Introduction to Automotive Service State Test Review

Levels:	Grades 10-12
Units of Credit:	0.5 minimum
CIP Code:	47.0604
Prerequisite:	None

STANDARD 470604-01

Students will be able to understand general shop safety.

470604-0101
Learn safe working habits and procedures. Pass a safety test with 100 percent.

- Personal safety.
- Tool and equipment safety.
- Workplace safety.

470604-0102
Comply with safety rules for working with automotive chemicals.

- Chemical manufacturers provide a material safety data sheet (MSDS) for each chemical they produce.
- Store chemicals in properly labeled containers.

Right-to-know what?

Material Safety Data Sheet

CONFIDENTIAL

Please restrict the use to your internal company requirements.

Material Safety Data Sheet

ENLUBE AIR LINE OIL-10W

HMIS	
Health	1
Flammability	1
Reactivity	0
Protective Equipment	ABC

Section 1 – Chemical Product and Company Identification

Engineered Lubricants Co.
11525 Rock Island Court
Maryland Heights, MO 63043-3597

Emergency Phone Numbers
Engineered Lubricants: 314-872-9540
Transportation Emergencies: Chemtrec: 1-800-424-9300
After Hours Medical Emergencies: 1-800-876-0008 Ext. 3068

Product Description: Petroleum Hydrocarbon Oil Blend

Section 2 – Composition / Information on Ingredients

Hazardous Components Per 40 CFR Parts 302.4, 355.5, & 372.65	CAS #	% Vol	Exposure Limits		Carcinogen		
			ACGIH TLV	OSHA PEL	NTP	IARC	OSHA
None							
Balance of Components: Trade Secret			N/E	N/E	N	N	N

470604-0103

Identify the gasses encountered in the automotive field and the hazards they present.

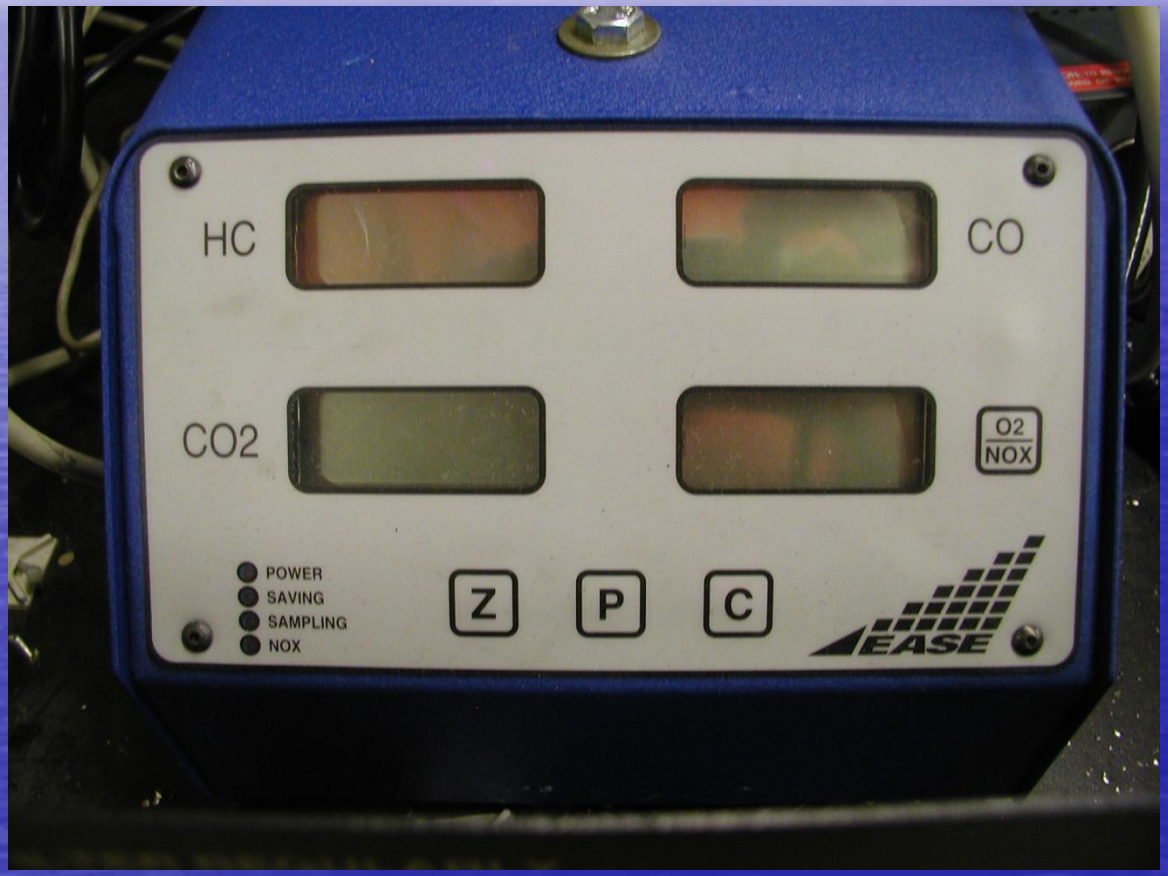
Non-Hazards:

