Module 19

Entretien général de systèmes d’injection diesel et de freins moteurs.

Les règles de bases dans l'atelier:

- Aucuns moteurs laissés sans couver de valves ni plastique.
- Toujours débrancher les batteries avant d'ajuster les jacobs.
- Penser à fermer le contact si on ne travaille pas sur le moteur.
- Ne pas laisser les batteries sur la charge toute la nuit.
- Fermer la porte de garage et les ordinateurs le soir en finissant.
- Ne jamais laisser un outil pour tourner le moteur installer sur le moteur…
- Ne pas laisser d'outils sur le dessus du moteur.
- Toujours boucher les orifices d'intake et de fuel lors des travaux.

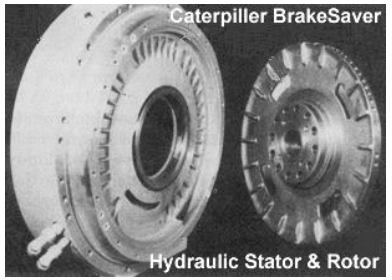
Freins Moteurs:

Freins moteurs:

- À compression interne:

- À compression externe:

- Hydraulique:

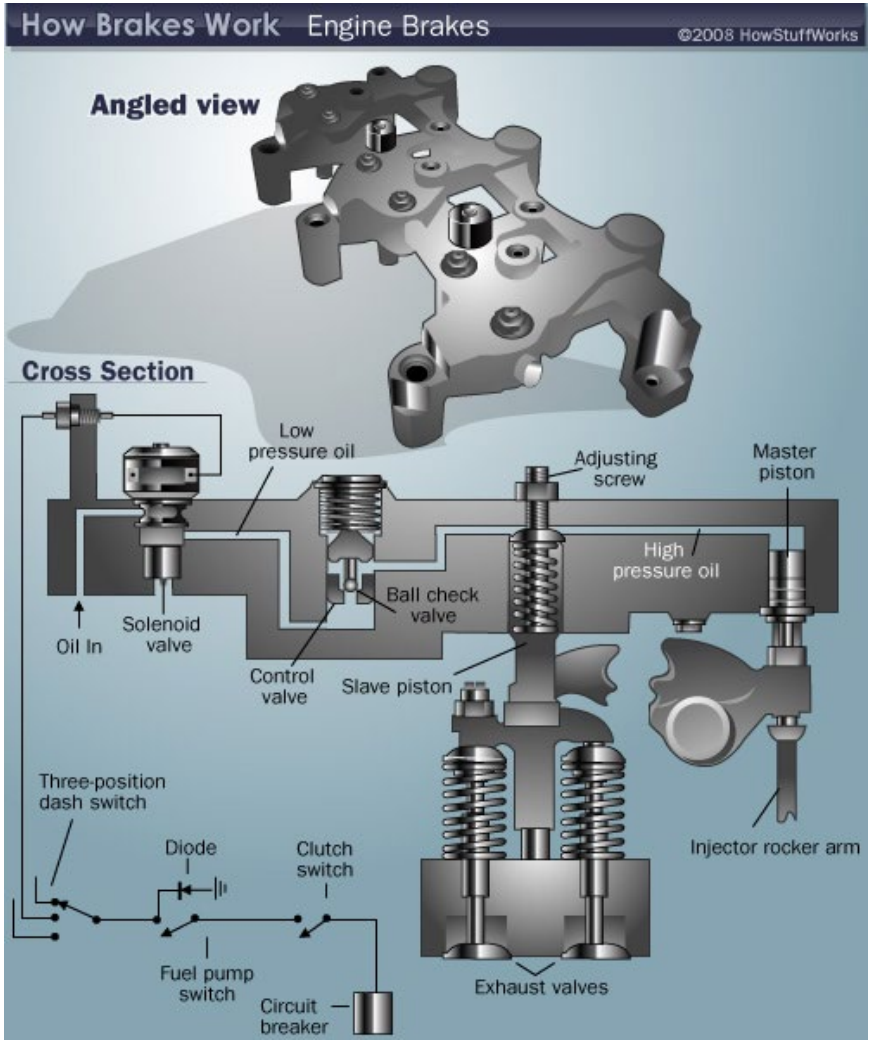


- Magnétique:

Frein à compression interne: (Jake brake, Jacob,retarder):

- Inverse la fonction du moteur le transformant en compresseur absorbant l'énergie.

- Plus le régime moteur est élevé, plus c'est efficace.



Juste pour le son!!!!

Jacobs Vehicle Systems™

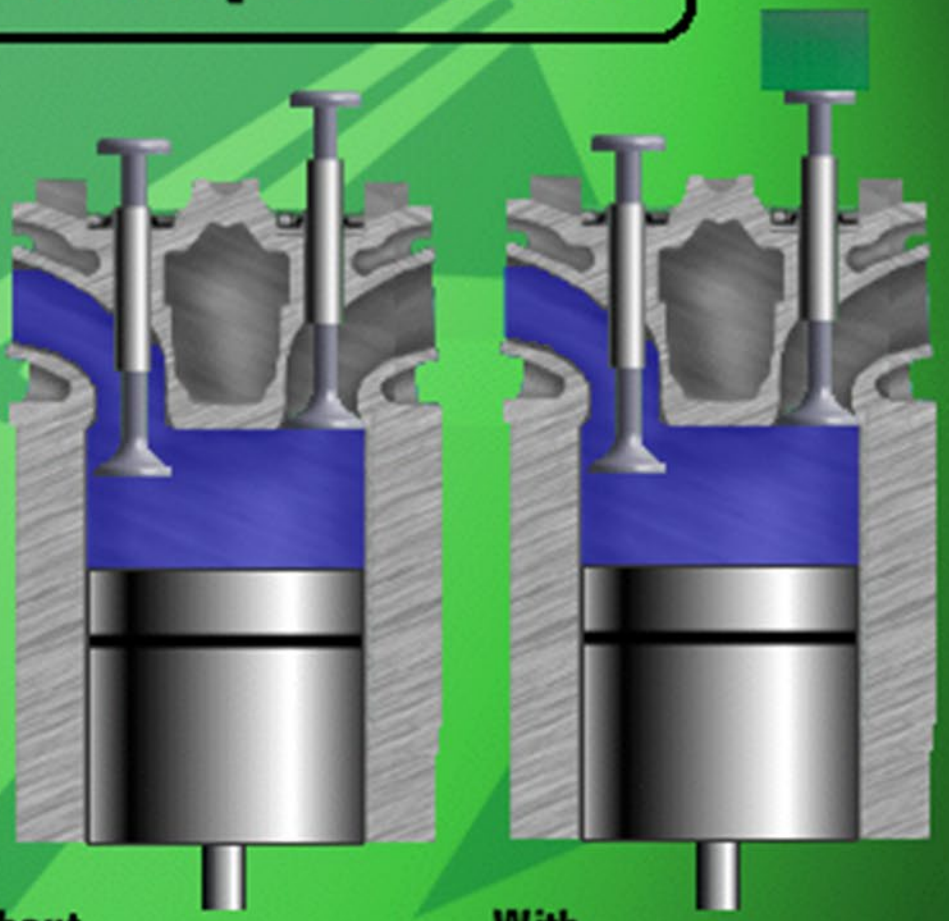
Jacobs Driveline Brake

Jacobs Engine Brake™

For 10-14 Liter Engines

Side By Side Comparison

- No Fuel to Engine
- Truck Decelerating



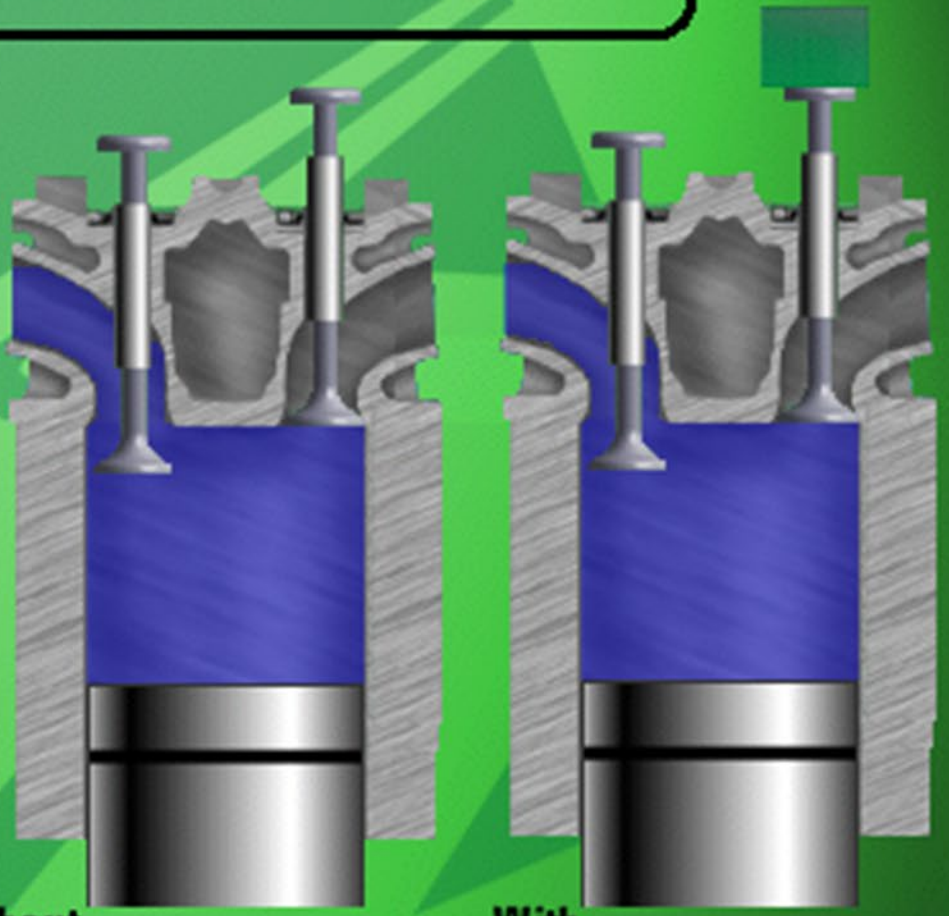
Without JakeBrake®

With JakeBrake®

With & Without Brake

Intake Stroke

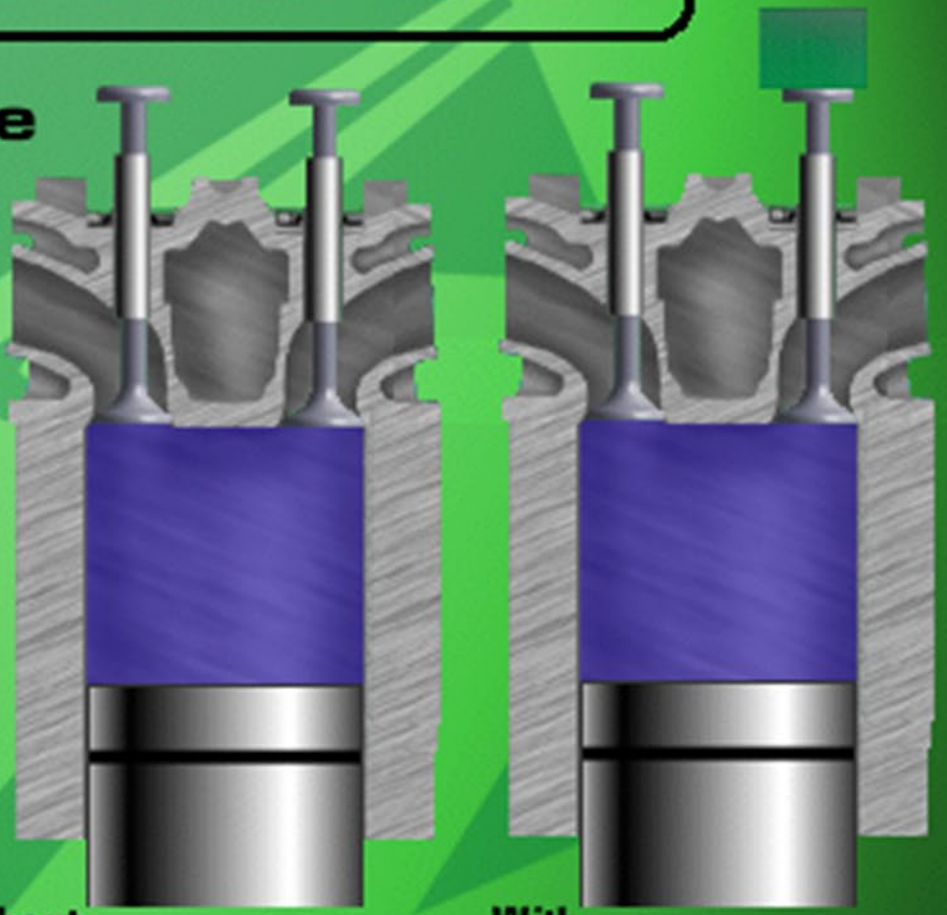
- Piston Pulled Down
- Air Flows In



With & Without Brake

Compression Stroke

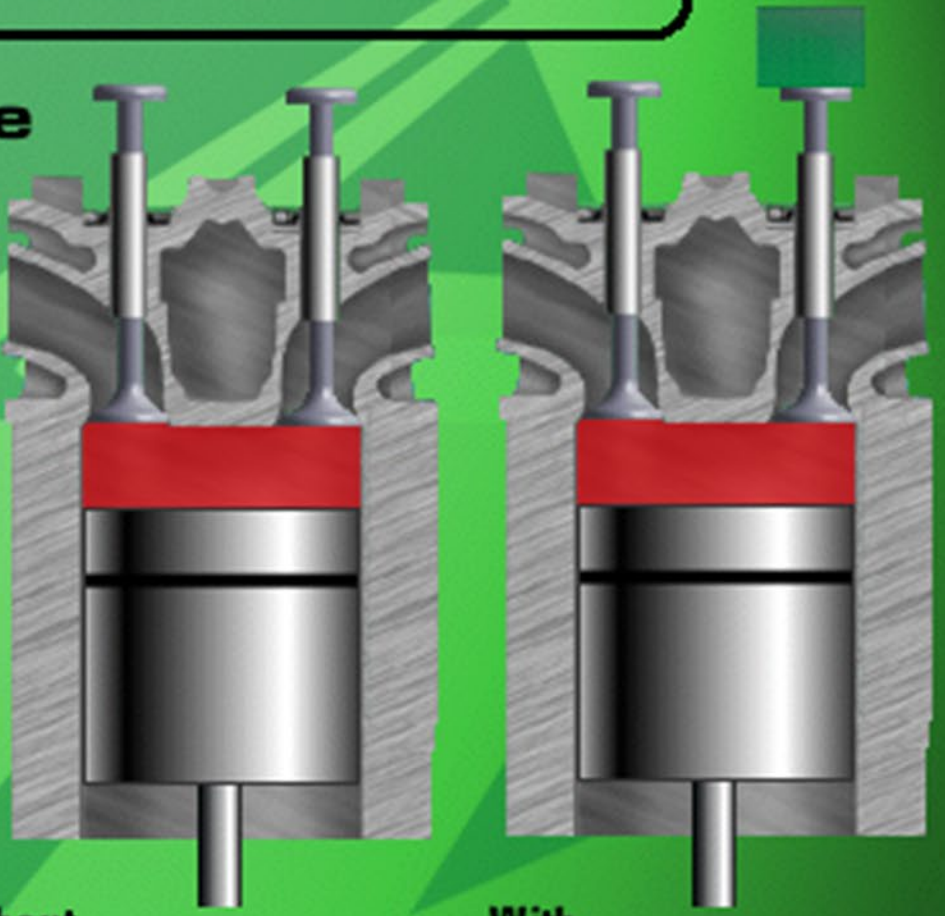
- Intake Valve Closes



With & Without Brake

Compression Stroke

- Air 500+ PSI
- Requires Power



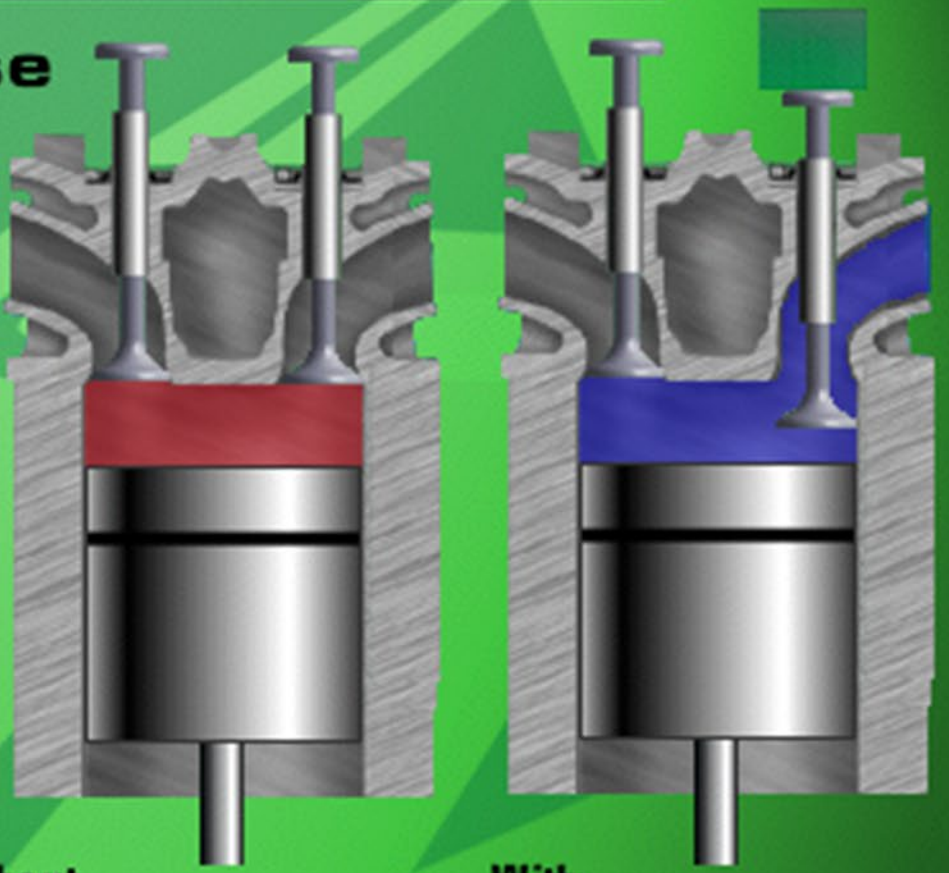
Without JakeBrake®

With JakeBrake®

With & Without Brake

Compression Release

- Unique to Engine Brake Equipped Engines
- Slave Piston Opens Exhaust Valve
- Pressure In Cylinder Drops



Without JakeBrake®

With JakeBrake®

With & Without Brake

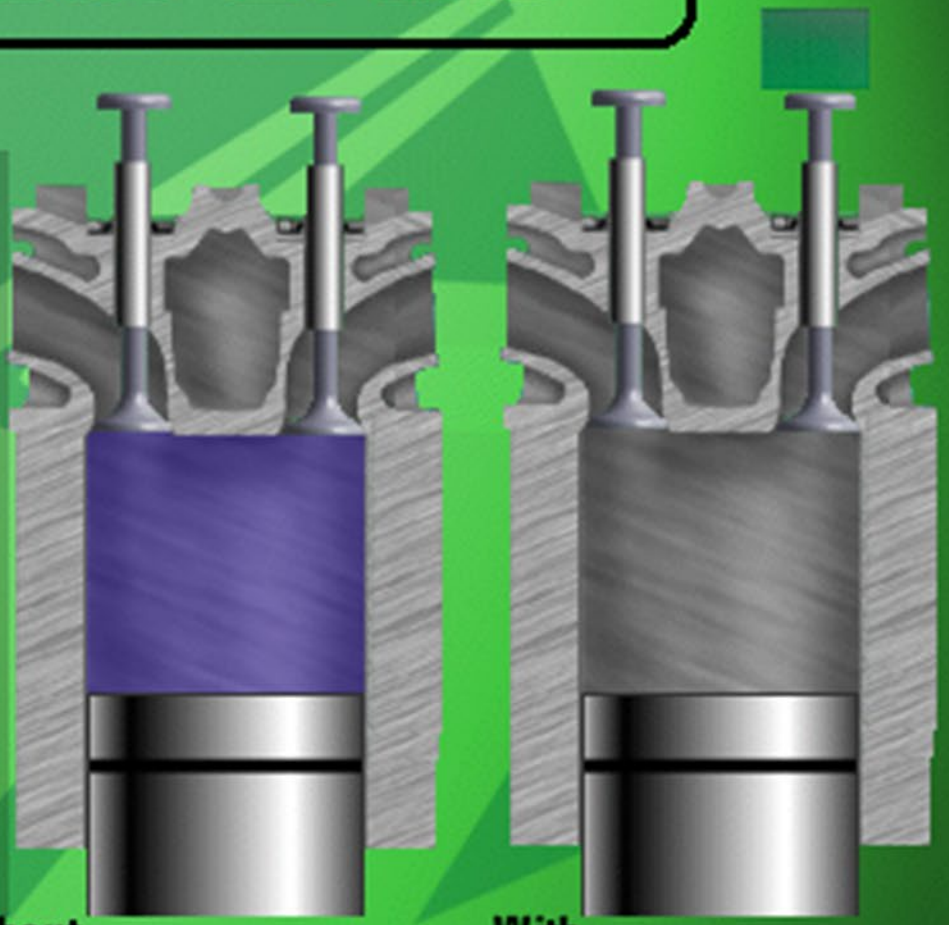
Expansion Stroke

With Engine Brake:

- Low Pressure In Cylinder
- Nothing To Push Piston
- Engine Pulls Piston Down
- No Power Returned to Engine

Without Engine Brake:

- Compressed Air Acts Like Big Spring
- Pushes Down On Piston
- Some Power Produced



