smoke, more fuel can be added to produce more power, but combustion efficiency goes down

White smoke is extreme over-fueling

Some white smoke is normal during cold start-up

Cylinder temperatures are too low to burn all the fuel, resulting in some blue and/or white smoke

Common rail technology makes use of 2 pumps in order to bring the fuel up to high pressures of up to 1350 bar.

During the first stage, an electronic pump draws required amount of fuel from the fuel tank; this low-pressure pump is governed by the engine management system. The speed of the pump is determined by driver inputs and other information obtained from sensors. This has allowed Common rail systems to reduced emissions due to absence of unburnt fuel.

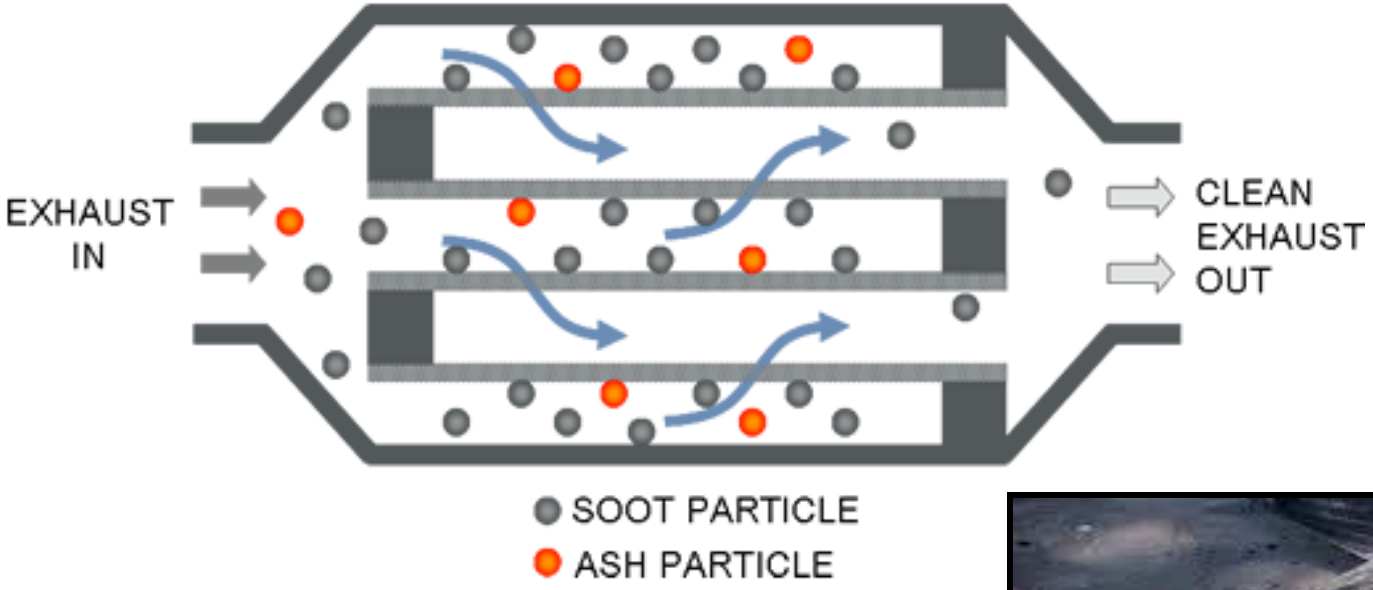
The second stage of pumping is done with the help of a mechanical pump that is coupled with the crankshaft and geared in order that it may rotate at half engine speed. The fuel now goes to an accumulating duct (rail), where these pressures maybe maintained. This tank allows for the maintaining of this constant pressure even during the injection.

The injection maybe carried out using electromagnetic valves, which govern the exact amount of fuel for injection. Leaks occurring at the pump, leaks for opening the valves etc are returned back to the fuel tank. Which in turn results in **zero** wastage of fuel.

When common rail technology is integrated with turbo chargers or superchargers the power delivered by a diesel engine may well exceed that attained by a similar sized petrol engine.

Today's manufacturers are embracing this technology due to all the advantages it holds. At the rate with which this technology is catching up, Diesel definitely holds the key as far as development in efficiency is concerned.

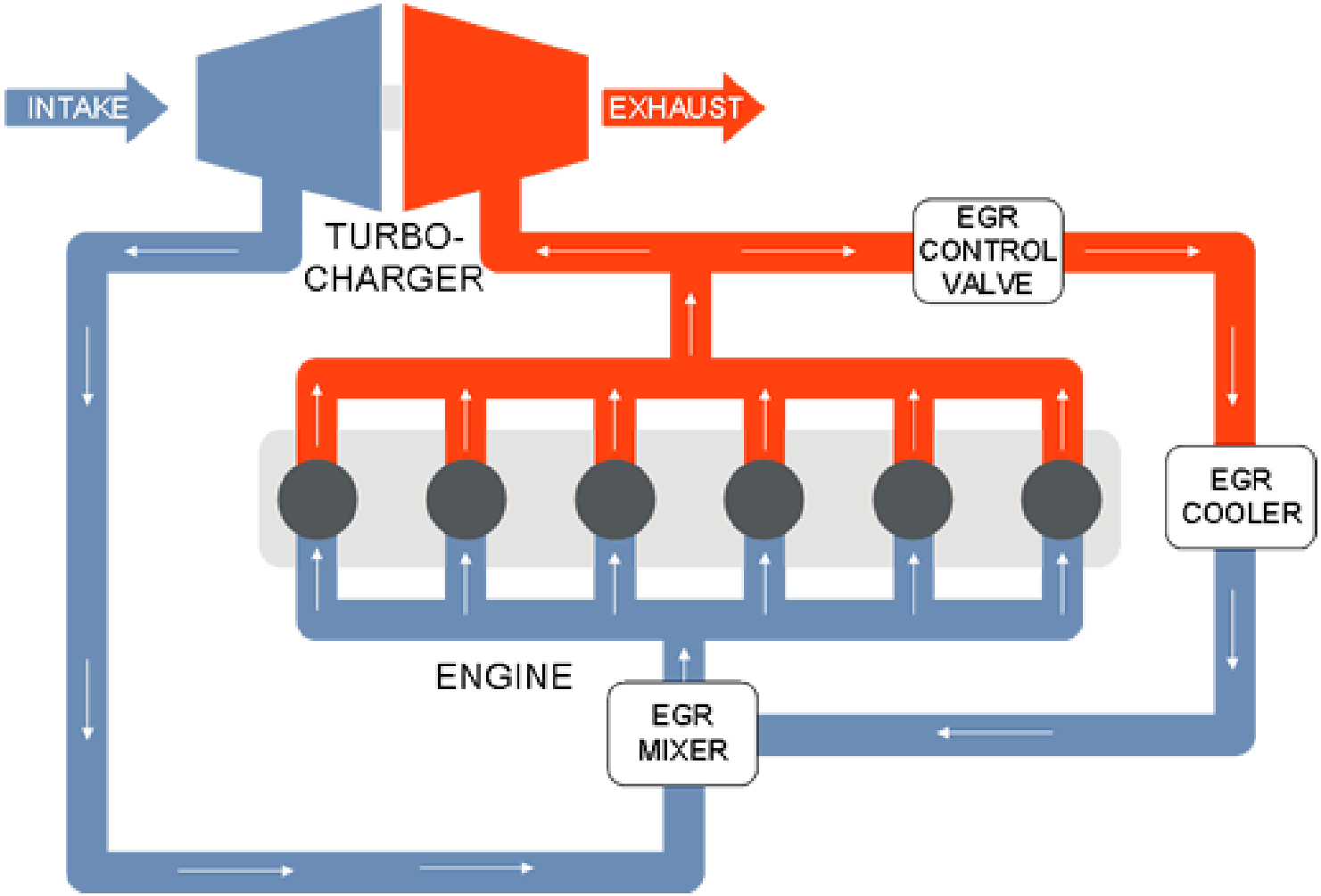
38. Emission laws require new diesels to have particulate _____ & filters to catch unburned carbon. (soot & ash)



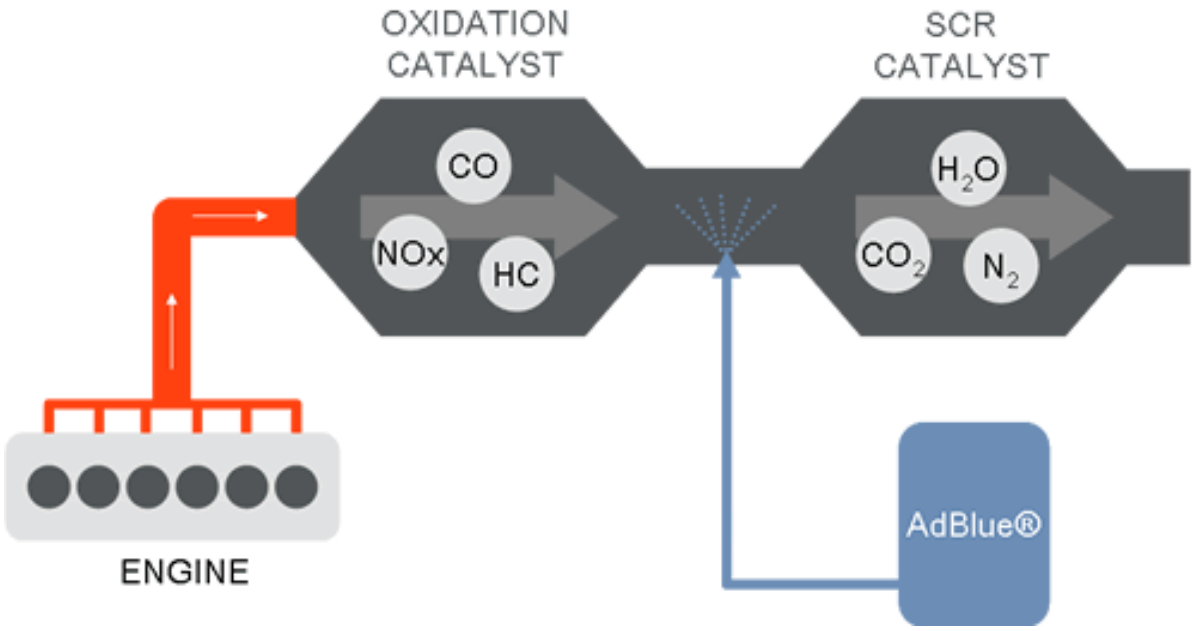
CATs
Traps
Burners

"burn-off" cycles to clean them are needed

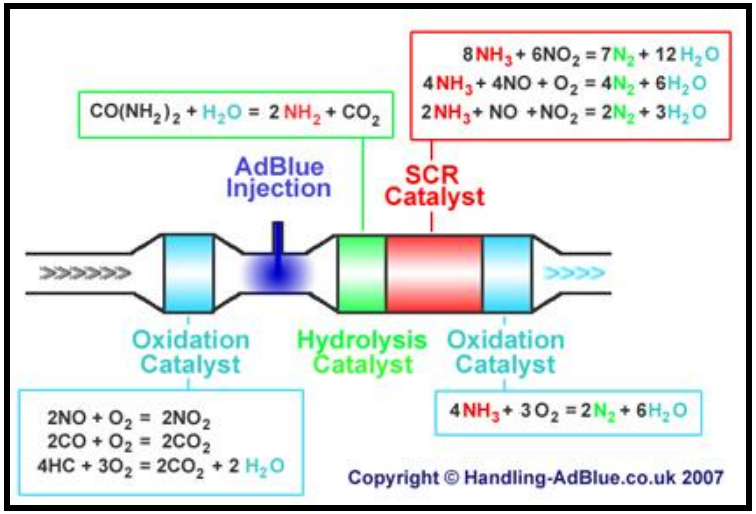
Emission laws require new diesels to control NOx pollutants also.
EGR plays a major part in combustion chamber temperature control

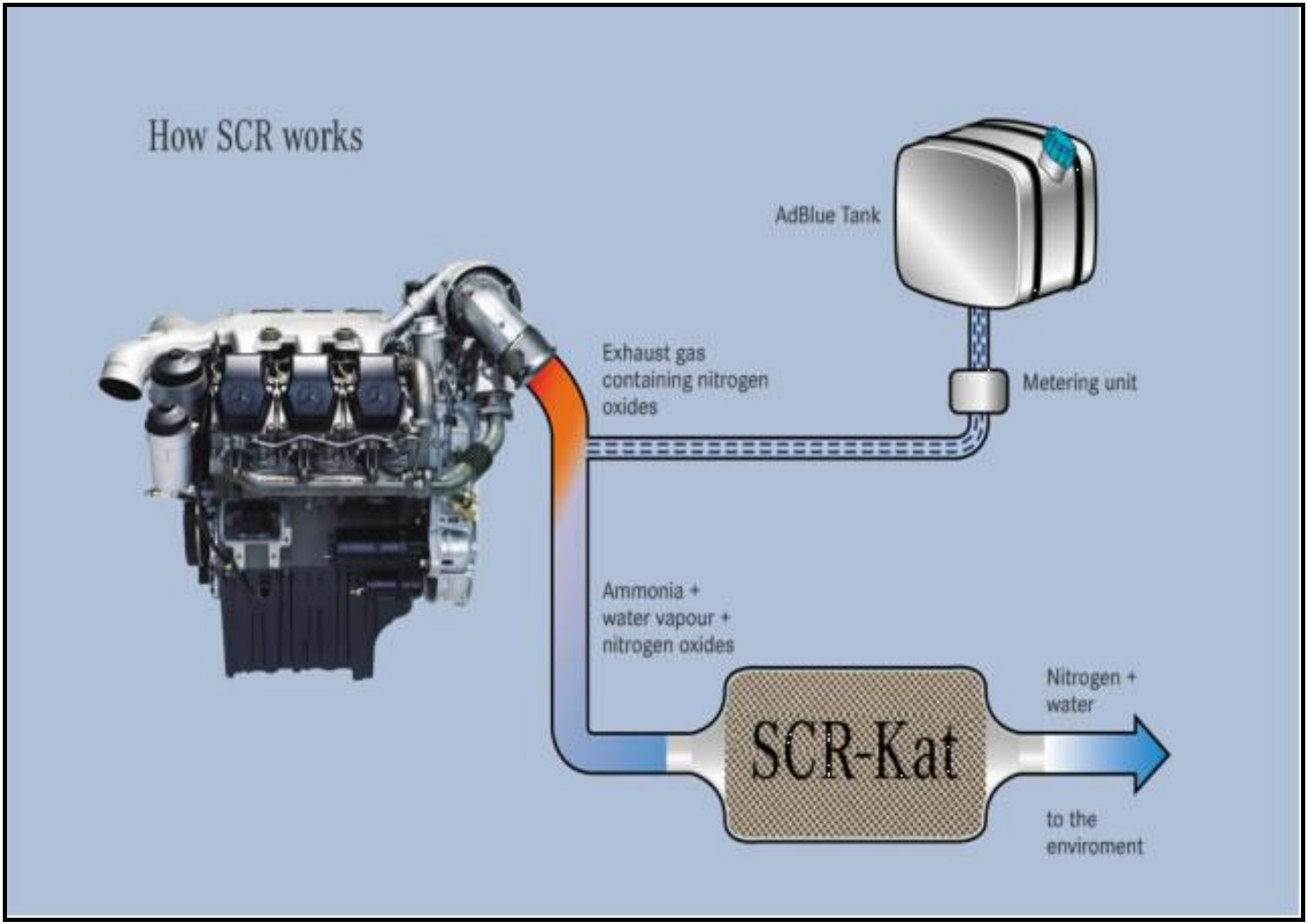


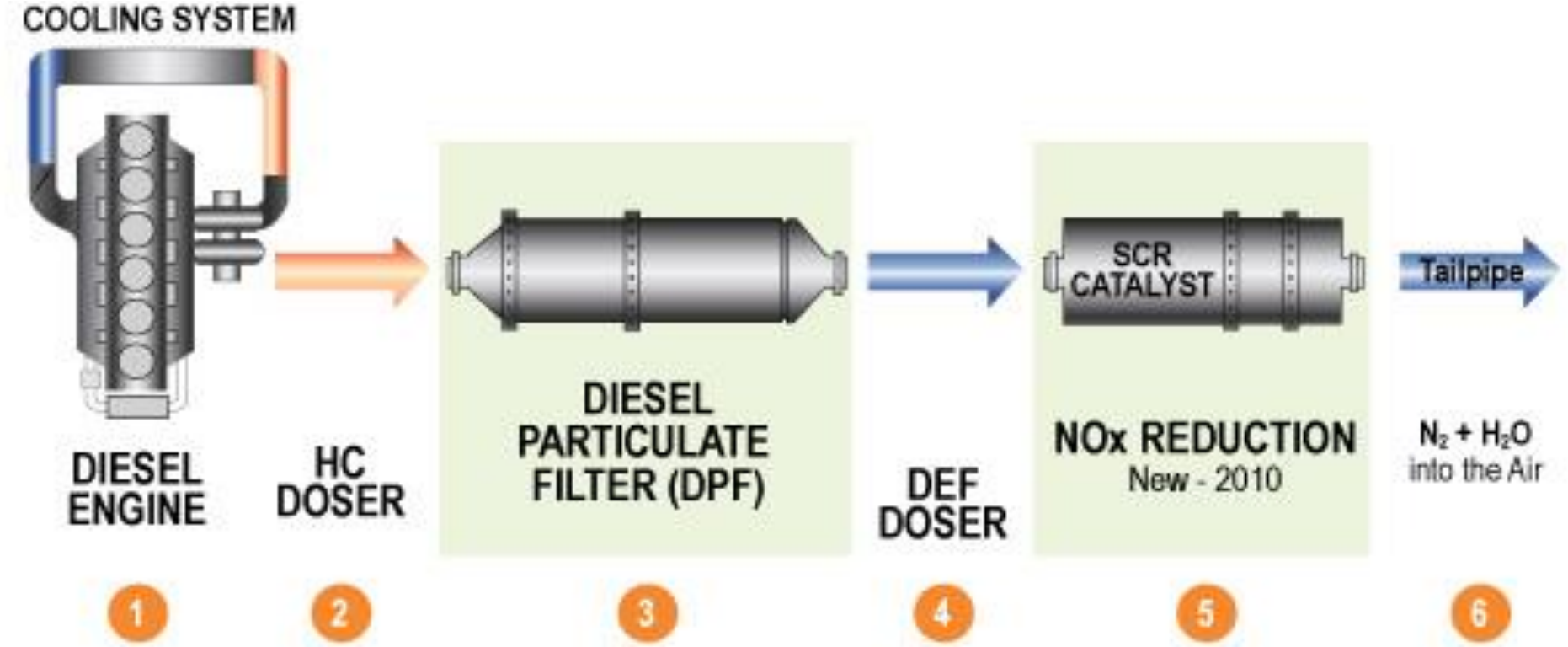
39. Selective _____ reduction (SCR) reduces diesel NOx by exhaust *"after-treatment"* with urea.