- Water (H_2O)
- Oxygen (O_2)
- Nitrogen (N)
- Carbon dioxide(CO_2) = global warming

Hazards:

- Hydrocarbons (HC), Volatile organic compounds (VOCs) = smog, health problems
- Oxides of nitrogen (NO_x) = smog, health problems
- Carbon monoxide (CO) = deadly cumulative poison
- Ground level ozone (O_3) = smog, health problems
- Particulate matter (PM-10, Pm-2.5) = smog, health problems
- Chloroflourocarbons (CFCs) = ozone depletion

Emissions analyzer



Non-Hazardous gasses:

- Water (H_2O)
- Oxygen (O_2)
- Nitrogen (N)

Non-hazardous gas—environmental threat

- Carbon dioxide(CO_2)
  - Not hazardous physiologically
  - Causes global warming

Hazardous gasses:

- Carbon monoxide (CO) = deadly cumulative poison
- Hydrocarbons (HC), Volatile organic compounds (VOCs) = smog, health problems
- Oxides of nitrogen (NOx) = smog, health problems
- Ground level ozone (O3) = smog, health problems
- Particulate matter (PM-10, Pm-2.5) = smog, health problems
- Chloroflourocarbons (CFCs) = frostbite, ozone depletion

Carbon Monoxide (CO):

- Caused by incomplete combustion (rich mixture)
  - Not enough oxygen to make CO2
- A rich air/fuel ratio can be caused by:
  - fuel enrichment during cold engine startup
  - Too much fuel (high fuel pressure, leaky injectors)
  - Too little air (restricted/dirty air filter)
- Colorless, odorless, tasteless gas
- Symptoms: headache, nausea, dizziness, fatigue
- Cumulative poison--builds up in bloodstream
- 1% = death in 3 minutes
- Removed with exhaust hoses/shop ventilation

Hydrocarbons (HC):

- HC in the exhaust is unburned fuel/gasoline
- The fuel is unburned because it did not light
- Typically caused by spark misfire/or lean air/fuel ratio misfire (vacuum leaks)
- HC is also any petroleum based solvents
- Referred to as VOCs--Volatile organic compounds
- Carcinogeous (cancer causing)
- Source of smog

Oxides of Nitrogen:

- Caused by high combustion chamber temperatures
- Can result from heat caused by:
  - Lean air/fuel ratio
  - Engine cooling system problems
- Prevention includes:
  - Exhaust Gas Recirculation
  - Valve overlap

470604-0104
Identify the hazards and control of asbestos dust.

- Asbestos is a carcinogen – a substance that causes cancer.
- Never use compressed air or dry brush to clean brake assemblies.
- Use a brake vacuum or brake washer.

Brake washer for asbestos

470604-02

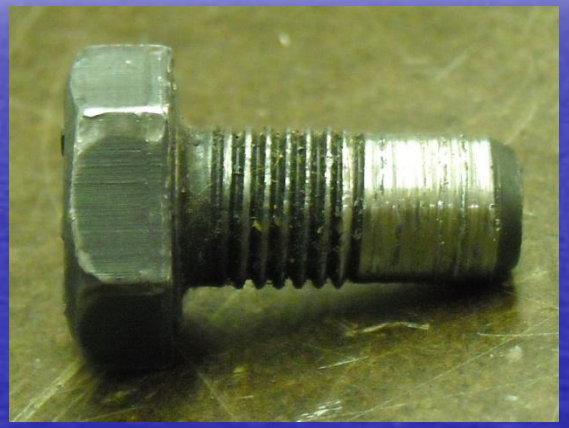
Students will be able to understand basic hand tools, fasteners, and shop equipment.

470604-0201
Identify and measure metric and standard fasteners.

- Machine screws/bolts, sheet metal screws, studs, nuts.
- Lock and flat washers.
- Head markings, thread series, right-hand and left-hand threads, major and minor diameters, thread pitch.