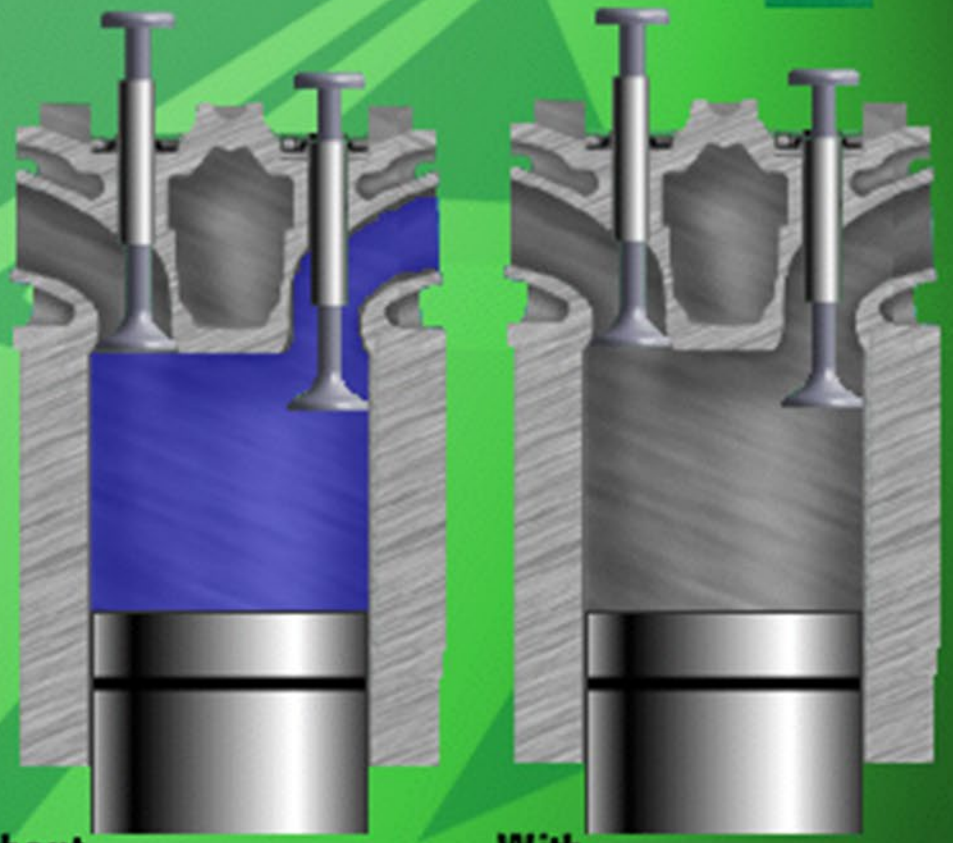
Without JakeBrake®

With JakeBrake®

With & Without Brake

Exhaust Stroke

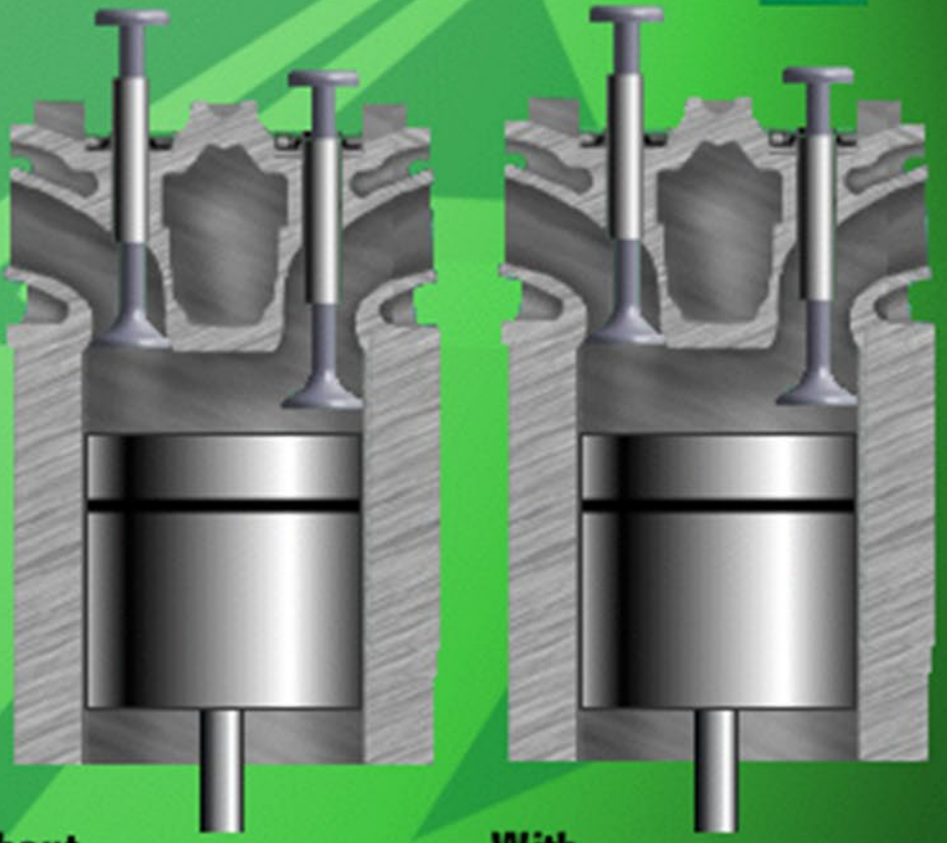
- Exhaust Valve Opens



With & Without Brake

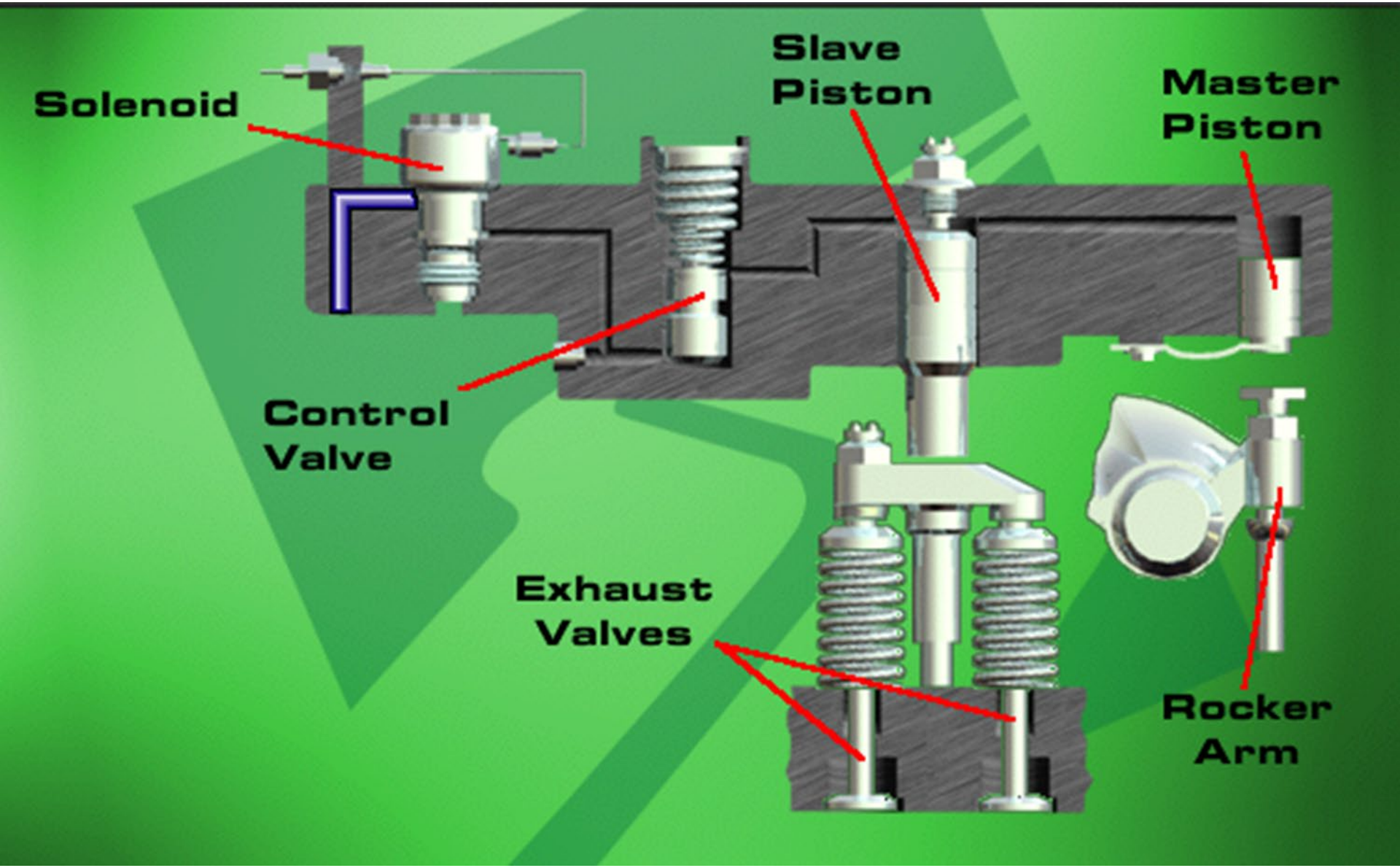
Exhaust Stroke

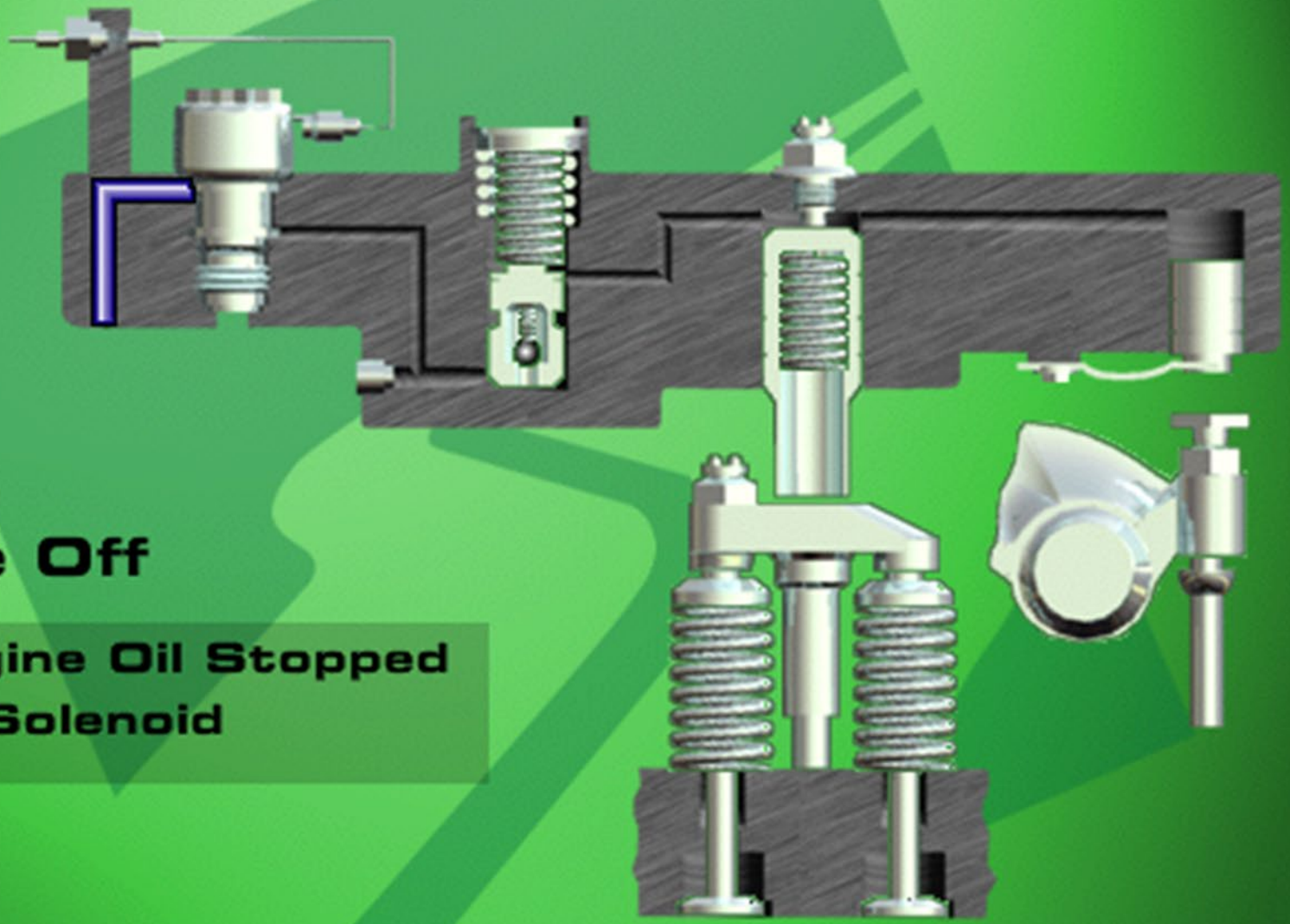
- Piston Pushed Up
- Air Forced Out



Without JakeBrake®

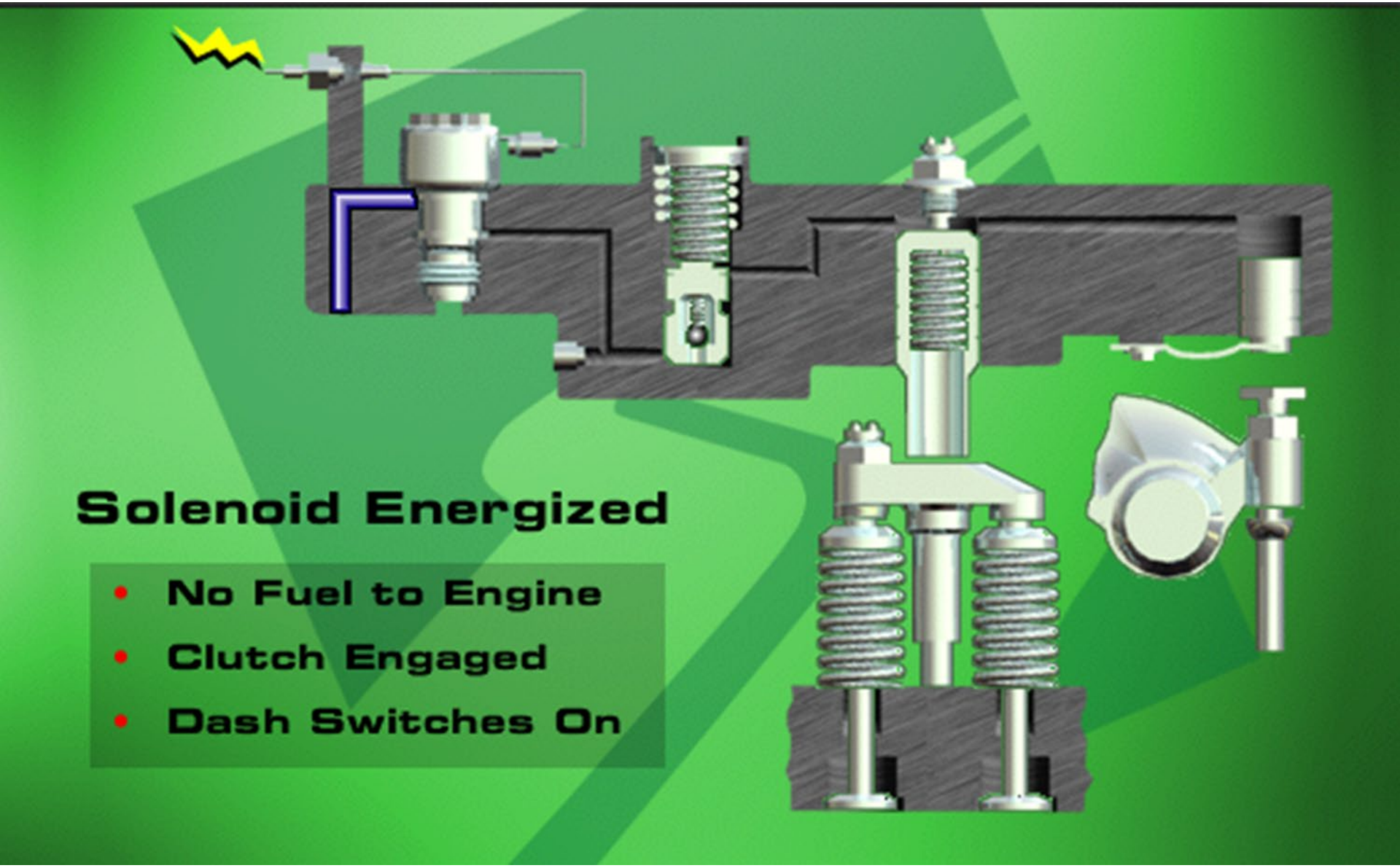
With JakeBrake®

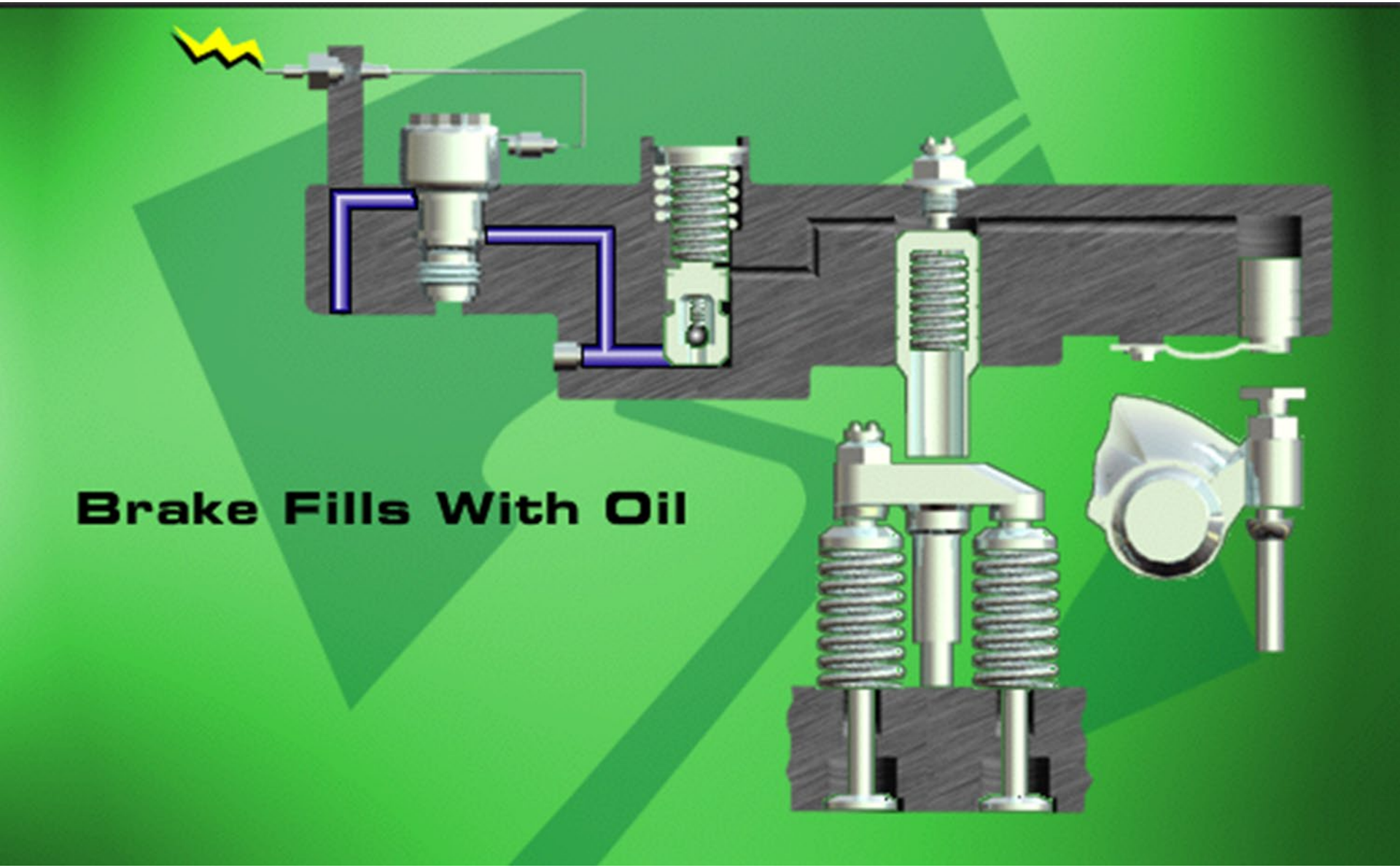

Solenoid
Slave Piston
Master Piston
Control Valve
Exhaust Valves
Rocker Arm

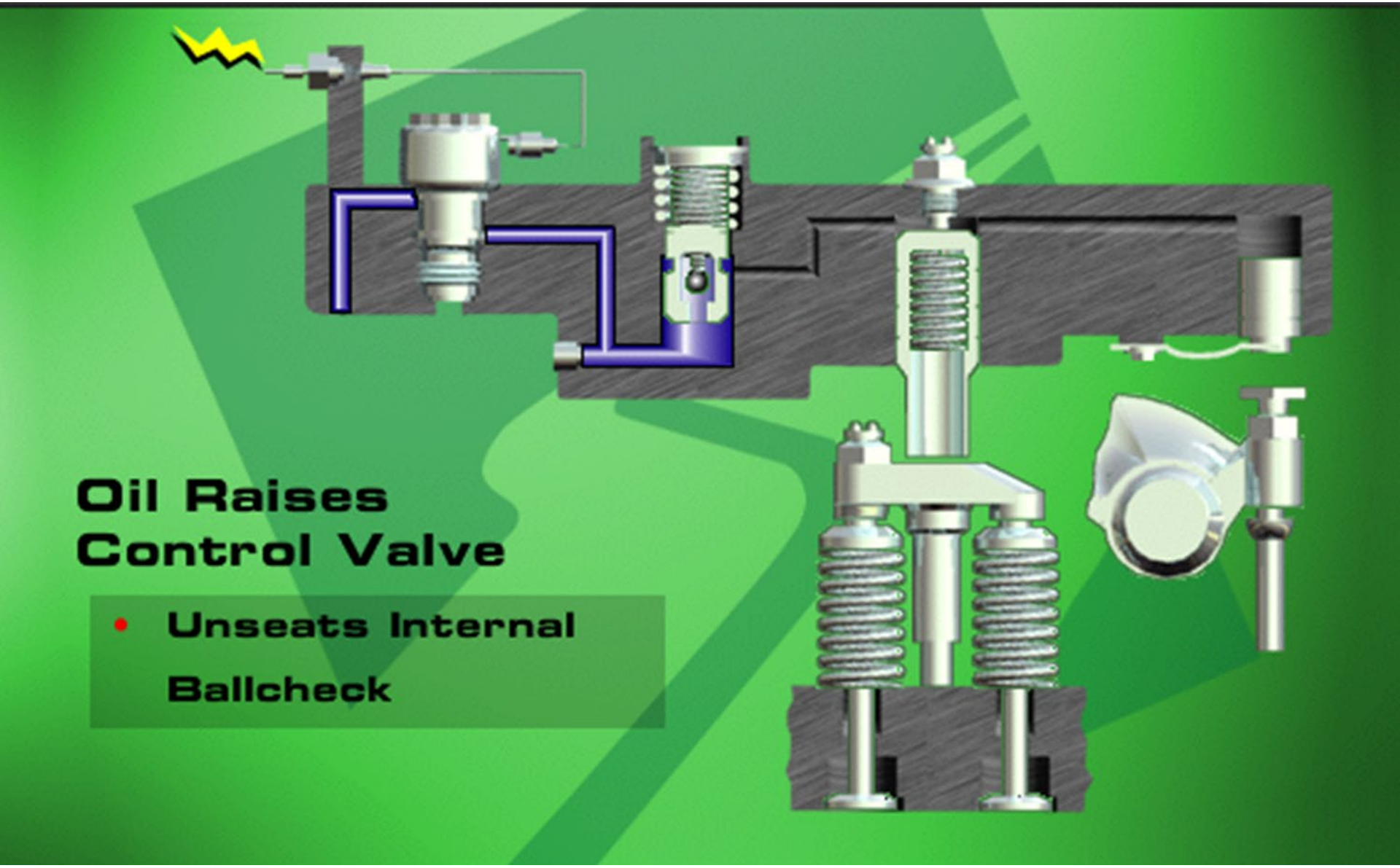


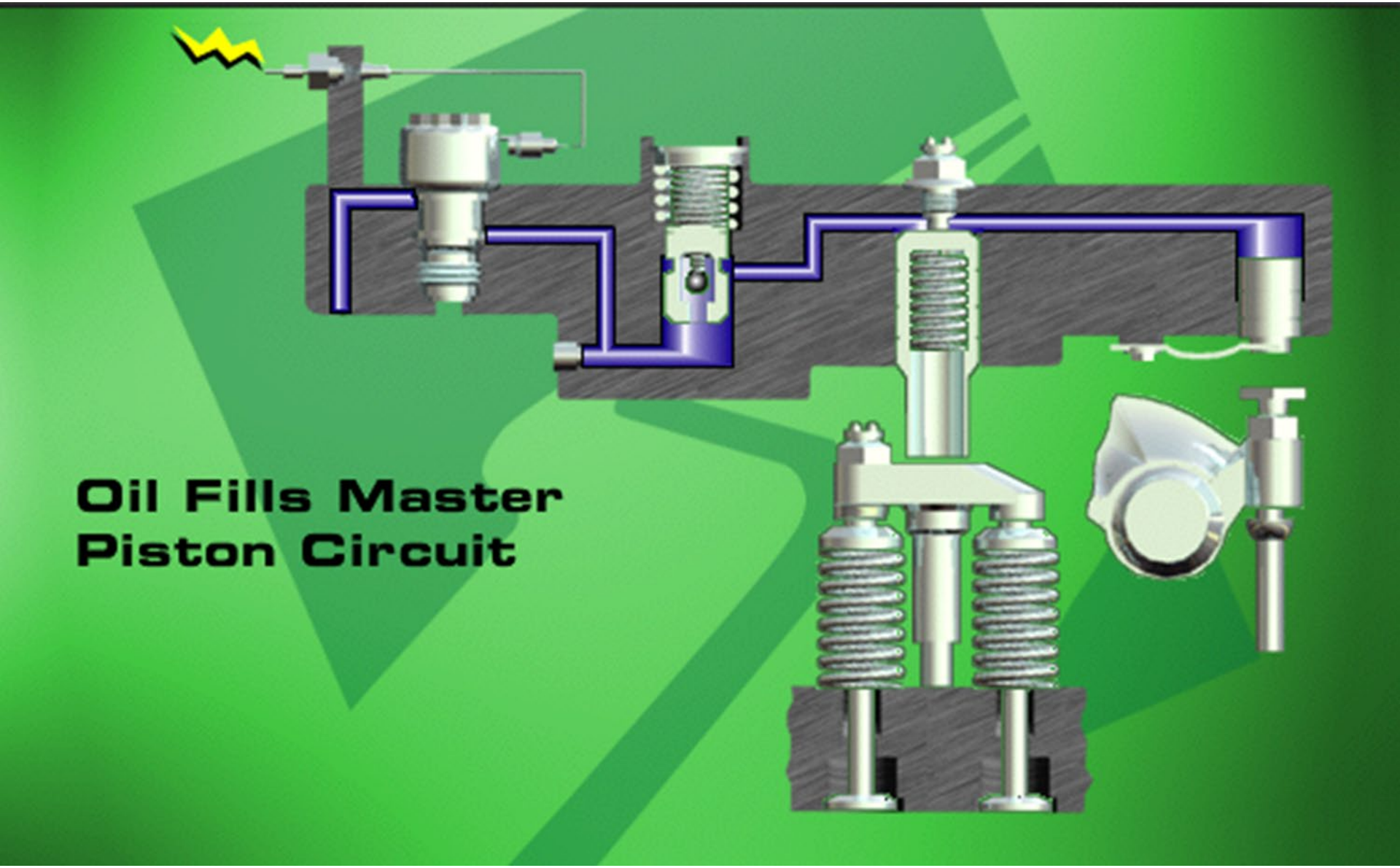
Brake Off

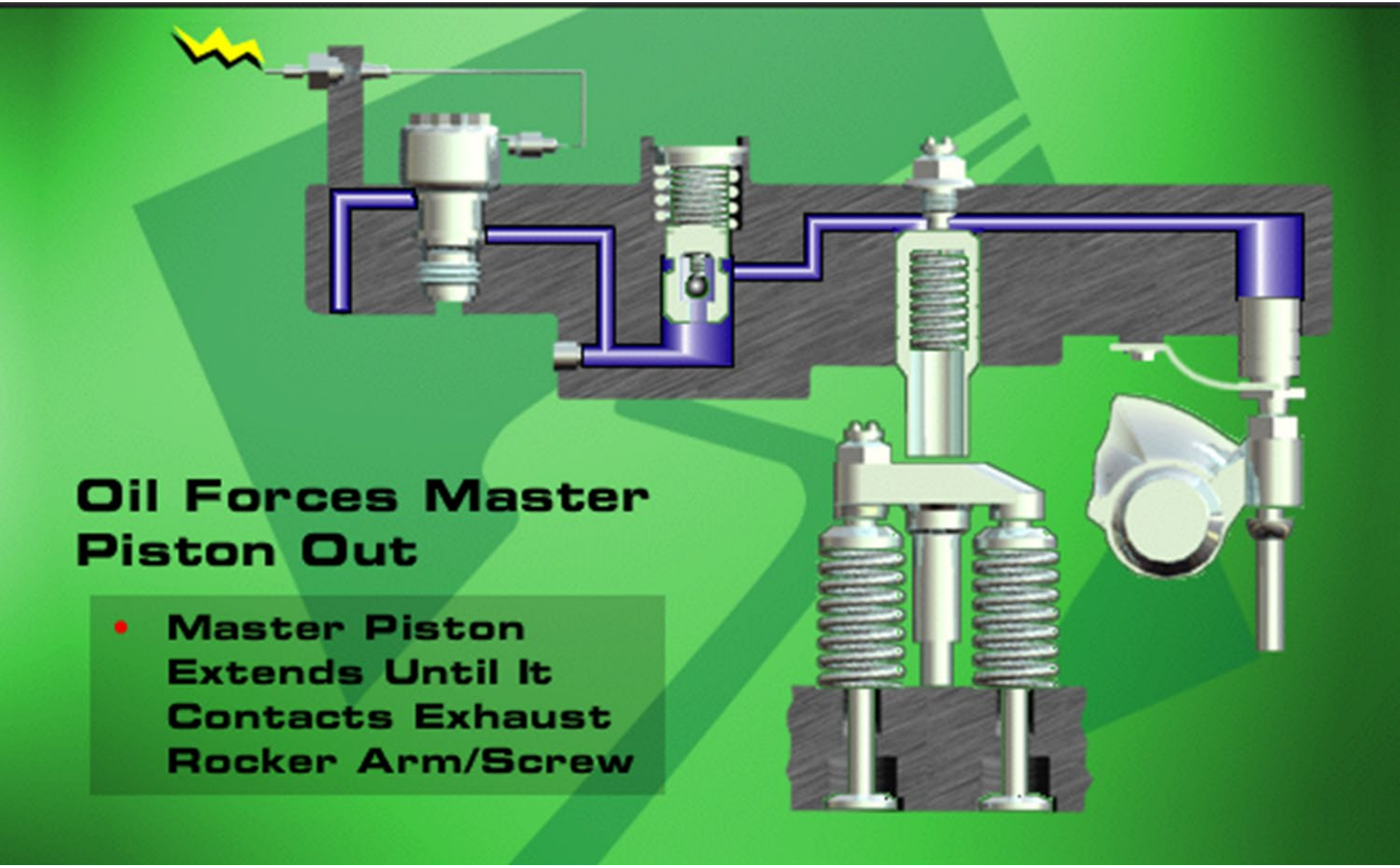
- Engine Oil Stopped at Solenoid


Solenoid Energized
• No Fuel to Engine
• Clutch Engaged
• Dash Switches On


Brake Fills With Oil

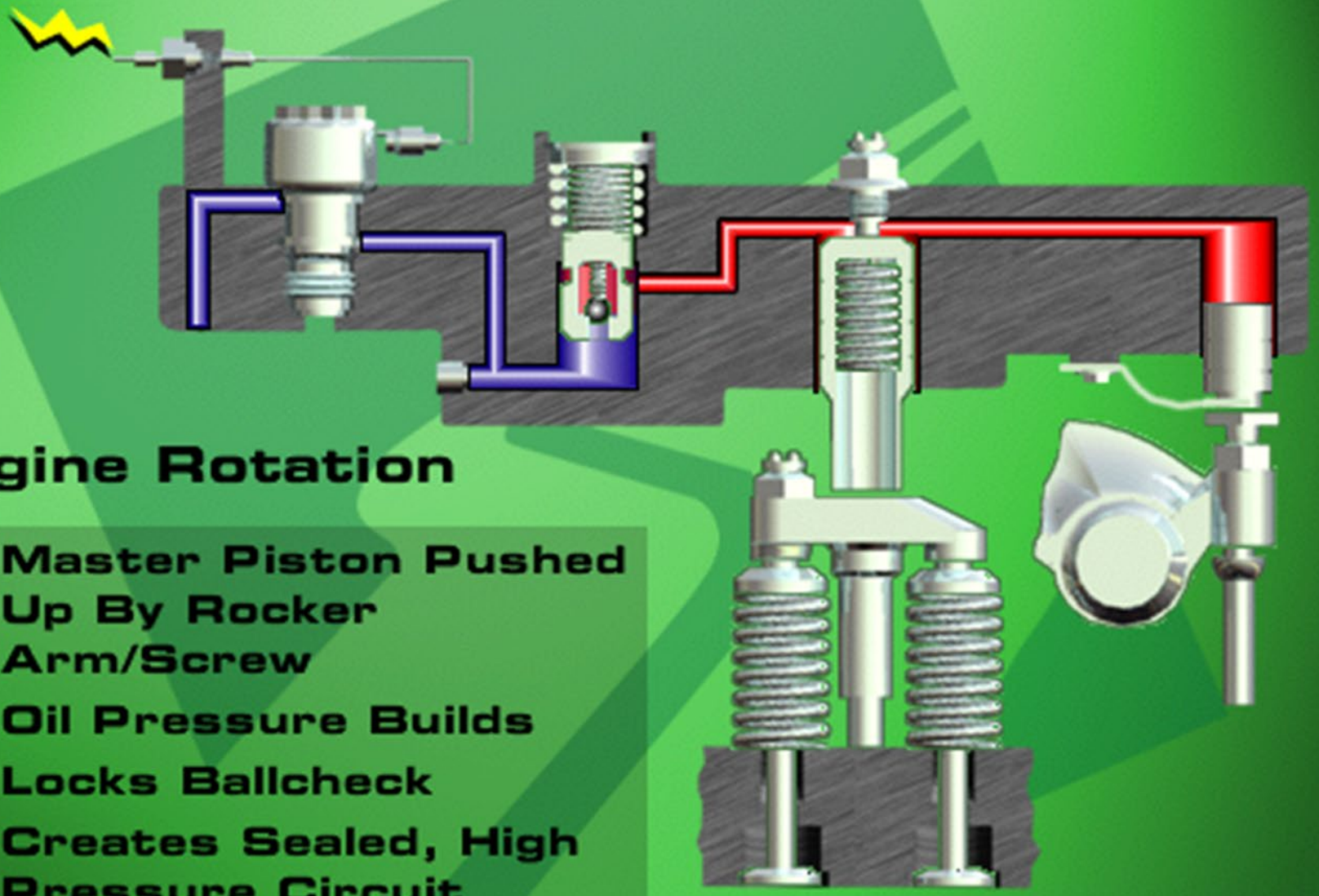

Oil Raises
Control Valve
• Unseats Internal
Ballcheck


Oil Fills Master
Piston Circuit



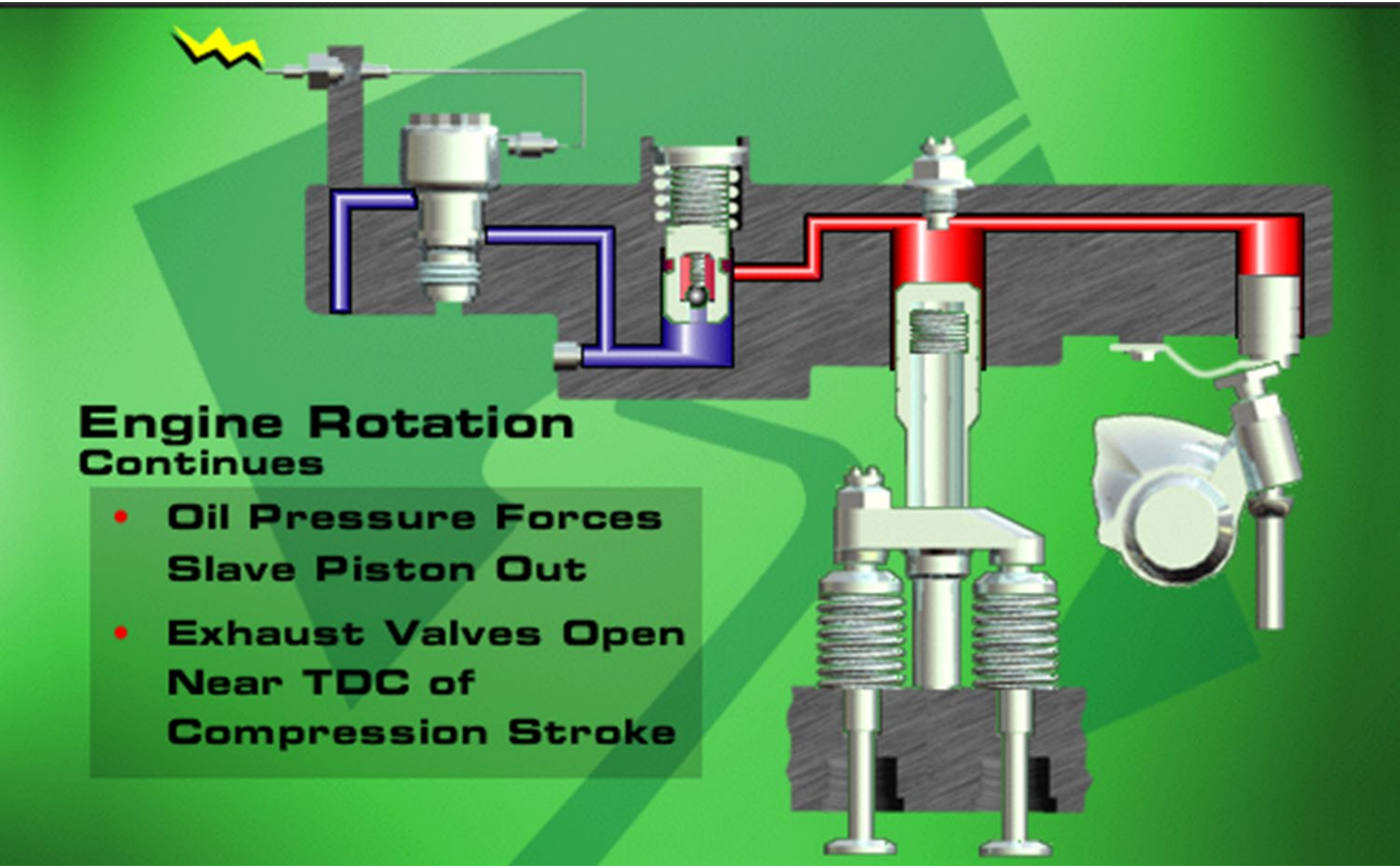
Oil Forces Master Piston Out

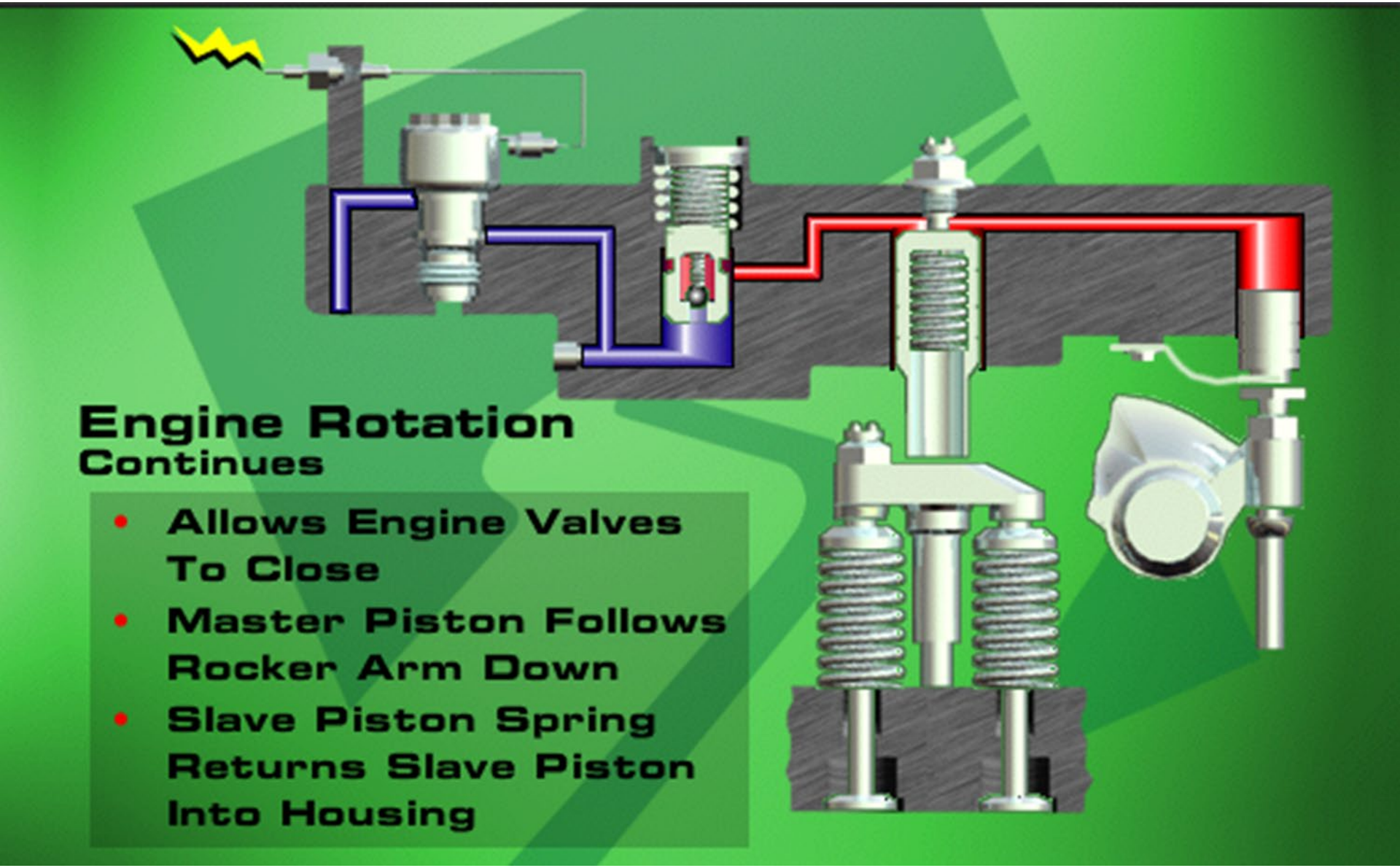
- Master Piston Extends Until It Contacts Exhaust Rocker Arm/Screw



Engine Rotation

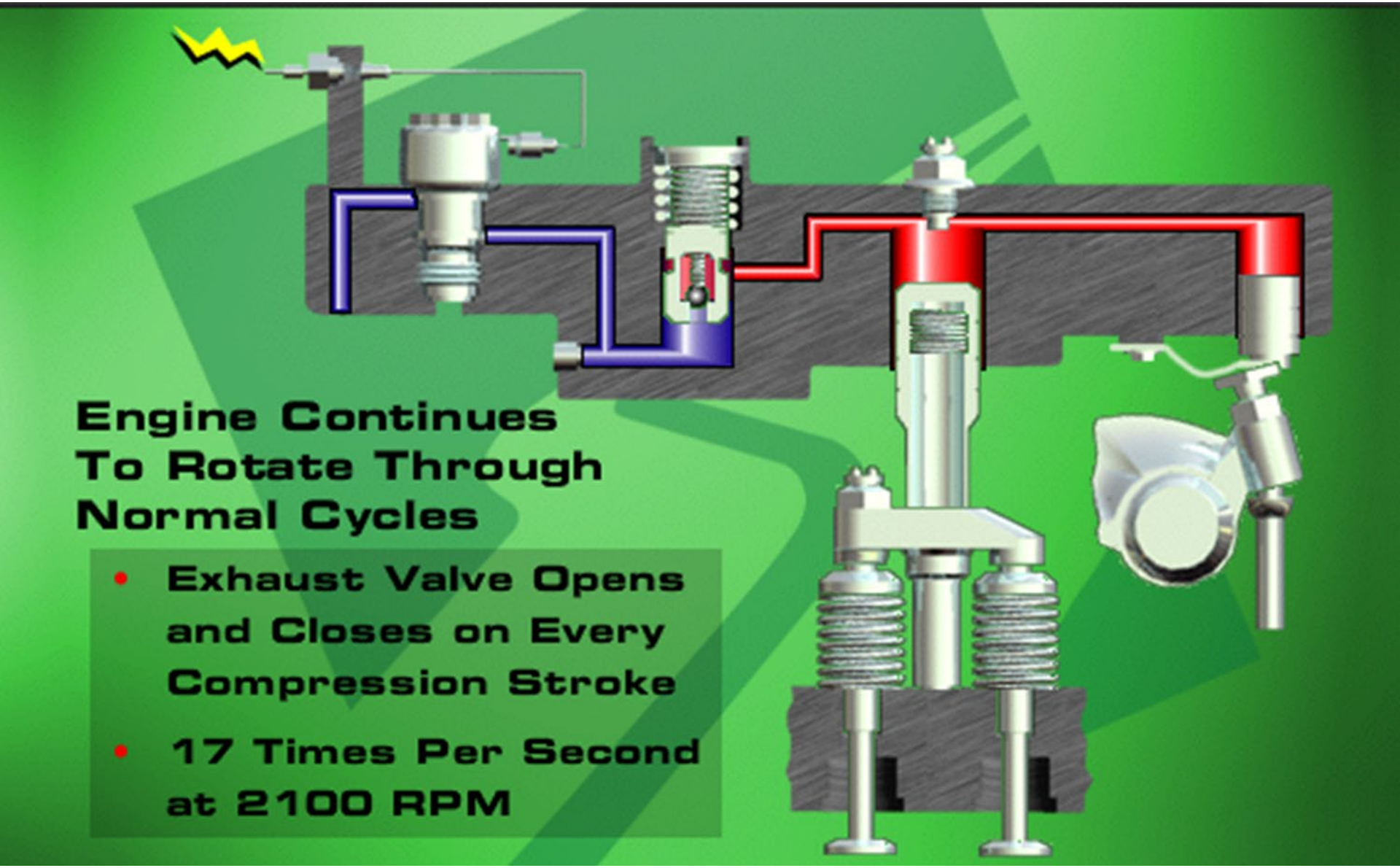
- Master Piston Pushed Up By Rocker Arm/Screw
- Oil Pressure Builds
- Locks Ballcheck
- Creates Sealed, High Pressure Circuit

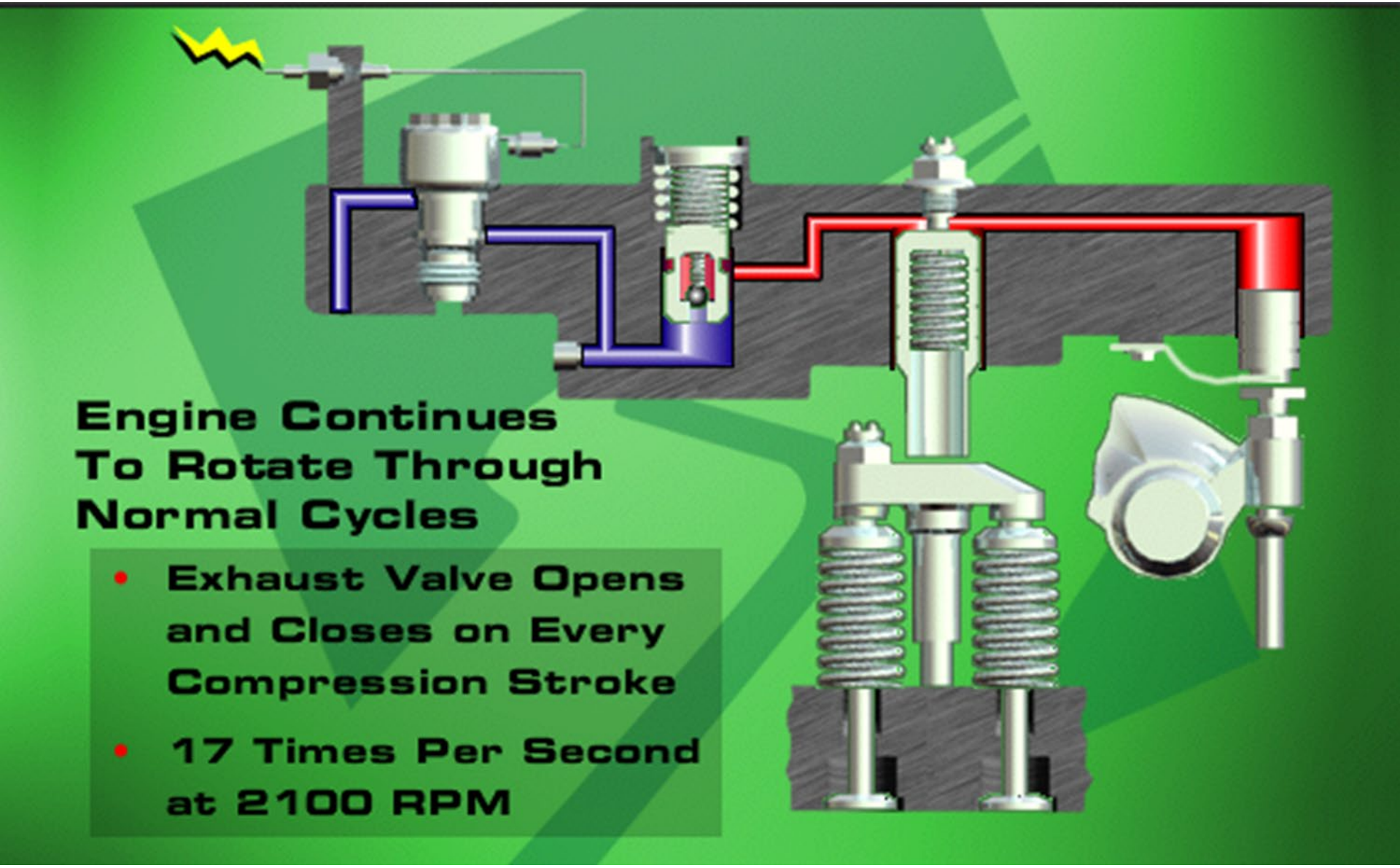

Engine Rotation
Continues
• Oil Pressure Forces Slave Piston Out
• Exhaust Valves Open Near TDC of Compression Stroke