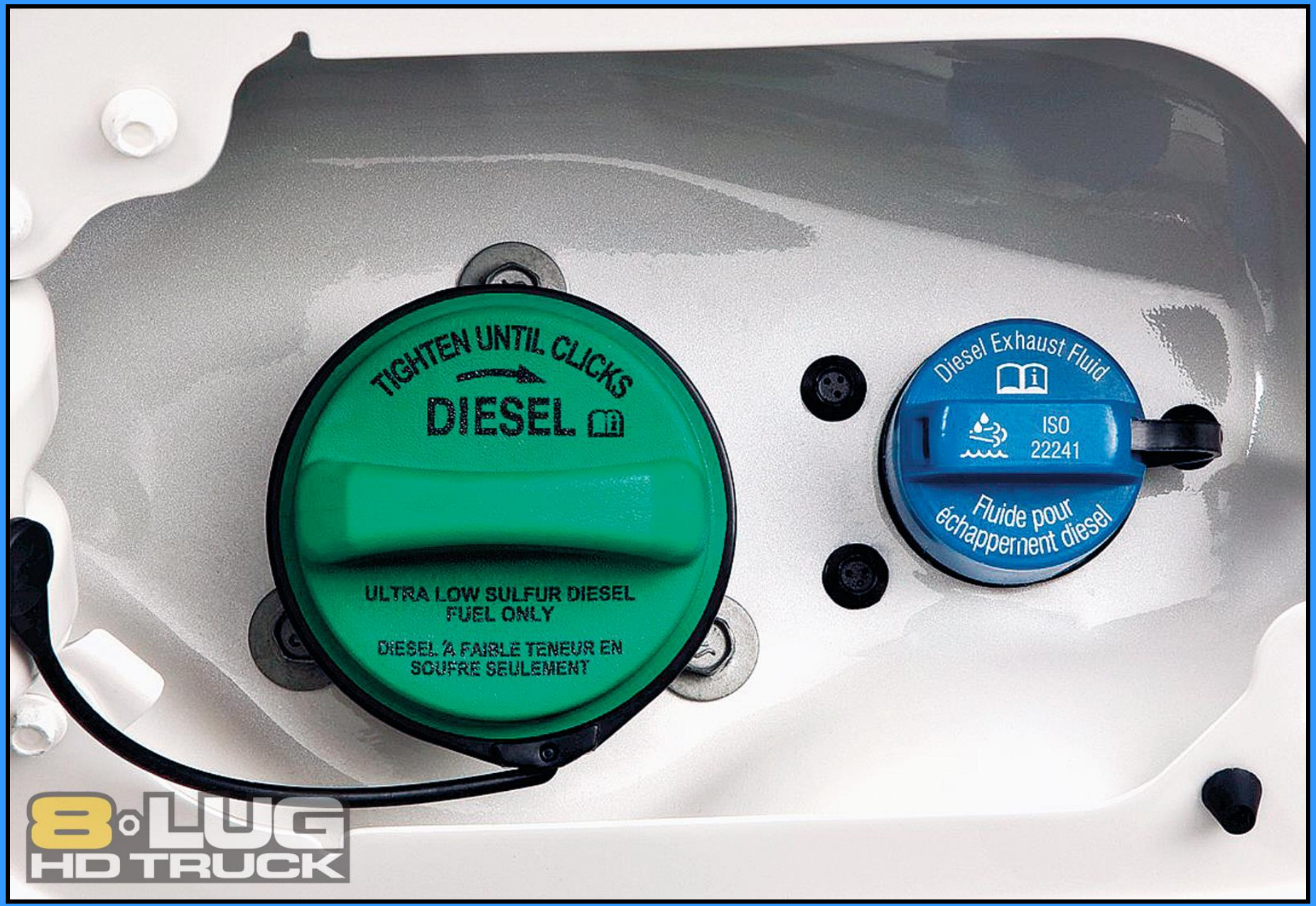
Catalytic
Analytic
Analgesic




How SCR works
AdBlue Tank
Exhaust gas containing nitrogen oxides
Metering unit
Ammonia + water vapour + nitrogen oxides
SCR-Kat
Nitrogen + water
to the enviroment


COOLING SYSTEM
DIESEL ENGINE
HC DOSER
DIESEL PARTICULATE FILTER (DPF)
DEF DOSER
SCR CATALYST
NOx REDUCTION
New - 2010
Tailpipe
$N_2 + H_2O$
into the Air
1
2
3
4
5
6

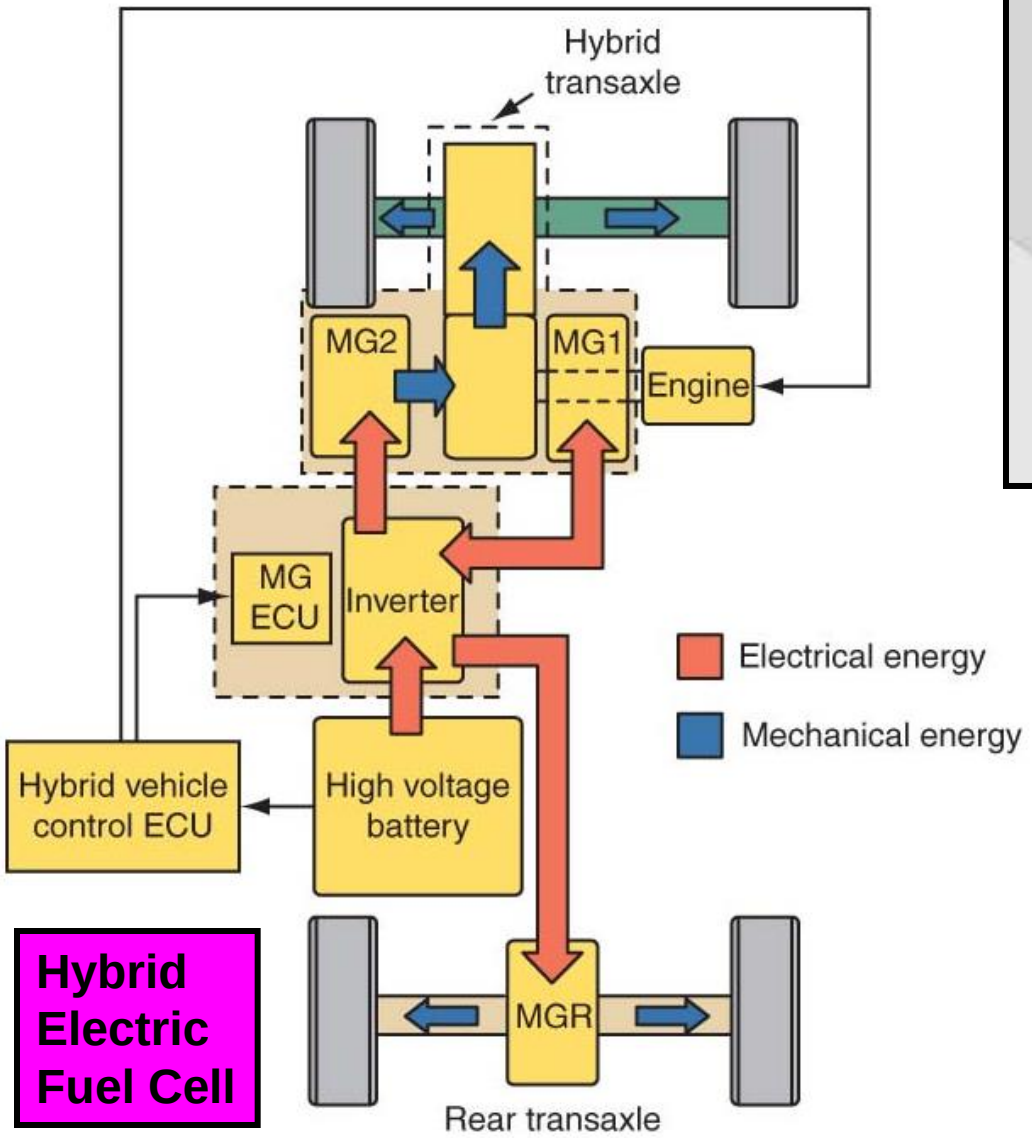
This is the location of the Urea tank. Urea is a combination of 67.5% ionized water and 32.5% urea. A 10 gallon tank can provide enough fluid to travel from LA to NYC. There are thousands of dealers that carry DEF.


TIGHTEN UNTIL CLICKS
DIESEL
ULTRA LOW SULFUR DIESEL FUEL ONLY
DIESEL À FAIBLE TENEUR EN SOUFRE SEULEMENT
Diesel Exhaust Fluid
ISO 22241
Fluide pour échappement diesel
8 LUG HD TRUCK

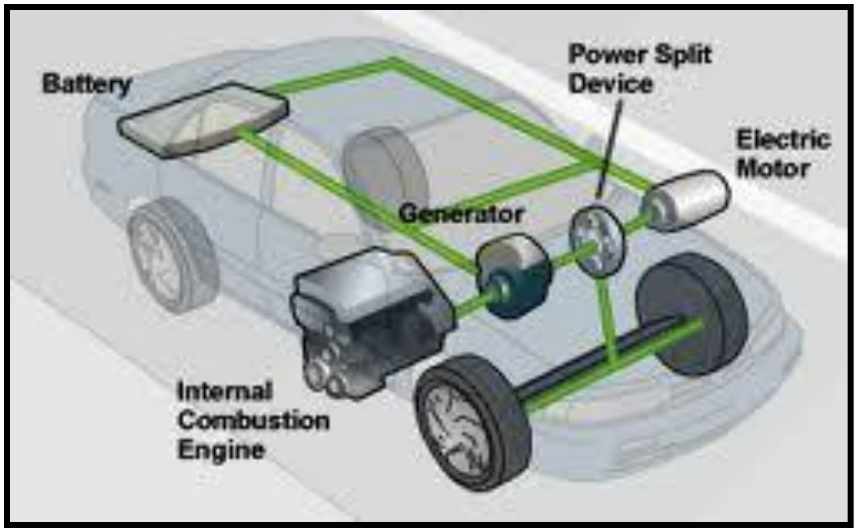

PEAK
Another Product
CERTIFIED
DEF ISO 22241
BlueDEF
Diesel Exhaust Fluid
Fluide d'échappement diesel
Fluido para Escape de Diesel
FOR DIESEL SCR ENGINES
POUR LES MOTEURS DIESEL SCR
PARA MOTORES DIESEL SCR
Driving to a cleaner environment
ONE U.S. GAL (3.78 L)


TerraCair
AUS 32
ULTRAPURE DIESEL EXHAUST FLUID
FLUIDE POUR GAZ D'ÉCHAPPEMENT DIESEL
FLUIDO PARA ESCAPE DE DIESEL
DEF
Dispensing nozzle included
Buse de distribution incluse
Incluye boquilla dispensadora
CERTIFIED
CAUTION
ATTENTION
PRECAUCIÓN
2.5 US GAL (9.46 L)

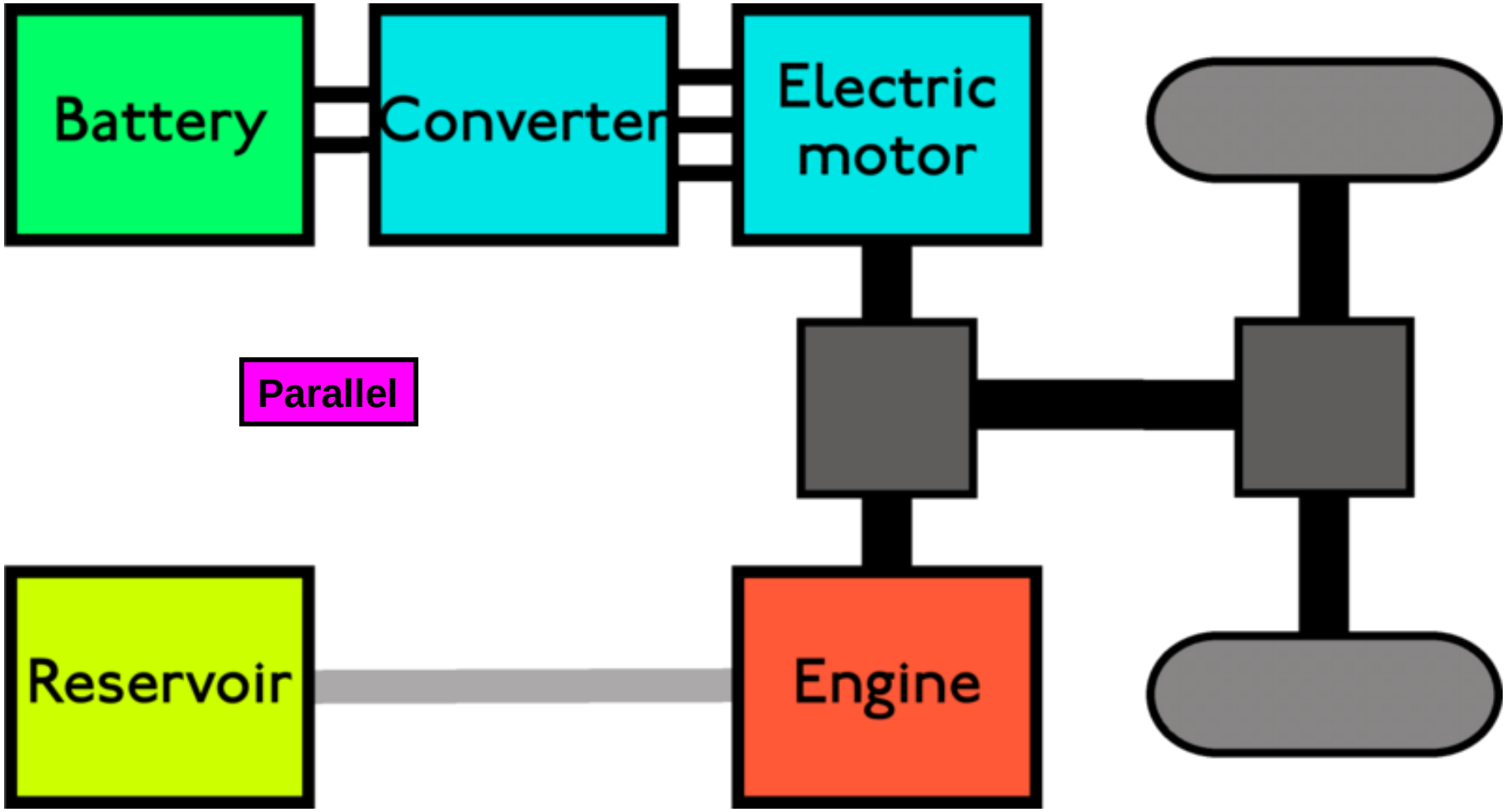
40. A _____ vehicle has at least two different types of power or propulsion systems. *(gas/electric)*