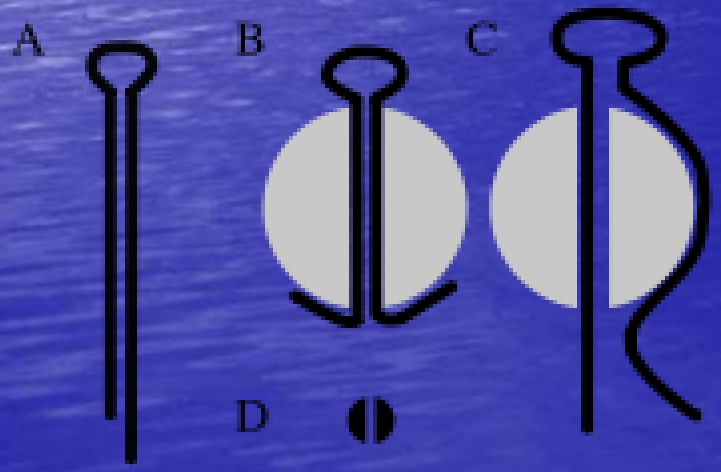
Hardness markings: Metric (10.9=hard), standard (3 marks=grade 5=medium)

Left hand threads:

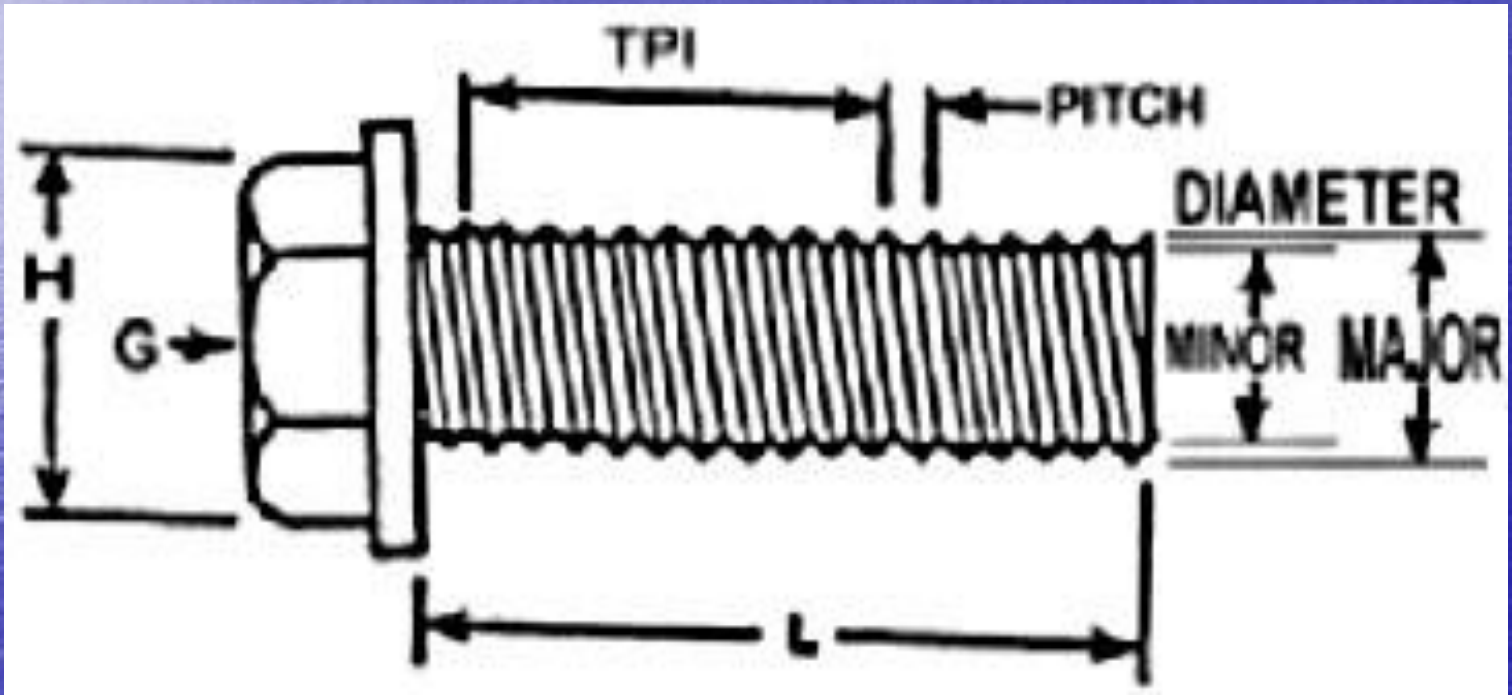


Fasteners:
bolt, nut,
flat washer, and lock washer.