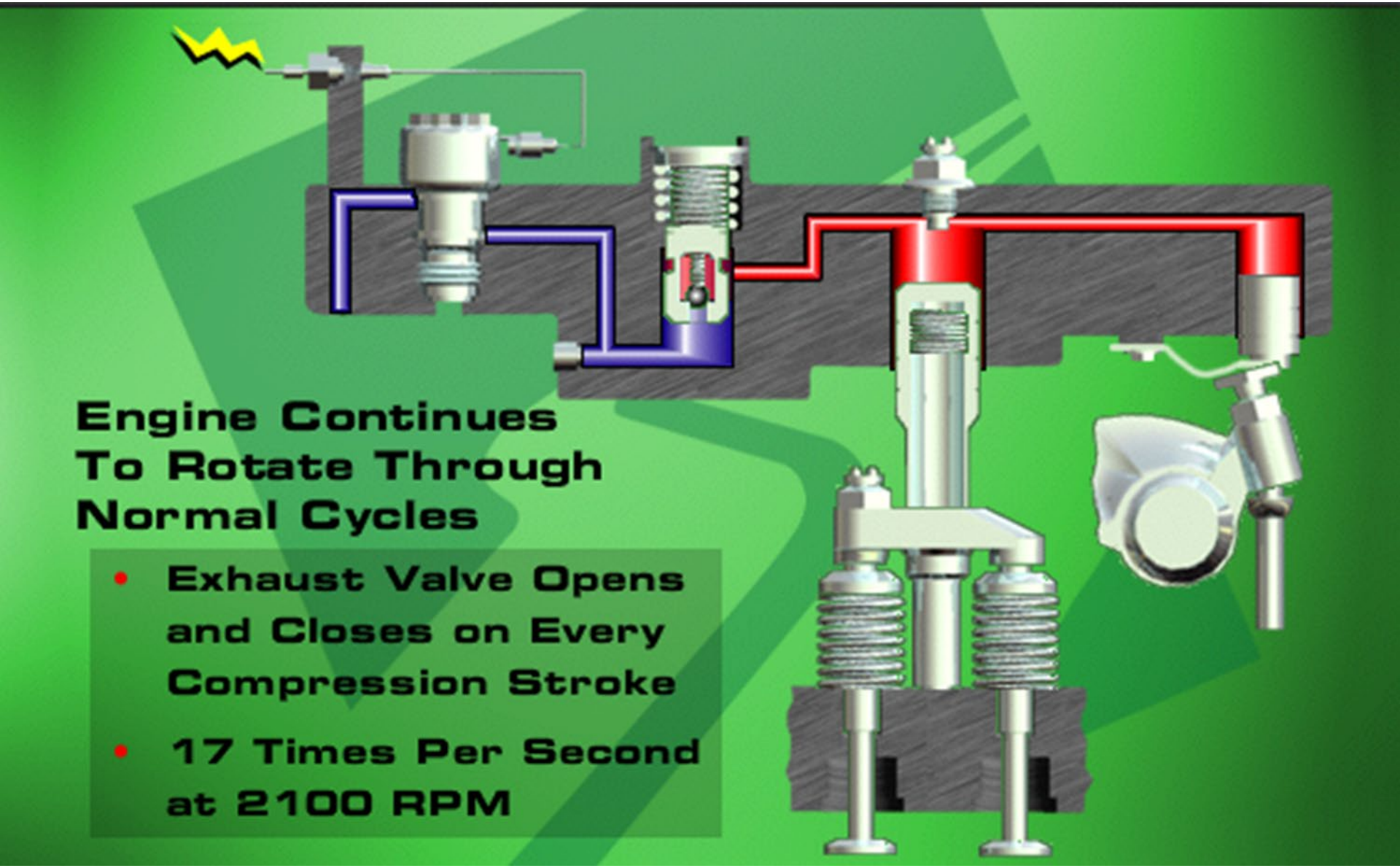


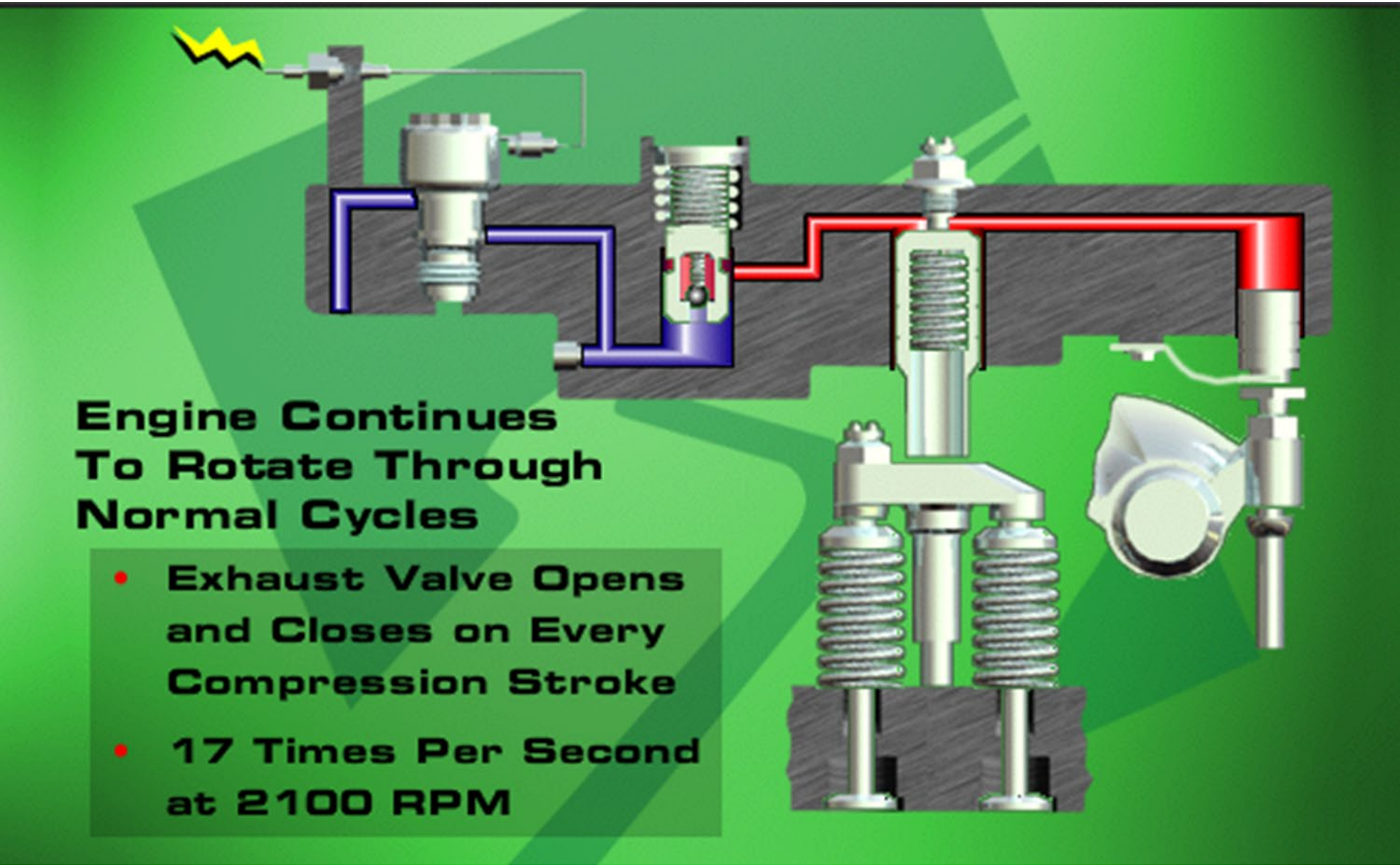
Engine Rotation Continues

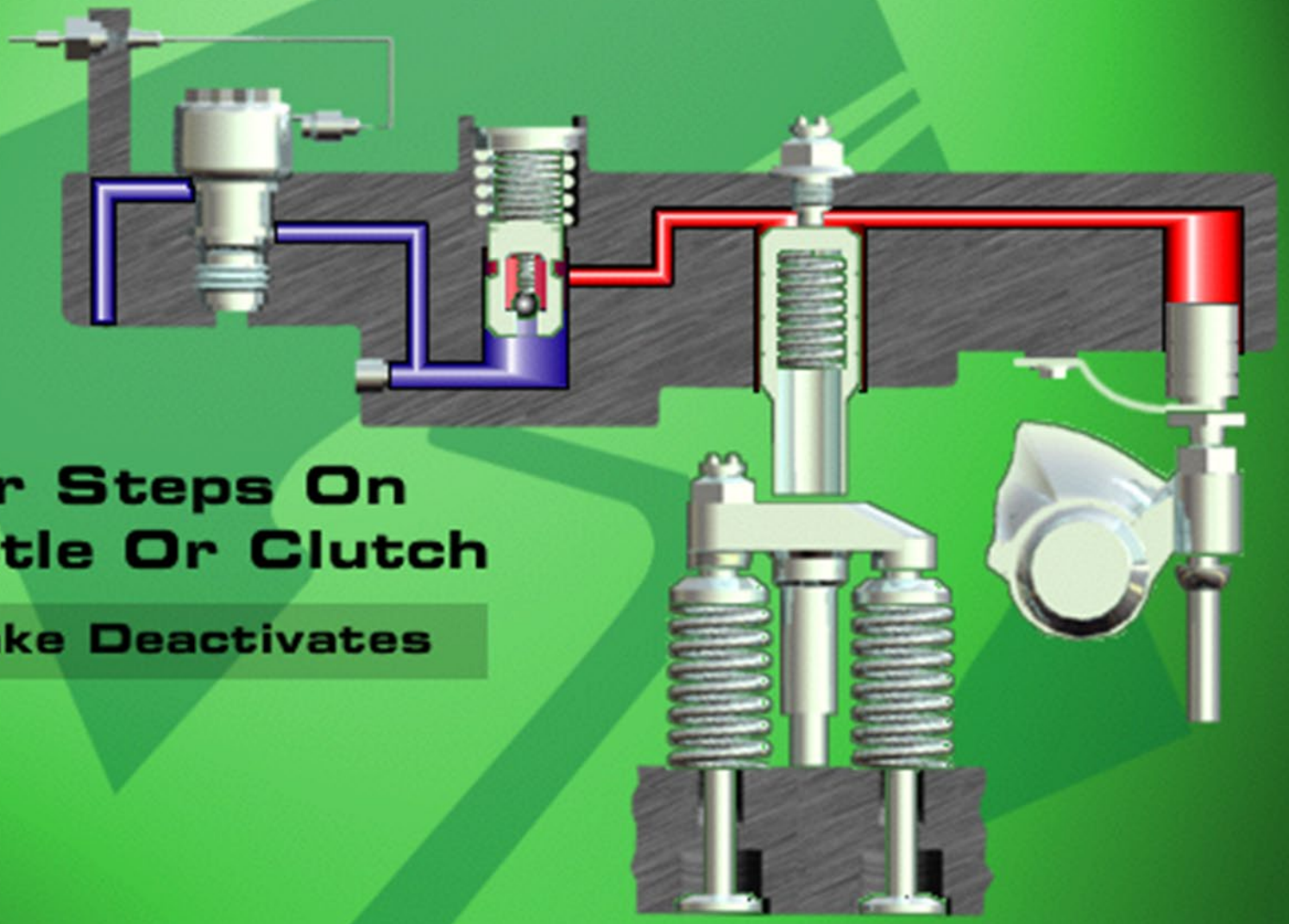
- Allows Engine Valves To Close
- Master Piston Follows Rocker Arm Down
- Slave Piston Spring Returns Slave Piston Into Housing


Engine Continues
To Rotate Through
Normal Cycles
• Exhaust Valve Opens and Closes on Every Compression Stroke
• 17 Times Per Second at 2100 RPM


Engine Continues
To Rotate Through
Normal Cycles
• Exhaust Valve Opens and Closes on Every Compression Stroke
• 17 Times Per Second at 2100 RPM

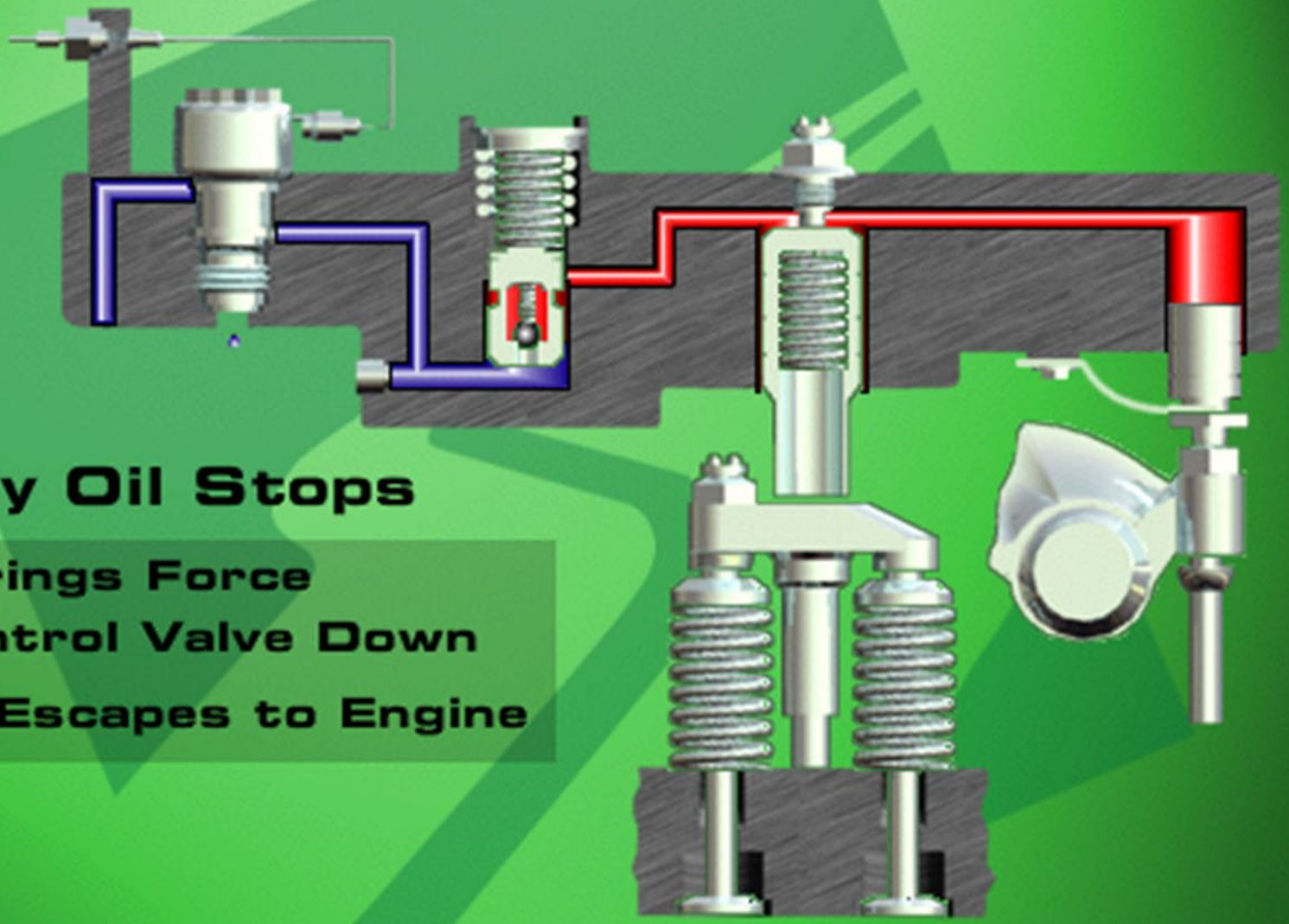

Engine Continues
To Rotate Through
Normal Cycles
• Exhaust Valve Opens and Closes on Every Compression Stroke
• 17 Times Per Second at 2100 RPM


Engine Continues
To Rotate Through
Normal Cycles
• Exhaust Valve Opens and Closes on Every Compression Stroke
• 17 Times Per Second at 2100 RPM



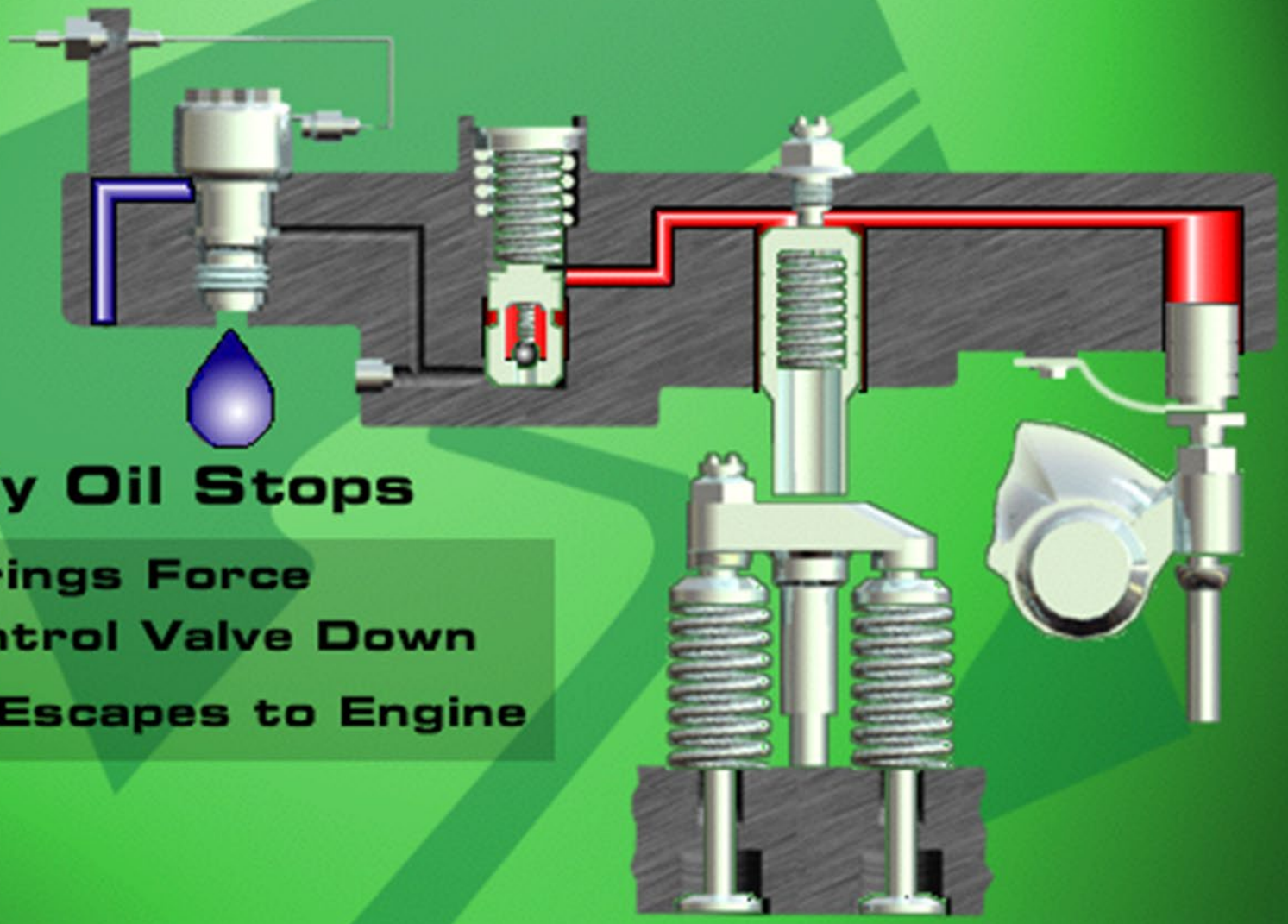
Driver Steps On Throttle Or Clutch

- Brake Deactivates



Supply Oil Stops

- Springs Force Control Valve Down
- Oil Escapes to Engine

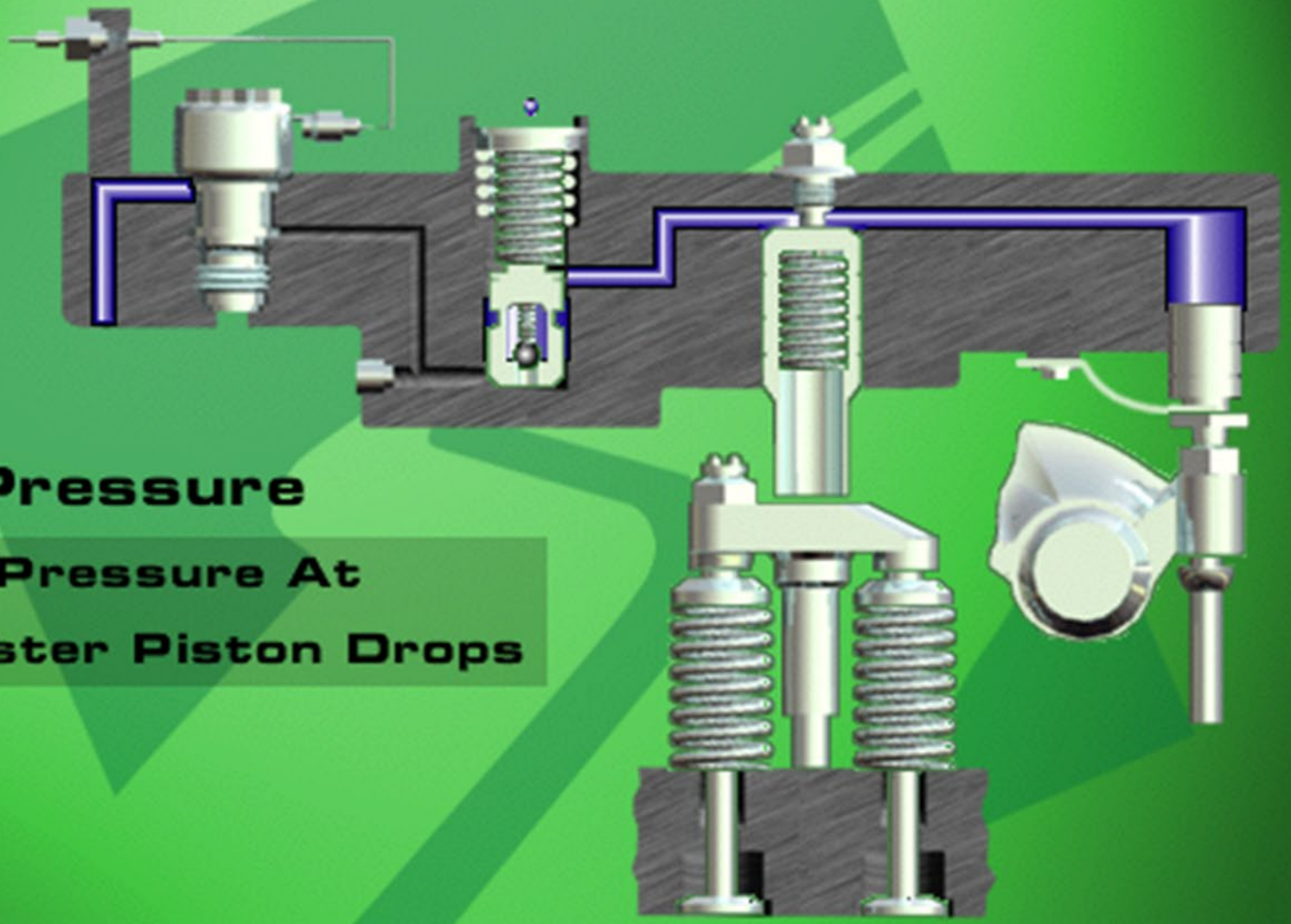


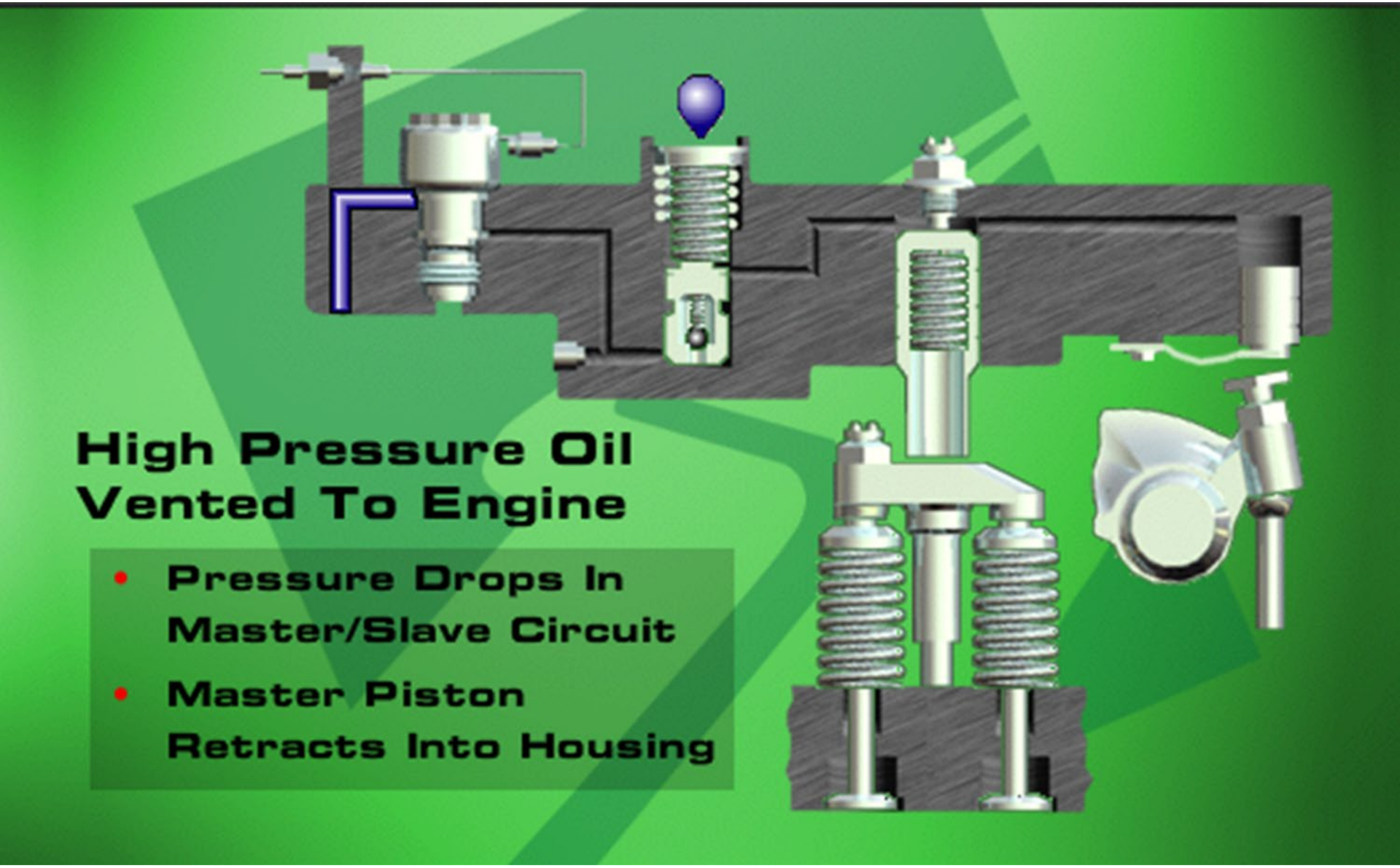
Supply Oil Stops

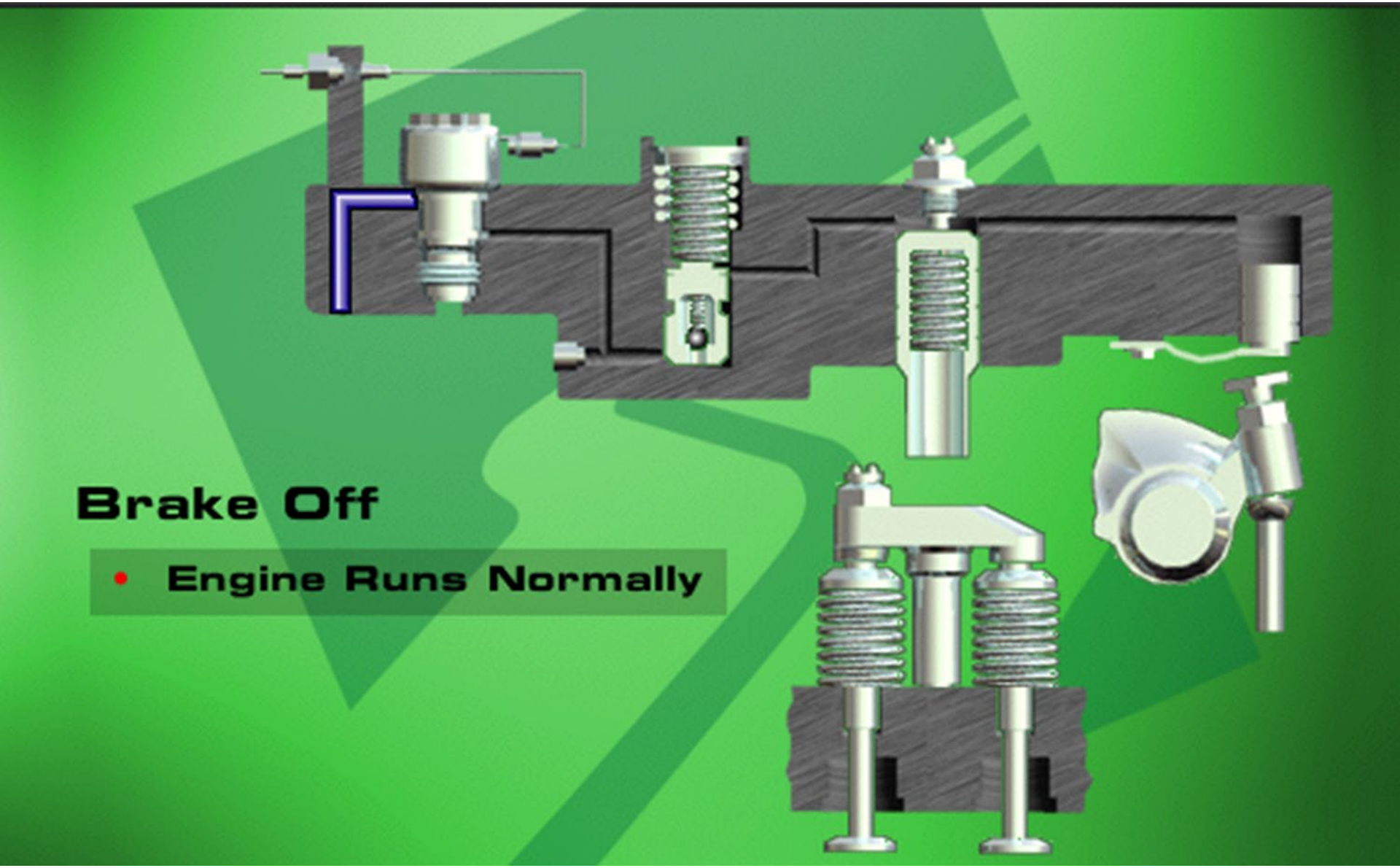
- Springs Force Control Valve Down
- Oil Escapes to Engine

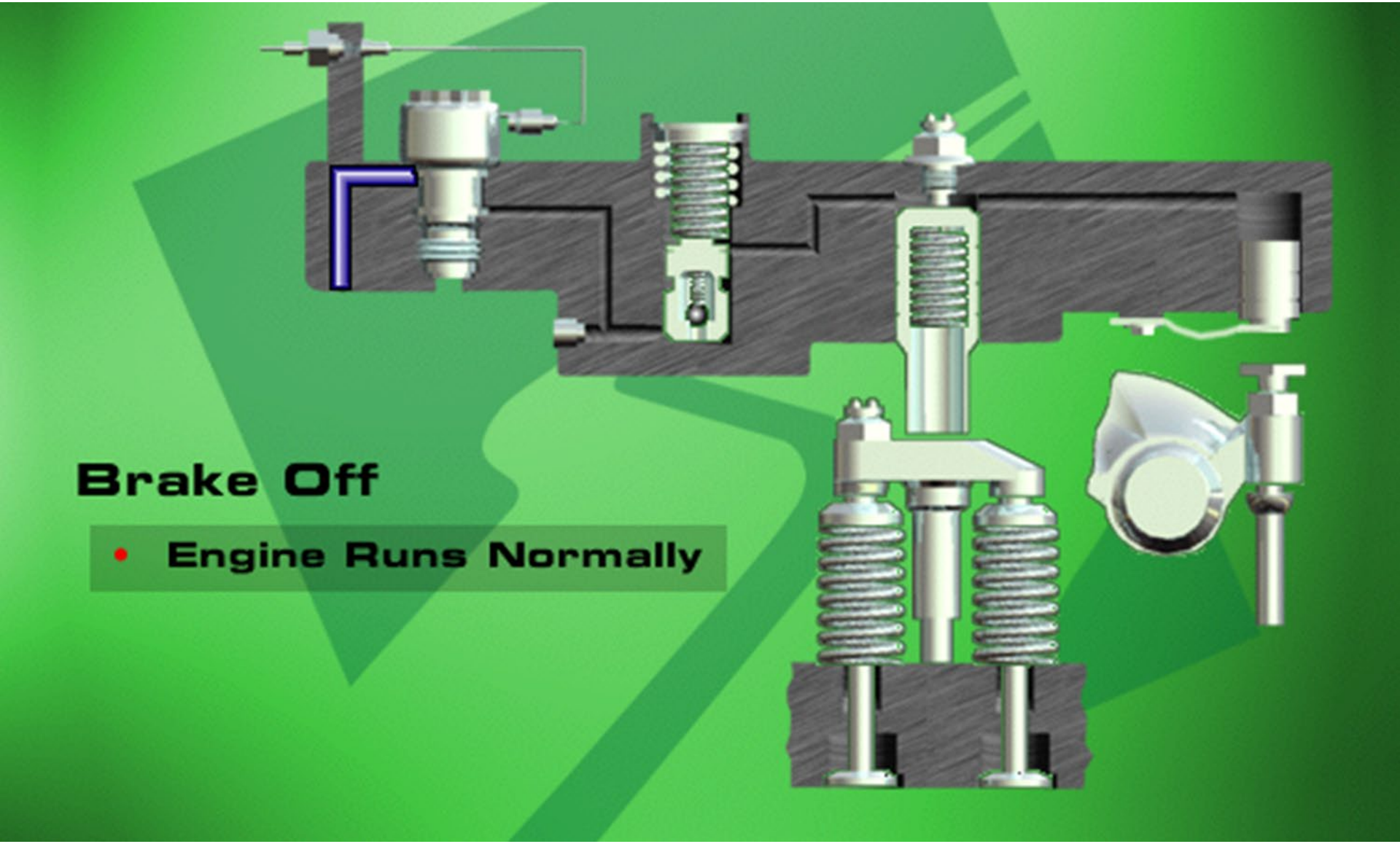
Low Pressure

- Oil Pressure At Master Piston Drops

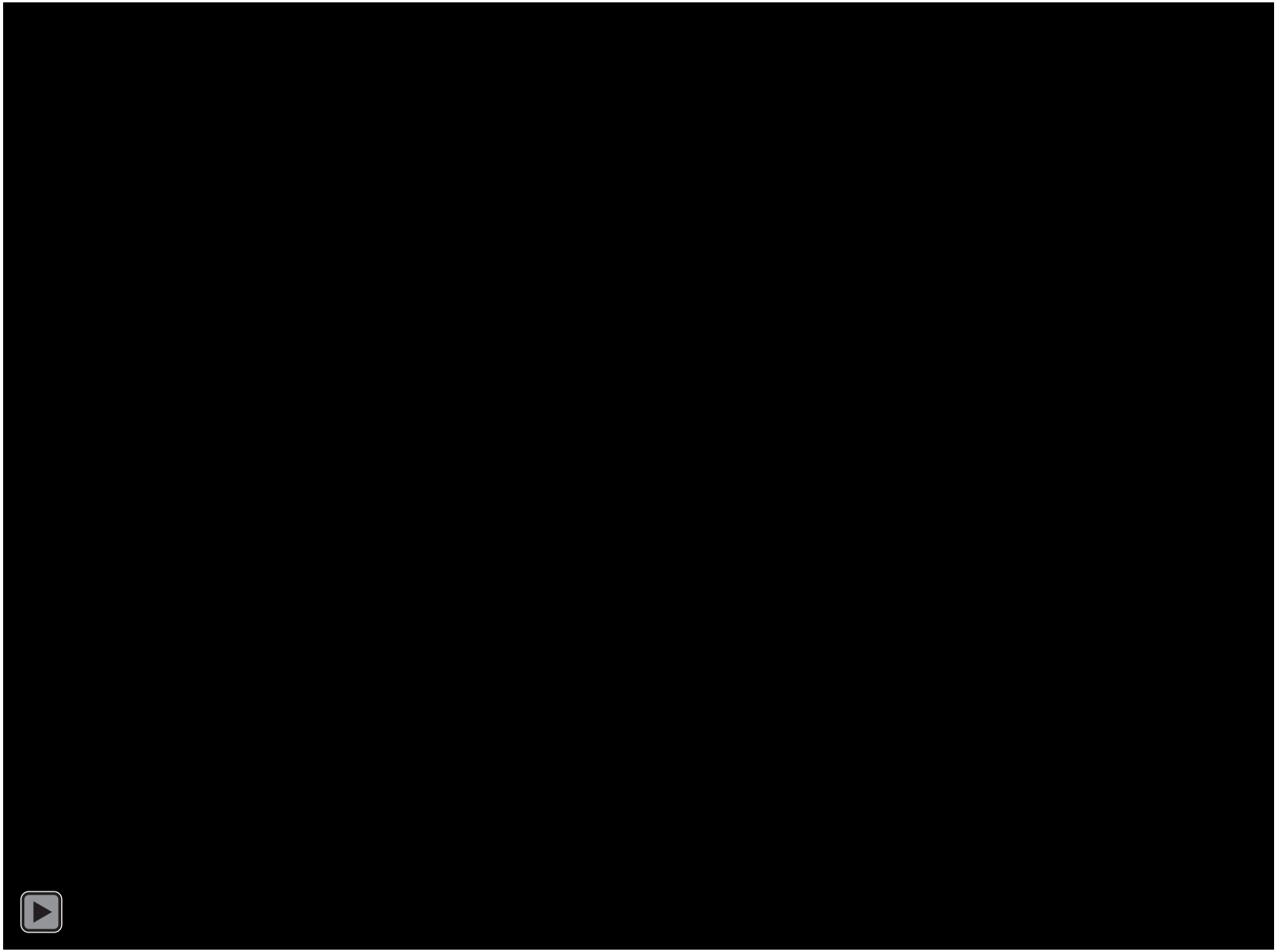



High Pressure Oil
Vented To Engine
• Pressure Drops In Master/Slave Circuit
• Master Piston Retracts Into Housing