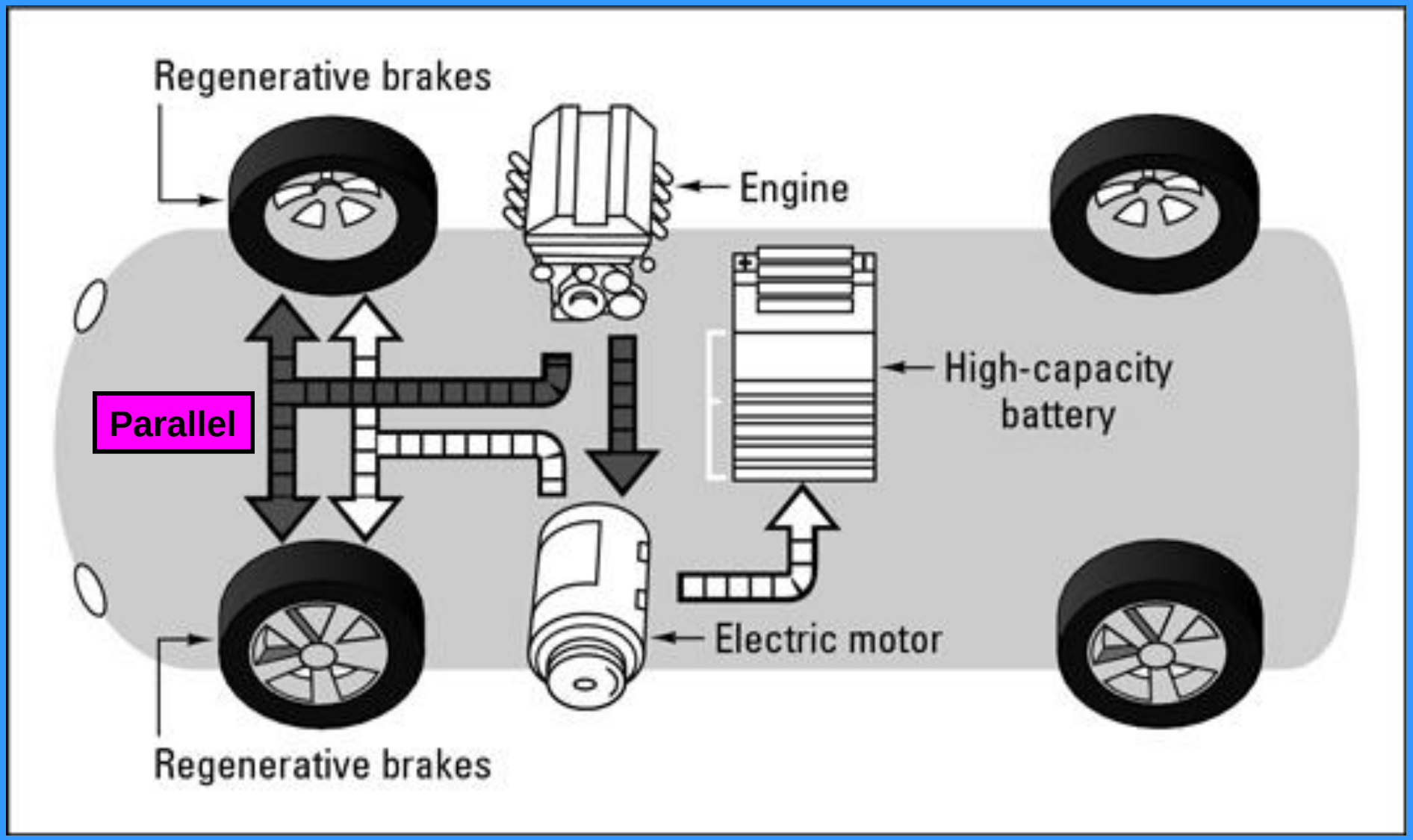
Hybrid Electric Fuel Cell



41. _____ hybrids can drive by just motor, just engine or a combination of both.

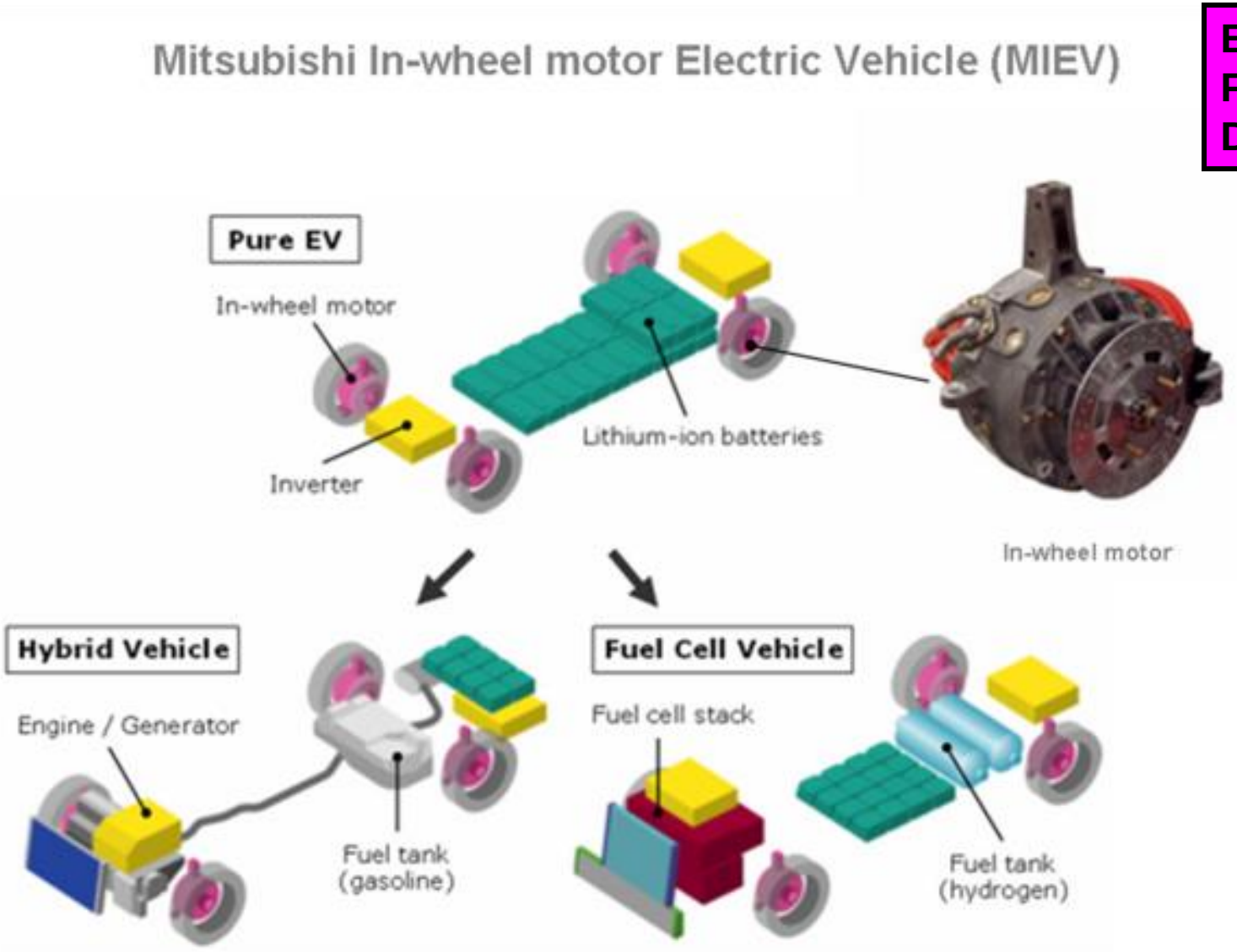


41. _____ hybrids can drive by just motor, just engine or a combination of both.



42. A fully _____ operated vehicle is known as an EV.
EVs are also called ZEVs or zero emission vehicles.

Electric
Fuel Cell
Diesel



42. A fully _____ operated vehicle is known as an EV.
EVs are also called ZEVs or zero emission vehicles.

features

- zero tailpipe emissions/Zero Emissions Vehicle (ZEV)
- 100% electric - no gas required
- high response 80kW AC synchronous electric motor
- range – 100 miles/charge based upon US EPA LA4 City cycle[1]
- speeds up to 90 mph
- 5 passengers, 5 doors
- Nissan Connection powered by CARWINGS™[2]

mechanical

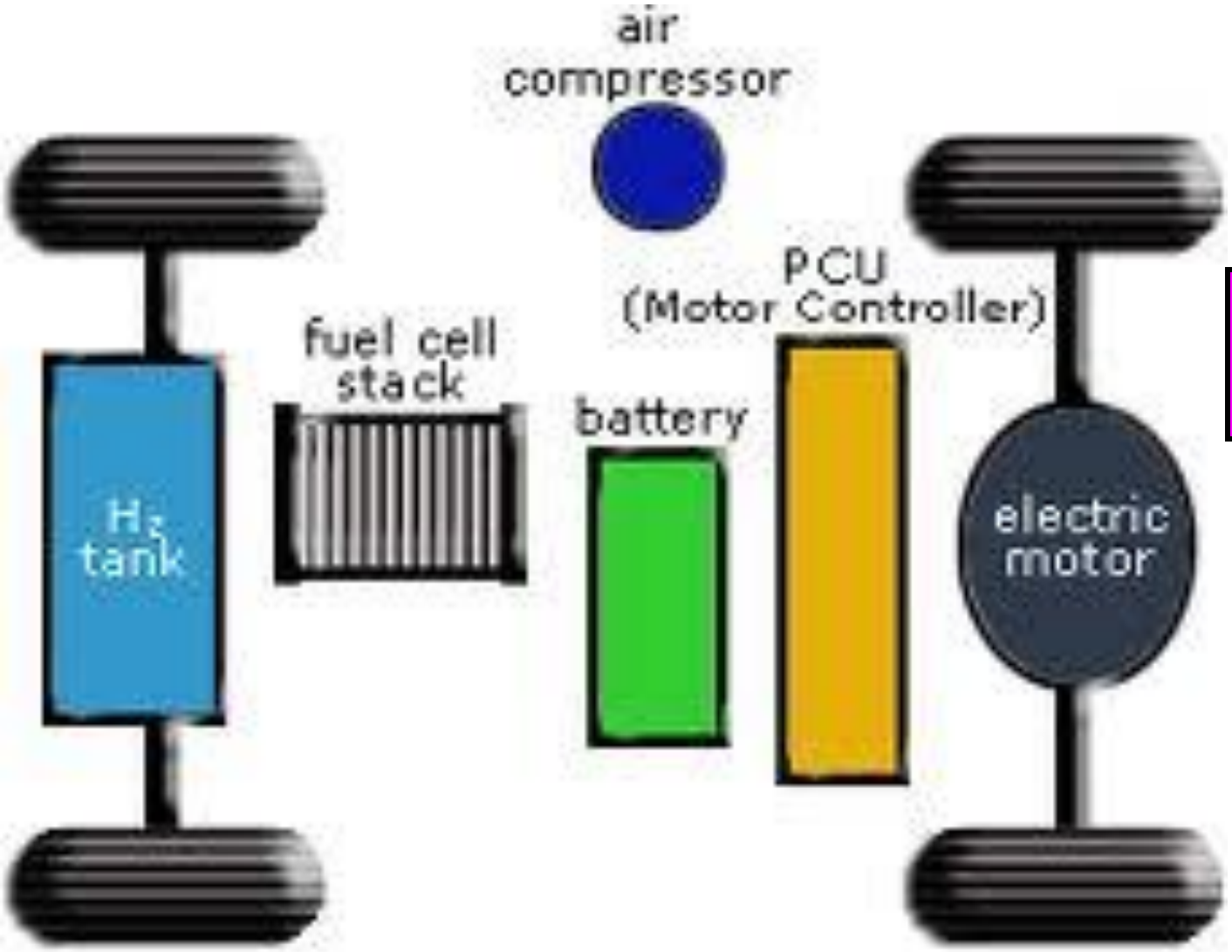
motor + battery

- battery heater
- 80 kW AC synchronous motor
- 24 kWh lithium-ion battery
- 3.3 kW onboard charger
- 120V portable trickle charging cable[3]

SL version includes SV features plus:
- Quick Charge Port

http://www.nissanusa.com/leaf-electric-car/specs-features/index#/leaf-electric-car/specs-features/index

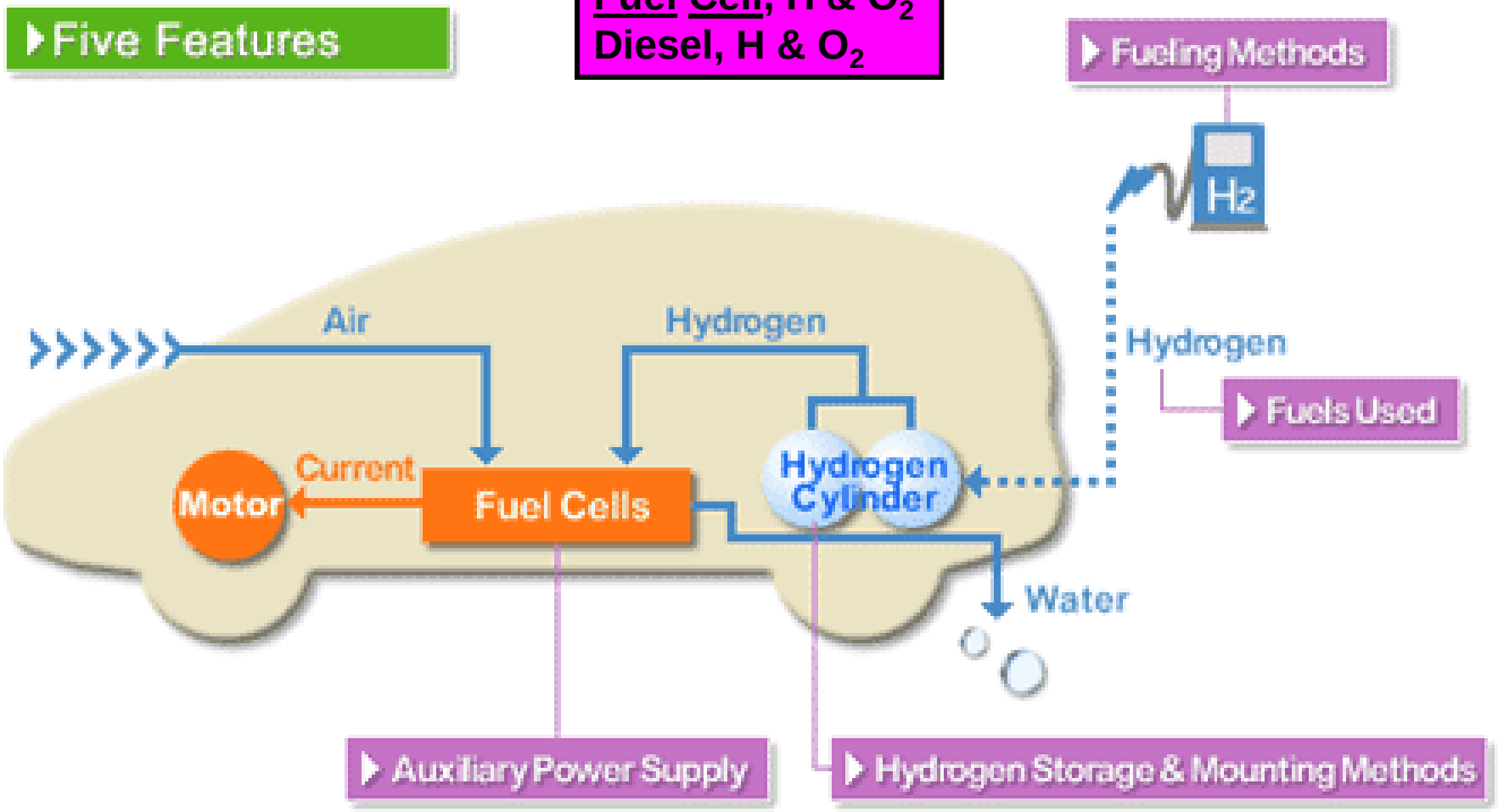
43. _____ _____ vehicles convert chemical energy to electrical energy by combining ____ with ____.



Electric, H & O_2
Fuel Cell, H & O_2
Diesel, H & O_2

43. _____ _____ vehicles convert chemical energy to electrical energy by combining ____ with ____.