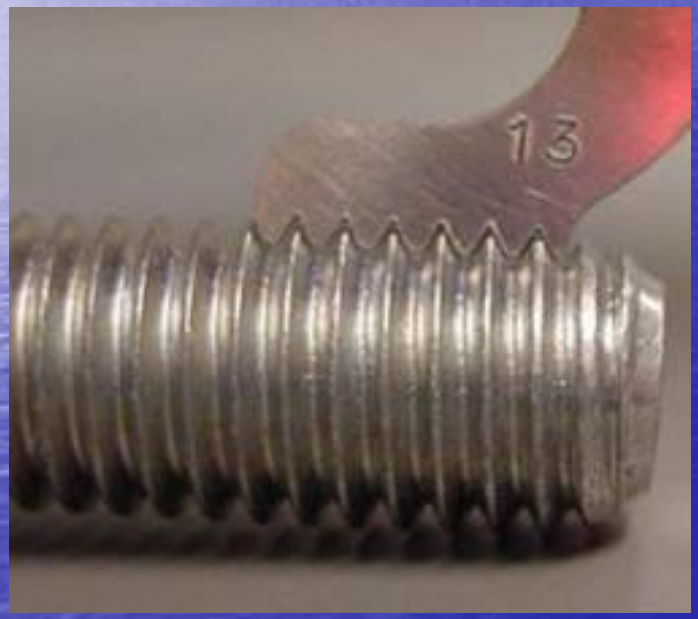
Fasteners:
machine screw, sheet metal screw, cotter pin, studs.



Threads per inch (tpi) is used with standard fasteners.
Pitch is used with metric fasteners.



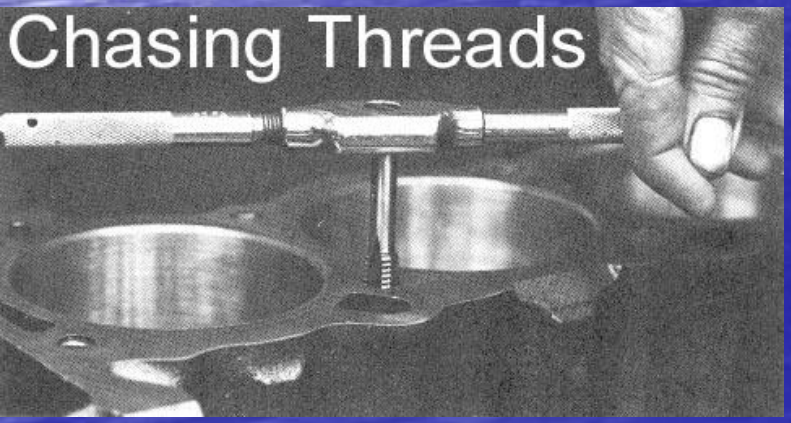
13 tpi and 1.5mm pitch



470604-0202
Correctly identify and use basic hand tools.

- Screwdrivers, wrenches, sockets, drive handles, extensions, pliers, hammer, chisels, punches, files, hacksaw, taps, dies, vises, drill bits
- Describe the use of each of the above tools.

T is for tap and D is for die.



Screwdriver: flat blade

Heads: allen, torx, phillips, posidrive

Wrenches: open end, box end, combination

Sockets:
6 point, impact,
12 point deep, spark plug

Drive handles: ratchet, breaker bar (flex handle), extension, speeder (speed handle)