Brake Off
• Engine Runs Normally


Brake Off
• Engine Runs Normally

Système Cummins (interbrake):

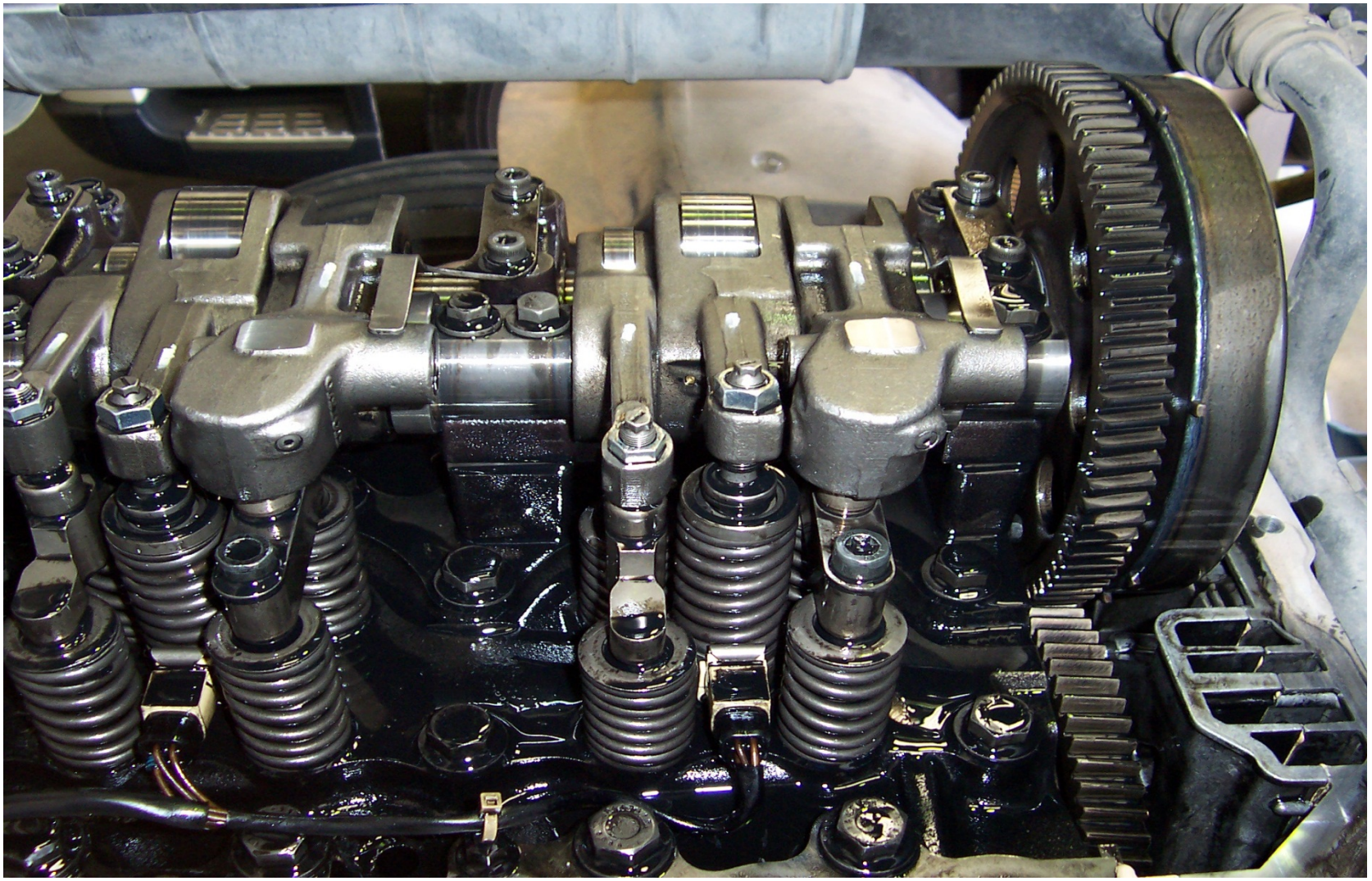


Système Détroit DD15

DETROIT DD15

455 TO 505 HP

Système VEB Volvo:



Engine Brake

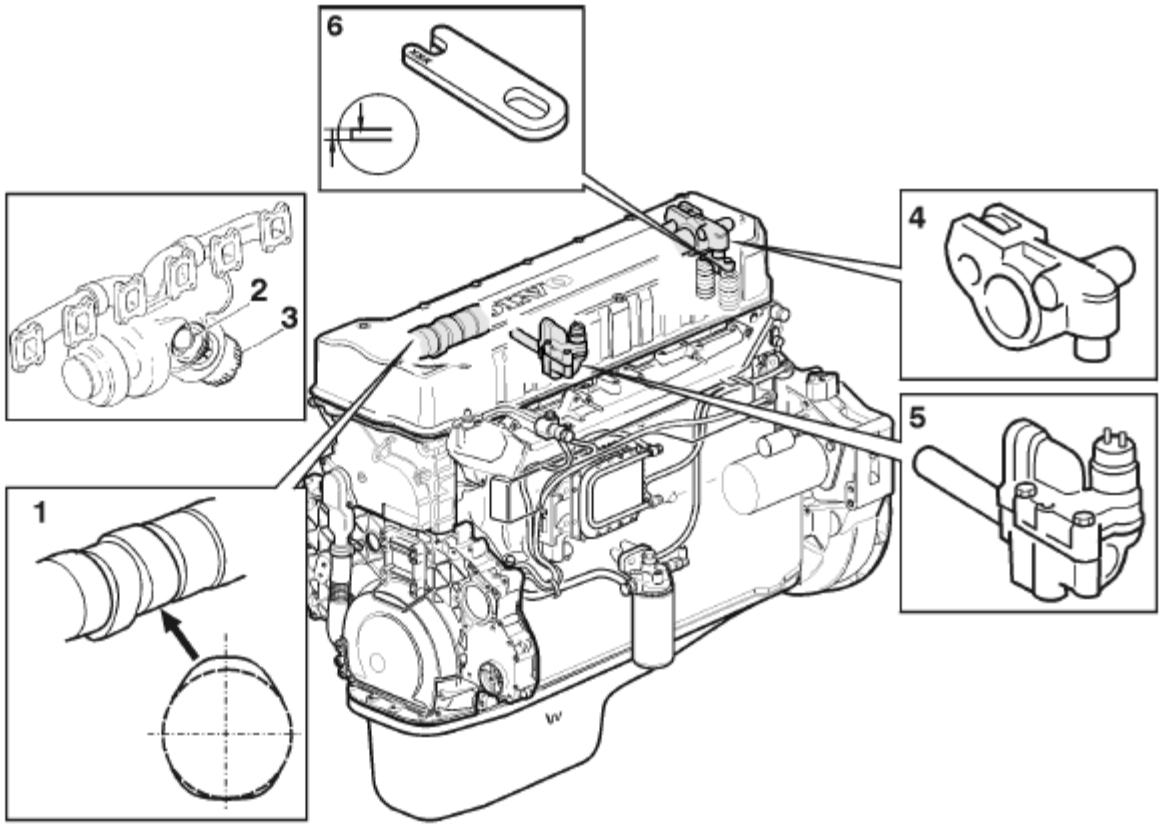


Fig. 3: D12 Engine

1	Camshaft	4	Rocker arm
2	Shutter	5	Control valve
3	Exhaust pressure governor	6	Shim

The Volvo Engine Brake (VEB) is a combination of two brake systems: the exhaust brake and the compression brake.

Control Valve

The control valve is mounted on the cylinder head under the valve cover, and is connected to the oil system ahead of the rocker arm shaft. Its purpose is to reduce the oil pressure to the rocker arms while the engine is operating (compression brake not activated).

There is always full system oil pressure to the control valve intake (1) because the intake is connected via a pipe to the lube oil gallery in the cylinder block. The oil pressure to the rocker arm shaft can be increased via a solenoid valve (2) mounted on the control valve, from approximately 100 kPa (14.5 psi) while the engine is operating, to more than 200 kPa (29 psi) during compression braking.

While the engine is operating, the oil pressure is reduced after the control valve by the plunger (3) being held in balance by the force of a spring (4) and the oil pressure in the oil chamber (6) on the opposite side of the plunger.

When the solenoid valve is activated, the oil chamber (6) is drained and the spring (4) presses the plunger (3) to its end position. The plunger completely opens the oil outlet (5) to increase oil pressure to the rocker arm shaft.

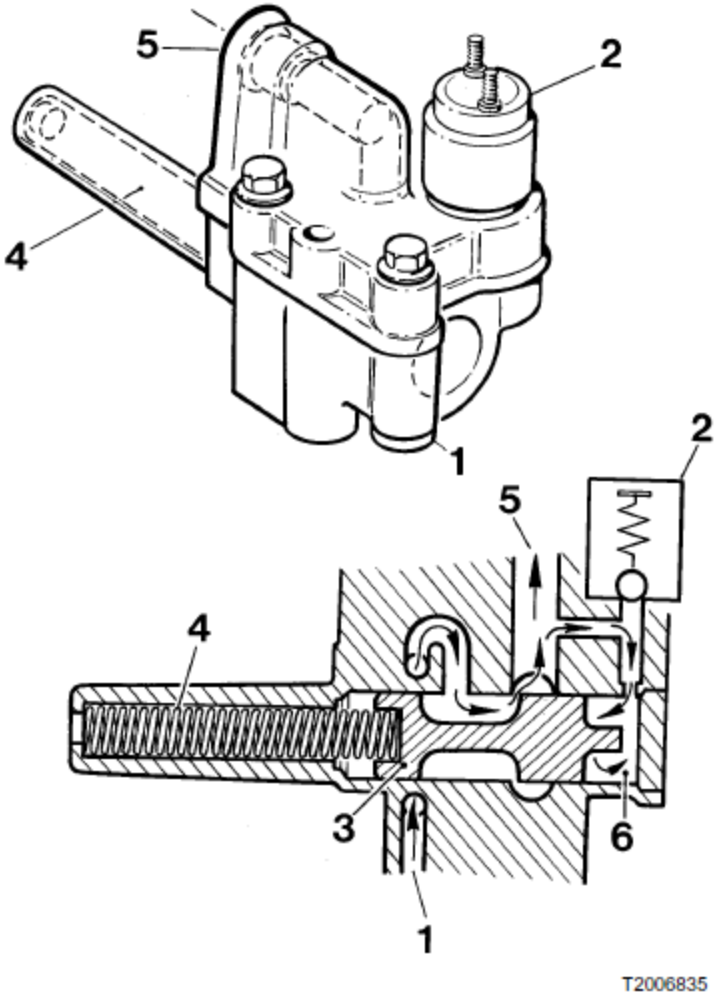


Fig. 4: Control Valve

1 Oil inlet
2 Solenoid valve
3 Plunger
4 Spring
5 Oil outlet
6 Oil chamber

Camshaft on Engine with Compression Brake

The camshaft on an engine with a compression brake has an induction lobe (1) and a decompression lobe (2) — in addition to the normal exhaust lobe (3) — on each cam profile for the exhaust valves.

The induction and decompression lobe lifting height is 0.8 mm (0.032 in.) above the basic circle, which is equivalent to approximately 1.1 mm (0.043 in.) at the valve bridge.

The induction lobe is positioned so that it opens the exhaust valves at the end of the intake stroke and holds them open until the beginning of the compression stroke.

The decompression lobe is positioned so that it opens the exhaust valves at the end of the compression stroke.

In order for the induction and decompression lobes to open the exhaust valves, the valve clearance must be reduced to zero by the activation of the non-return valve and plunger located in the rocker arm for the exhaust valves.

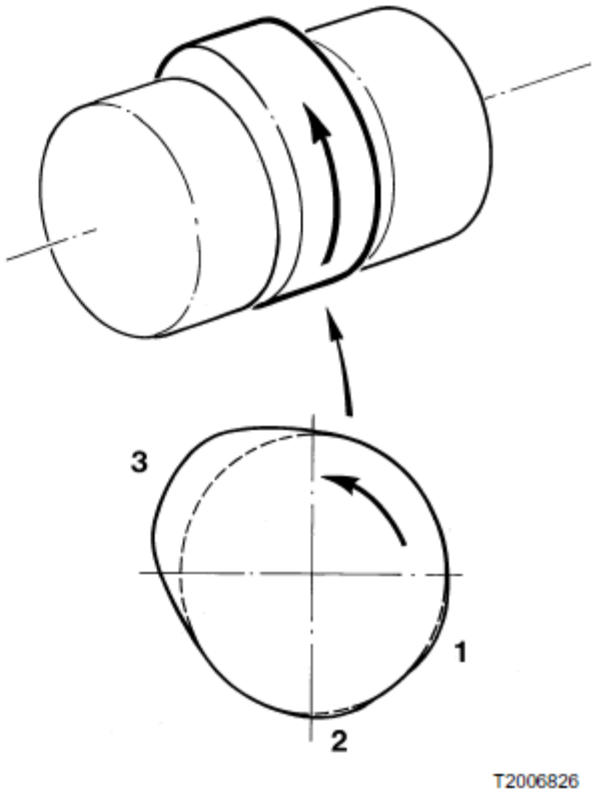


Fig. 5: Cam Shaft Profile

1 Induction lobe
2 Decompression lobe
3 Exhaust lobe

Exhaust Rocker Arms

The exhaust rocker arms on an engine with a compression brake are larger than those on a conventional engine.

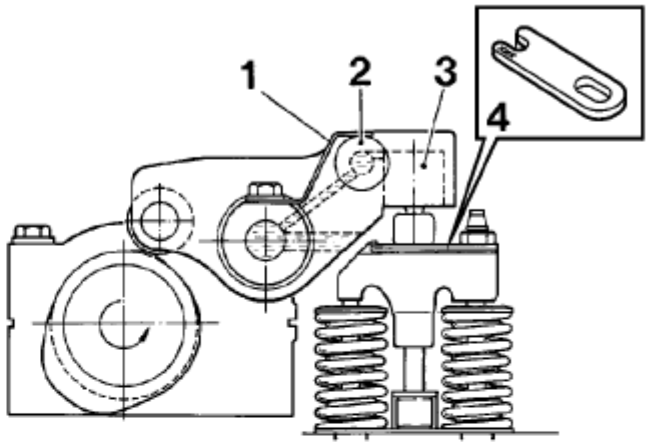
The rocker arm includes a non-return valve (2) and a plunger (3) with a pressure limiting valve, the purpose of which is to regulate the oil flow during compression braking.

The rocker arm is held in its position against the valve bridge with the help of a spring tab (1).

The valve clearance is greater than that on an engine without a compression brake, because the induction and decompression lobes must not open the exhaust valves while the engine is in normal operating mode (compression brake not activated).

Valve adjustment is carried out with shims which are placed on the valve bridge.

Note: A maximum of two shims are allowed to obtain proper valve clearance.



W2003502

Fig. 6: Rocker arm assembly, side view:

1 Spring tab
2 Non-return valve
3 Rocker arm plunger
4 Shims

Non-Return Valve

The engine brake has a non-return valve, consisting of a plunger (1), spring (2) and a ball (3) in the rocker arm. When oil from the rocker arm shaft enters the valve, the movement of the plunger is determined by the spring force and the oil pressure.

When the oil pressure is low — approximately 100 kPa (14.5 psi); the control valve is in its normal engine operating position — the plunger (1) will not move out of its rest position because the oil pressure is not sufficient to overcome the spring force. The plunger pin prevents the ball (3) from entering the seating area, and the oil can then flow freely through the valve in both directions.

When the control valve takes up the position for compression braking, the oil pressure increases to the non-return valve. The spring force in the non-return valve is such that when the oil pressure exceeds approximately 200 kPa (29 psi), the spring force is overcome and the plunger (1) moves so that it no longer influences the ball (3). The spring (5) presses the ball (3) against the seat and prevents the oil contained above the plunger (4) from flowing past the ball (3). This forms high oil pressure above the plunger (4).

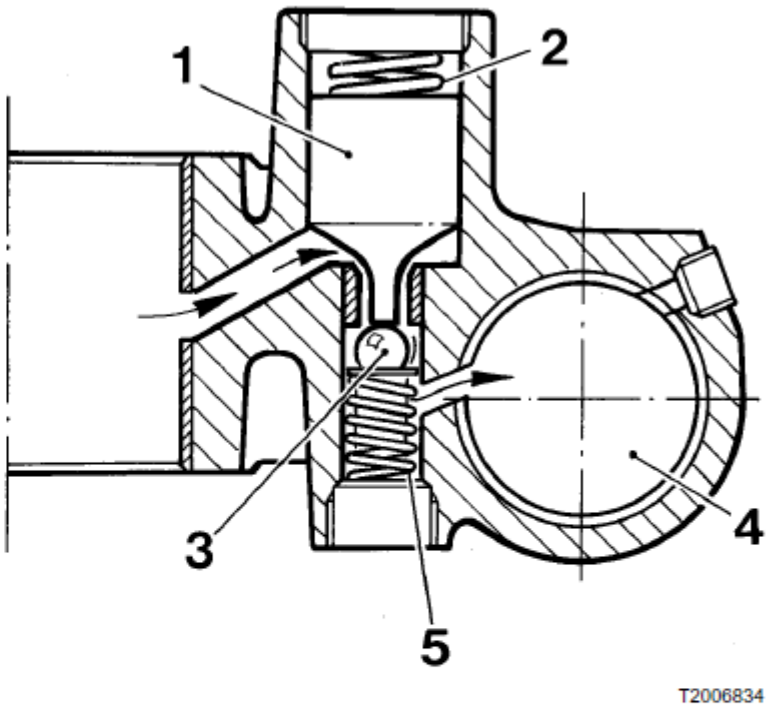


Fig. 7: Rocker arm assembly, top view:

1 Plunger
2 Spring
3 Ball
4 Rocker arm plunger
5 Spring

Rocker Arm Plunger

The purpose of the rocker arm plunger is to eliminate all valve clearance during the compression braking.

Engine Operation

When the engine is operating (compression brake not activated), there is reduced oil pressure — approx. 100 kPa (14.5 psi) — via the control valve to the rocker arm shaft and the rocker arm non-return valve (1) is open. Oil can flow freely through the non-return valve in both directions. As a result, no oil pressure is built up between the rocker arm plunger (2) and the rocker arm.

The set valve clearance is great enough to prevent the camshaft induction and decompression lobes from opening the exhaust valves.

The valve mechanism operates the same as on an engine without a compression brake; in other words, only the exhaust lobe opens the exhaust valves.

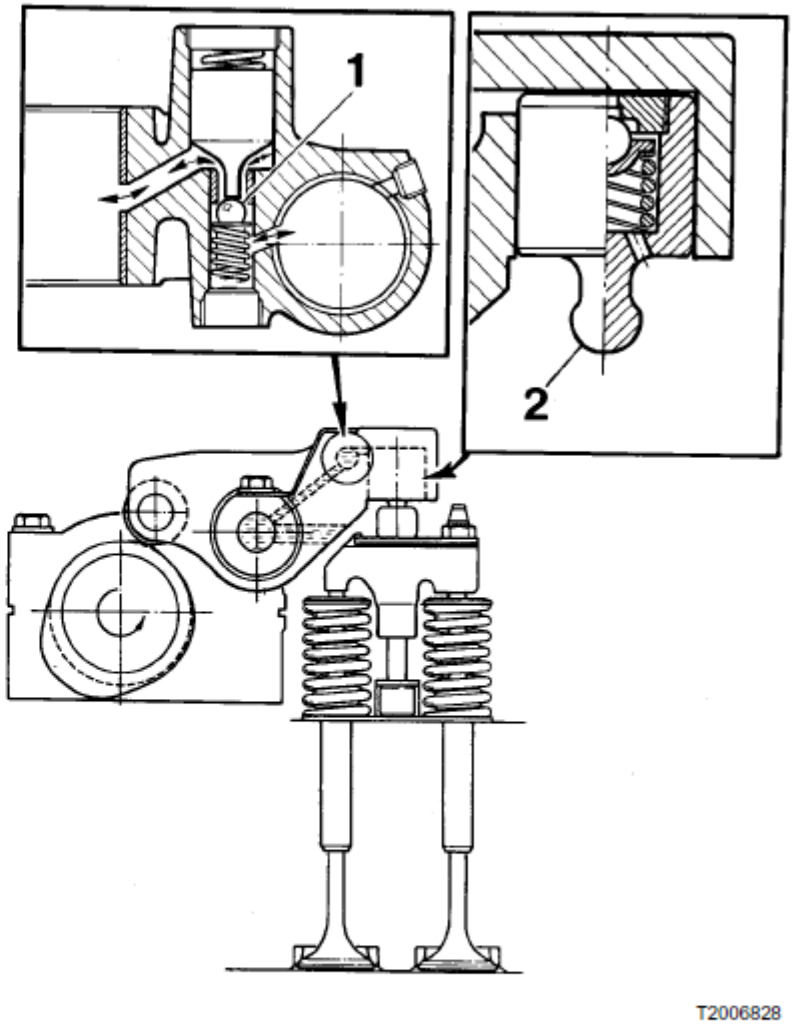


Fig. 8: Rocker Arm Plunger

1 Non-return valve
2 Rocker arm plunger

Compression Braking

During compression braking, the control valve does not reduce the oil pressure, so an oil pressure of at least 200 kPa (29 psi) is delivered to the rocker arm shaft.

The pressure in the rocker arm non-return valve (1) becomes so great that the plunger in the non-return valve is moved out of its rest position, and the ball now functions as a non-return valve. Pressure is built up between the rocker arm plunger (2) and the rocker arm. The plunger is pressed out and presses the rocker arm roller against the lobes on the camshaft. In this way, the valve clearance is eliminated and the lifting height on the induction and decompression lobes is sufficient to open the exhaust valves.

The rocker arm plunger is fitted with a pressure limiting valve (3). When the oil pressure between the rocker arm plunger and the rocker arm becomes too great, the pressure limiting valve opens and oil can exit through the hole in the bottom of the plunger. The opening pressure of the pressure limiting valve is governed by the force of the valve spring.

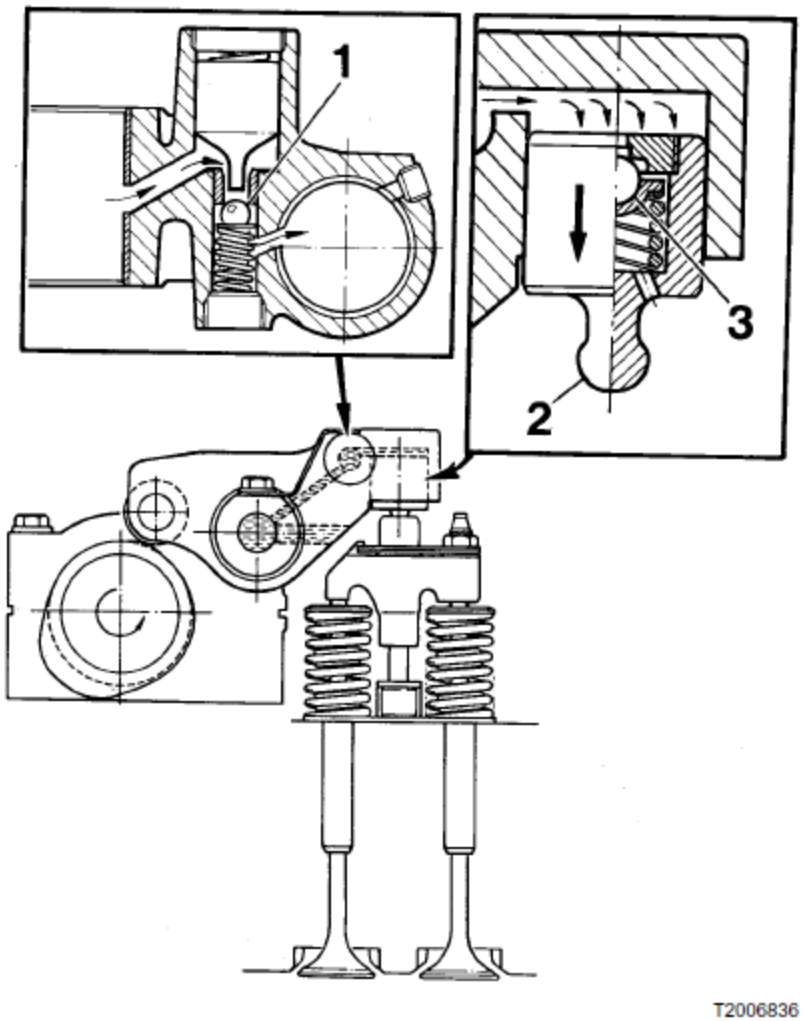


Fig. 9: Rocker Arm Plunger

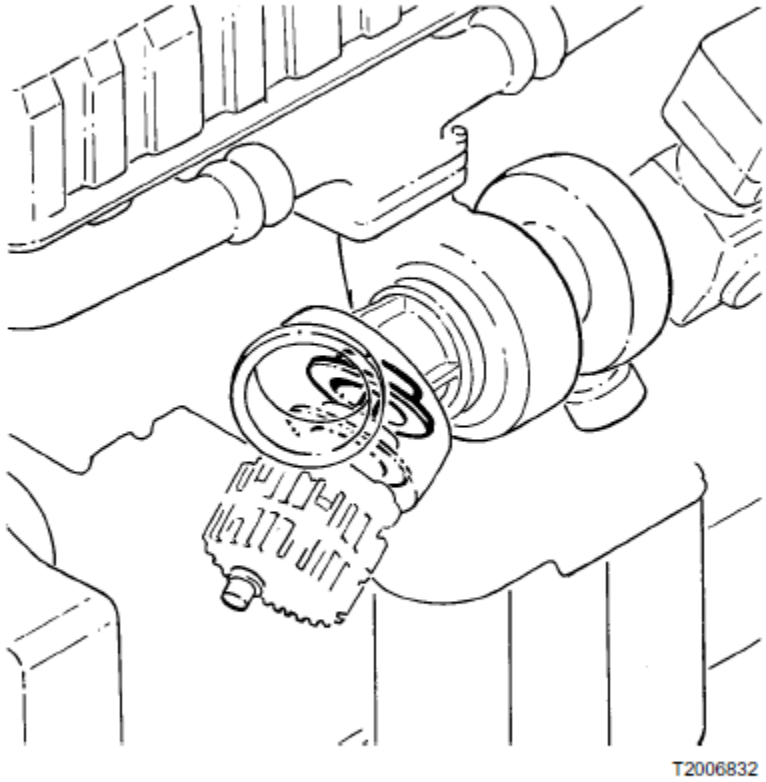
1 Non-return valve
2 Rocker arm plunger
3 Pressure limiting valve

Exhaust Brake

When exhaust braking, the exhaust pressure governor (EPG) is activated with a control pressure of approximately 750 kPa (110 psi). At this point, the shutter is forced out of the EPG and into the shutter housing. This restricts the flow of exhaust gases out of the cylinders, as the shutter blocks the outlet from the turbocharger.

Restricting the flow of exhaust gases forms an air cushion between the shutter and the piston crowns. During the exhaust stroke, this air cushion provides a braking effect on the pistons as the exhaust valves are then opened.

The higher the engine speed during the exhaust braking, the greater the braking effect.



T2006832

Fig. 11: Exhaust pressure governor

Control System

The engine brake is connected to the throttle pedal and is activated when the pedal is completely released, according to the selection made with the engine brake switch on the instrument panel.

The selection made with this switch also regulates engine braking activated by the cruise control.

Note: The engine brake functions as long as the engine control system has received signals from engine sensors indicating that the required preconditions for engine braking have been met. For example, the engine speed must be greater than 1100 rpm, the vehicle speed must be greater than 12 km/h (7.5 mph), and the engine temperature must be above 70° C (160° F).

The switch has three positions:

0 No engine brake engaged

1 Exhaust brake, EPG

2 Exhaust brake and compression brake, VEB

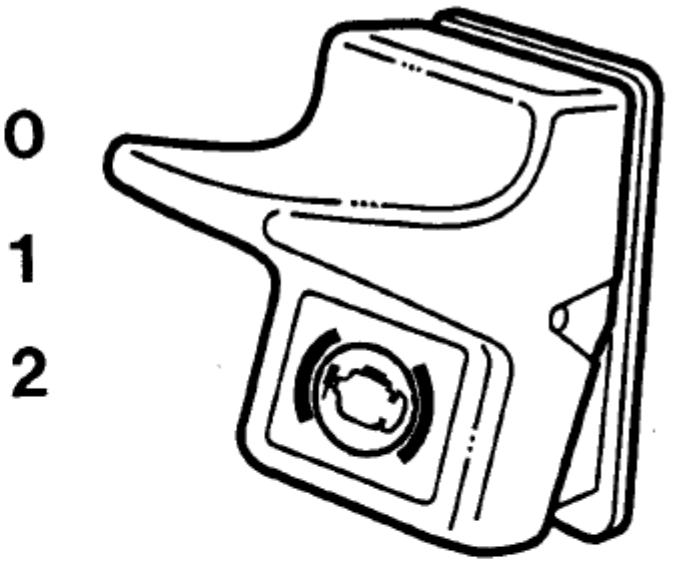
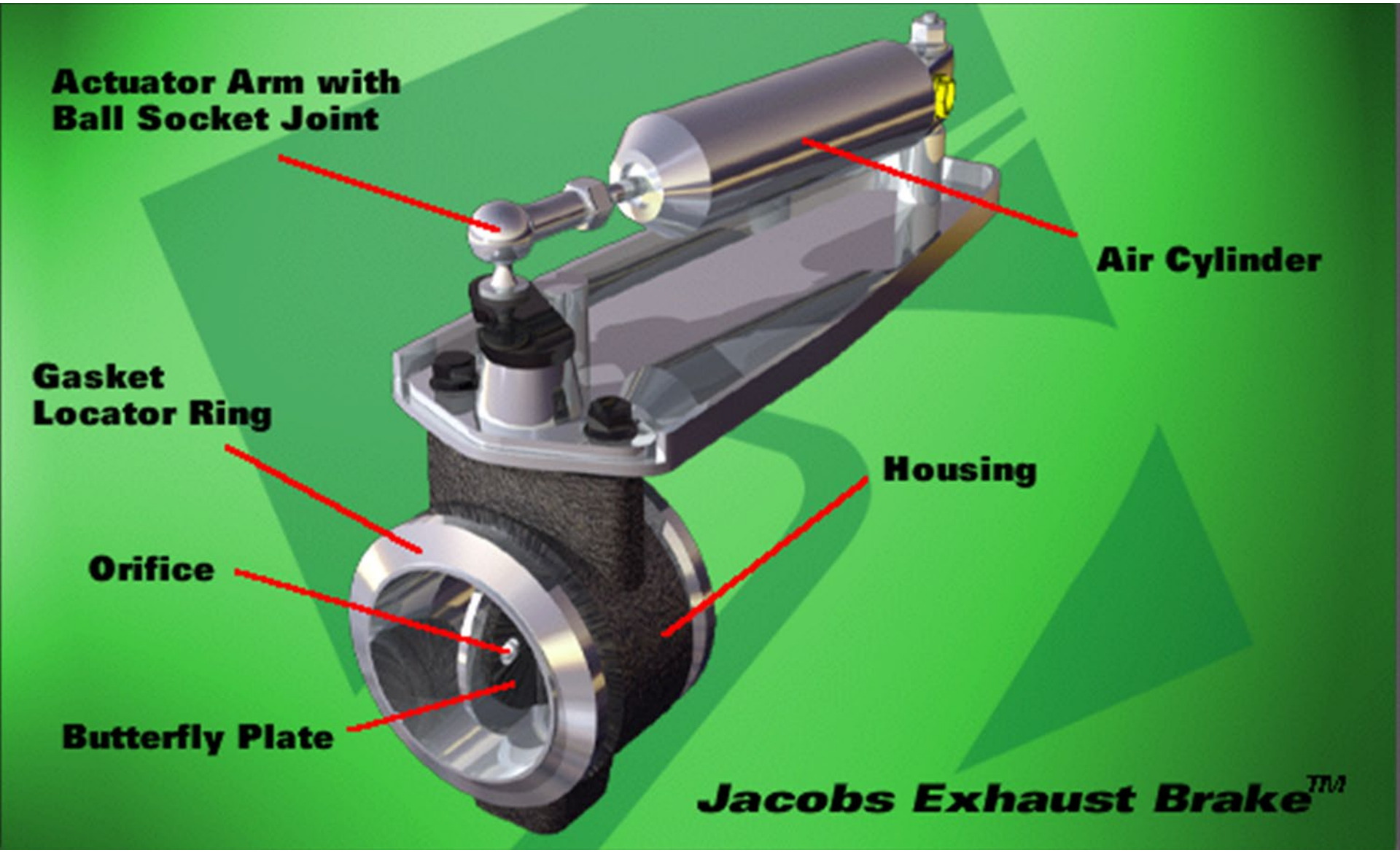


Fig. 10: Switch for engine brake

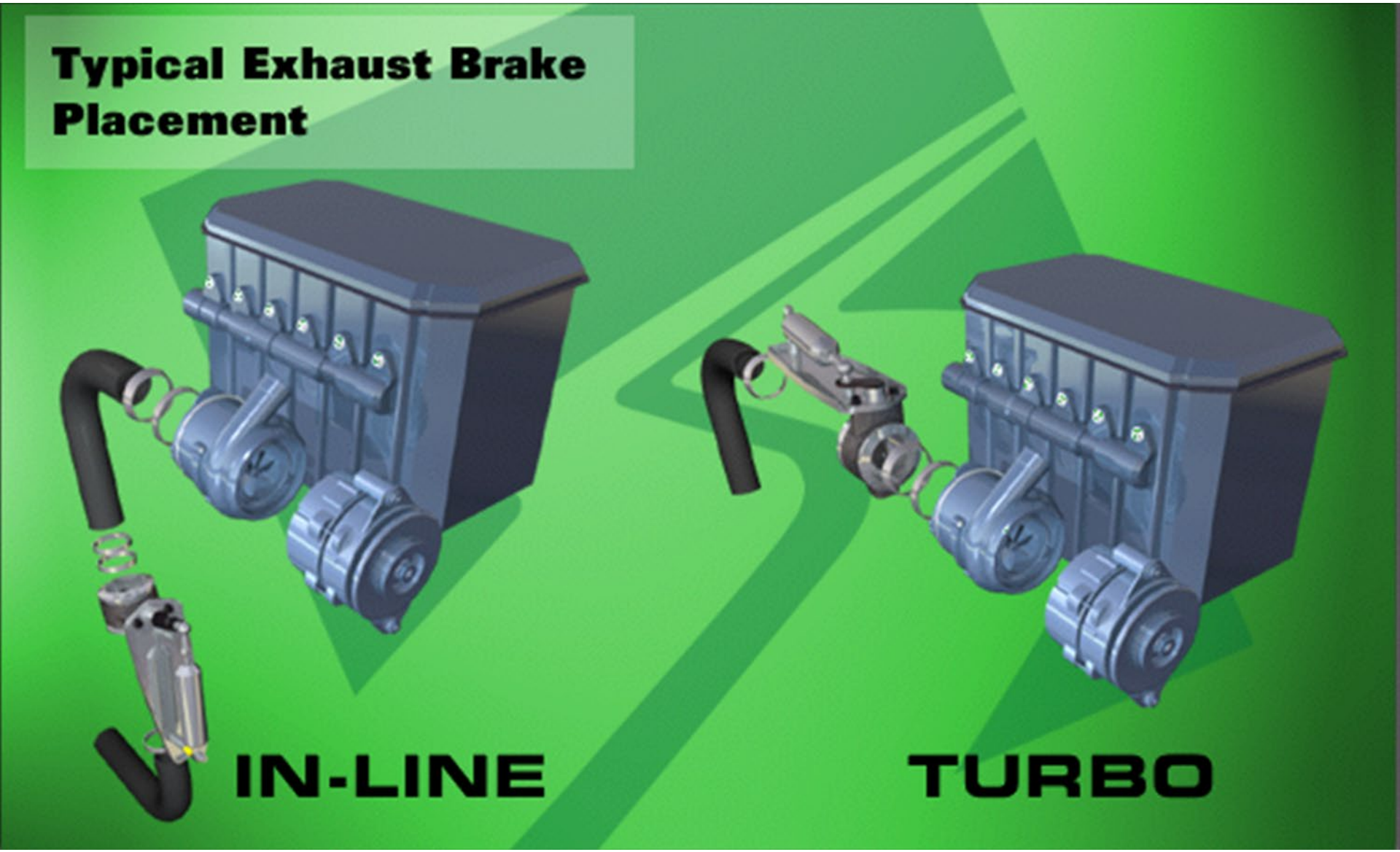
Frein à compression externe: (exhaust brake):