Electric, H & O_2
Fuel Cell, H & O_2
Diesel, H & O_2



44. The _____ engine has no pistons or valves.
The Mazda Renesis® is a twin rotor Wankel engine.

Diesel
Rotary
Otto

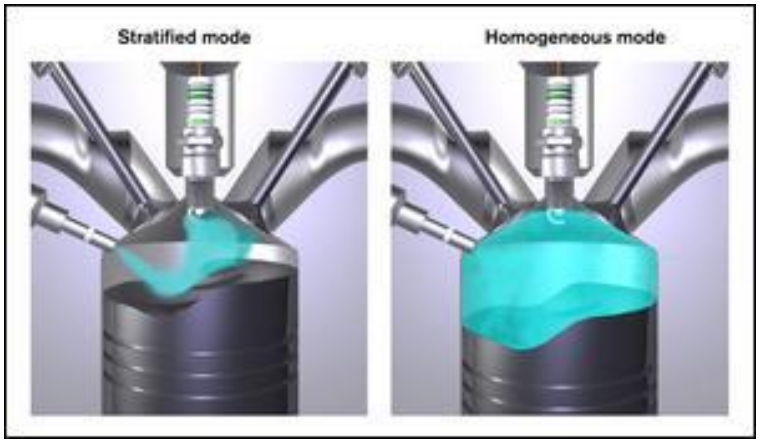
http://www.youtube.com/watch?v=Z7kj9rO8CgI&feature=related

http://www.youtube.com/watch?v=6BCgI2uumlI&feature=related

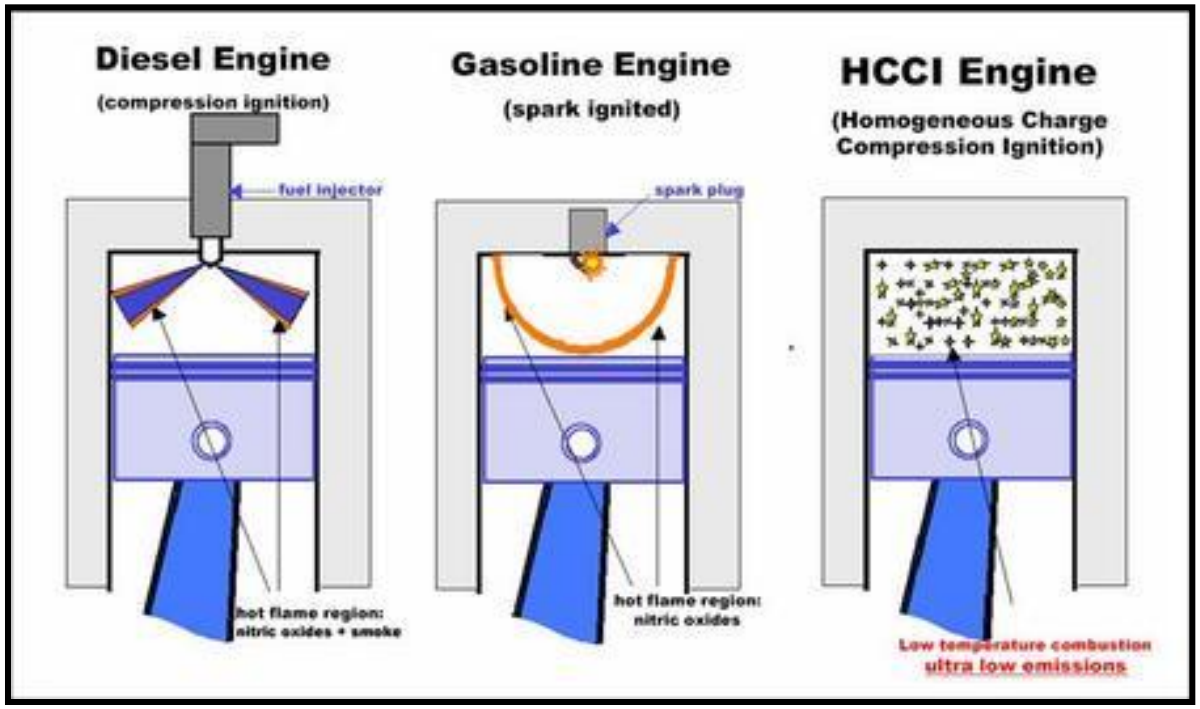
45. The _____ charge *(layered)* engine can run on lower octane fuel & produces less emissions.

Stratified
Nullified
Mummified

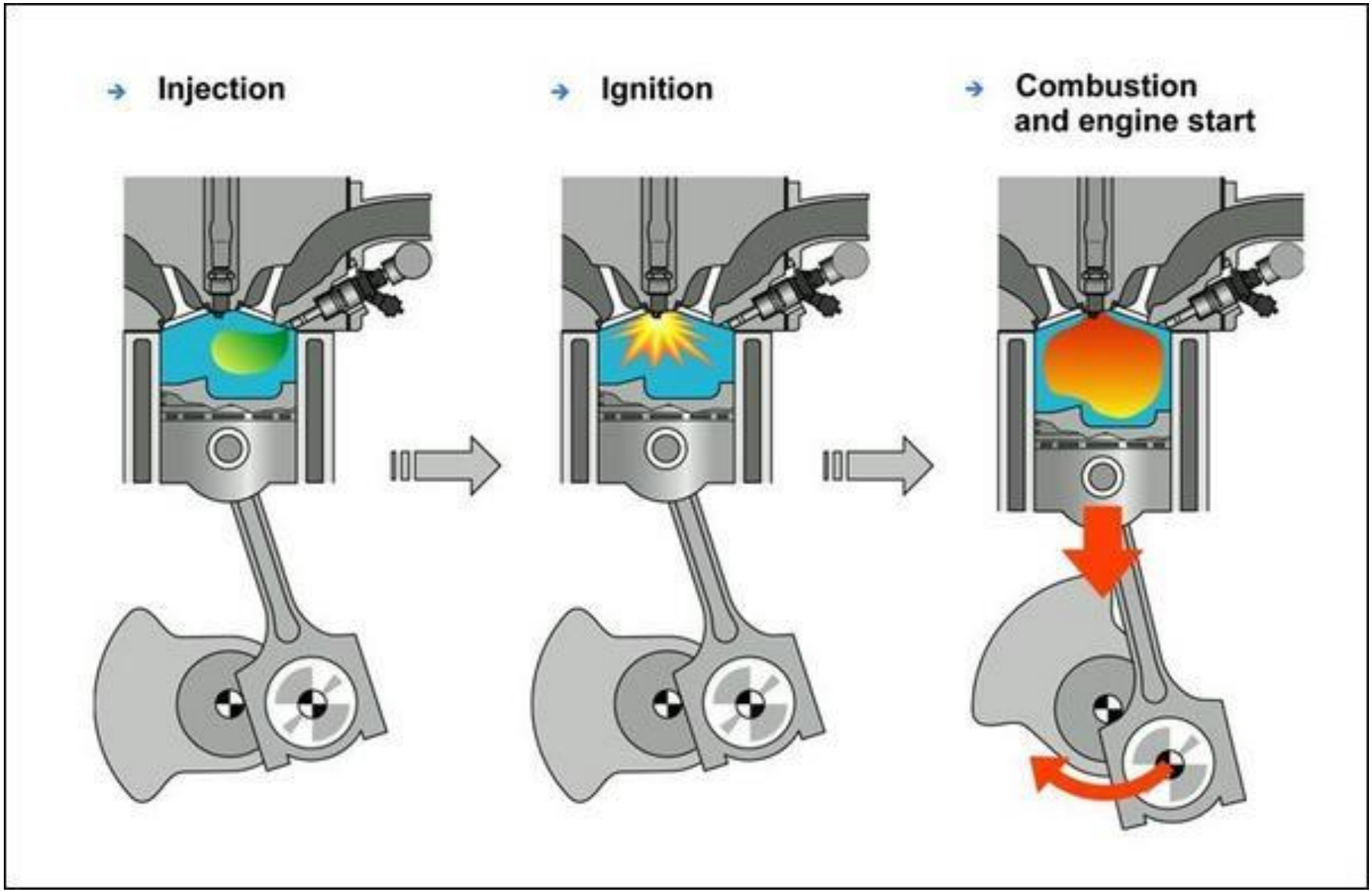
46. Homogeneous charge _____ ignition engines (HCCI) “autoignite” a lean, diluted A/F mixture.



Depression
Recession
Compression

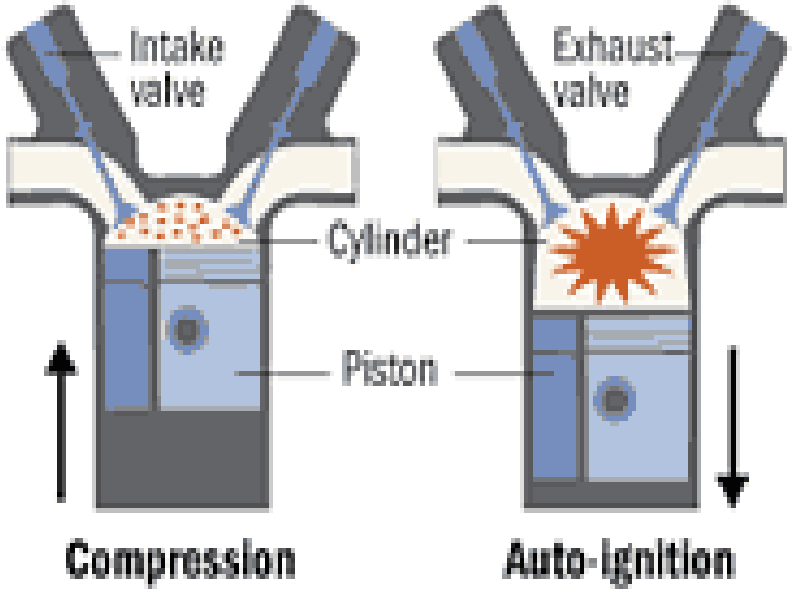


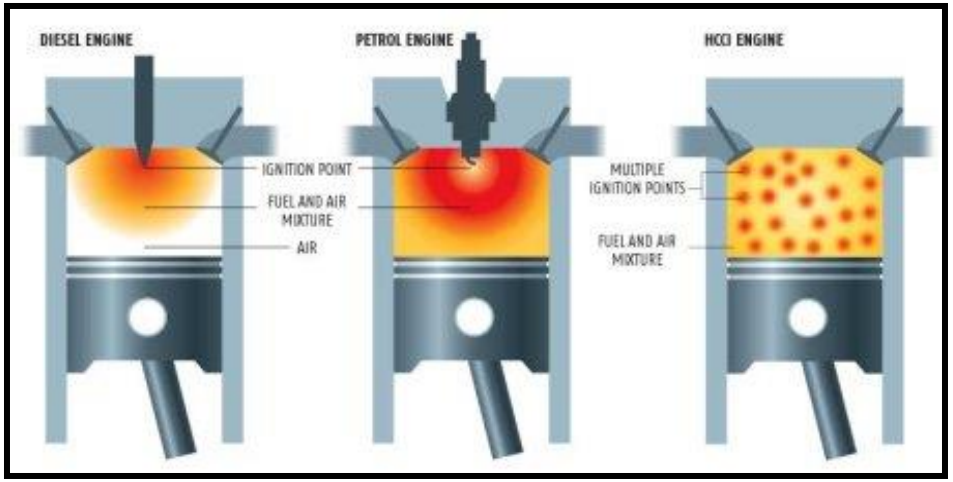
http://www.youtube.com/watch?v=Pxvp9F-PS34

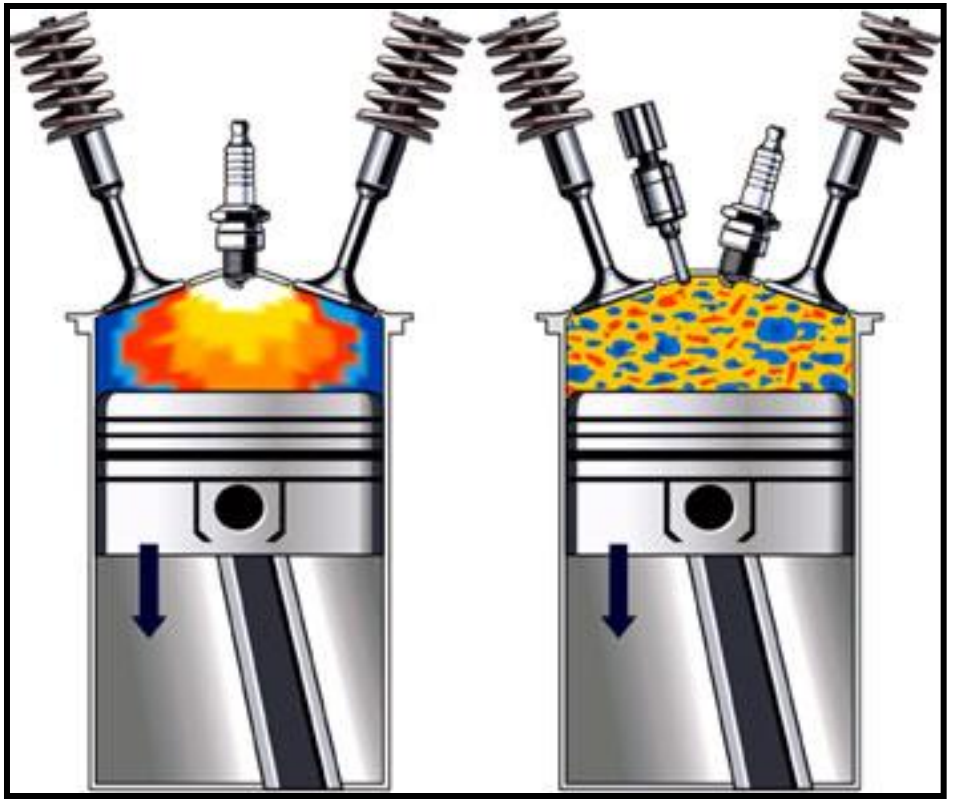


THE PRESSURE'S ON

Instead of using a spark plug to ignite air and gas in the cylinder, as in a traditional engine, efficient HCCI engines use pressure created by a piston to heat the mix until it combusts.

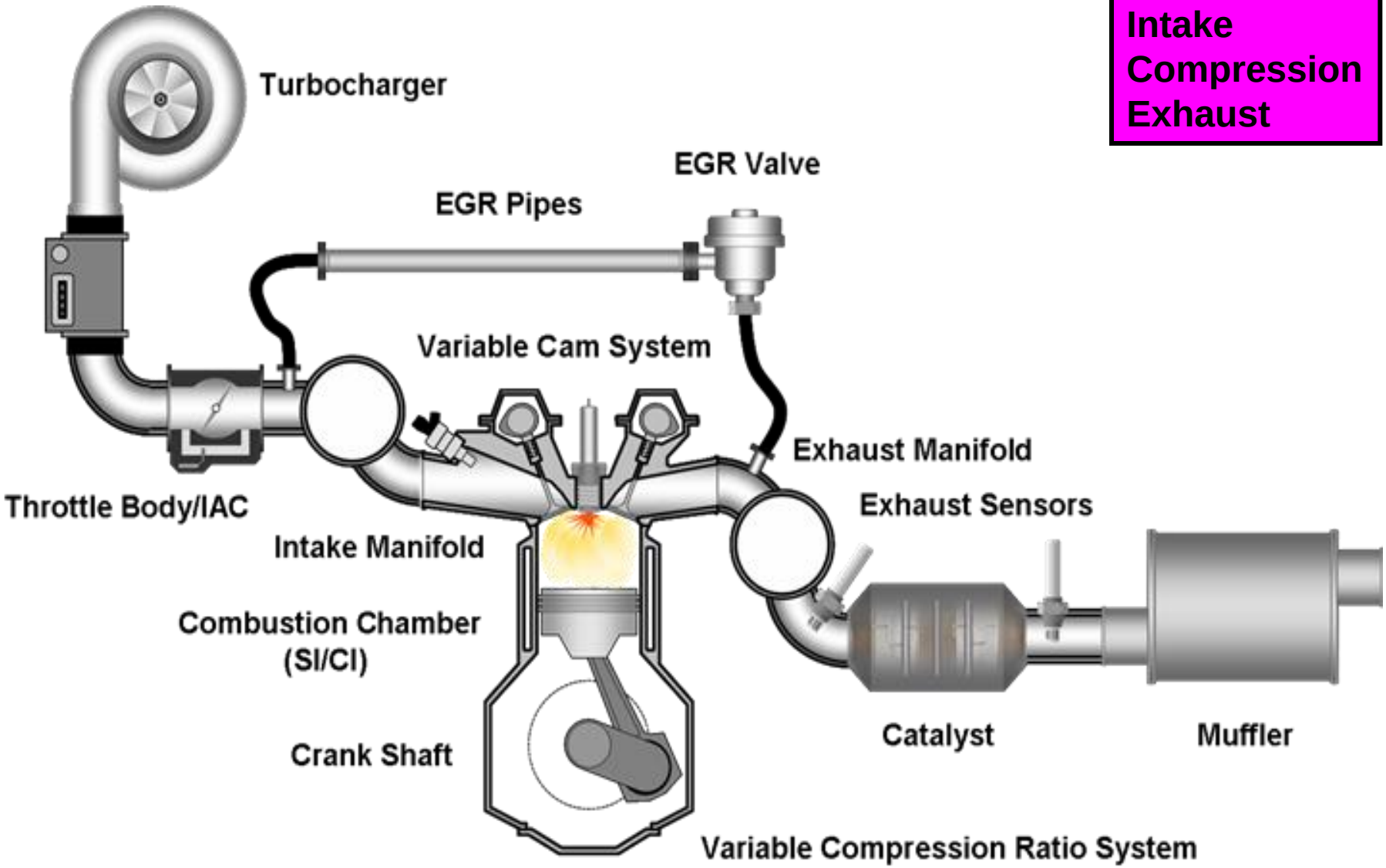






47. Variable _____ ratio engines provide power when needed & also reduce fuel consumption.

Intake
Compression
Exhaust



48. The _____ is a 17 - character code used to identify vehicle OEM options. The ___character tells the country of origin, the _____ character identifies the engine, the _____ character tells the year of mfgr.