Pliers:
slip-joint, diagonal cutters, channel-locks, vise grips

Ball peen hammer, cold chisels

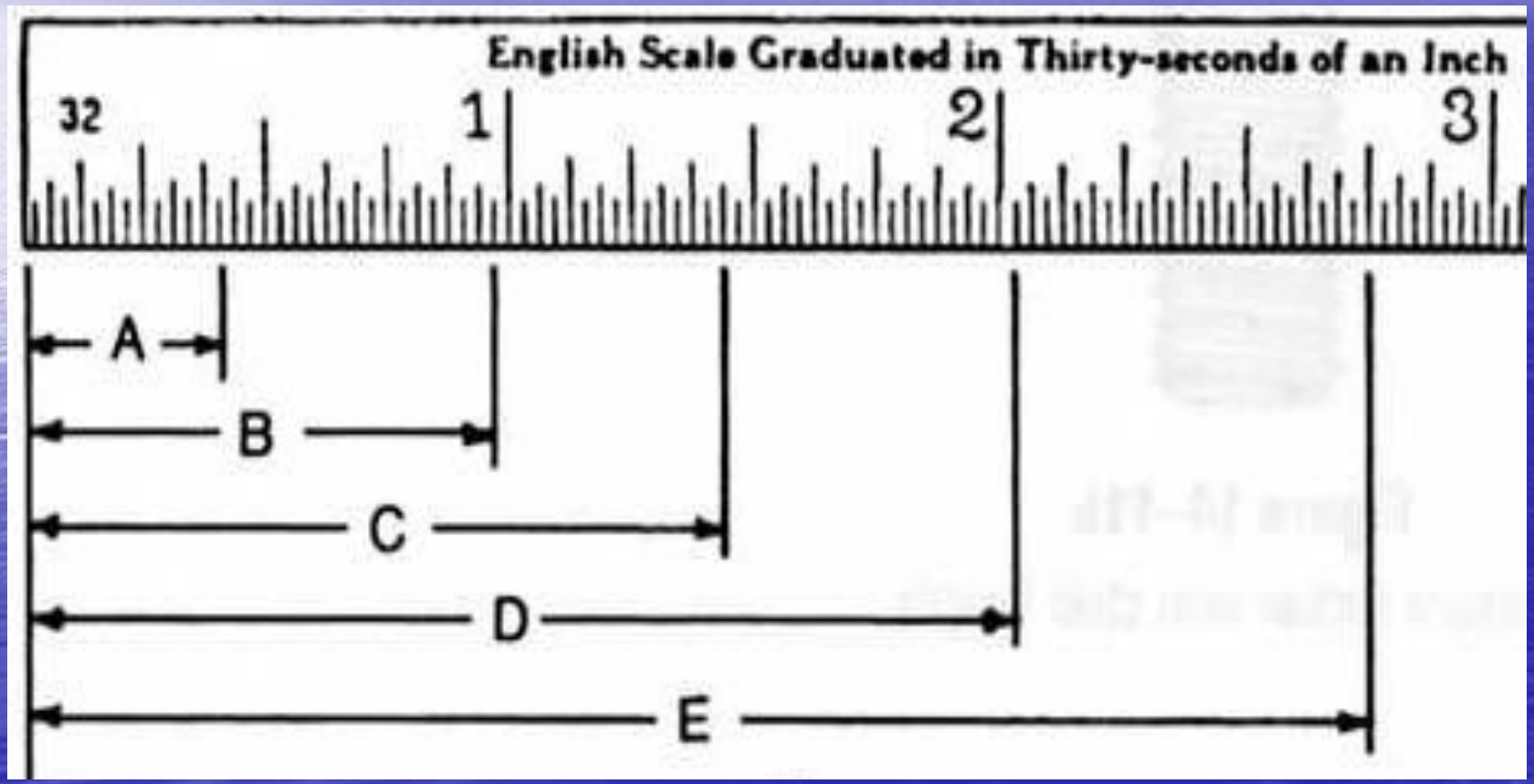
Punches: taper (starting), center, pin punch

Files, hacksaw

470604-0203
Identify and demonstrate use of basic measuring tools (accurate to 1/32 or 1mm).

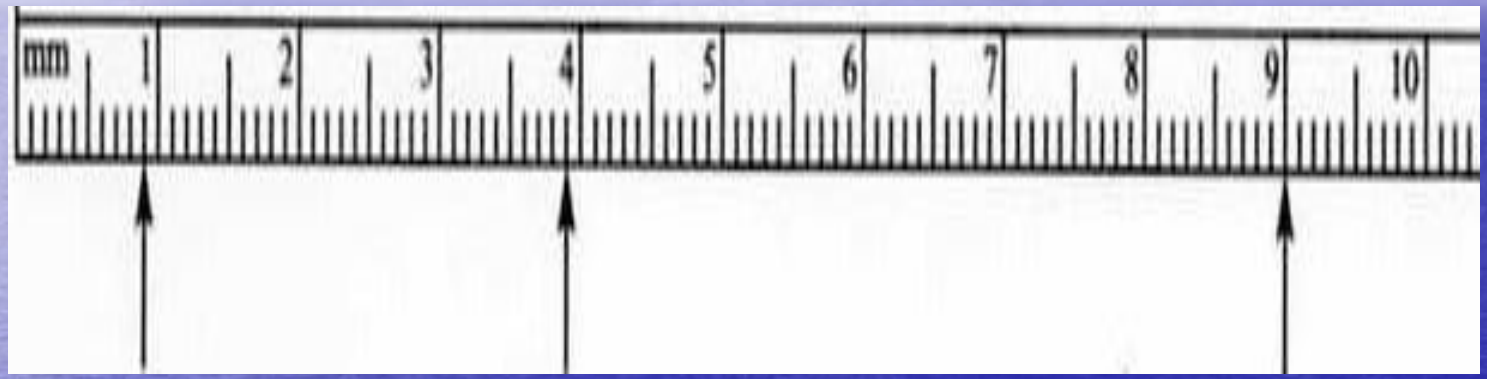
- Scales, rulers, tire and brake thickness gauges.
- Electrical testers, feeler gauges, tire pressure gauges