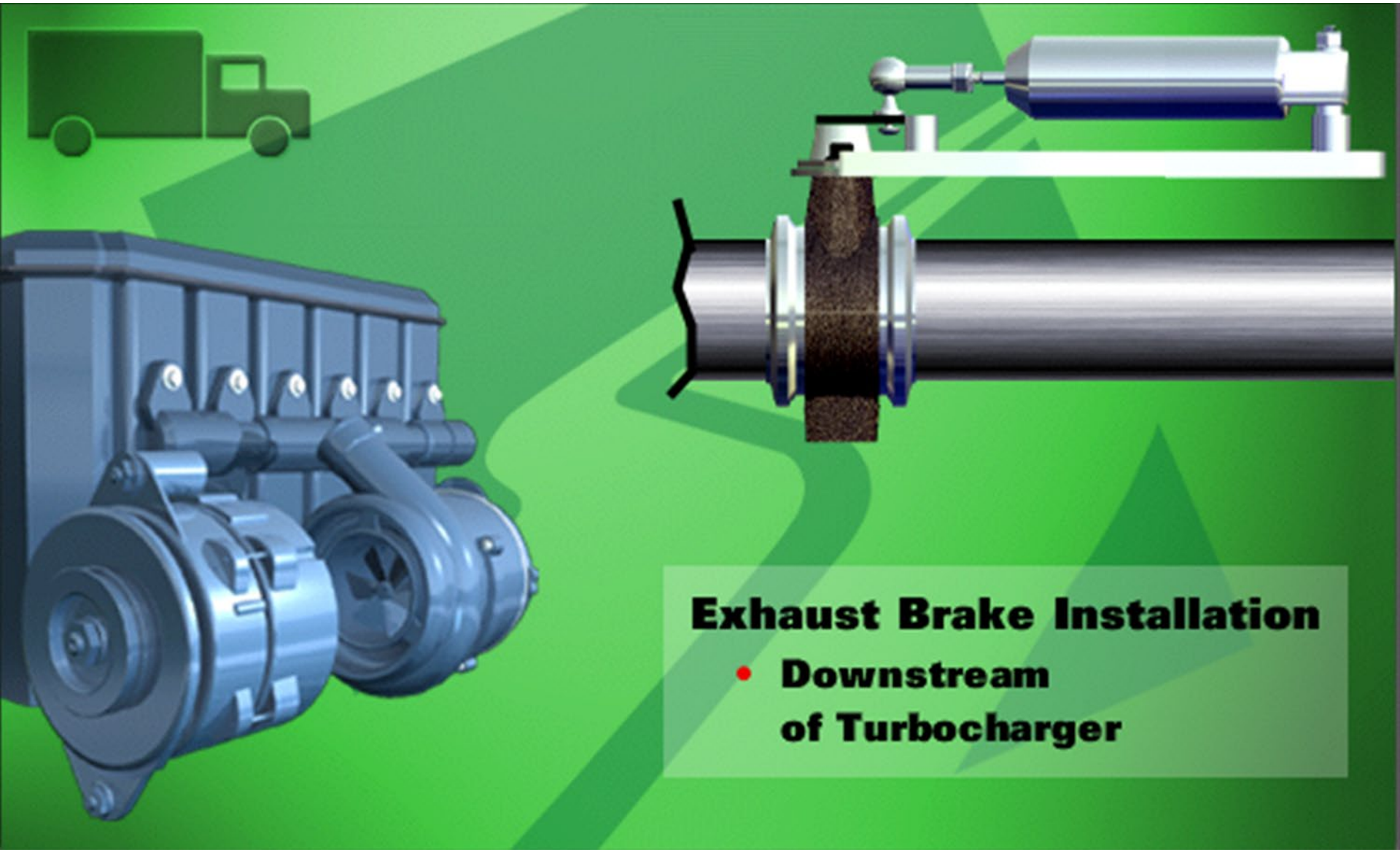
- Un clapet obstrue la sortie d'échappement.

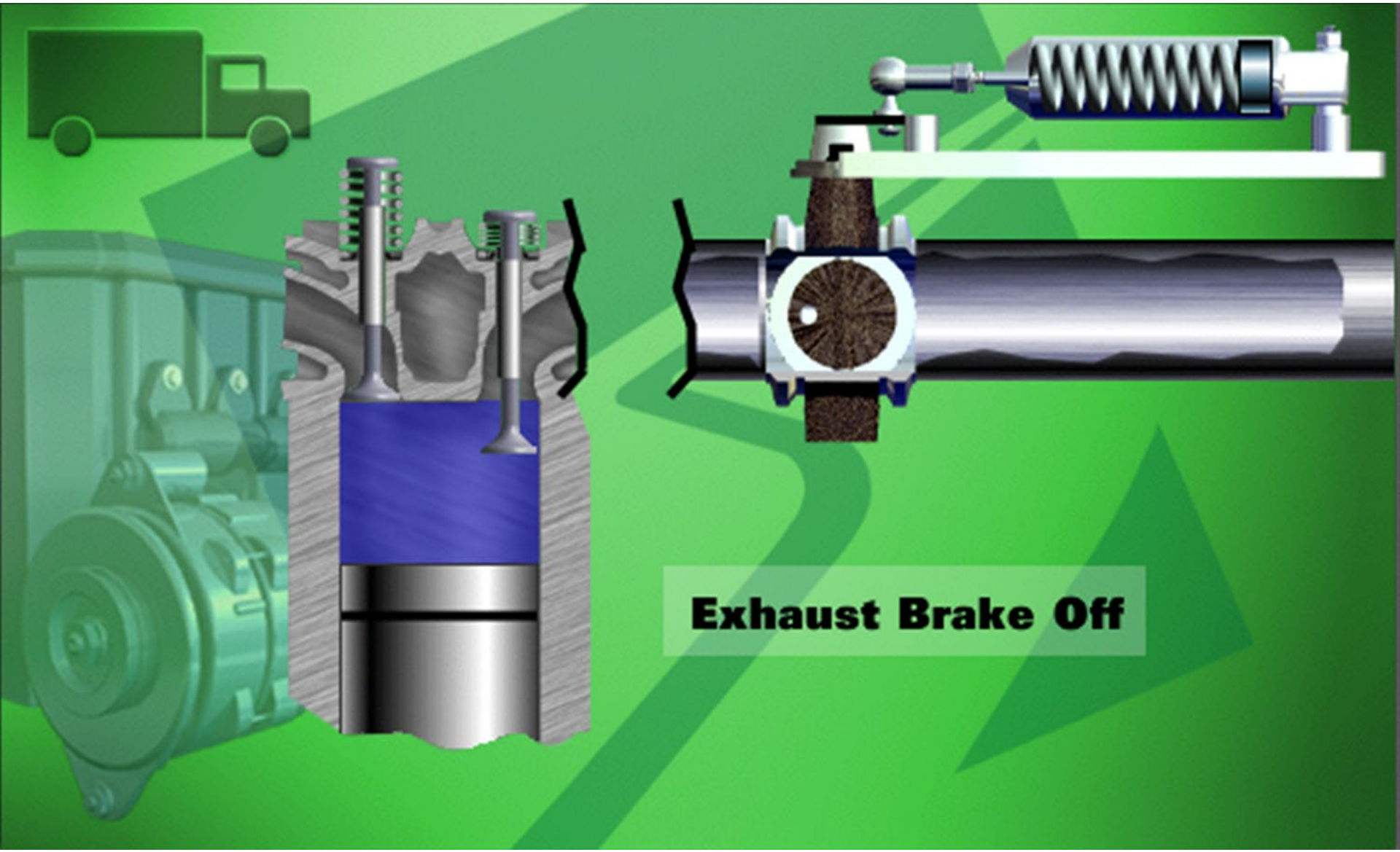
- Contrairement au frein interne on se sert du temps échappement pour ralentir le moteur.

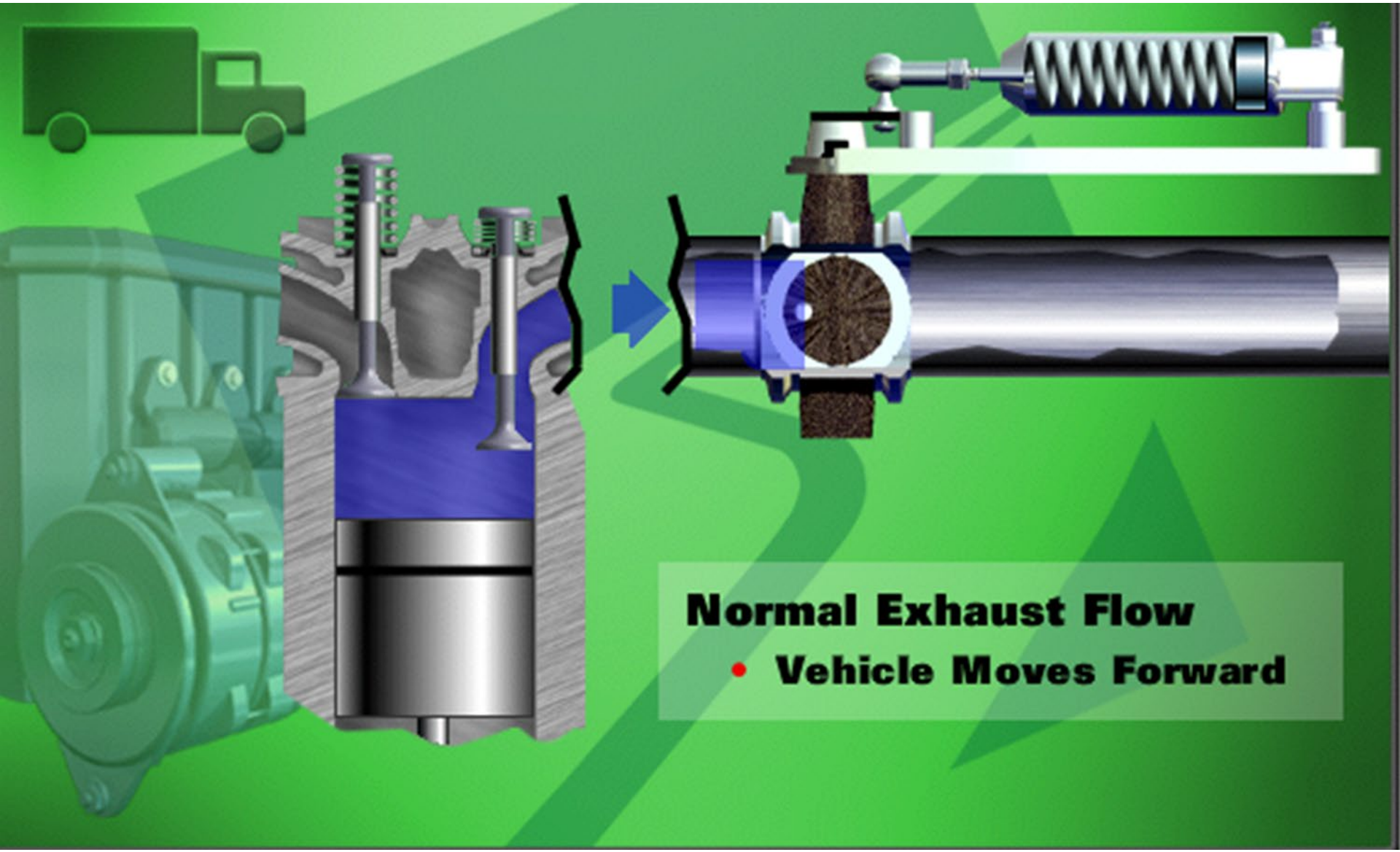

Actuator Arm with
Ball Socket Joint
Air Cylinder
Gasket
Locator Ring
Housing
Orifice
Butterfly Plate
Jacobs Exhaust Brake™

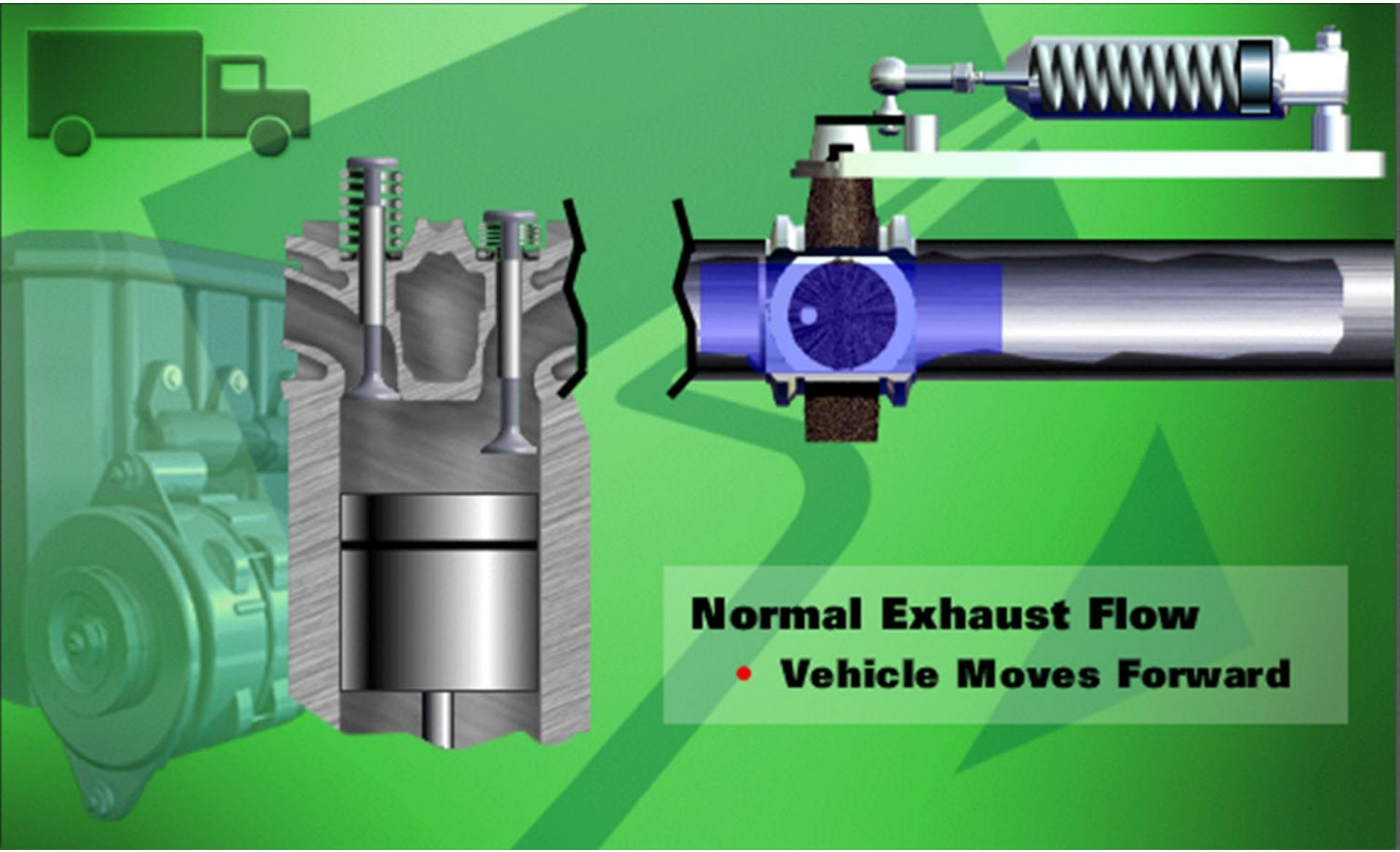
Typical Exhaust Brake Placement

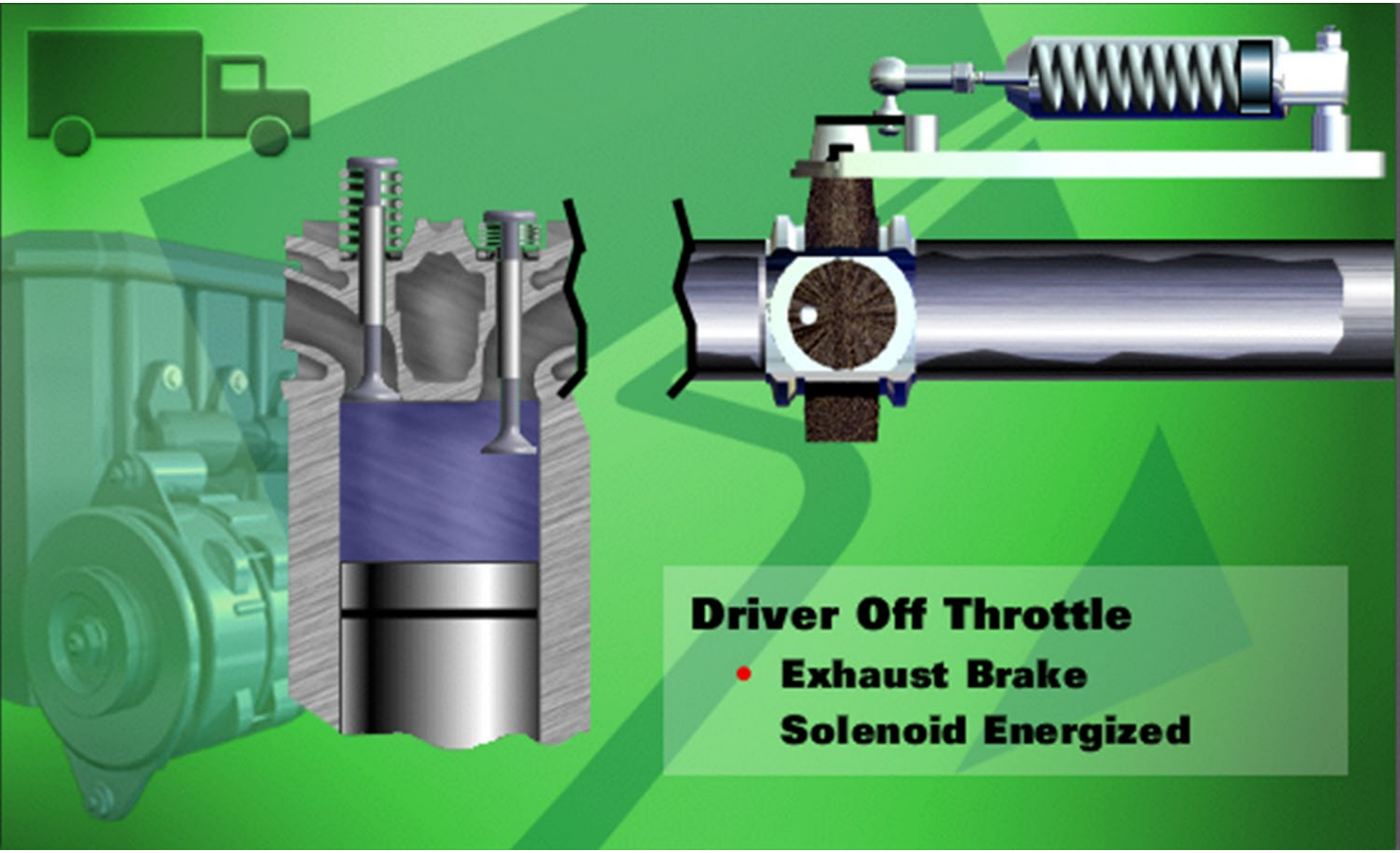


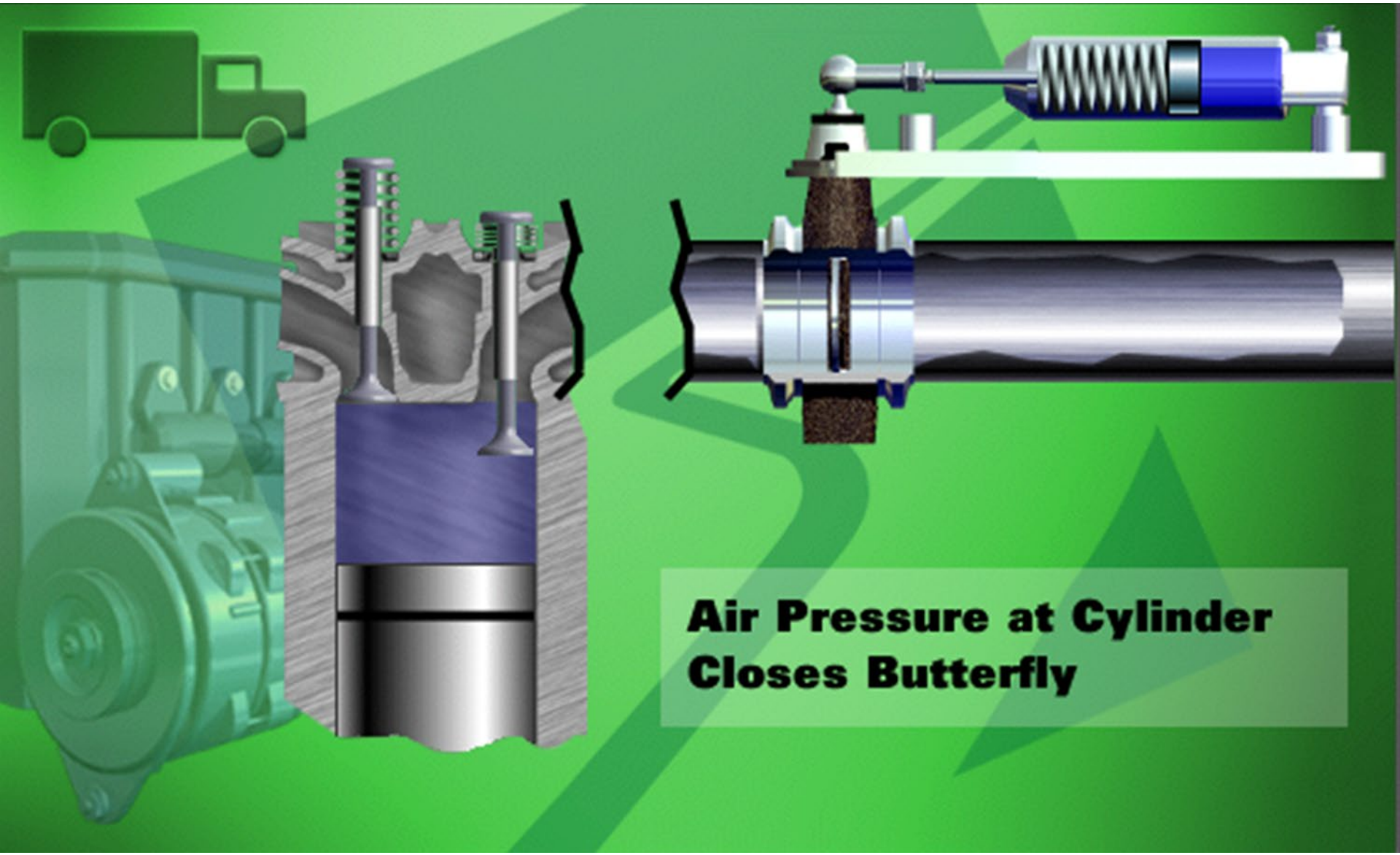

Exhaust Brake Installation
• Downstream
of Turbocharger

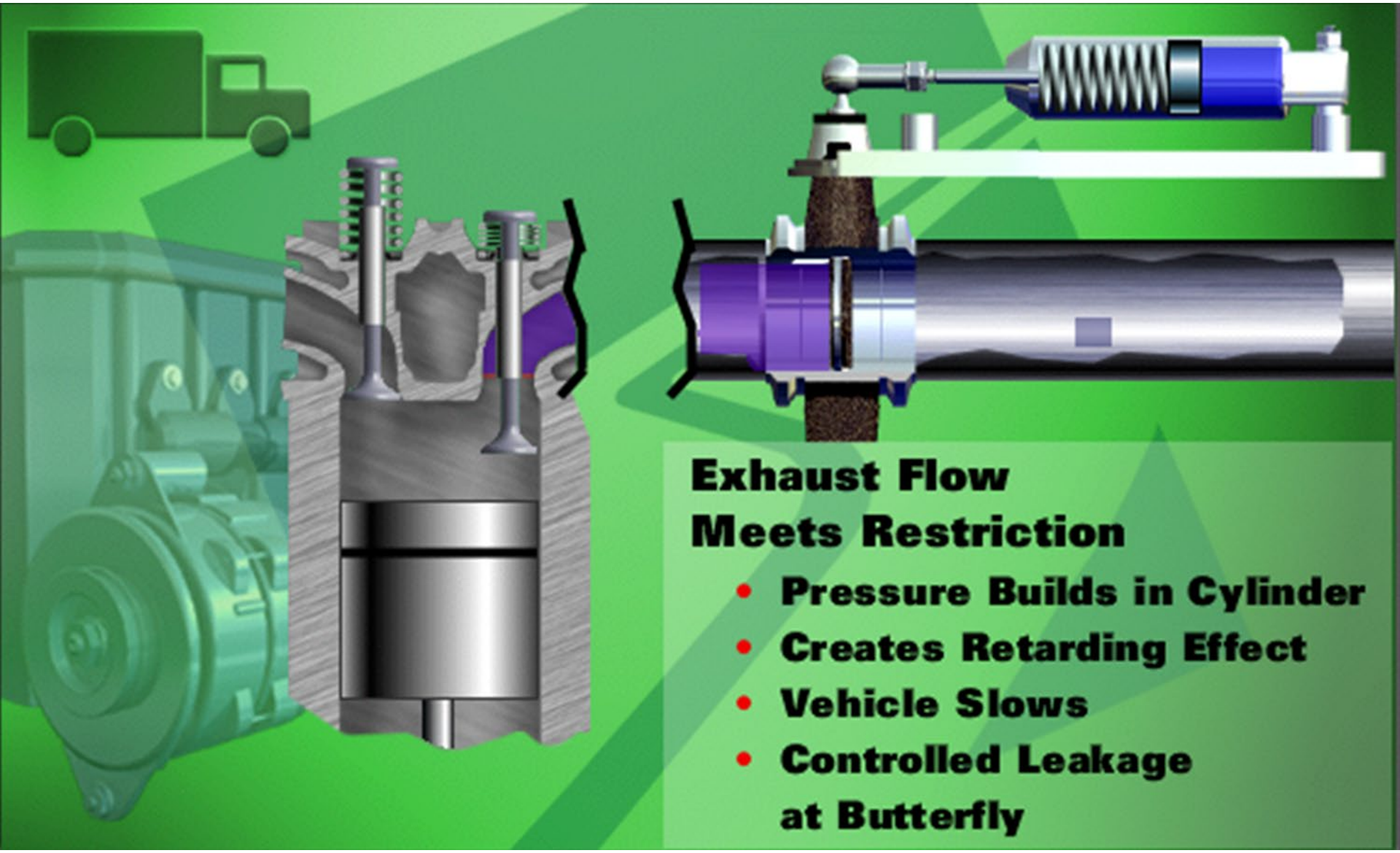

Exhaust Brake Off

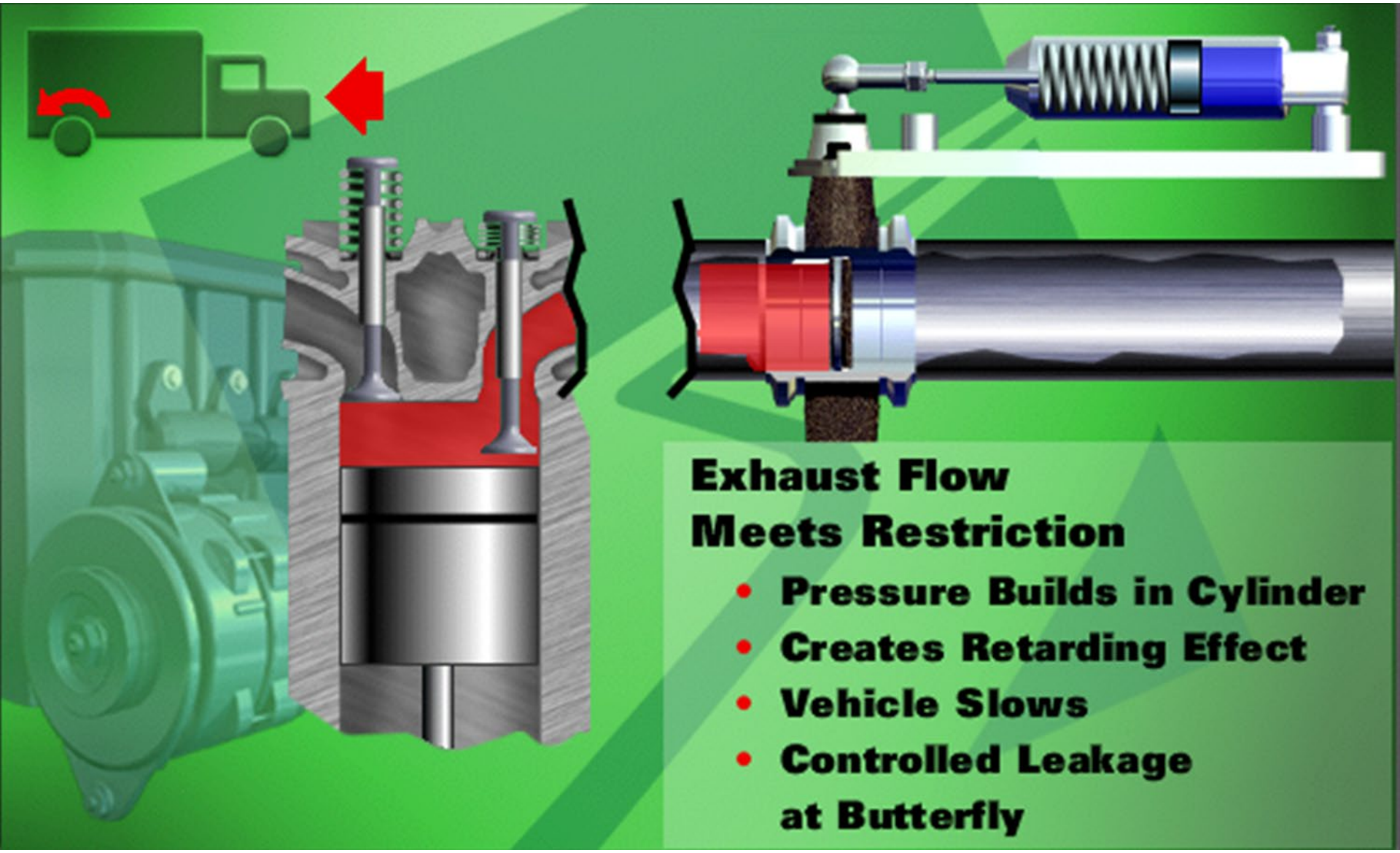

Normal Exhaust Flow
• Vehicle Moves Forward


Normal Exhaust Flow
• Vehicle Moves Forward


Driver Off Throttle
• Exhaust Brake
Solenoid Energized


Air Pressure at Cylinder
Closes Butterfly


Exhaust Flow
Meets Restriction
• Pressure Builds in Cylinder
• Creates Retarding Effect
• Vehicle Slows
• Controlled Leakage
at Butterfly

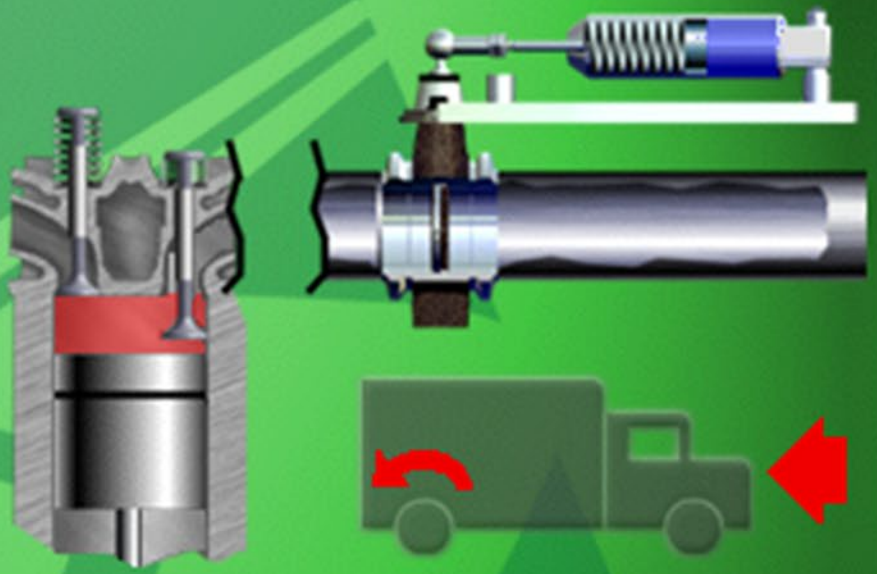

Exhaust Flow
Meets Restriction
• Pressure Builds in Cylinder
• Creates Retarding Effect
• Vehicle Slows
• Controlled Leakage
at Butterfly