Reads and clears generic and manufacturer specific diagnostic trouble codes (DTC)

Supports multiple trouble code requests

Resets check engine light

Reviews the emission readiness status of OBD II monitors

Retrieves VIN number

VIN, 1, 8, 10

49. The _____ label, a.k.a. VECI label (vehicle emission control information) holds valuable information for use when servicing engine systems like mechanical, ignition, fuel, and emission.

VEHICLE EMISSION CONTROL INFORMATION		
	ENGINE FAMILY EFN 2.8VBT2EA DISPLACEMENT 2.8 L	OBD II CERTIFIED
	THIS VEHICLE CONFORMS TO U.S. EPA AND STATE OF CALIFORNIA REGULATIONS APPLICABLE TO 2008 MODEL YEAR NEW LEV PASSENGER CARS	
REFER TO SERVICE MANUAL FOR ADDITIONAL INFORMATION TUNE UP CONDITIONS: NORMAL OPERATING ENGINE TEMPERATURE, ACCESSORIES OFF, COOLING FAN OFF, TRANSMISSION IN NEUTRAL		
EXHAUST EMISSIONS STANDARDS	STANDARD CATEGORY	
CERTIFICATION	TLEV	
IN USE	TLEV INTERMEDIATE	
SPARK PLUG Type NGK BFRES-1P GAP 1.1 mm	CATALYST	EFN 2.8V8T2EA

Door Jamb
Under Hood
***Engine**

50. Diagnosis always begins with _____ the *customer complaint* and searching for TSB's.

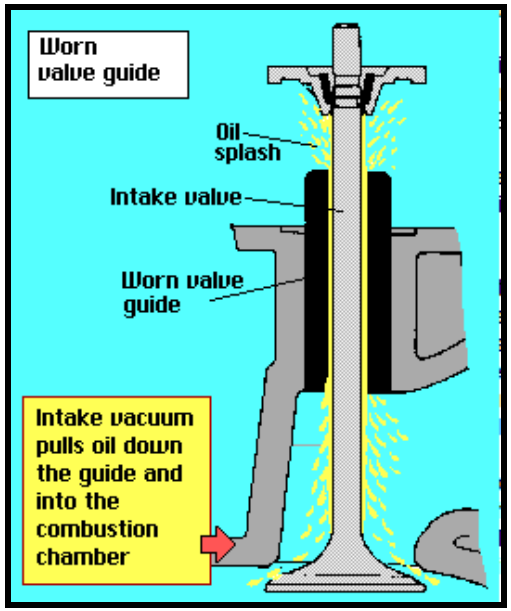
Note: The 3 C's of repair are: Complaint > Cause > Correction

Verifying Customer Complaint

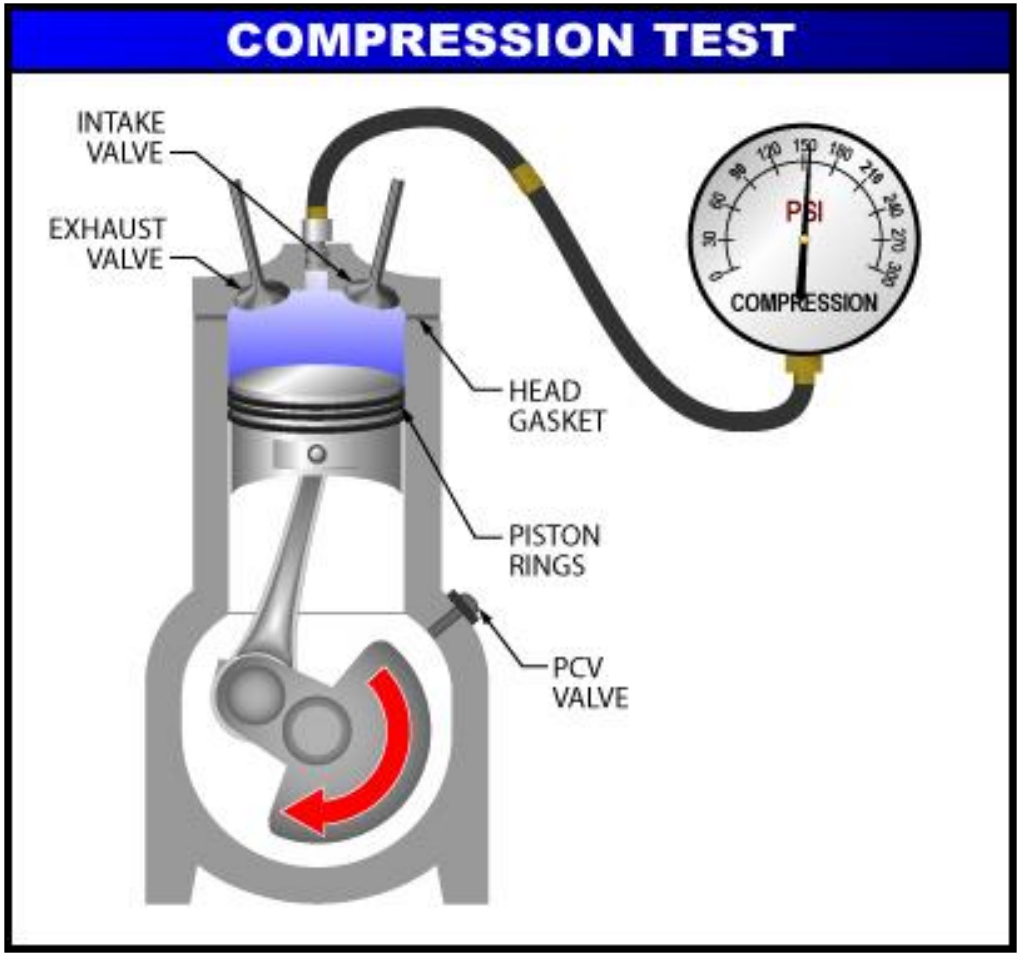
Determining the Cause

Making the Correction

3 C's of Auto Repair

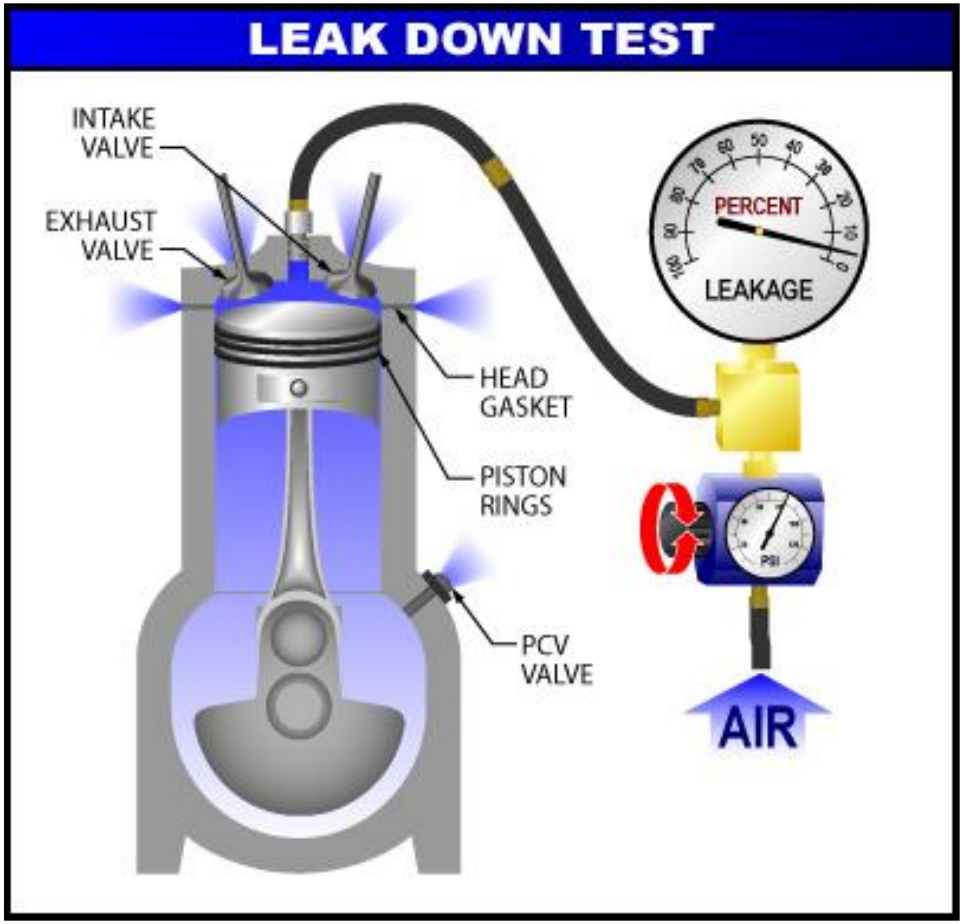


51. Following a dry compression test with a _____ compression test can verify the piston ring condition.

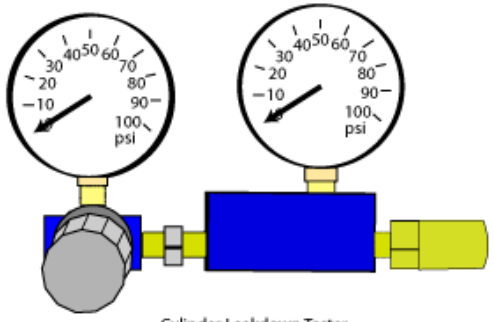


Low Dry & Same Wet = Valves
Low Dry & Higher Wet = Rings or Crosshatch

52. Cylinder _____ tests can pinpoint the cause of a low compression problem.



Leak Into Adjacent Cylinder
Leak Past Piston rings
Leak Past Exhaust Valve
Leak Past Intake Valve
Leak into Water Jackets

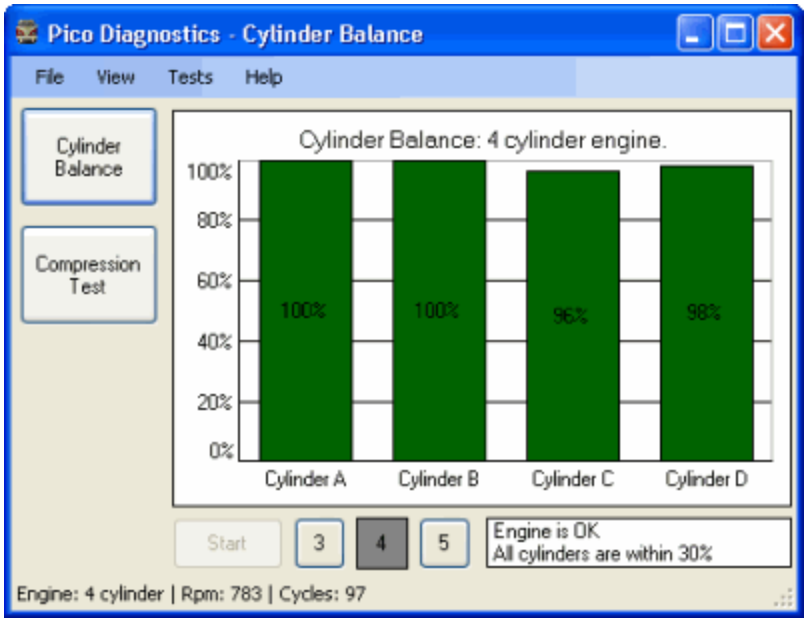


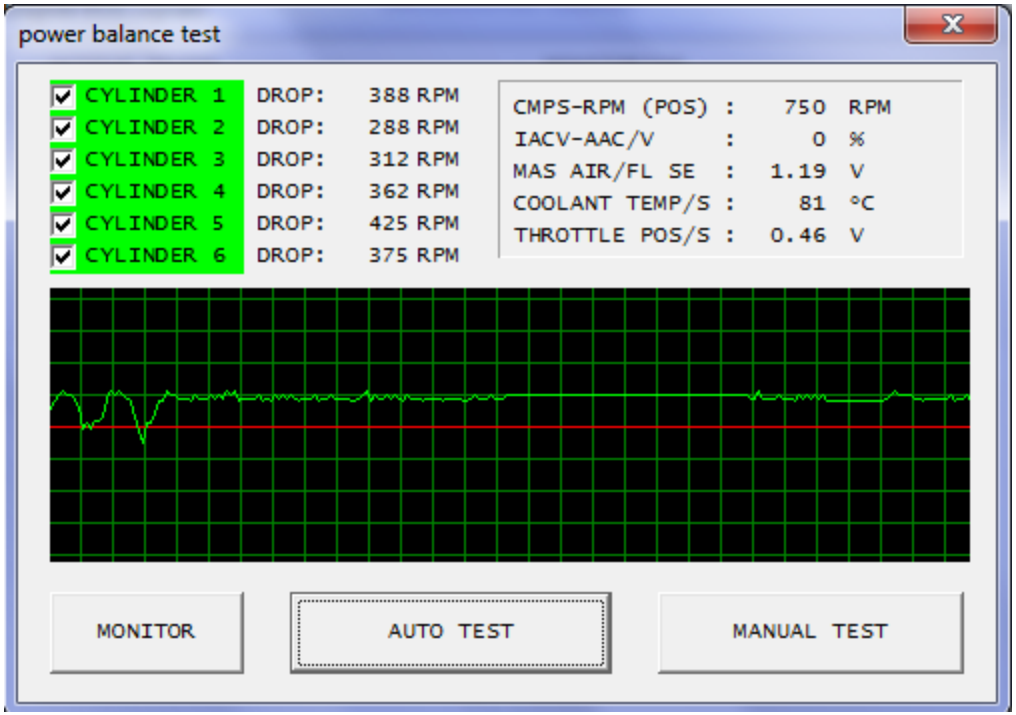
Cylinder Leakdown Tester

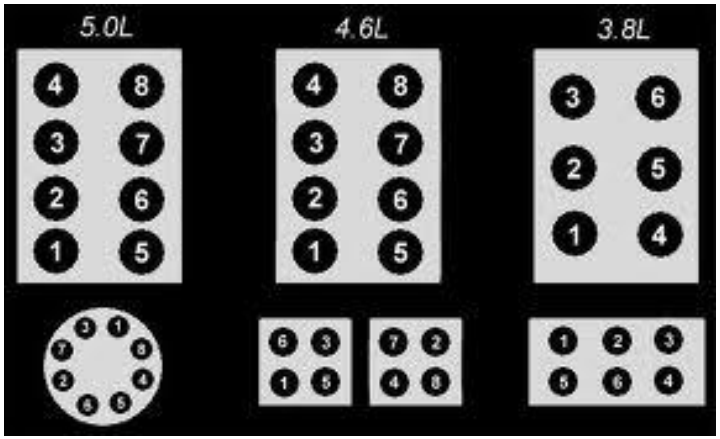
Leakage
Compression
Smoke

53. A cylinder _____ _____ test can check if all the engine's cylinders are producing the same amount of power.

This is sometimes known as a cylinder contribution test.