Measuring in thirty-seconds:



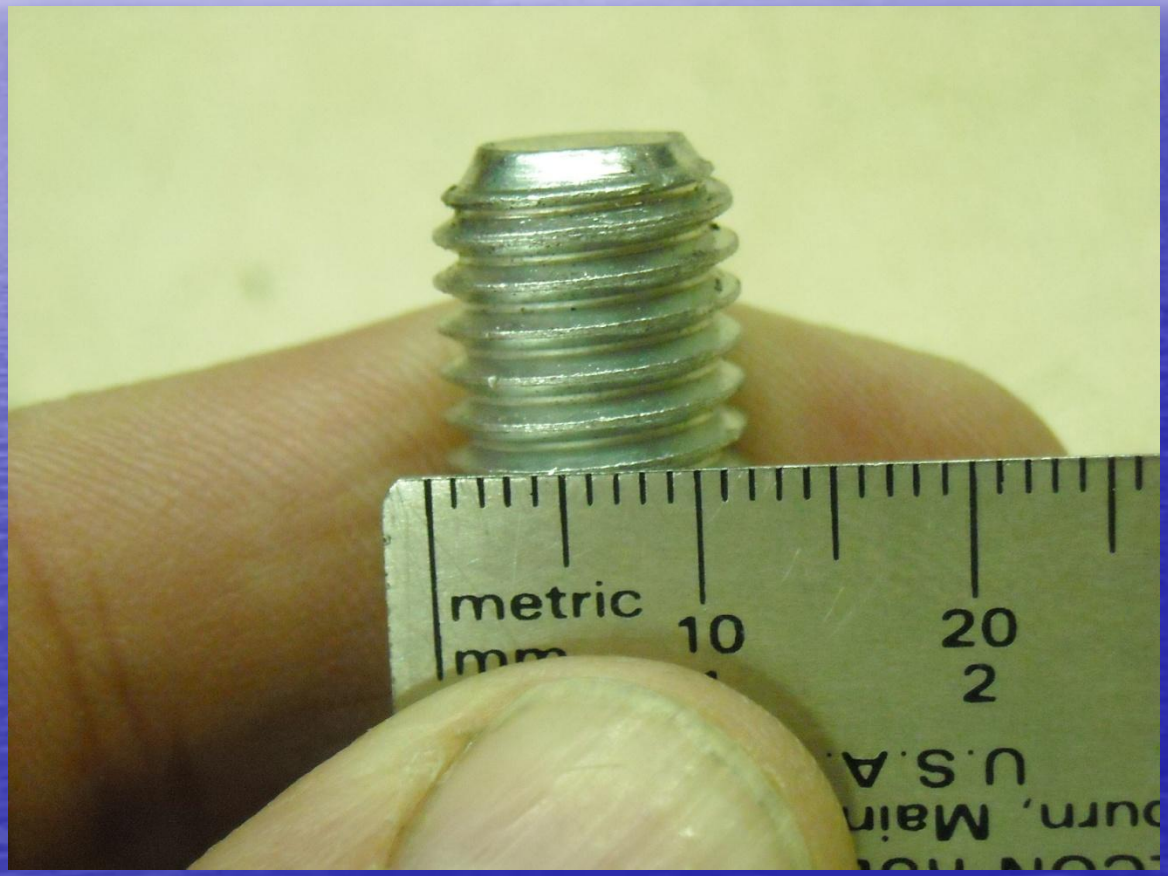
One inch equals about 25 millimeters
(dia. of a quarter) (25 cents)

Measuring in millimeters:

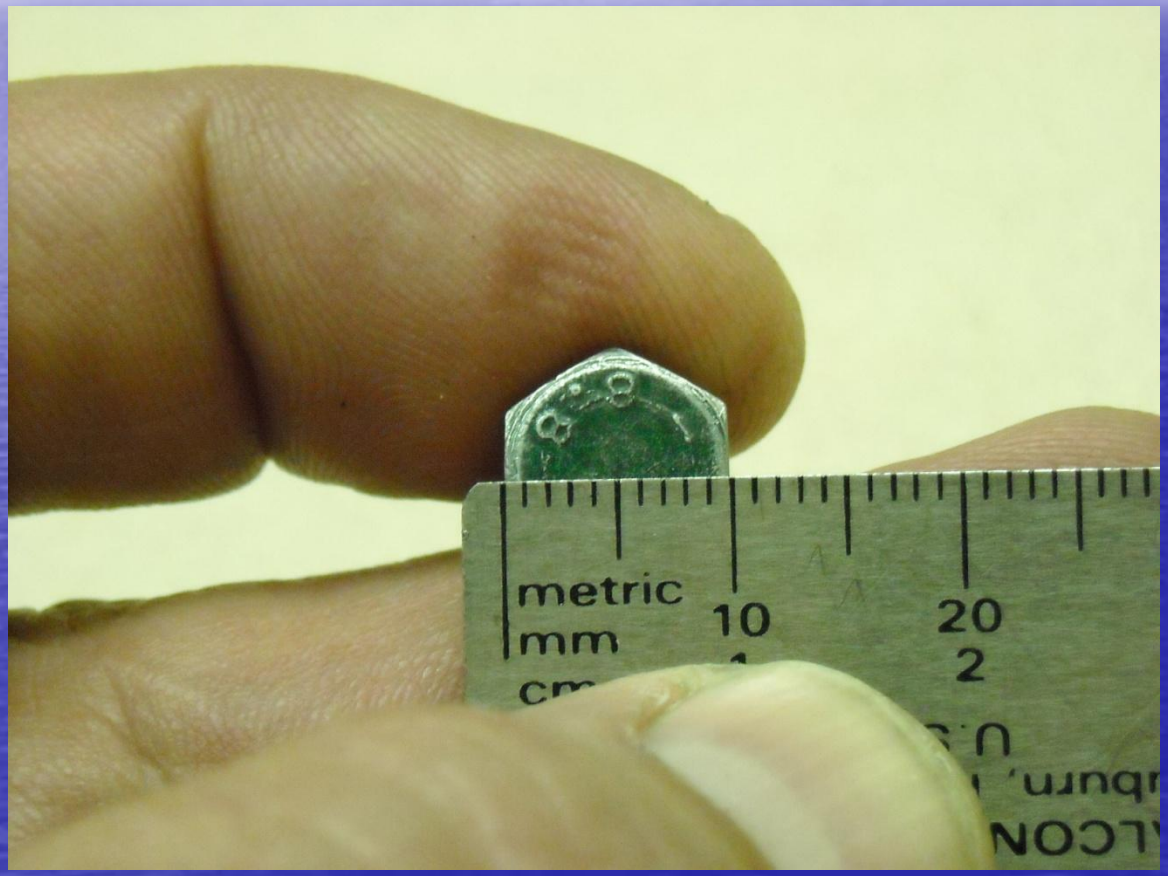


How many 32nds of tread remain?

What size hole for this bolt?

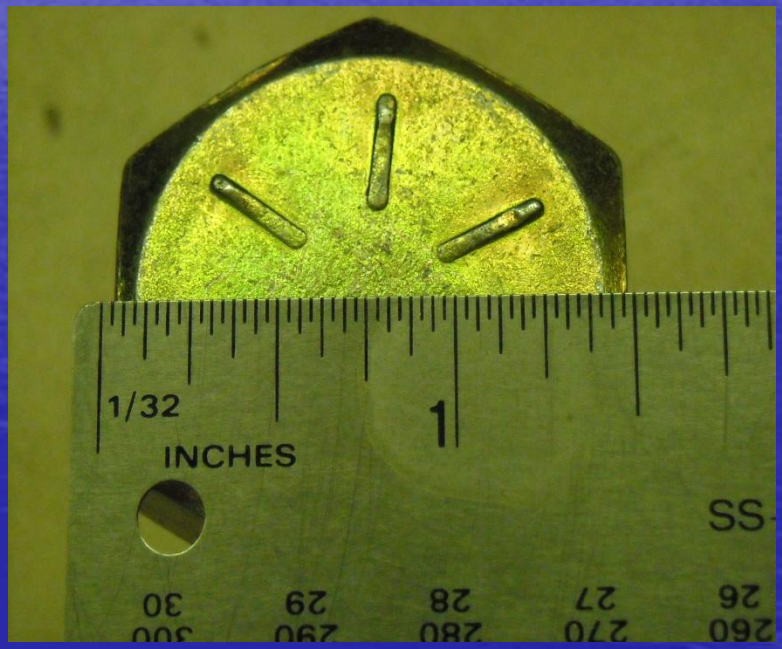


What size wrench for this bolt?