Brake Off

No Restriction

- Vehicle Moves Forward

Brake On

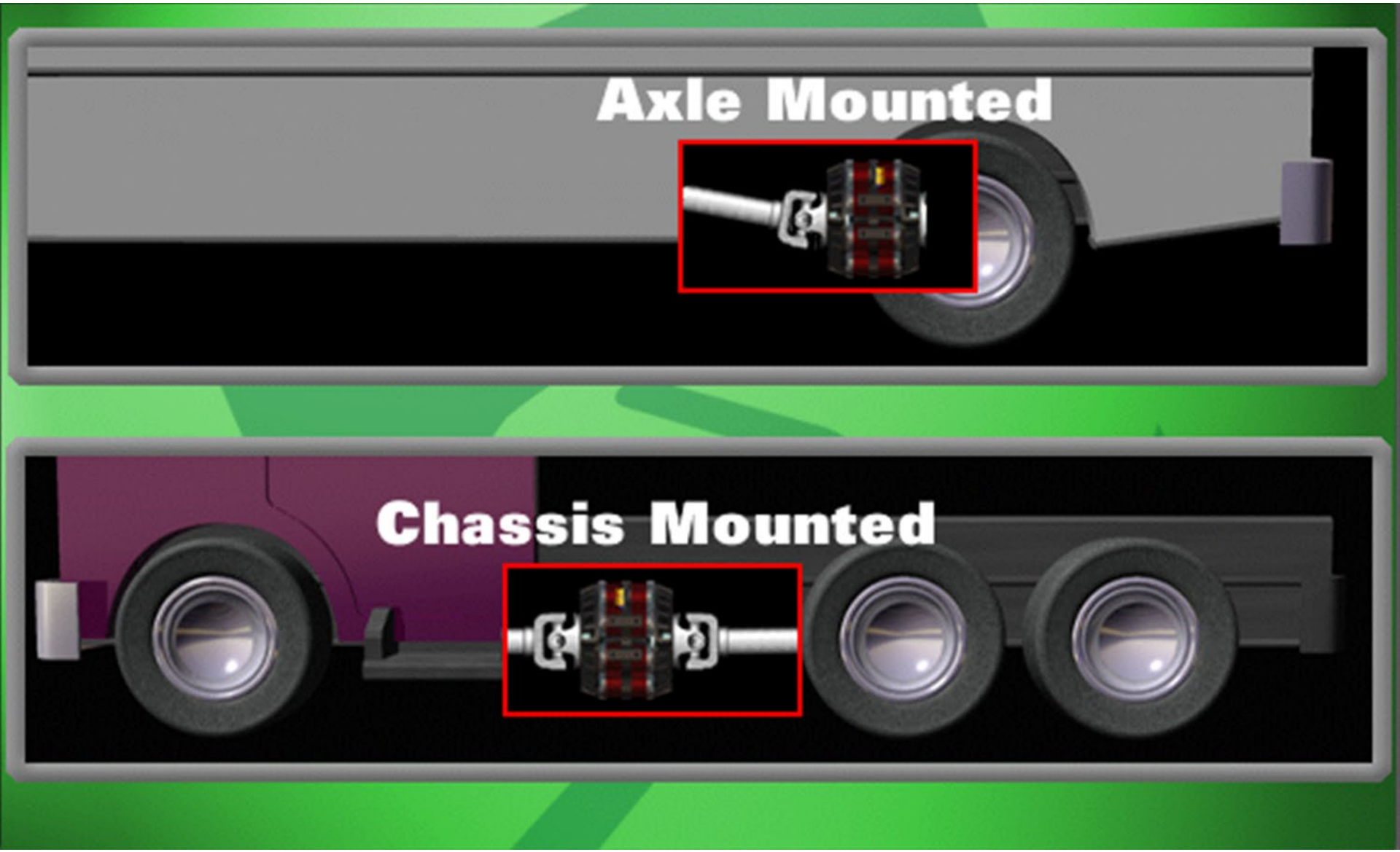


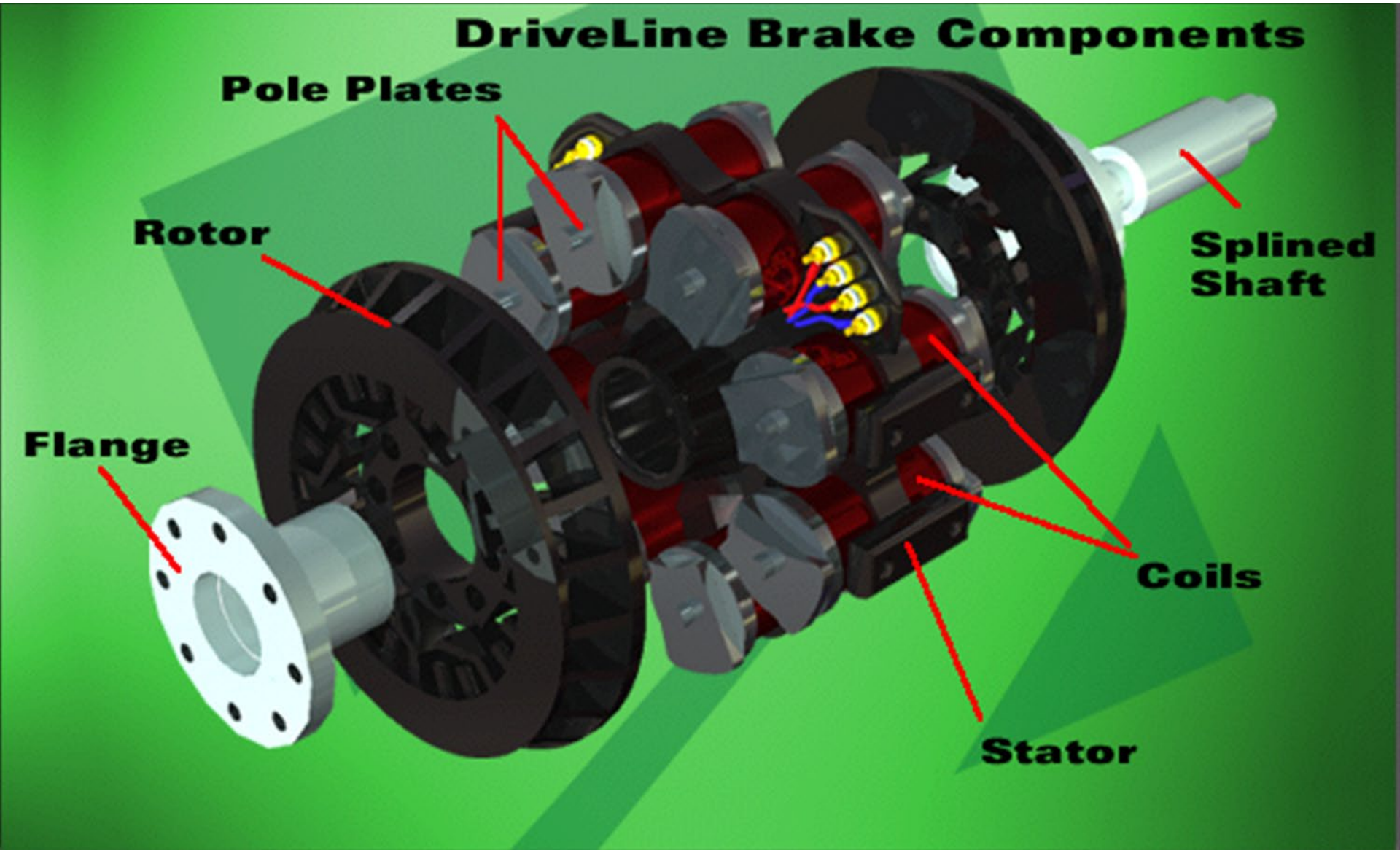
Restriction Builds Pressure

- Vehicle Slows Down

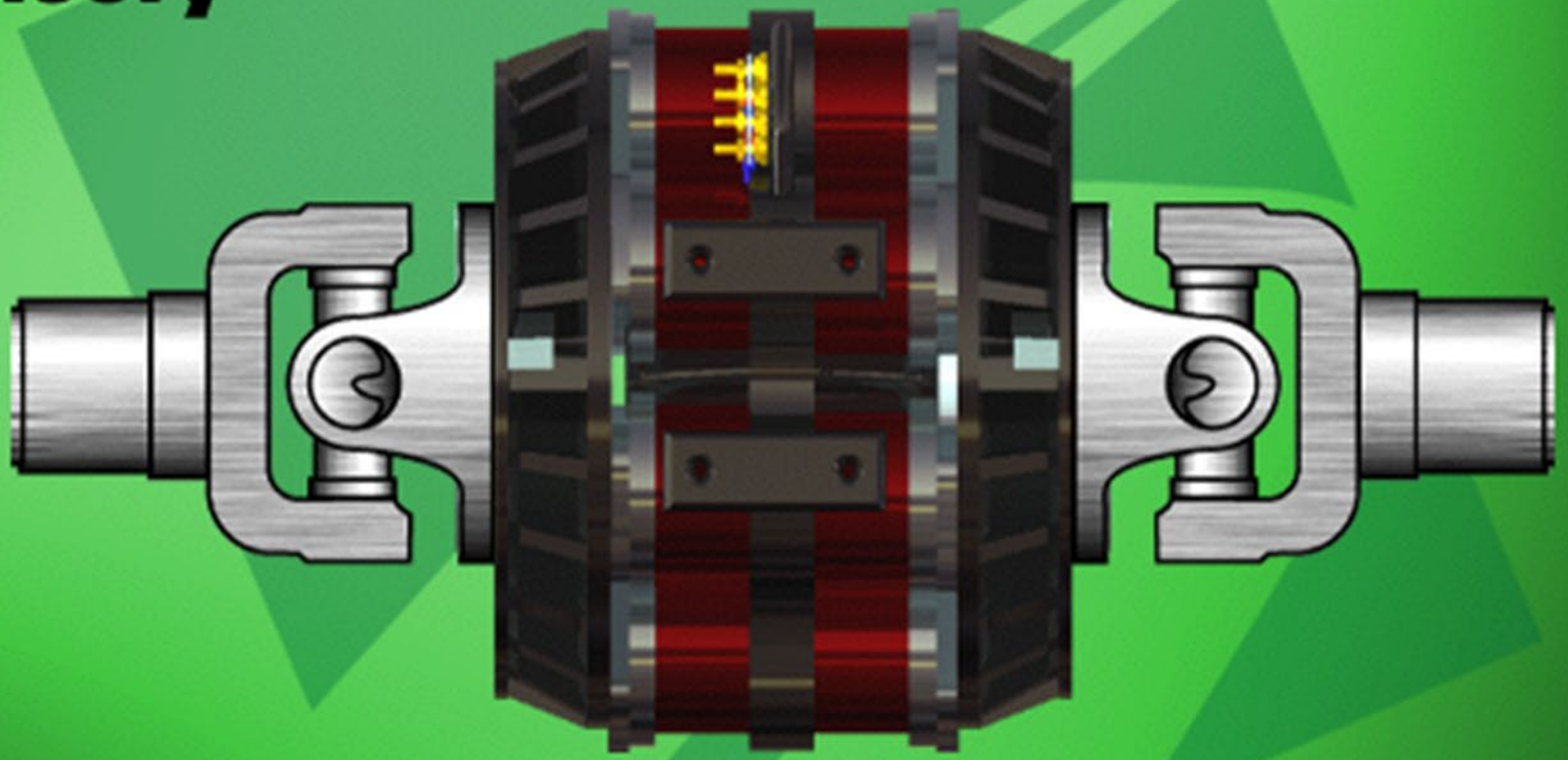
Retarder électromagnétique:

- Installer sur le drive shaft.
- Aucun frottement
- Peut être combiné au freins compression.


Axle Mounted
Chassis Mounted

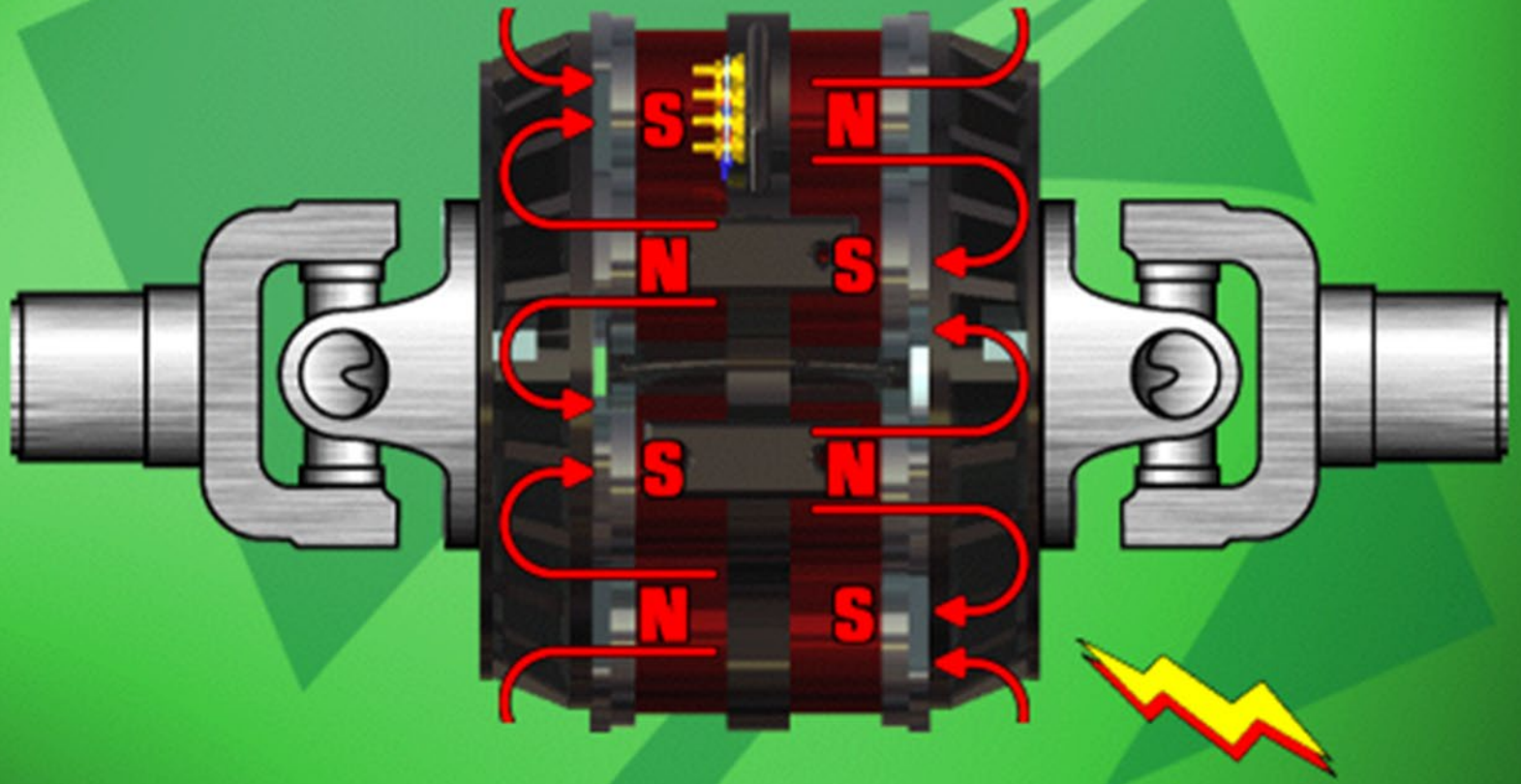

DriveLine Brake Components
Pole Plates
Rotor
Splined Shaft
Flange
Coils
Stator

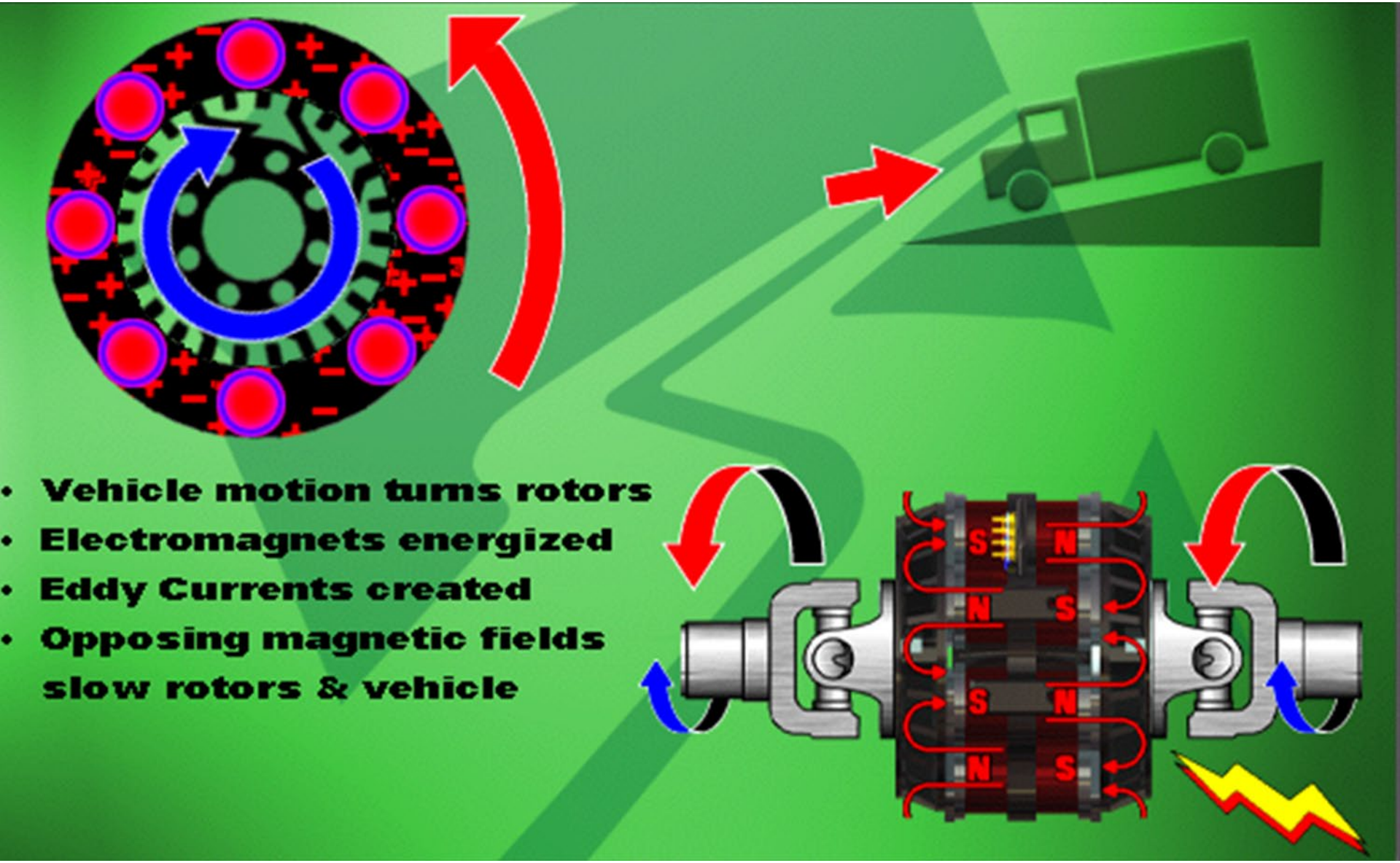
Operating Theory



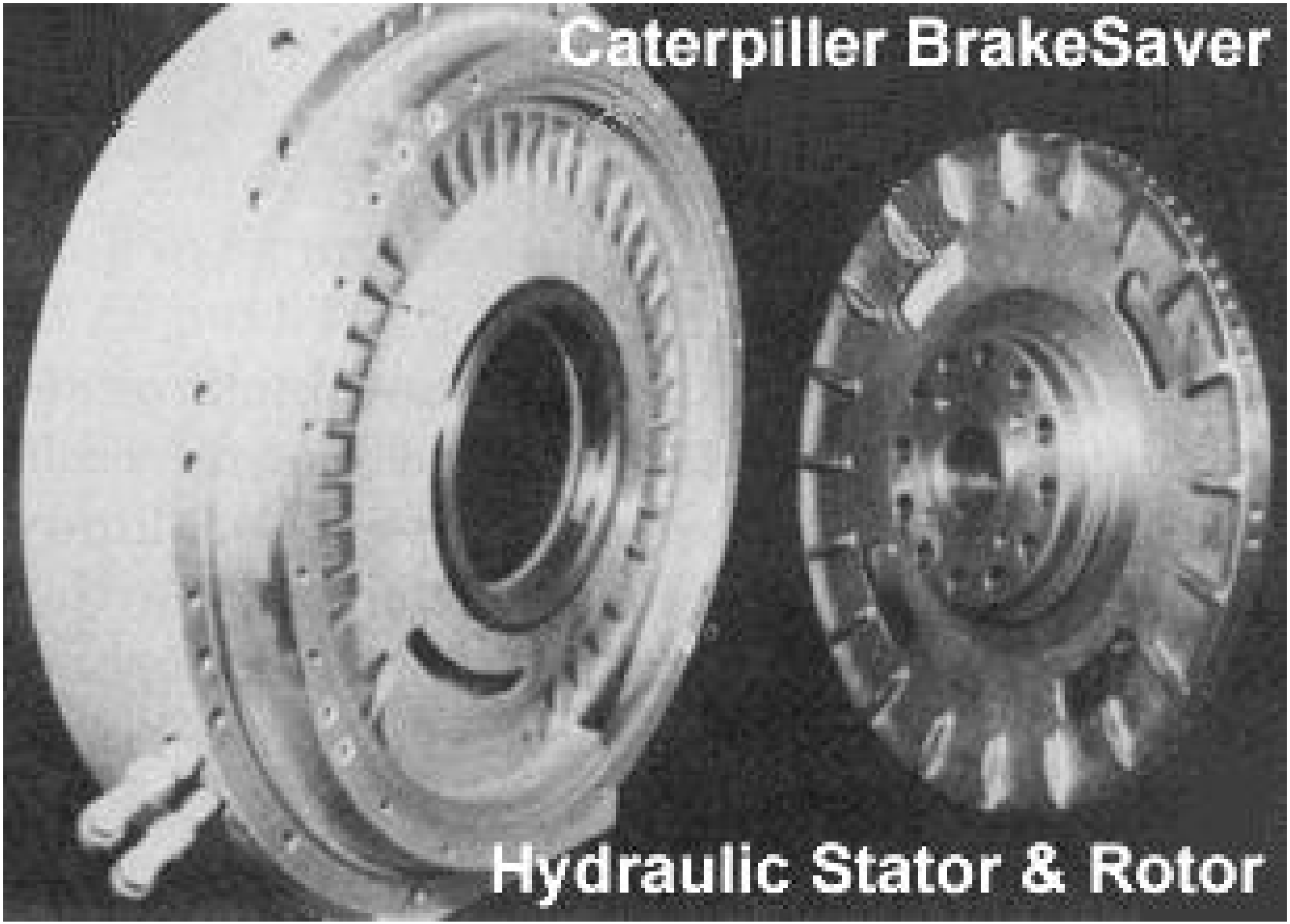
Brake activates electrically

- Current flowing through coils creates magnetic field




• Vehicle motion turns rotors
• Electromagnets energized
• Eddy Currents created
• Opposing magnetic fields slow rotors & vehicle
S
N
N
S
S
N
N
S

Caterpillar ``brakesaver``


Caterpiller BrakeSaver
Hydraulic Stator & Rotor

Fin

Systèmes d'Injection:

Terminologie des carburants:

- Carburant diesel:

Composé de pétrole distillé formulé pour être utilisé dans les moteurs à allumage par combustion.

Le diesel se compose généralement de fraction de paraffine, d'hydrocarbures naphténiques et de fractions de pétrole brut.

- Indice d'octane:

Mesure de l'habileté d'un carburant (habituellement l'essence) à ne pas produire de détonation.

- Indice de cétane:

Mesure de l'habileté d'un carburant diesel à prendre feu.

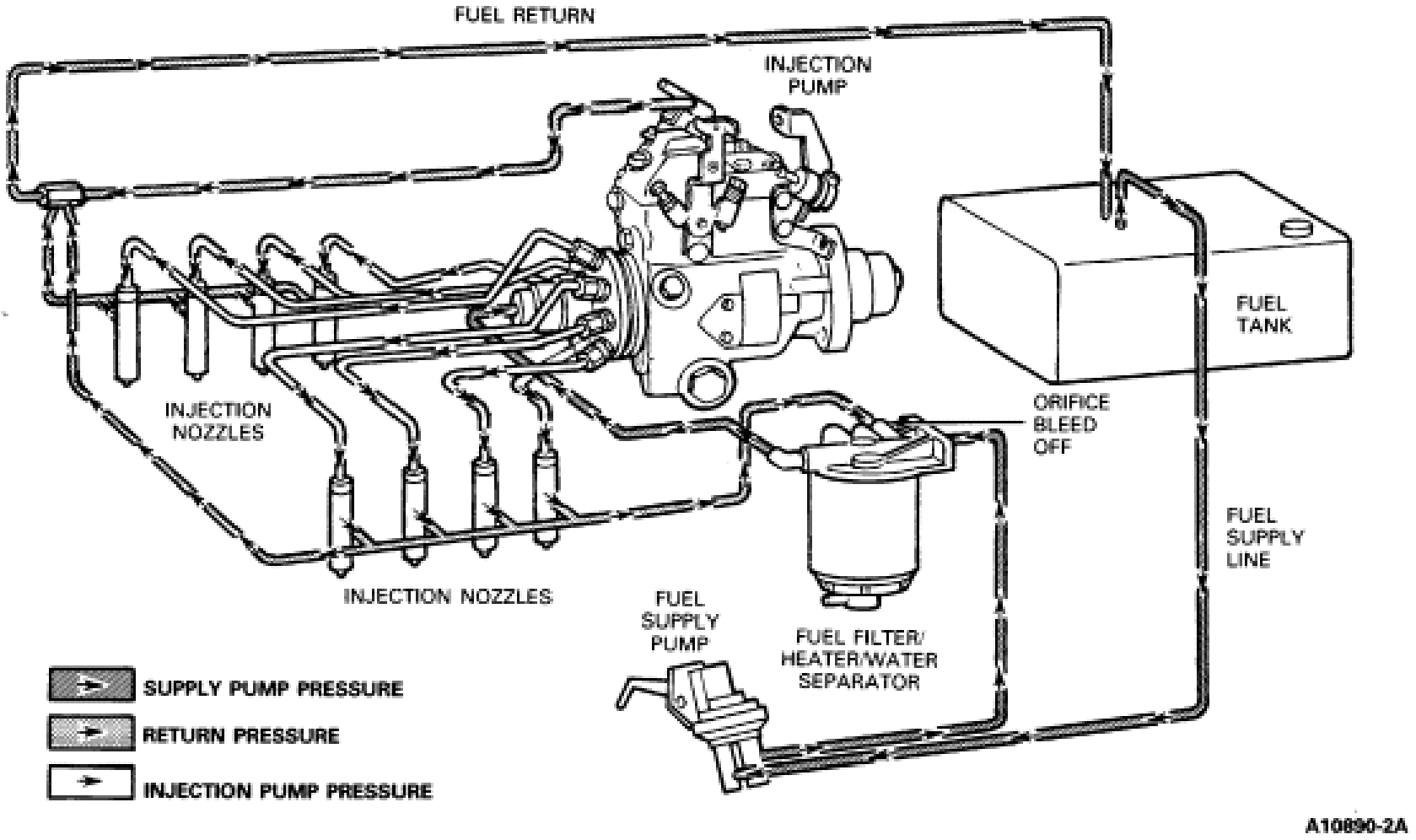
- Point d'éclair:

Température à laquelle un carburant liquide produit suffisamment de vapeurs inflammables pour produire une combustion momentanée quand une flamme est approchée.

- Teneur en soufre:

Depuis 2006 tout les carburants diesel en amérique du nord sont classé ulta low sulfur donc 15ppm de soufre.

Systèmes d’alimentation de carburant:



Amorçage du système d'alimentation (saigner, bleeder le système)

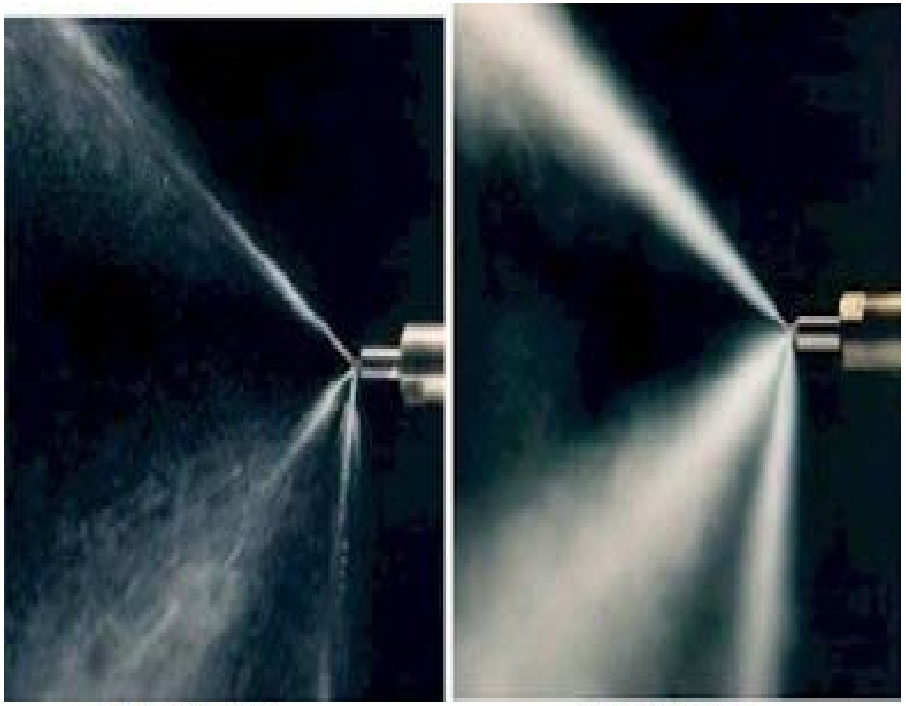
1. Démonter les filtres et remplir de carburant filtré**.**
2. Desserrer la vis de purge. (s'il n'y a pas de vis de purge desserrer le raccord de retour.
3. Actionner la pompe de transfert jusqu'à ce qu'il n'y ai plus de bulles d'air.
4. Resserrer la vis de purge, démarrer pendant 30 sec. Et recommencer jusqu'à ce que le moteur démarre.
5. Sur les systèmes mécaniques on peut desserrer les raccords d'injecteurs jusqu'à ce que le carburant sorte, (portez vos lunettes, gardez des guenilles proche).

Principe de base de l’injection

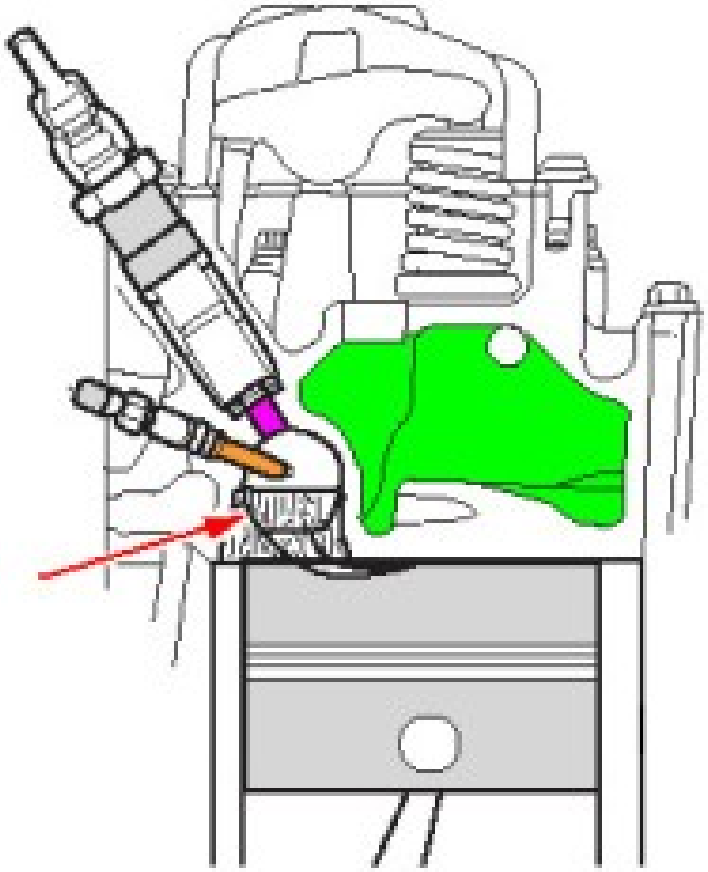
L’atomisation:

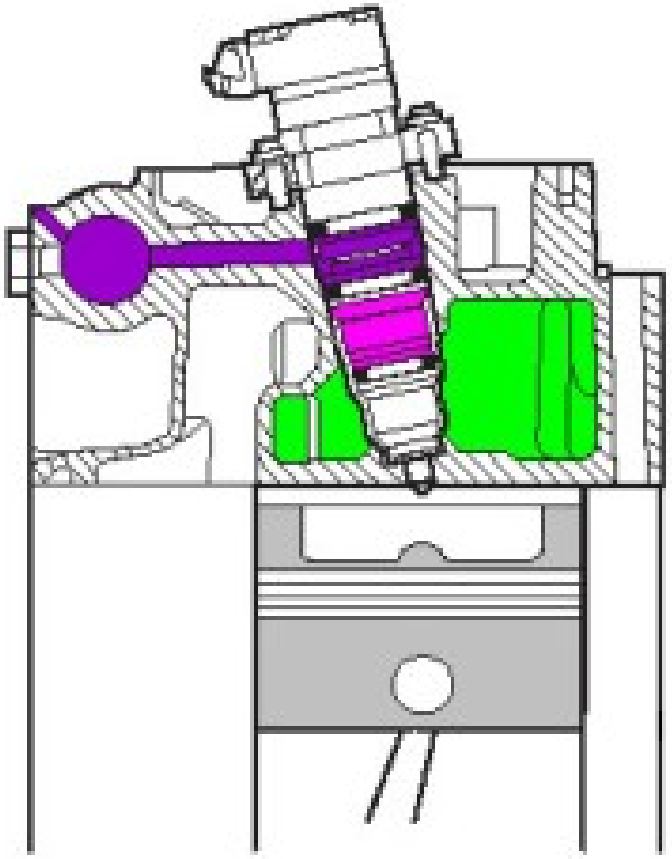
- Le carburant doit être atomisé de sorte que le calibre de ses gouttelettes s’établisse entre 10 et 100 microns.

- Le degré d’atomisation dépend de deux facteurs principaux:
  - La pression du carburant amener vers les orifices
  - Le calibre des orifices d’injection



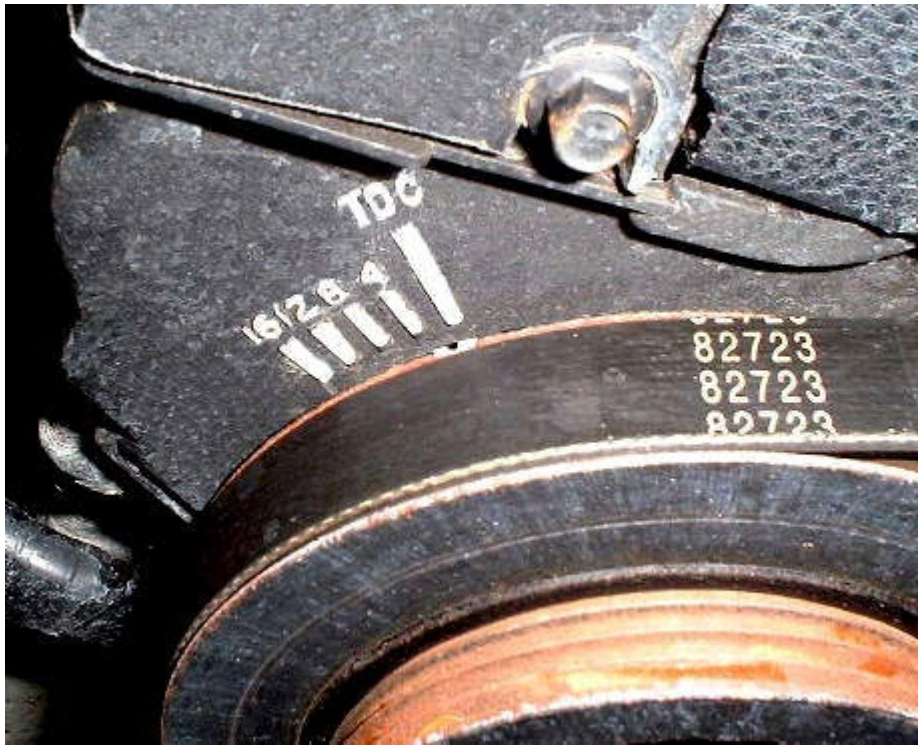
Injection indirect/direct:





Synchronisation (timing):

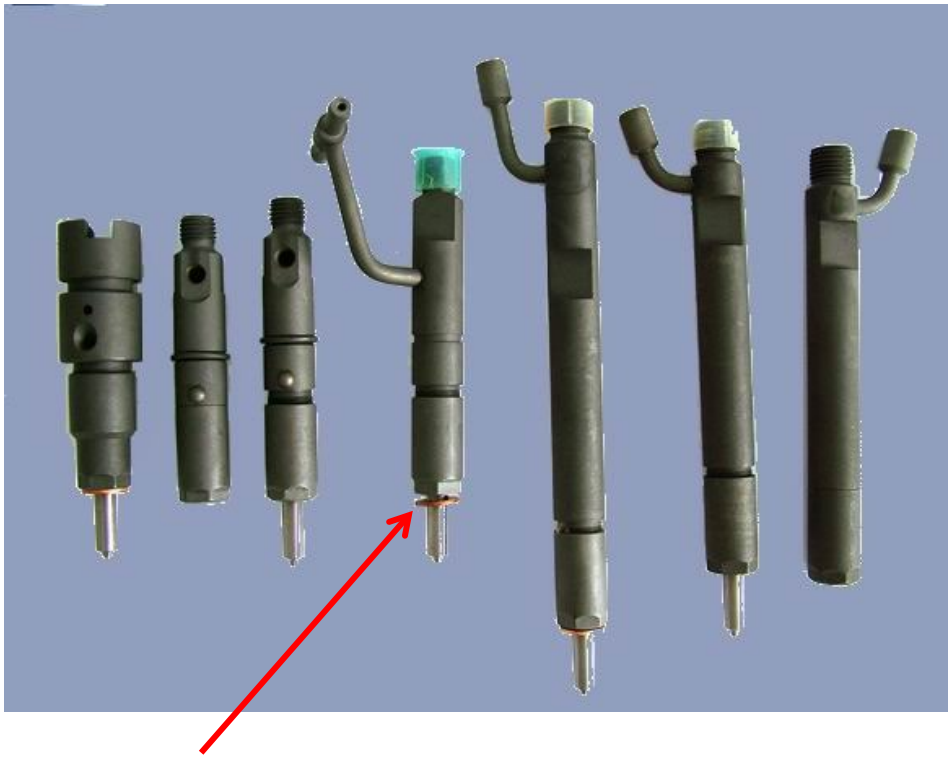
- Le carburant doit être injecté très peu de temps avant que le piston n’achève sa course de compression.