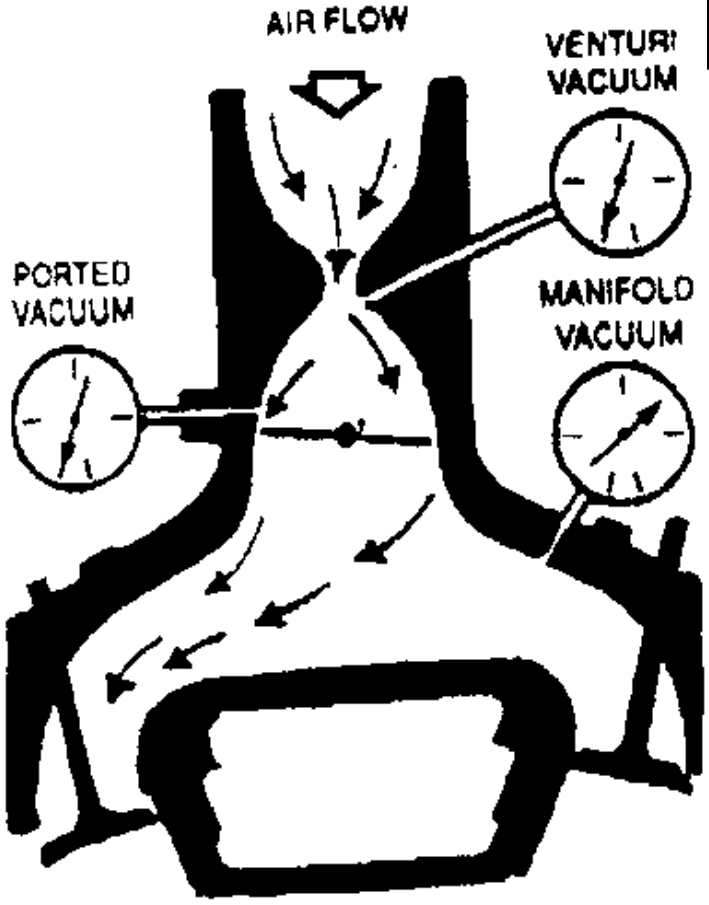
Power Balance
Injector Balance
Crankshaft Balance

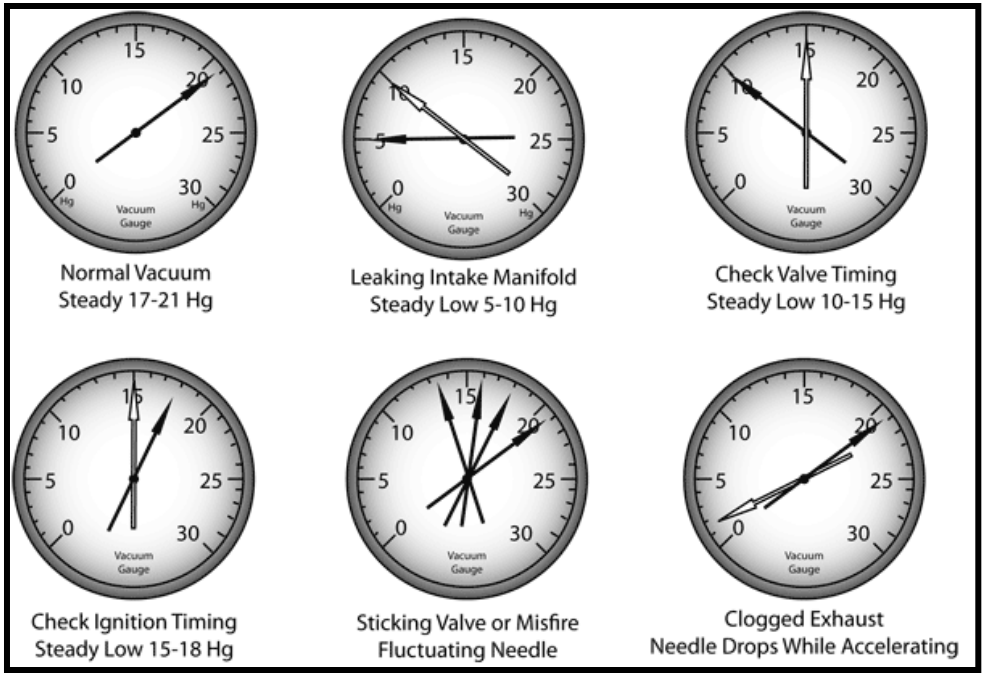
54. When shut off, a cylinder with little or no decrease in rpm is the _____ cylinder. ***Note: Power balance tests can be done manually or with the use of a scan tool.***

Good
Dead

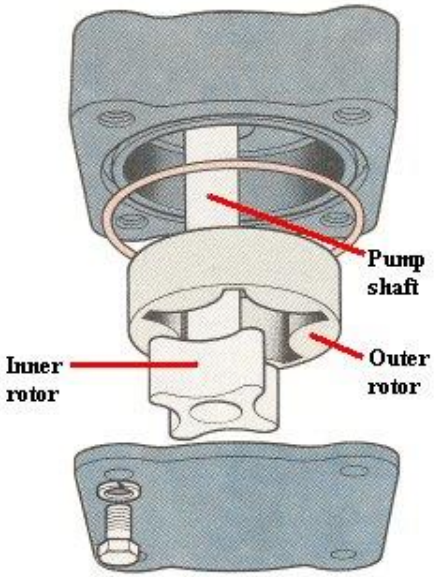
55. Checking for normal & even intake manifold _____ is another way to diagnose engine condition.

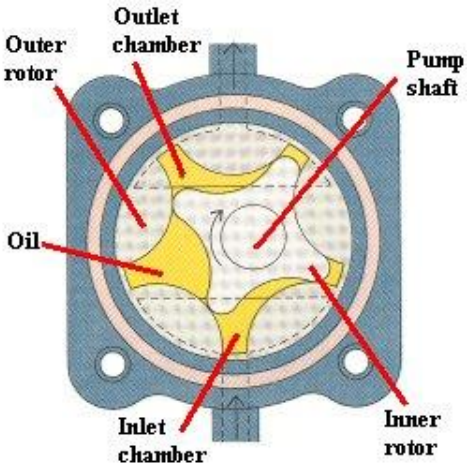
Leakage
Vacuum
Compression

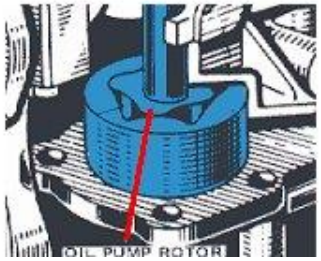


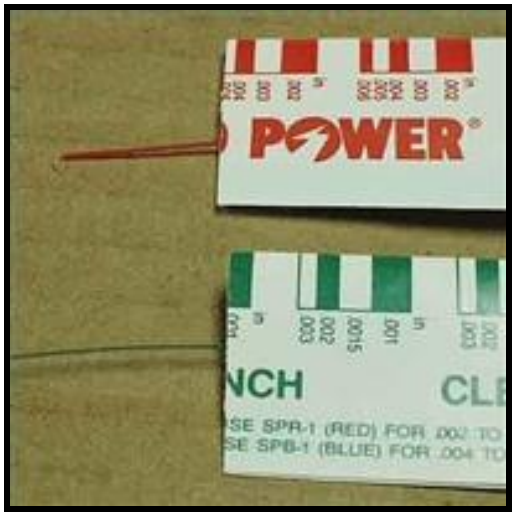


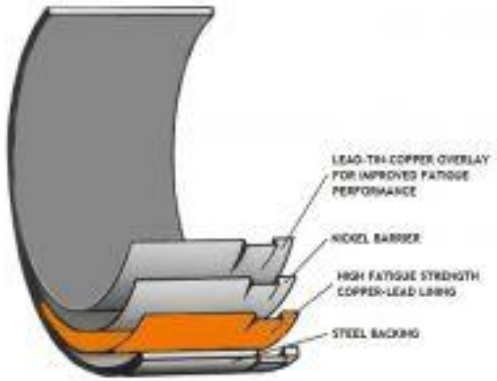
56. _____ pressure problems may be caused by lubrication system faults or by loose bearing clearances.











Oil
Air
Fuel

57. Interpreting exhaust _____ and _____ leaks can give clues to potential engine problems.

The main cause of excessive ***BLACK SMOKE*** is too much diesel fuel. A rich air-fuel mixture allows carbon (ash) to blow out of the exhaust system. Black smoke may be due to problems with the injection pump, injection timing, air cleaner, injectors fuel, or the engine itself.

- Faulty injectors (injectors need attention at about 100,000 to 120,000 km)
- Faulty injectors pumps
- Dirty air cleaner
- Turbocharger or intercooler faulty
- Problems within cylinder head, valves clogged up due to faulty EGR (exhaust gas recycling unit)

WHILE SMOKE occurs mainly during cold starts. The smoke usually consists of condensed fuel particles. The cold engine parts cause the fuel to condense into a liquid, which will not burn. The most common reasons for white exhaust smoke are inoperative glow plugs, low engine compression, thermostat stuck open, bad injector spray pattern, late injection timing, and cold start (injection pump) problems. The smoke will burn your eyes.

- Engine/pump timing out.
- Fuel starvation to pump causing the pumps timing not to operate correctly.
- Low engine compression
- Water/petrol in the fuel

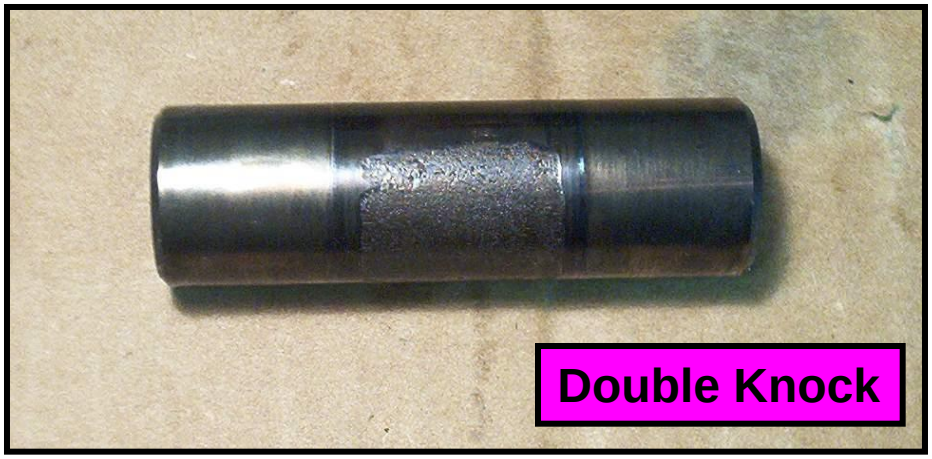
Excessive ***BLUE SMOKE*** may be due to oil consumption from worn piston rings, scored cylinder walls, or leaking valve stem seals. White-blue smoke, however, is normally caused by incomplete combustion or injection system problems.

- Warn cylinders or piston rings
- Faulty valves or valve stern seals,
- Engine over full with engine oil.
- Faulty injector pump/lift pumps allowing engine oil to be mixed with the diesel.

Smoke, Fluid
Odor, Fluid
Noise, Fluid

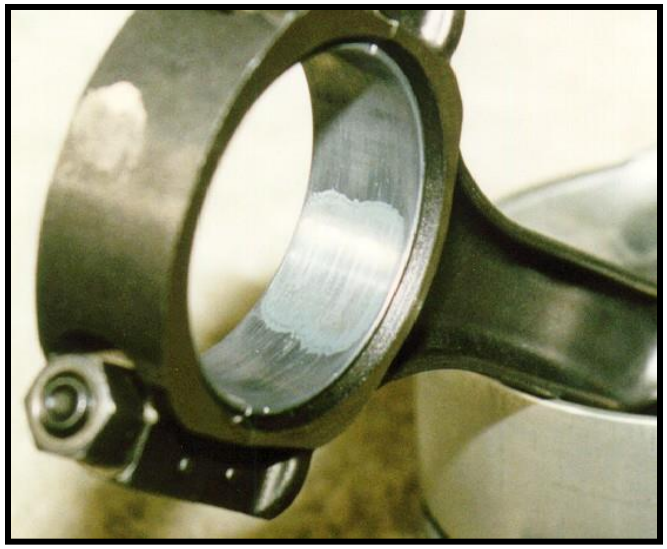
58. Engine *noises* can tell a lot. Piston _____ (*skirt hitting cylinder wall*) is more noticeable on a cold engine.

59. *Piston pin* noises sound like a _____ _____ at idle speeds.