Dosage (réglage du débit) (metering):

- Consiste à contrôler avec précision la quantité de carburant injectée.
- Le seul facteur qui détermine la puissance d'un moteur diesel, c'est la quantité de carburant qu'on y injecte...
- À l'inverse d'un moteur à essence ou l'on contrôle l'air

Injecteur mécanique:



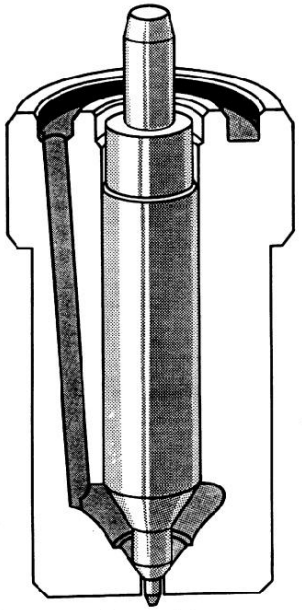
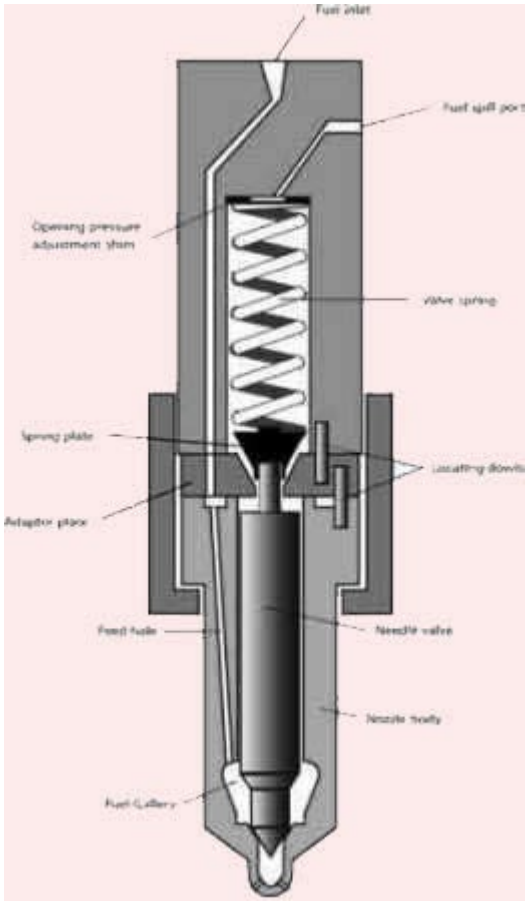


Fig. 15 - Schematic of fuel injector and nozzle holder

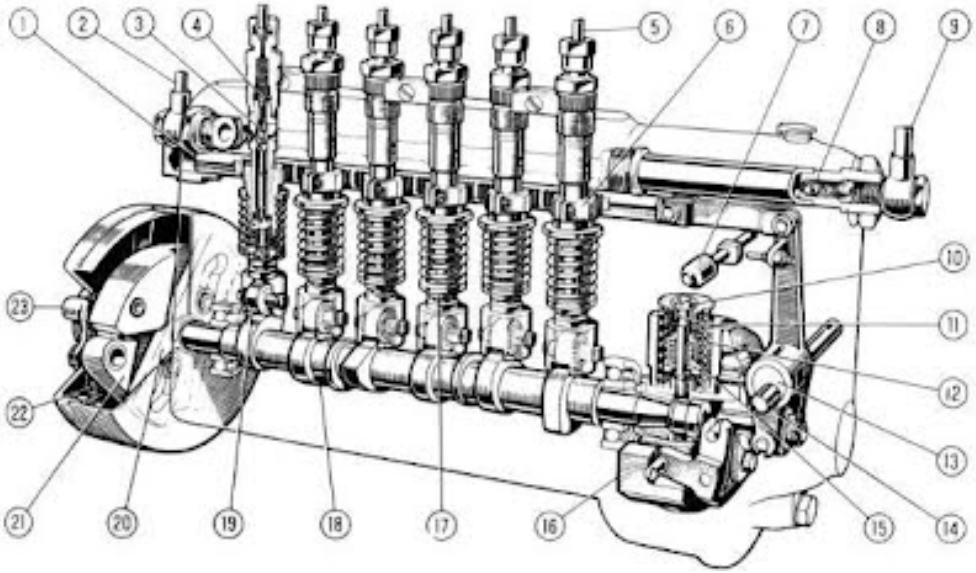


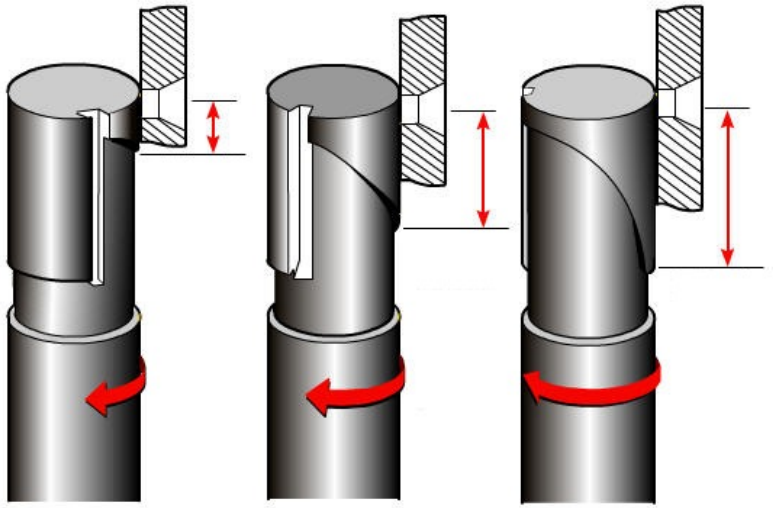
Test:

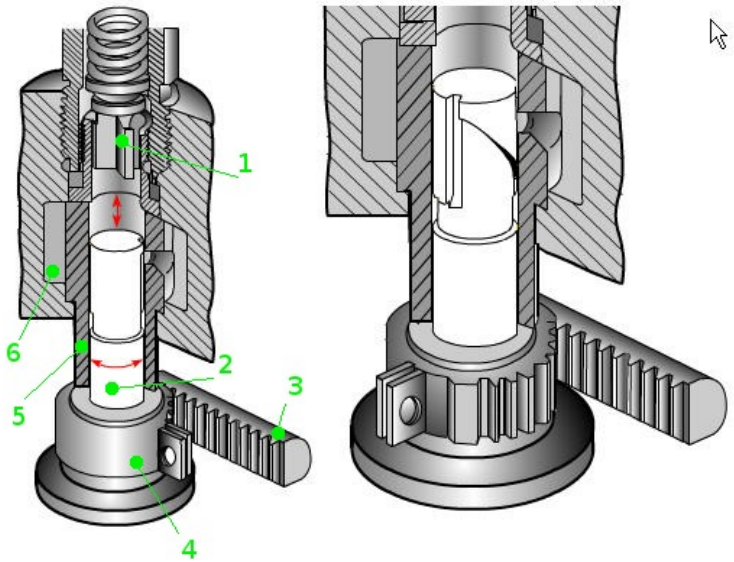
- Test de pression:

- Test d’étanchéité:

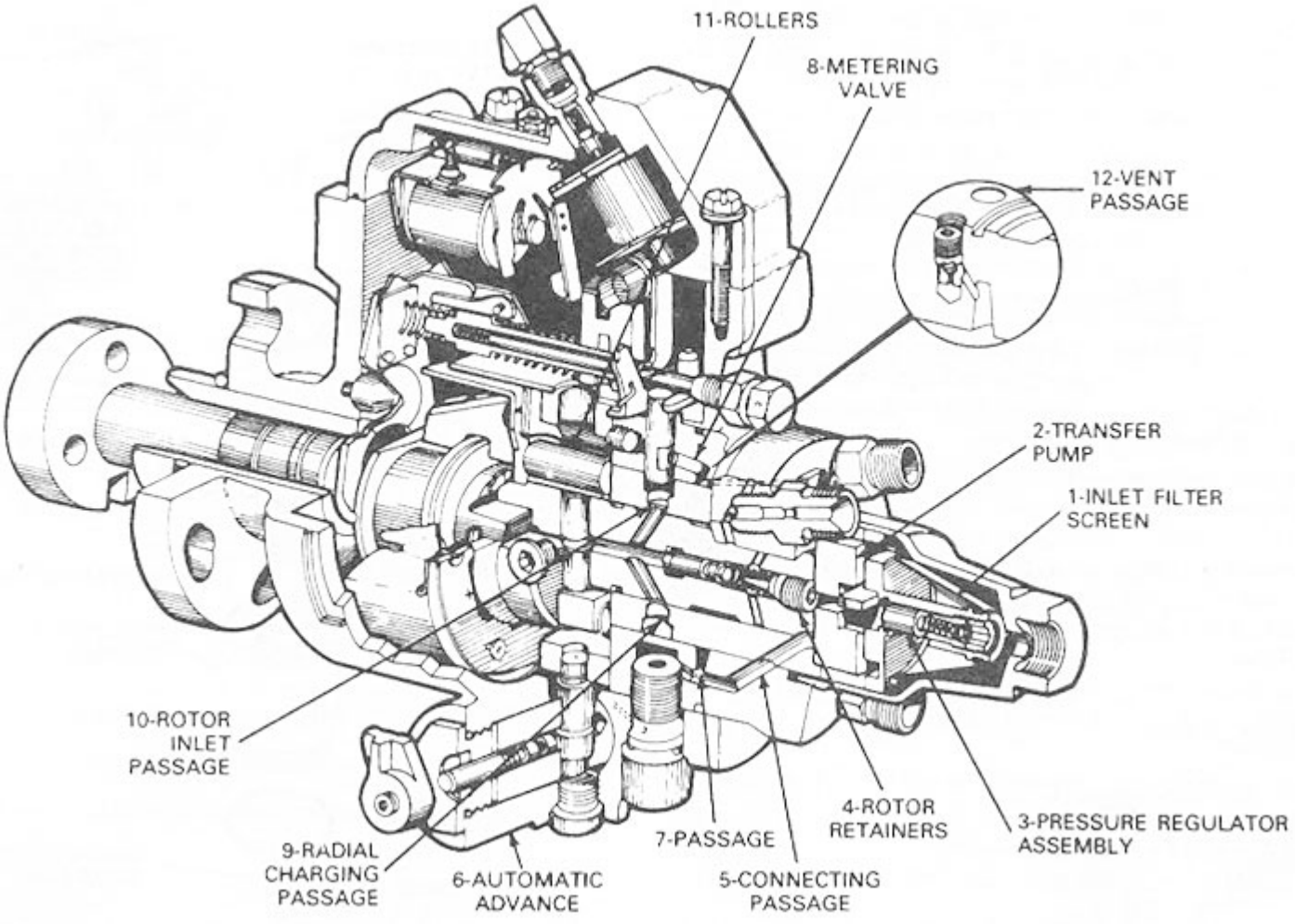
Pompe d’injection en ligne:



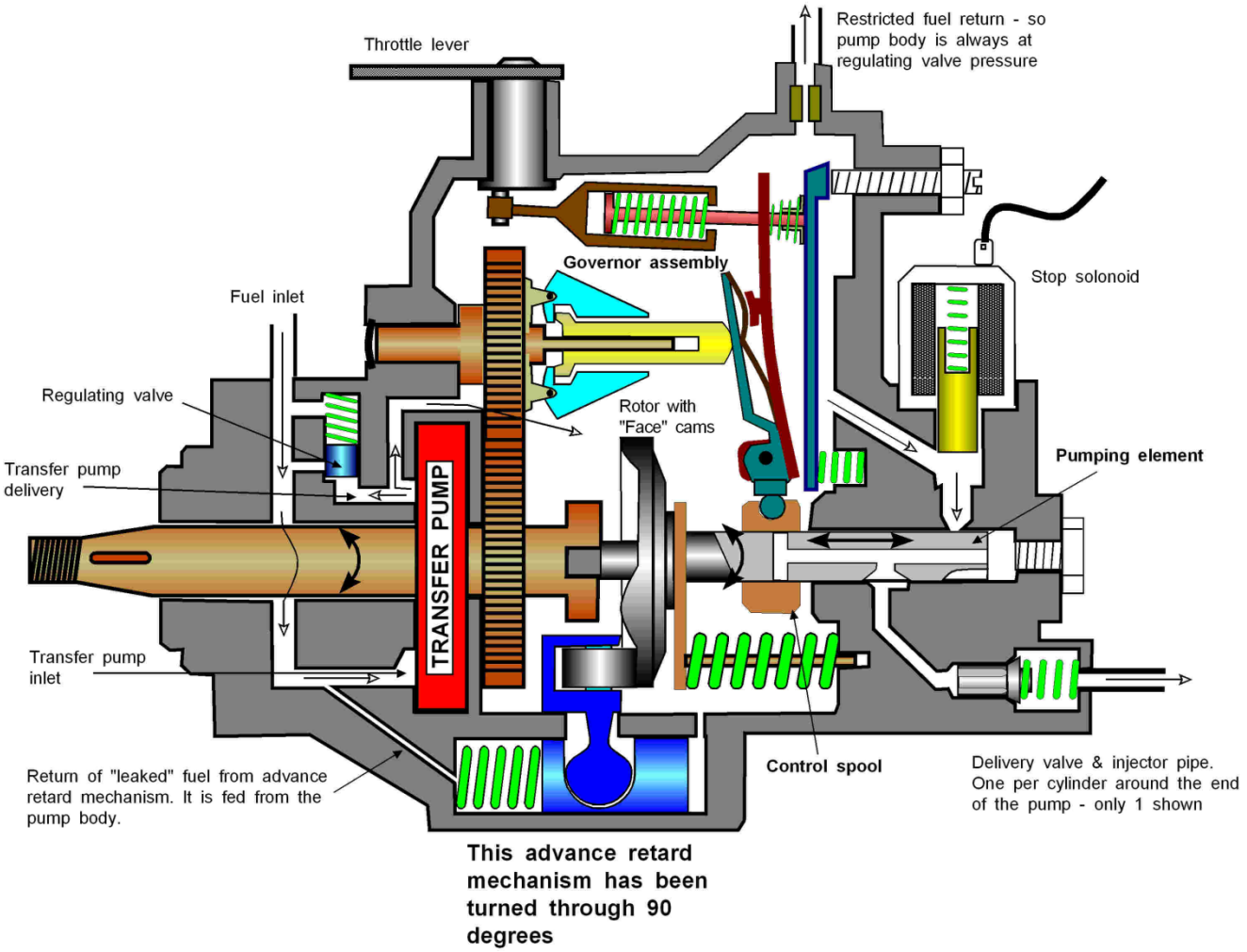


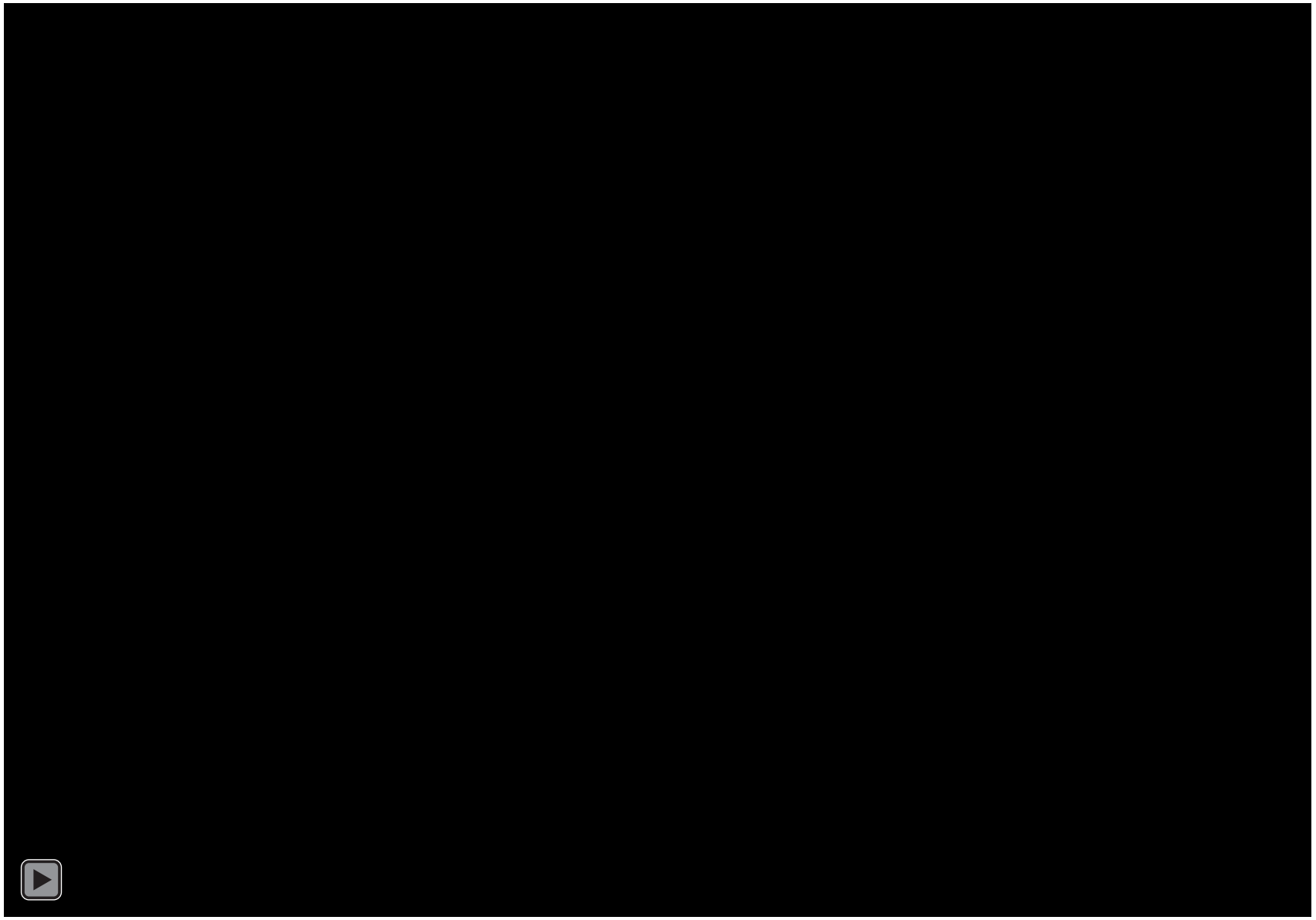


Pompe rotatives:



Gouverneur:

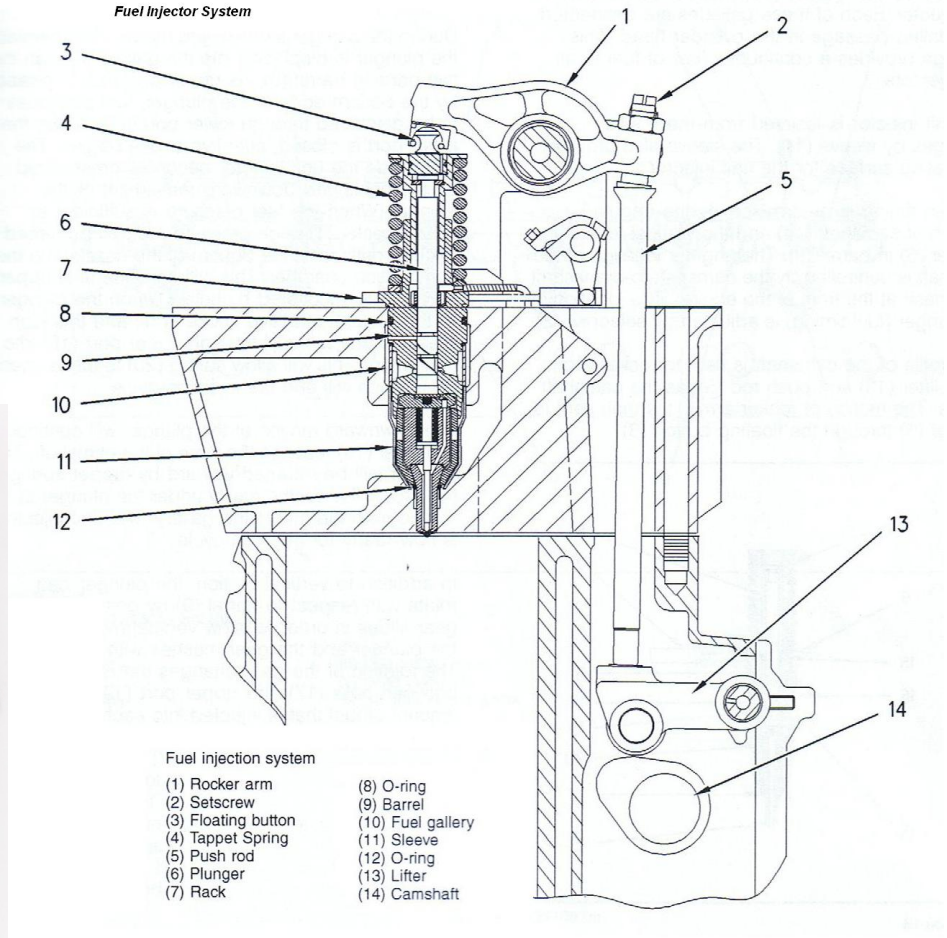

Throttle lever
Restricted fuel return - so pump body is always at regulating valve pressure
Governor assembly
Stop solonoid
Fuel inlet
Regulating valve
Rotor with "Face" cams
Transfer pump delivery
TRANSFER PUMP
Pumping element
Transfer pump inlet
Return of "leaked" fuel from advance retard mechanism. It is fed from the pump body.
Control spool
Delivery valve & injector pipe. One per cylinder around the end of the pump - only 1 shown
This advance retard mechanism has been turned through 90 degrees

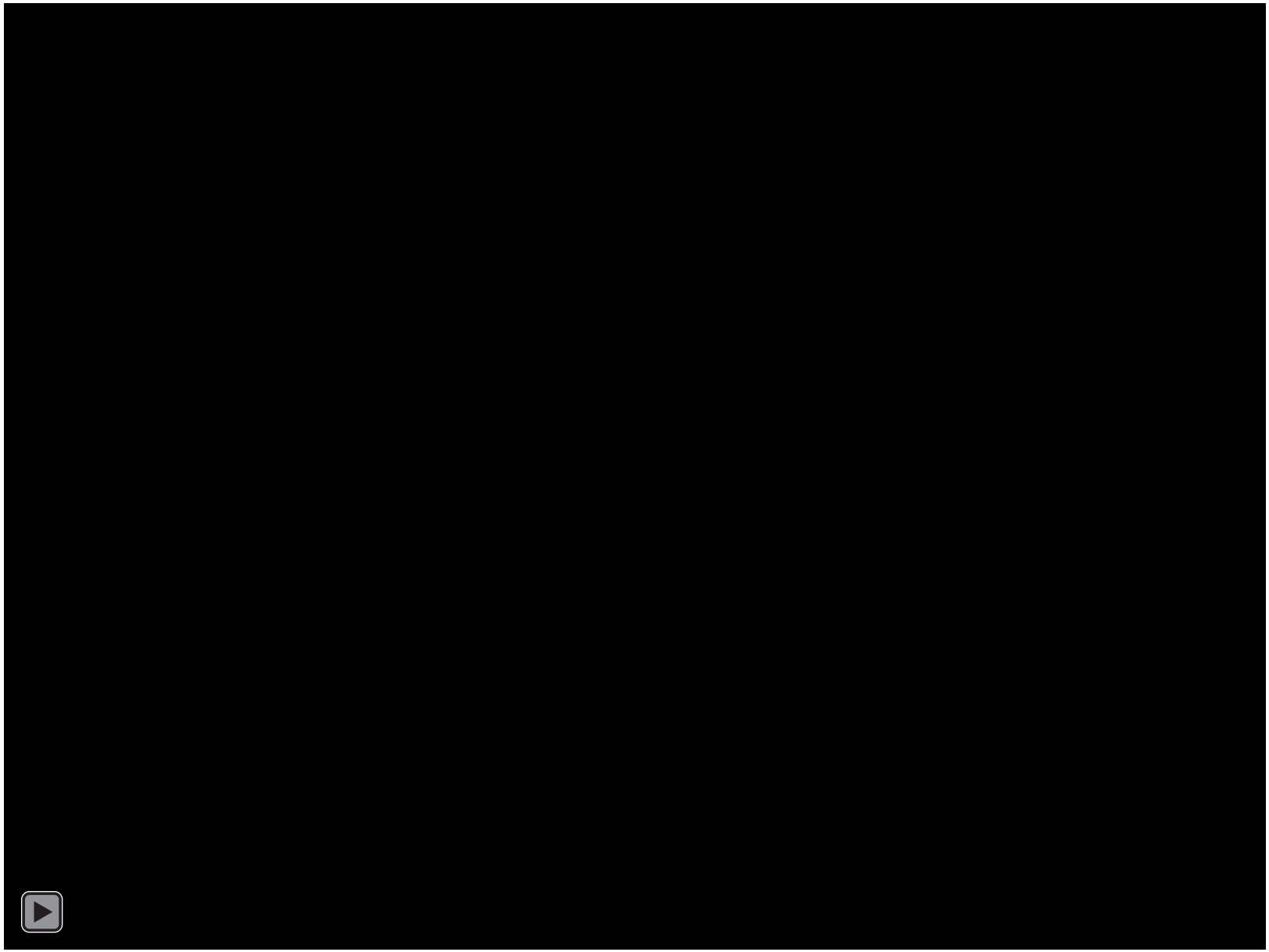


Injecteur mécaniques (MUI):

- Timing fixe (cam)
- Débit variable

(crémaillière)

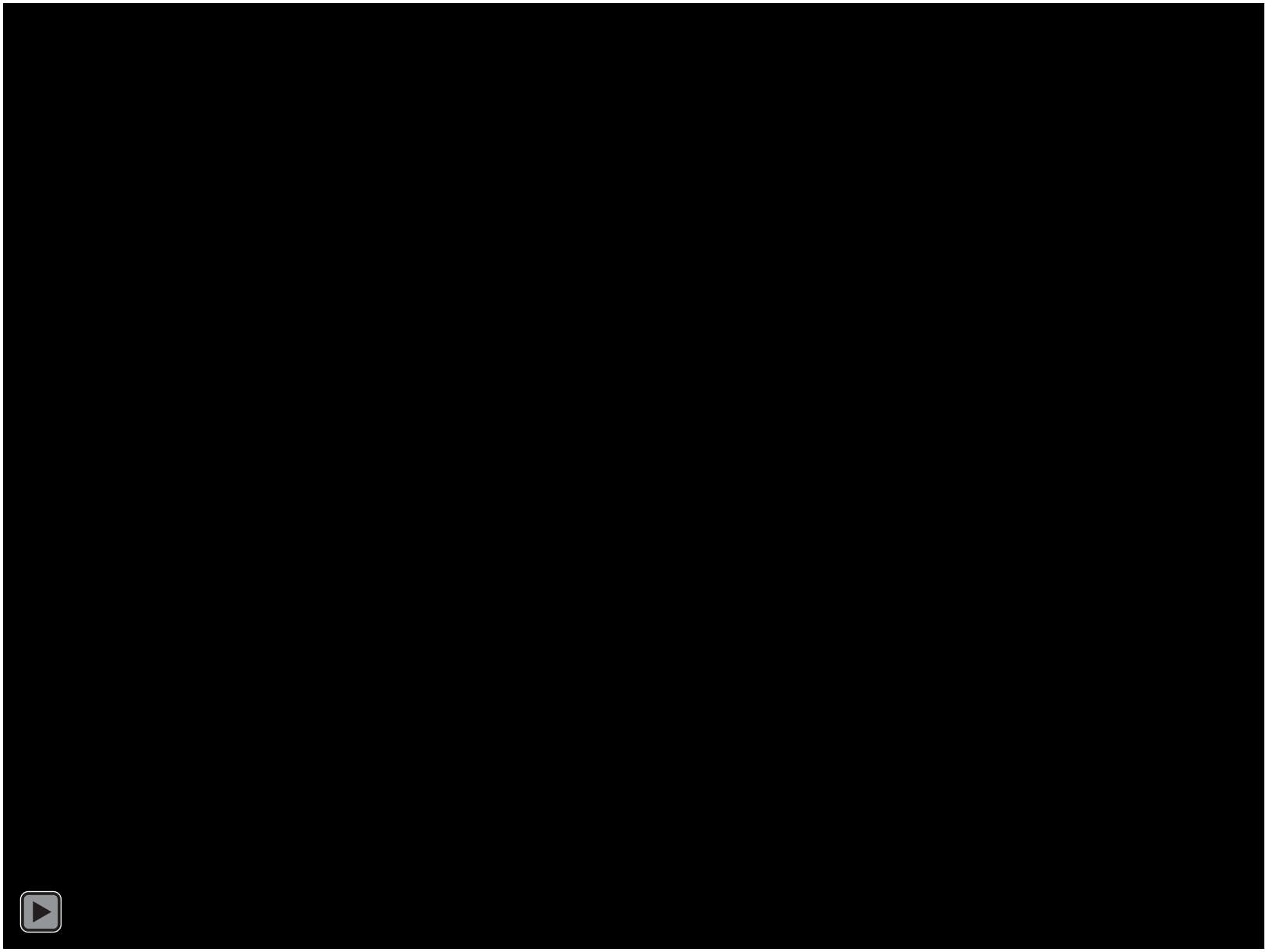




Injecteur EUI:

- Electronic
- Unit
- injector:

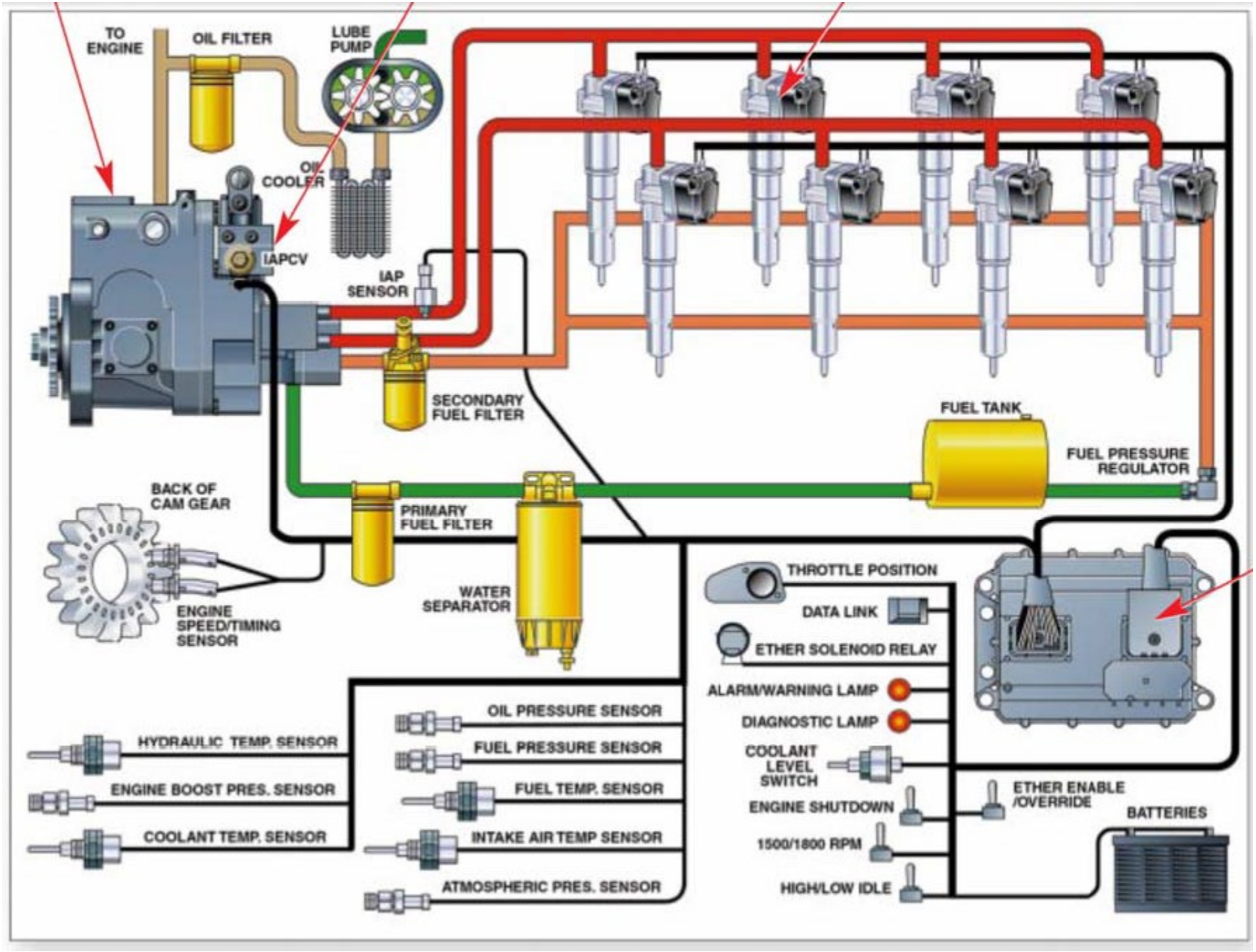
- L’injection est faite mécanique par l’arbre à cames et le dosage électroniquement par le solénoïde, contrôlé par le ECM

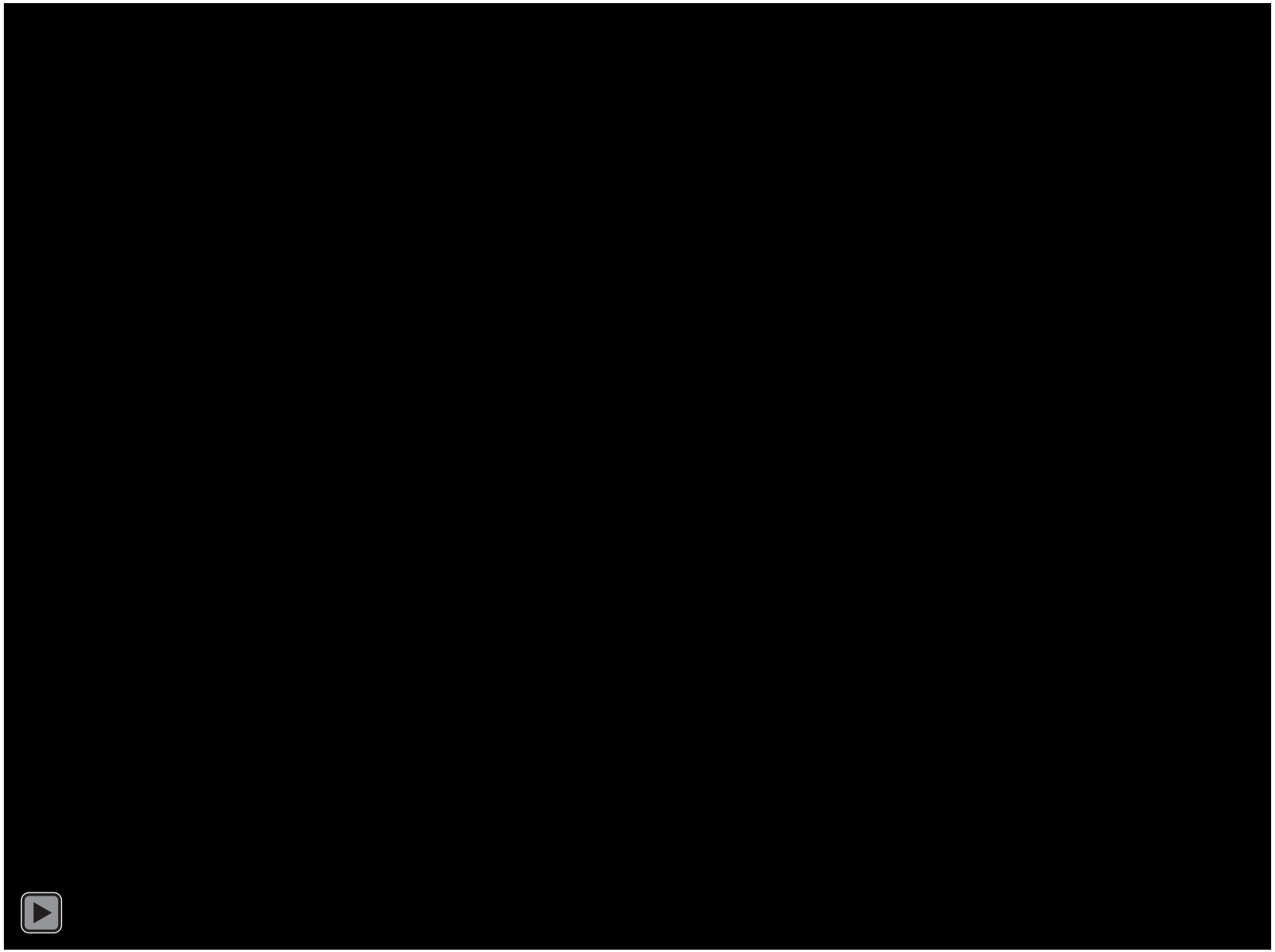


Injecteurs HEUI

- Hydraulique
- Electronique
- Unit
- Injector

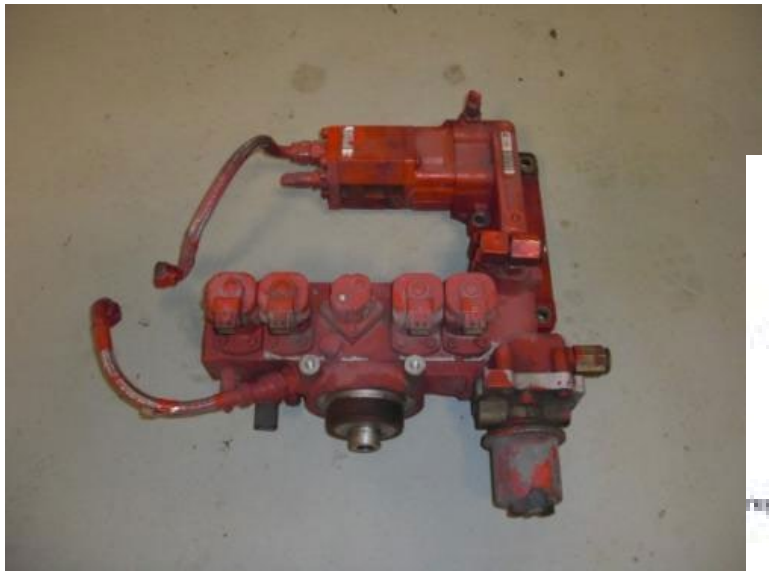
- Le dosage est contrôlé électroniquement.
- Le timing est contrôlé hydrauliquement.

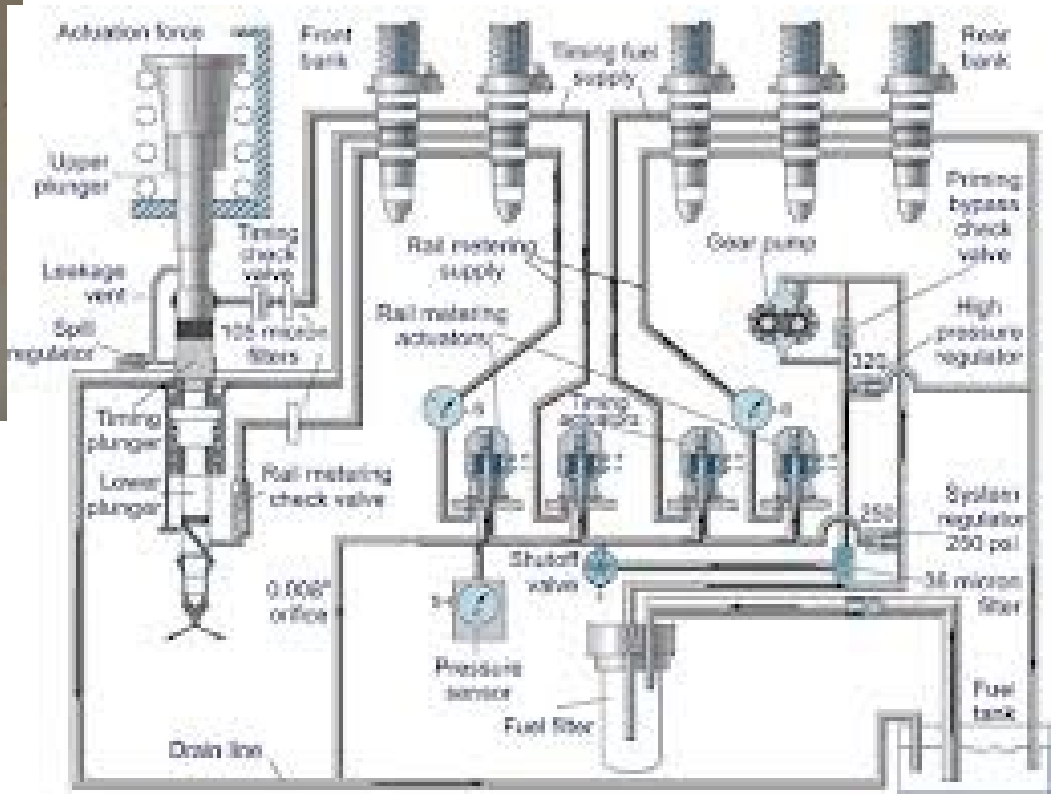

TO ENGINE
OIL FILTER
LUBE PUMP
OIL COOLER
IAPCV
IAP SENSOR
SECONDARY FUEL FILTER
FUEL TANK
FUEL PRESSURE REGULATOR
BACK OF CAM GEAR
PRIMARY FUEL FILTER
WATER SEPARATOR
ENGINE SPEED/TIMING SENSOR
THROTTLE POSITION
DATA LINK
ETHER SOLENOID RELAY
ALARM/WARNING LAMP
DIAGNOSTIC LAMP
COOLANT LEVEL SWITCH
ENGINE SHUTDOWN
1500/1800 RPM
HIGH/LOW IDLE
ETHER ENABLE /OVERRIDE
BATTERIES
HYDRAULIC TEMP. SENSOR
ENGINE BOOST PRES. SENSOR
COOLANT TEMP. SENSOR
OIL PRESSURE SENSOR
FUEL PRESSURE SENSOR
FUEL TEMP. SENSOR
INTAKE AIR TEMP SENSOR
ATMOSPHERIC PRES. SENSOR

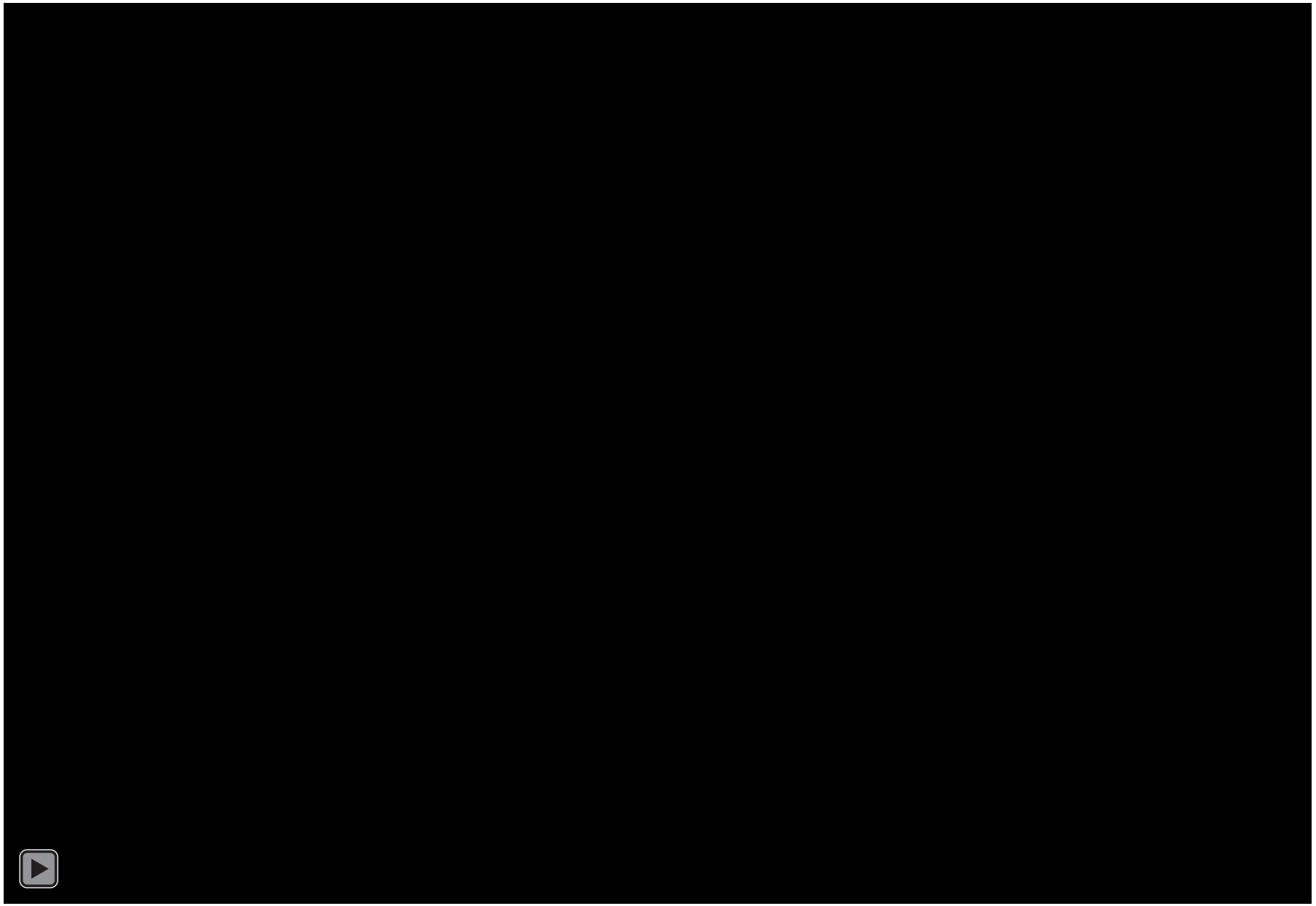


Système HPI-TP Cummins:

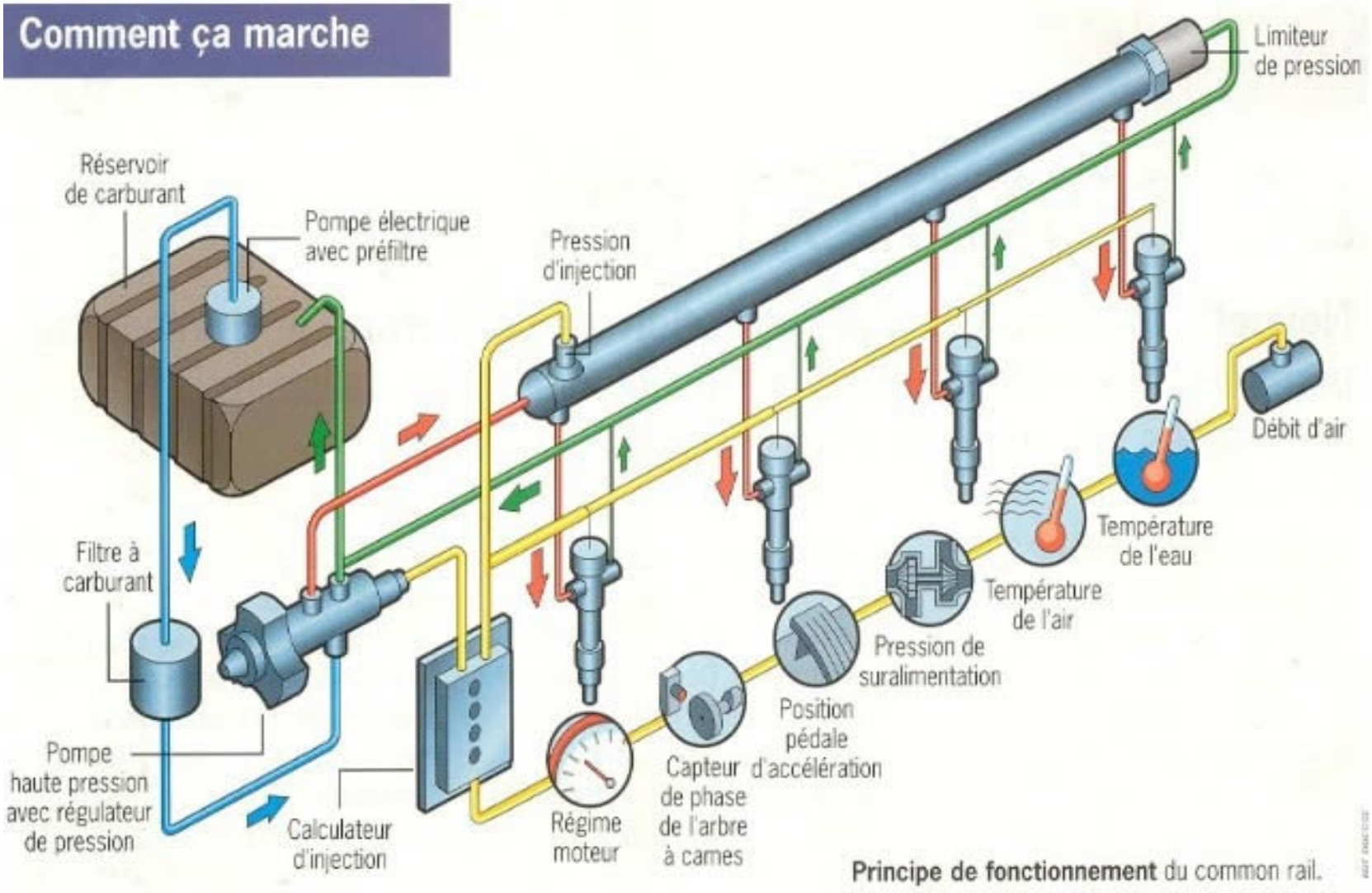
IFSM:



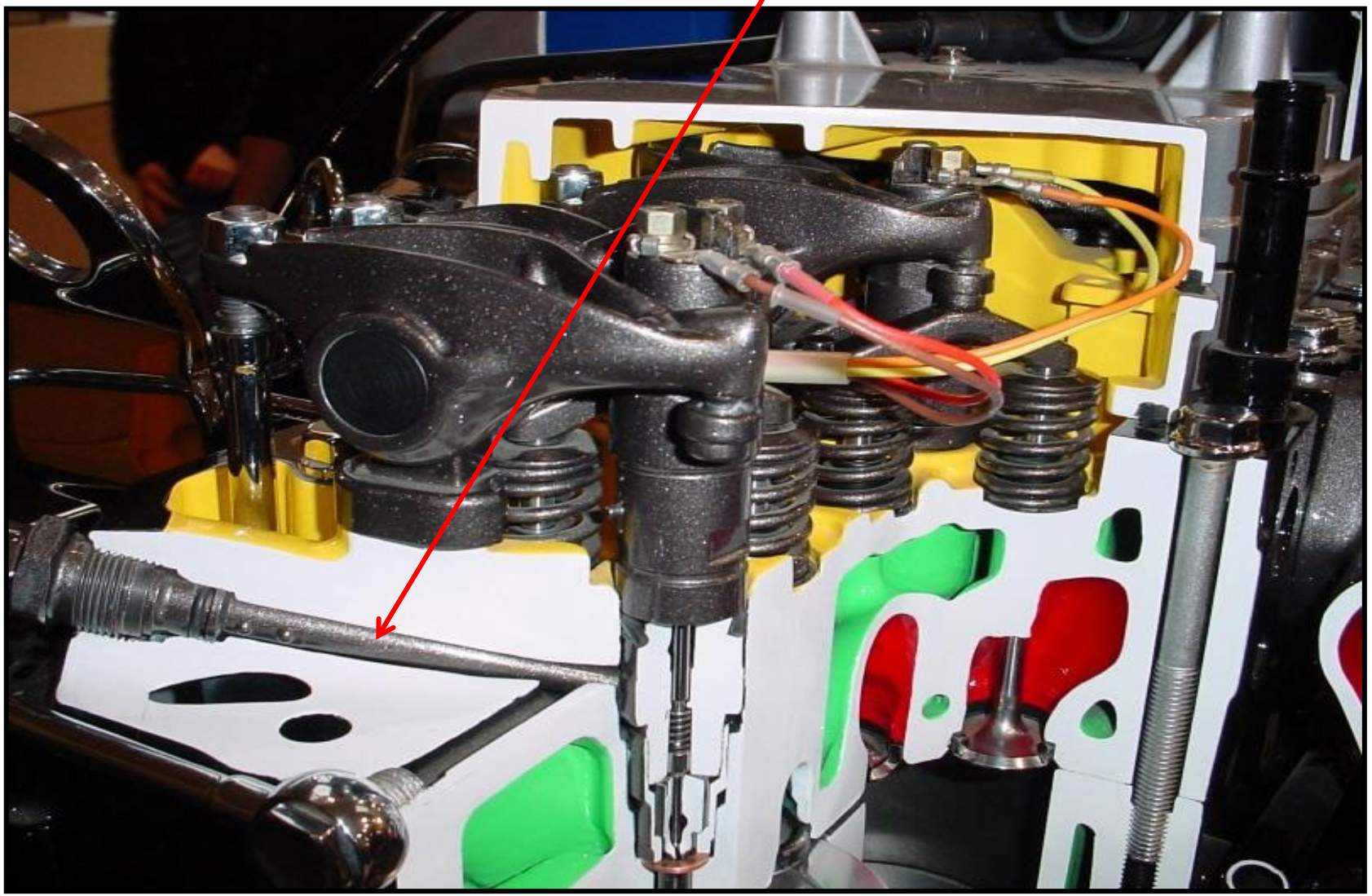

Actuation force
Front bank
Timing fuel supply
Rear bank
Upper plunger
Priming bypass check valve
Timing check valve
Rail metering supply
Gear pump
Leakage vent
Rail metering actuator
High pressure regulator
Spill regulator
105 micron filters
Timing plunger
Timing actuator
Lower plunger
Rail metering check valve
System regulator 250 psi
Shutoff valve
0.006" orifice
38 micron filter
Pressure sensor
Fuel filter
Fuel tank
Drain line



Système common rail

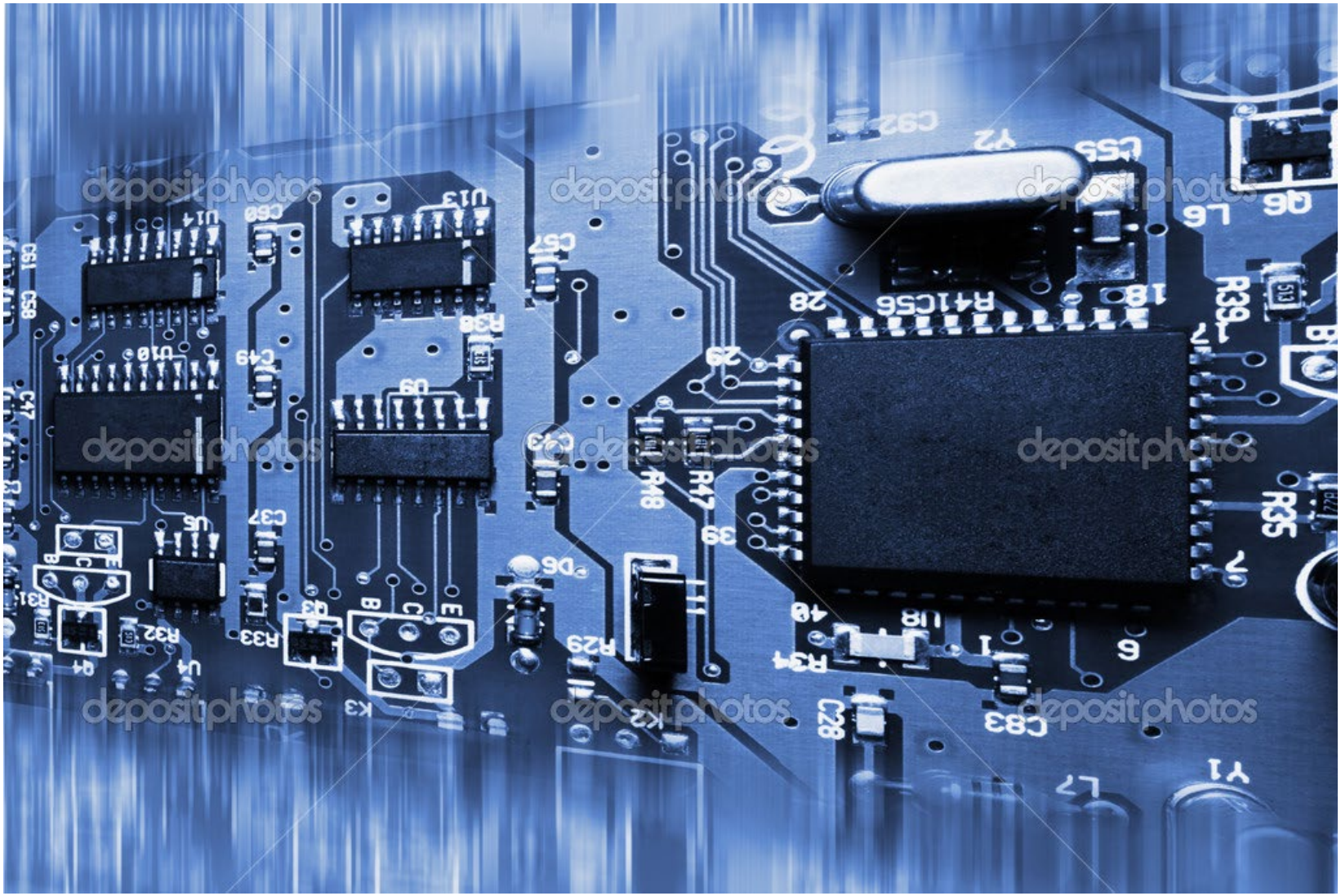


Connecteur tube:



Connector tube:

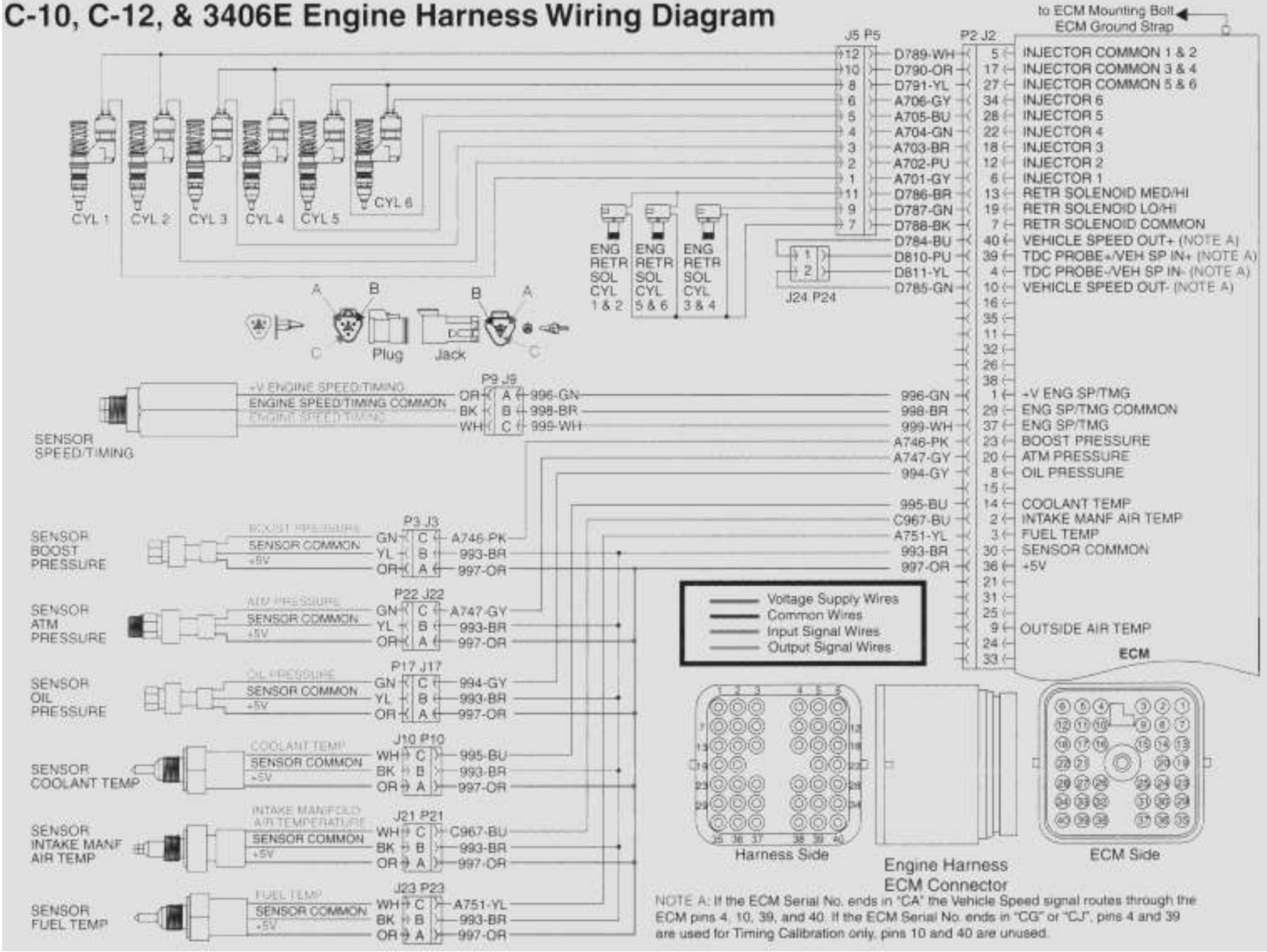
Contrôle électronique:



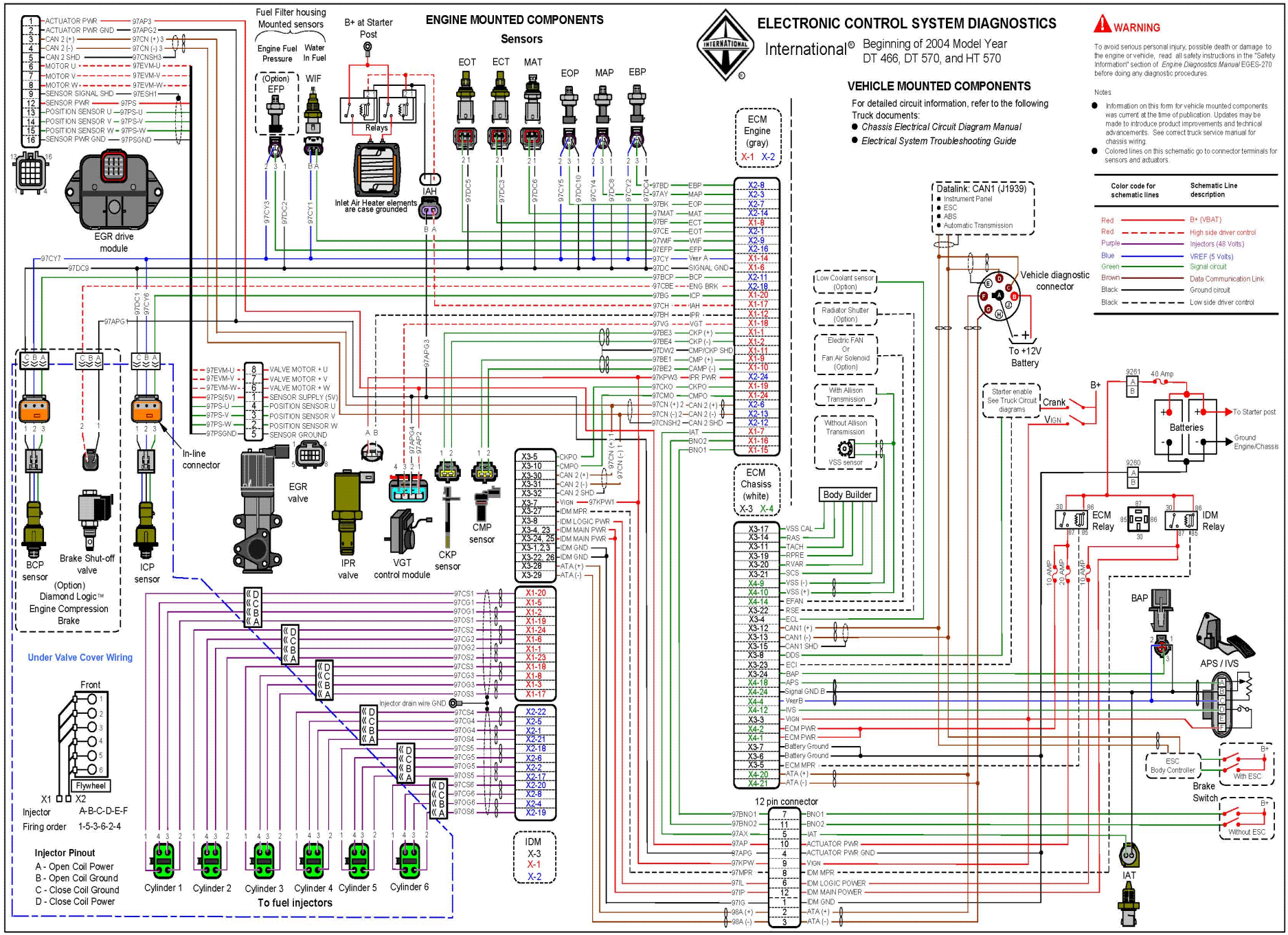
ECM:

- Entrée:
- Traitement:
- Sortie:

C-10, C-12, & 3406E Engine Harness Wiring Diagram

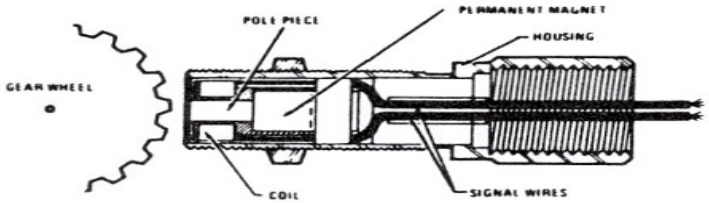


NOTE A: If the ECM Serial No. ends in "CA" the Vehicle Speed signal routes through the ECM pins 4, 10, 39, and 40. If the ECM Serial No. ends in "CG" or "CJ", pins 4 and 39 are used for Timing Calibration only, pins 10 and 40 are unused.

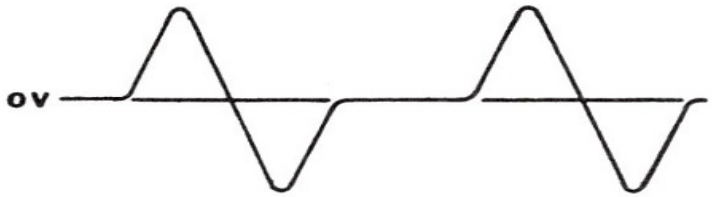


Les senseurs:

- Capteurs magnétiques:
- 2 fils
- Générateurs de voltages
- Onde sinusoïdale
- Utiliser comme capteur de vitesse (cam- crank)



TYPICAL VARIABLE RELUCTANCE PICKUP



VOLTAGE WAVEFORM FROM PICKUP

Capteur effet hall

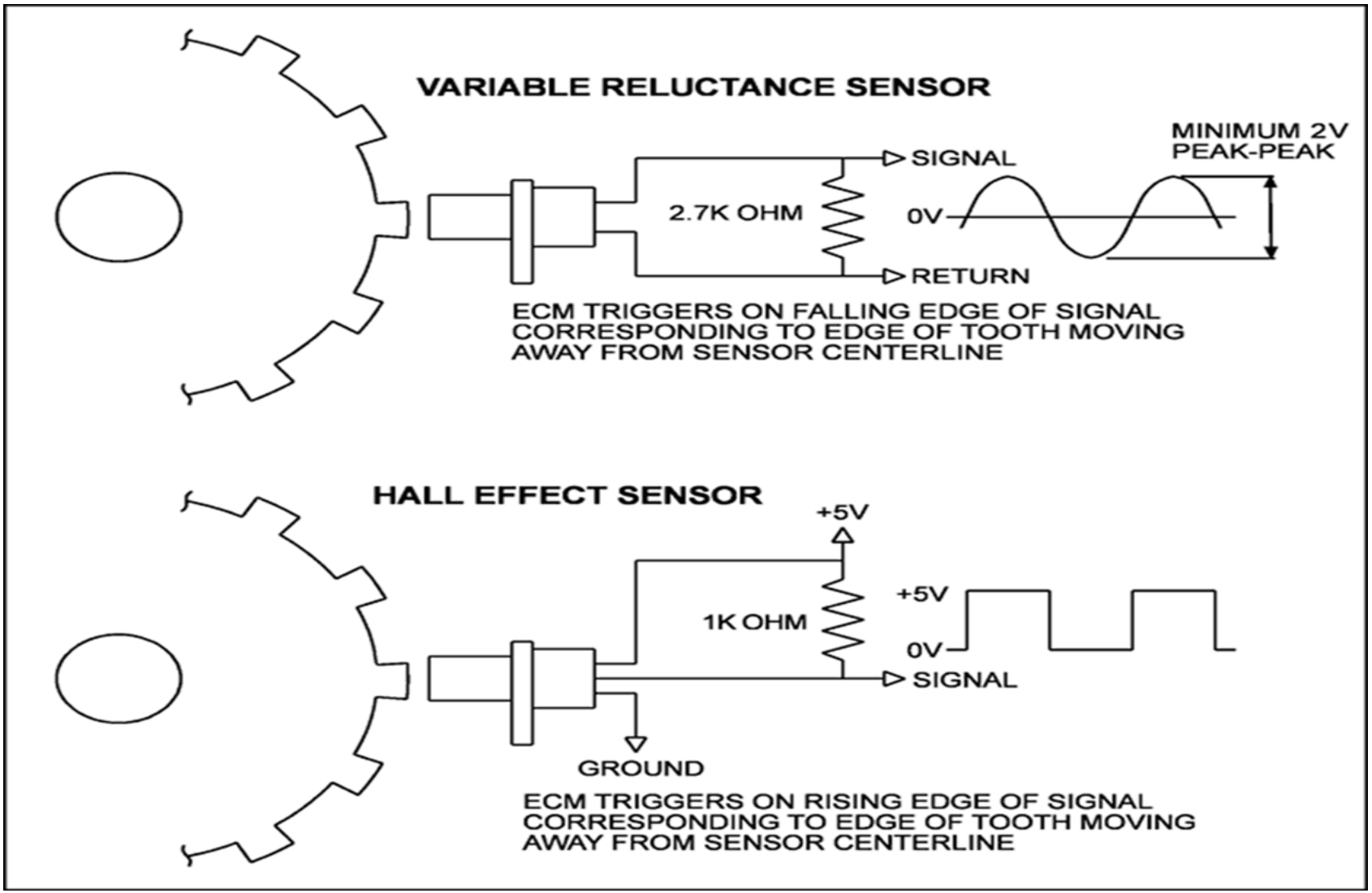
- Capteur de vitesse ou de timing.

- Onde numérique

- 3 fils

- Voltage de référence
- Signal
- ground

Magnétique vs hall effect

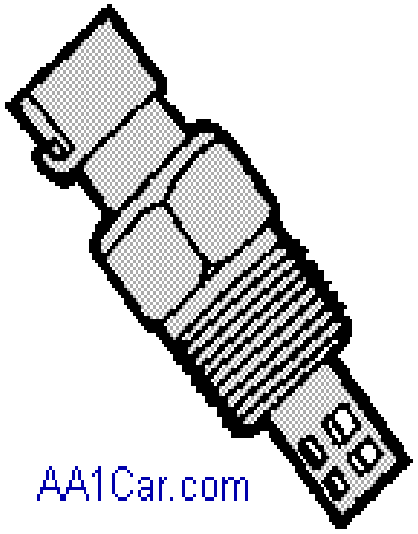


Capteur de températures:

- thermistances

- 2 fils
- Voltage de référence (5V)
- retour

Manifold Air Temperature Sensor



Air Temp Sensor Values

(Typical readings for Ford EEC-IV)

Temperature °F	Temperature °C	Voltage	Resistance
248	120	0.28 v	1.18K
230	110	0.36	1.55
212	100	0.47	2.07
194	90	0.61	2.80
176	80	0.80	3.84
158	70	1.04	5.37
140	60	1.35	7.60
122	50	1.72	10.97
104	40	2.16	16.15
86	30	2.62	24.27
68	20	3.06	37.30
50	10	3.52	58.75

Capteurs de presions:

- 3 fils:

- Voltage de référence(5V)
- Signal
- Ground

Pédale à fuel

- Potentiomètre
- IVS: (idle validation switch)