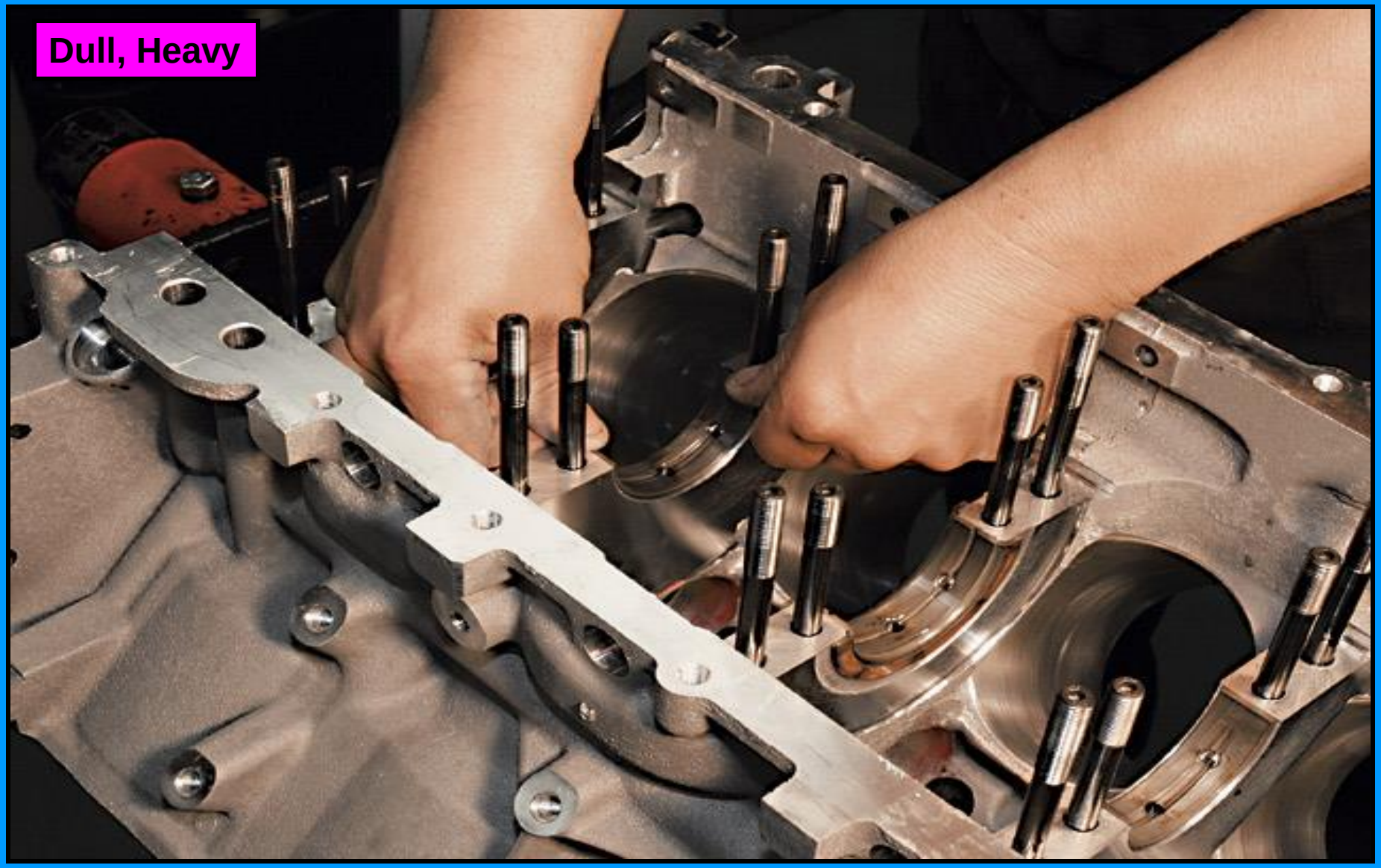


60. A rod bearing knock is heard at most speeds, but goes away when that cylinder is _____ out.

Cancelled or Shorted

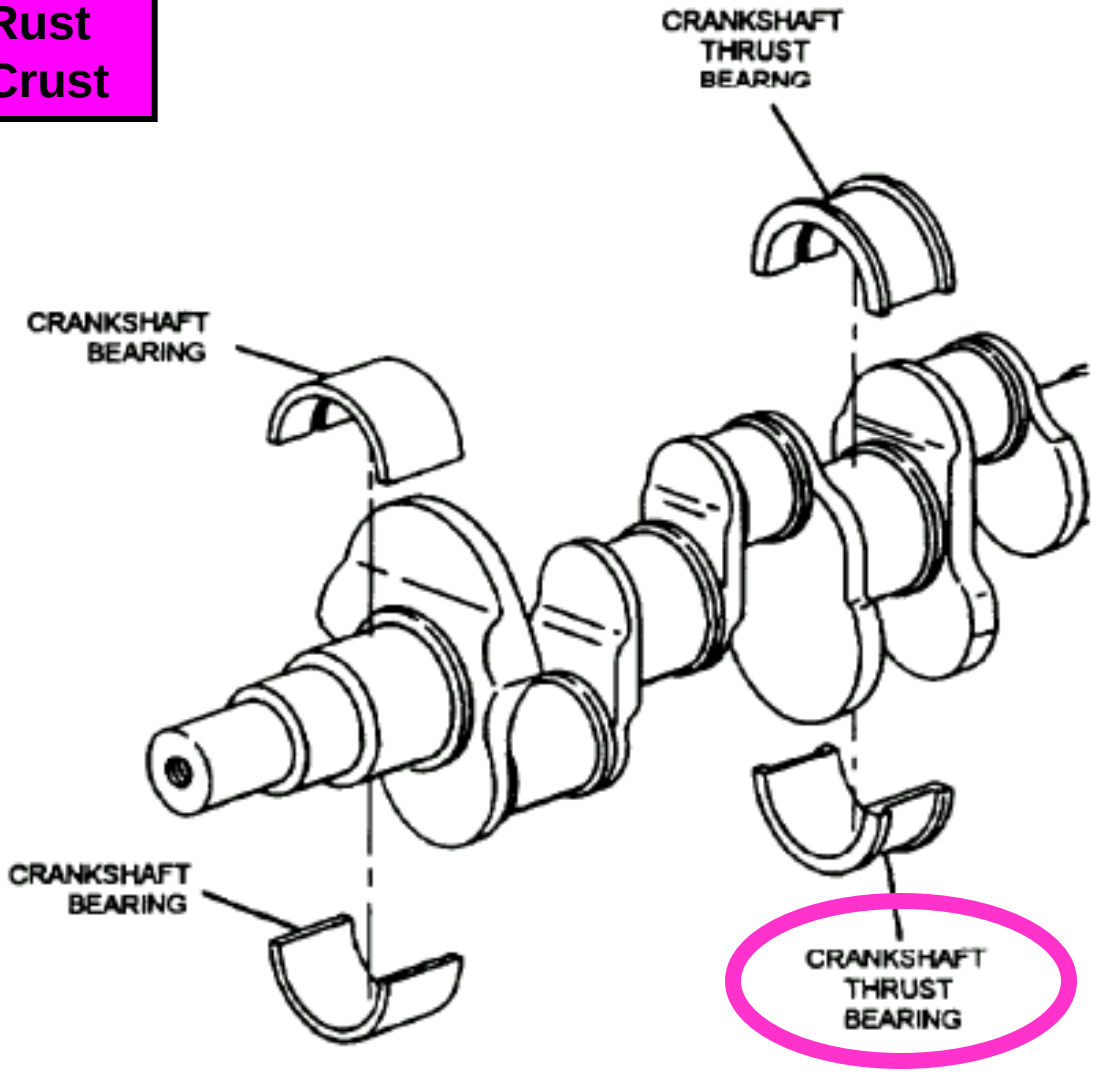


61. A *main bearing* knock is a _____, _____ knock from the lower end, oil pan or block area.



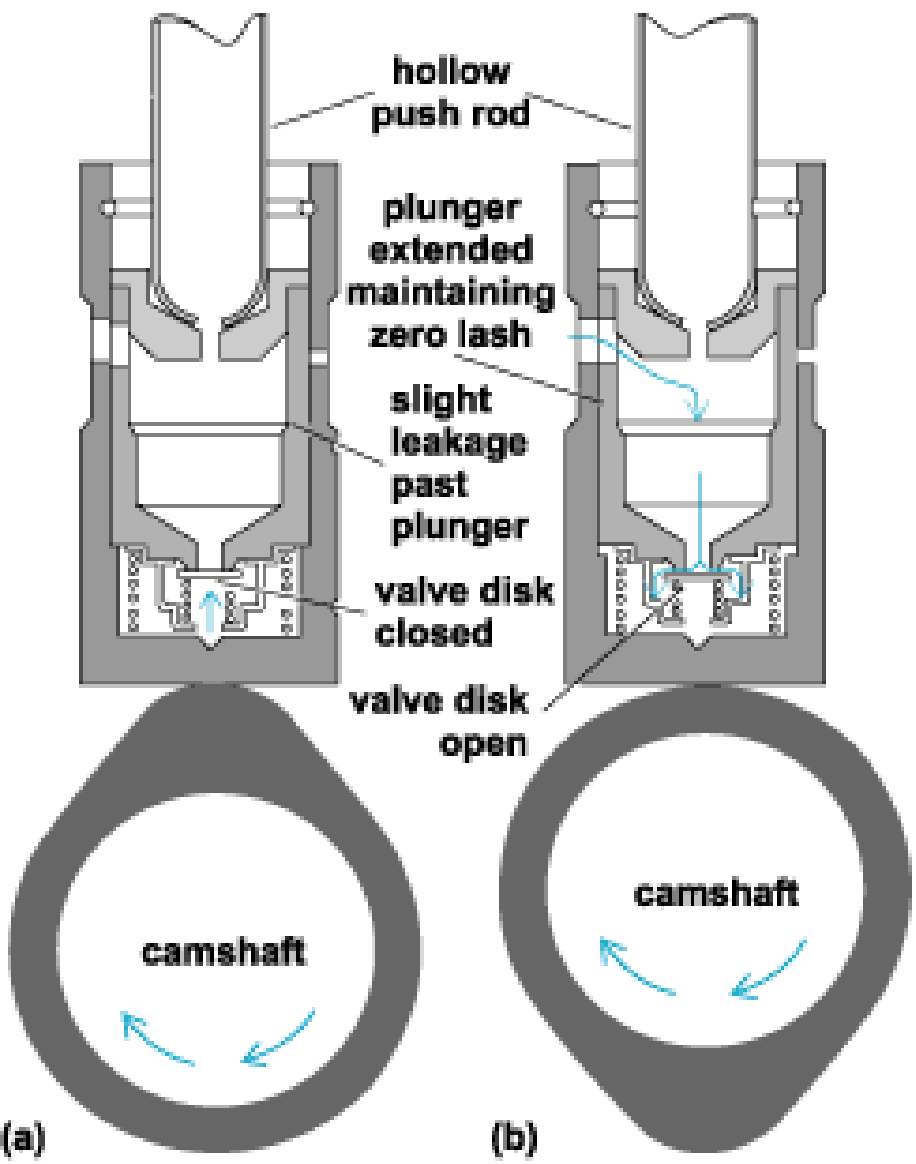
62. A loose crankshaft main _____ bearing produces a ***heavy thump at irregular intervals***.

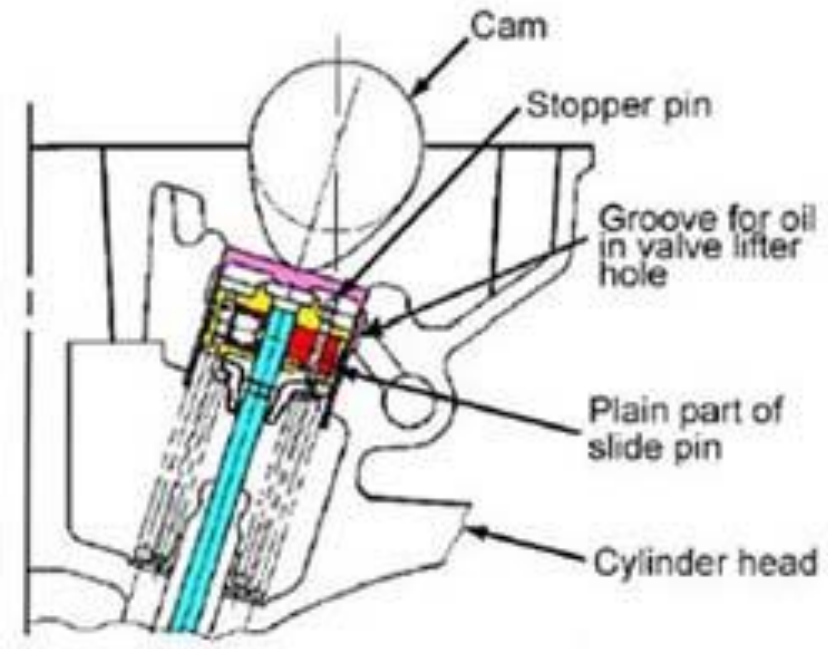
Thrust
Rust
Crust



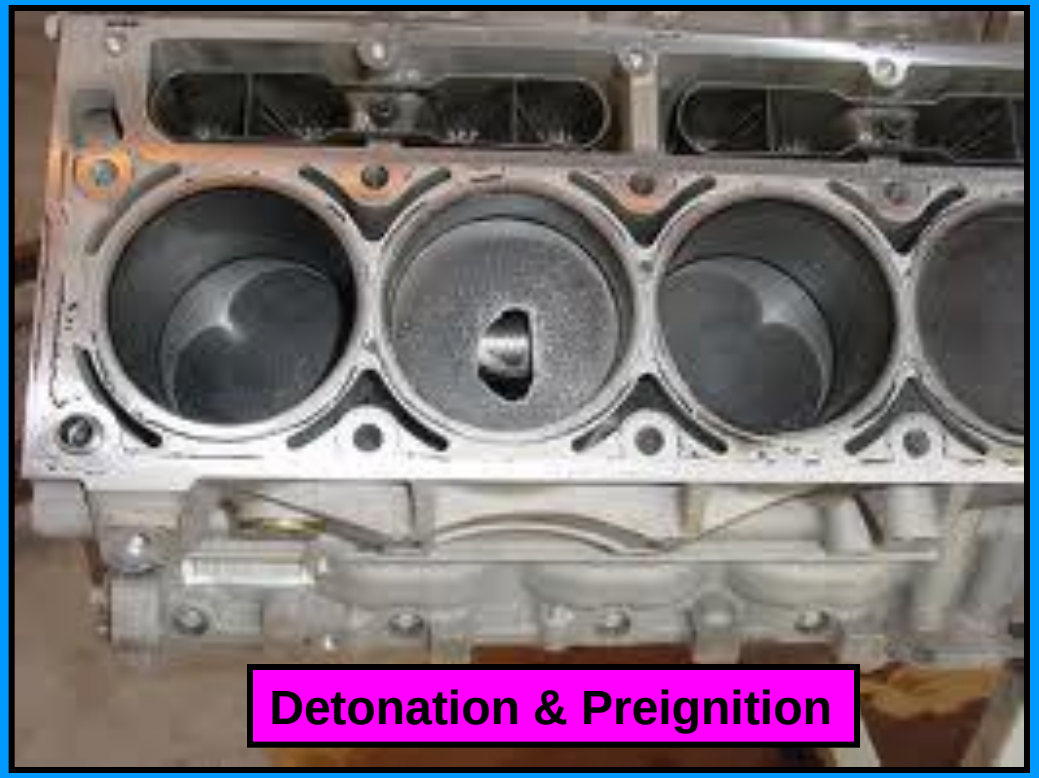
63. _____ noise is a light, regular clicking sound, more noticeable at idle speeds *in the upper end*.

Lifter or Tappet



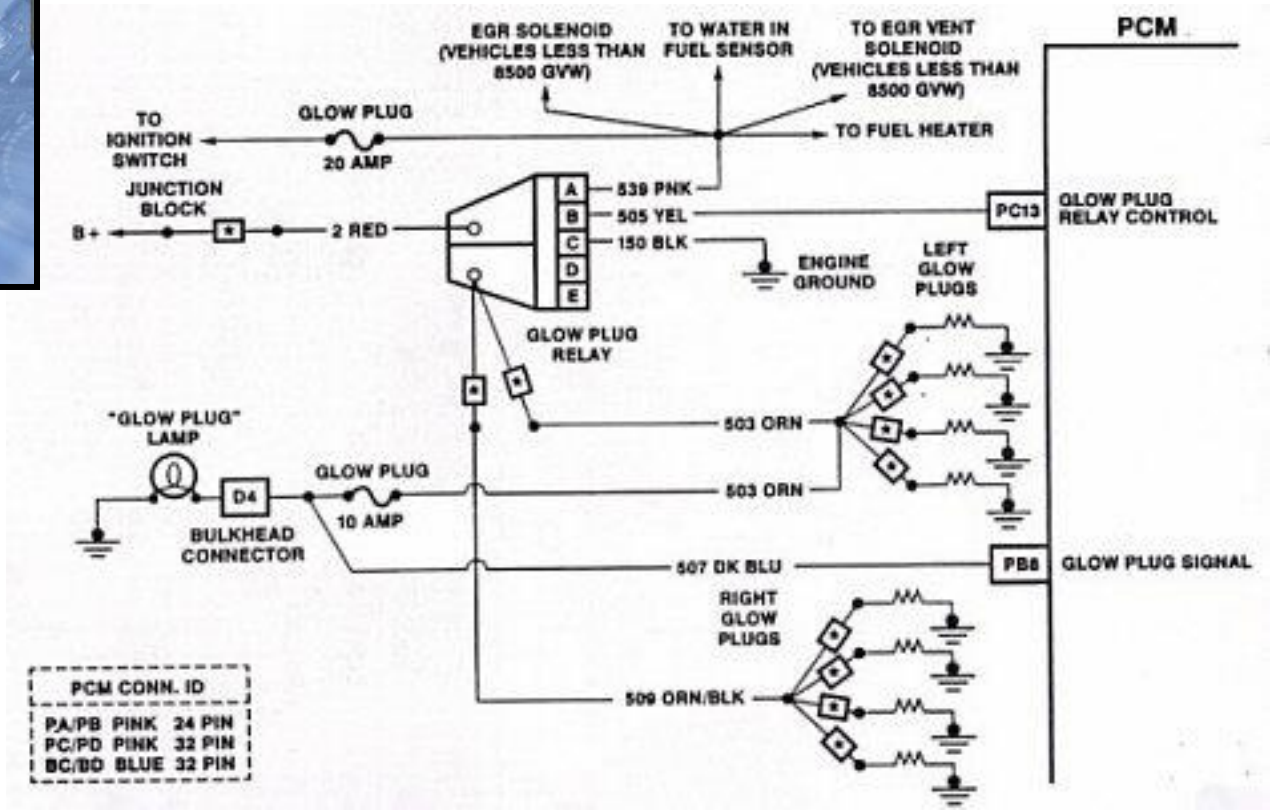


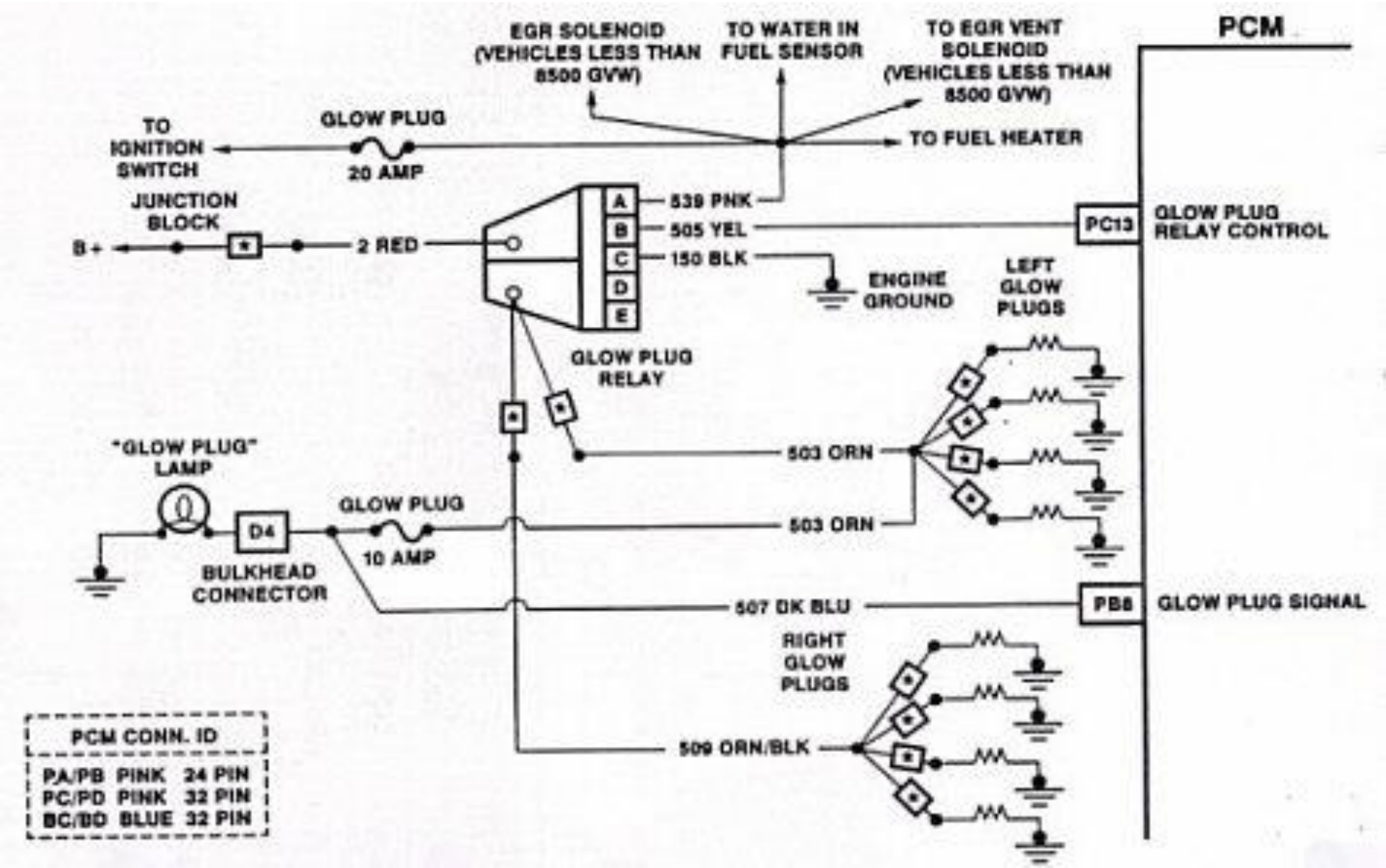
64. _____ & _____ cause knocks or pings produced by abnormal combustion.



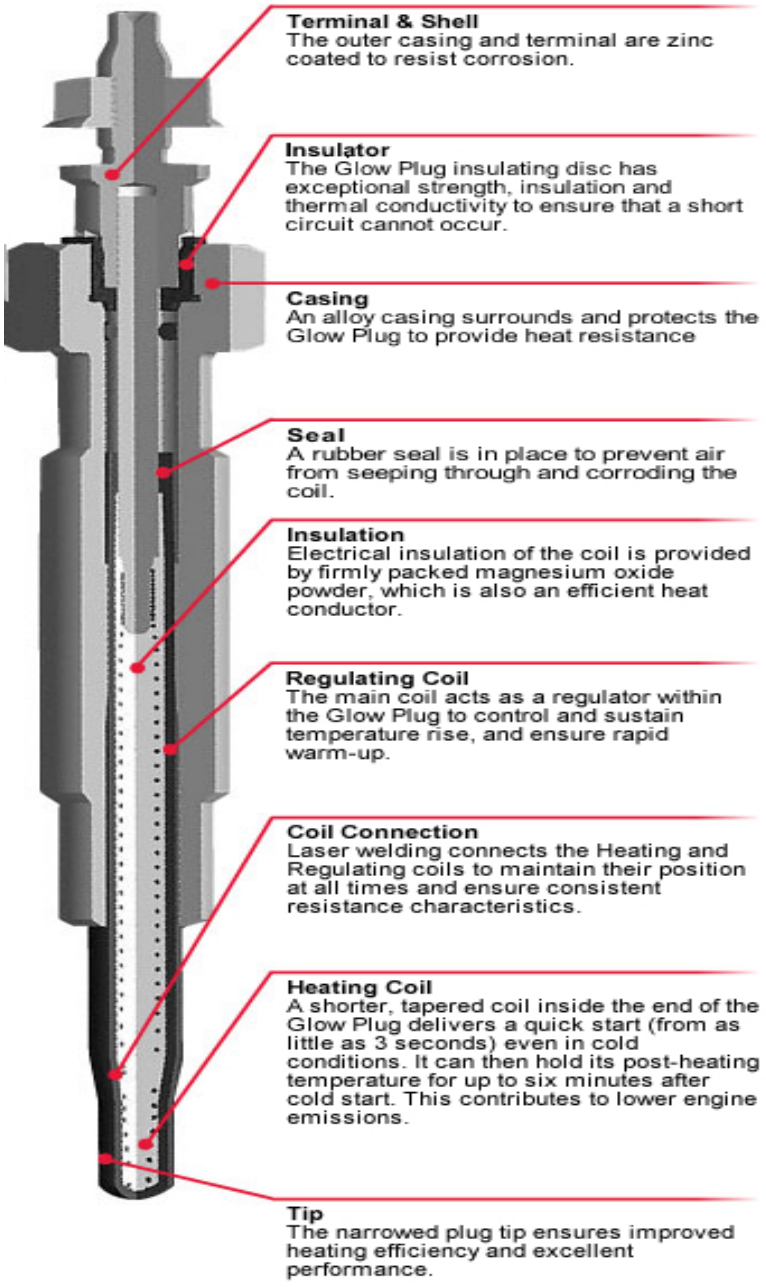
Detonation & Preignition

Diesel engines use 12-volt _____ _____ to *warm the combustion chamber* during cold starting.

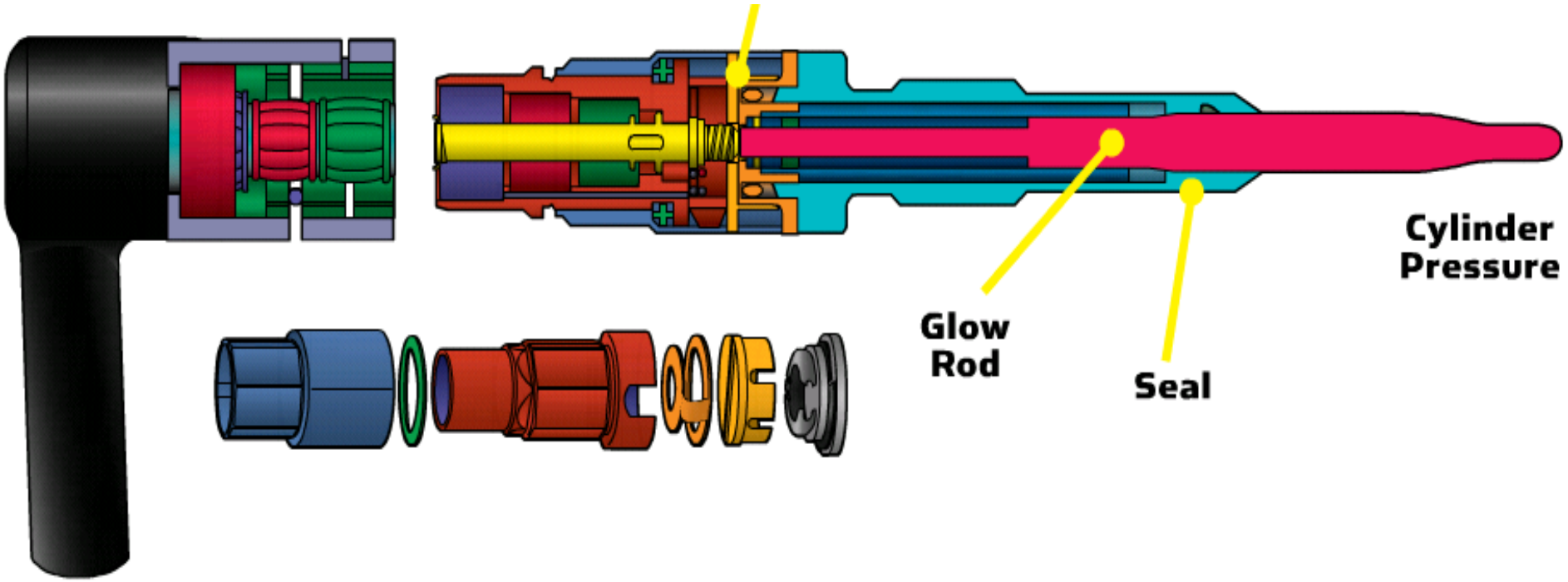



EGR SOLENOID (VEHICLES LESS THAN 8500 GVW)
TO WATER IN FUEL SENSOR
TO EGR VENT SOLENOID (VEHICLES LESS THAN 8500 GVW)
PCM
TO IGNITION SWITCH
GLOW PLUG
20 AMP
TO FUEL HEATER
JUNCTION BLOCK
B+
2 RED
A
B
C
D
E
539 PNK
505 YEL
150 BLK
PC13
GLOW PLUG RELAY CONTROL
ENGINE GROUND
LEFT GLOW PLUGS
GLOW PLUG RELAY
"GLOW PLUG" LAMP
D4
BULKHEAD CONNECTOR
GLOW PLUG
10 AMP
503 ORN
503 ORN
507 DK BLU
PB8
GLOW PLUG SIGNAL
RIGHT GLOW PLUGS
509 ORN/BLK
PCM CONN. ID
PA/PB PINK 24 PIN
PC/PD PINK 32 PIN
BC/BD BLUE 32 PIN

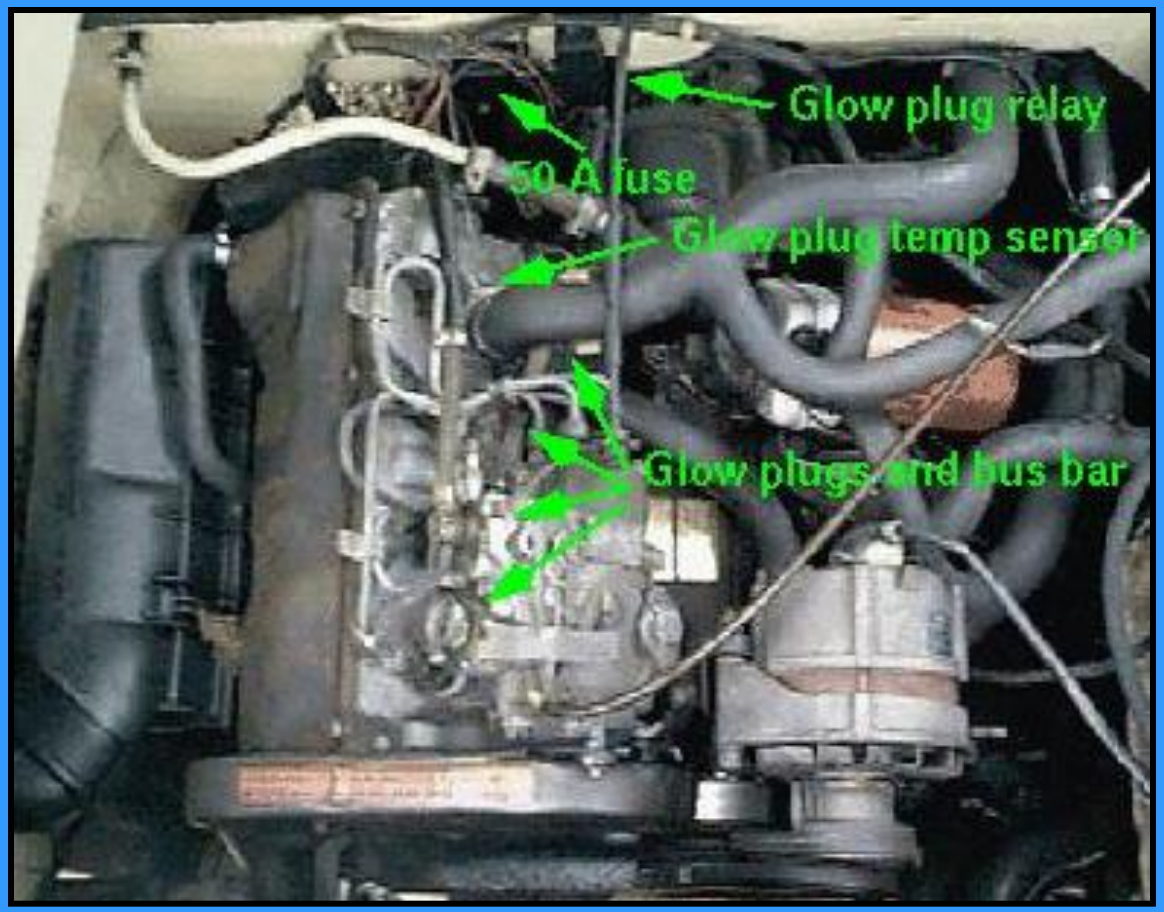

NGK
NGK

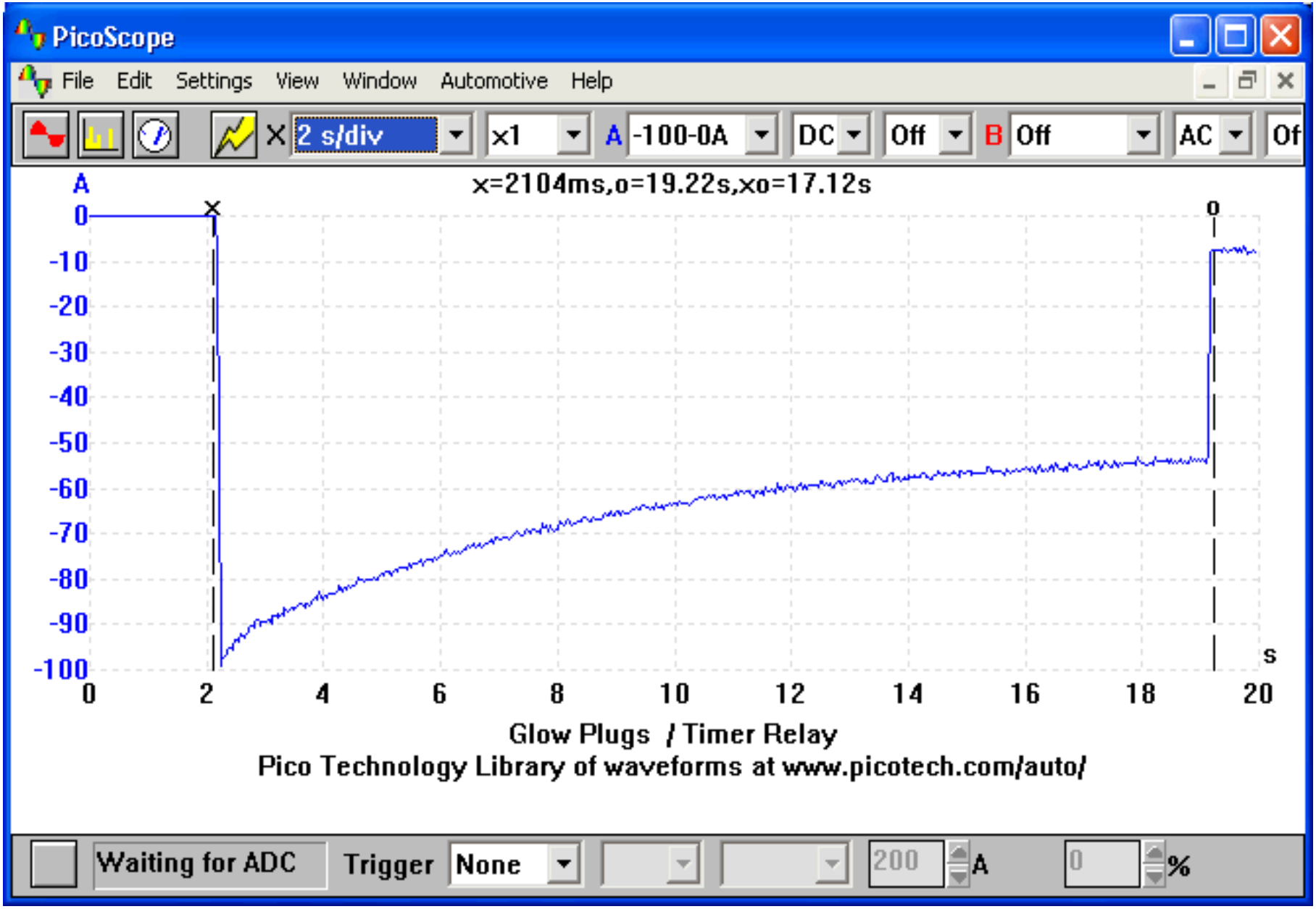

Terminal & Shell
The outer casing and terminal are zinc coated to resist corrosion.
Insulator
The Glow Plug insulating disc has exceptional strength, insulation and thermal conductivity to ensure that a short circuit cannot occur.
Casing
An alloy casing surrounds and protects the Glow Plug to provide heat resistance
Seal
A rubber seal is in place to prevent air from seeping through and corroding the coil.
Insulation
Electrical insulation of the coil is provided by firmly packed magnesium oxide powder, which is also an efficient heat conductor.
Regulating Coil
The main coil acts as a regulator within the Glow Plug to control and sustain temperature rise, and ensure rapid warm-up.
Coil Connection
Laser welding connects the Heating and Regulating coils to maintain their position at all times and ensure consistent resistance characteristics.
Heating Coil
A shorter, tapered coil inside the end of the Glow Plug delivers a quick start (from as little as 3 seconds) even in cold conditions. It can then hold its post-heating temperature for up to six minutes after cold start. This contributes to lower engine emissions.
Tip
The narrowed plug tip ensures improved heating efficiency and excellent performance.

The Beru/Sensata PSG (Pressure Sensing Glow plug) uses a glow plug rod that can move axially in its mounting body. The glow plug is acted on by combustion pressure and pushes on a piezoresistive strain gauge. Electronics built into the PSG condition the signal for use by the ECM.



Smart Glow Plug PDG with Integrated Cylinder pressure


Glow plug relay
50 A fuse
Glow plug temp sensor
Glow plugs and bus bar


PicoScope
File Edit Settings View Window Automotive Help
2 s/div
x1
A -100-0A
DC
Off
B Off
AC
x=2104ms,o=19.22s,xo=17.12s
A
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0 2 4 6 8 10 12 14 16 18 20
s
Glow Plugs / Timer Relay
Pico Technology Library of waveforms at www.picotech.com/auto/
Waiting for ADC
Trigger
None
200
A
0
%

Measuring Cylinder Bore Taper & Out-of-Round

A **mnemonic** (pronounced /nəˈmɒnɪk/) is a memory aid. Mnemonics are often verbal, something such as a very short poem or a special word used to help a person remember something, particularly lists. Mnemonics rely not only on repetition to remember facts, but also on associations between easy-to-remember constructs and lists of data, based on the principle that the human mind much more easily remembers insignificant data attached to spatial, personal, or otherwise meaningful information than that occurring in meaningless sequences.

The major assumption is that there are two sorts of memory: the "natural" memory and the "artificial" memory. The former is inborn, and is the one that everyone uses every day. The artificial memory is one that is trained through learning and practicing a variety of mnemonic techniques. The latter can be used to perform feats of memory that are quite extraordinary, impossible to carry out using the natural memory alone.