Hole size?

Wrench size?

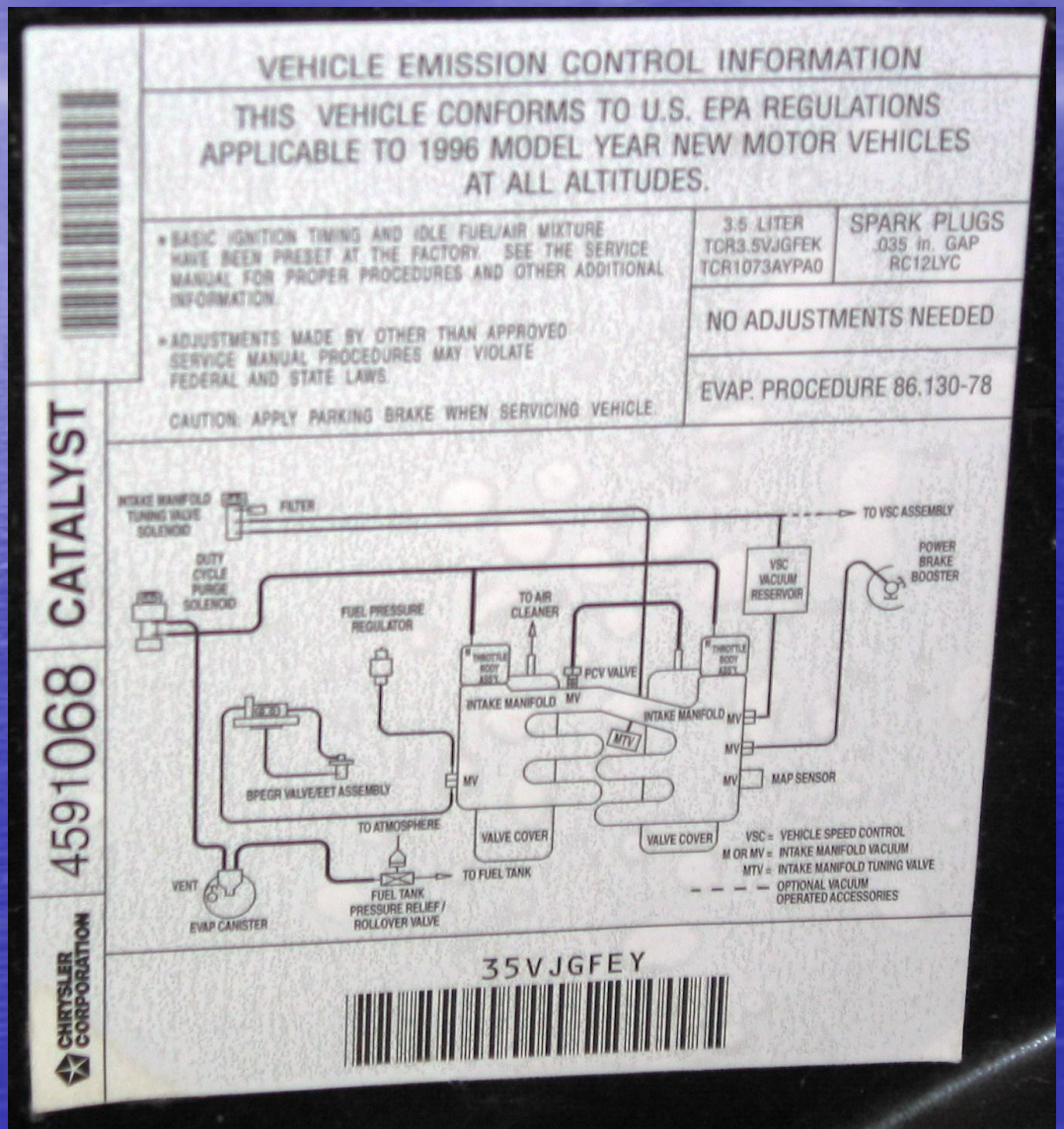


470604-0204
Use reference manuals or information systems to find service procedures and specifications.

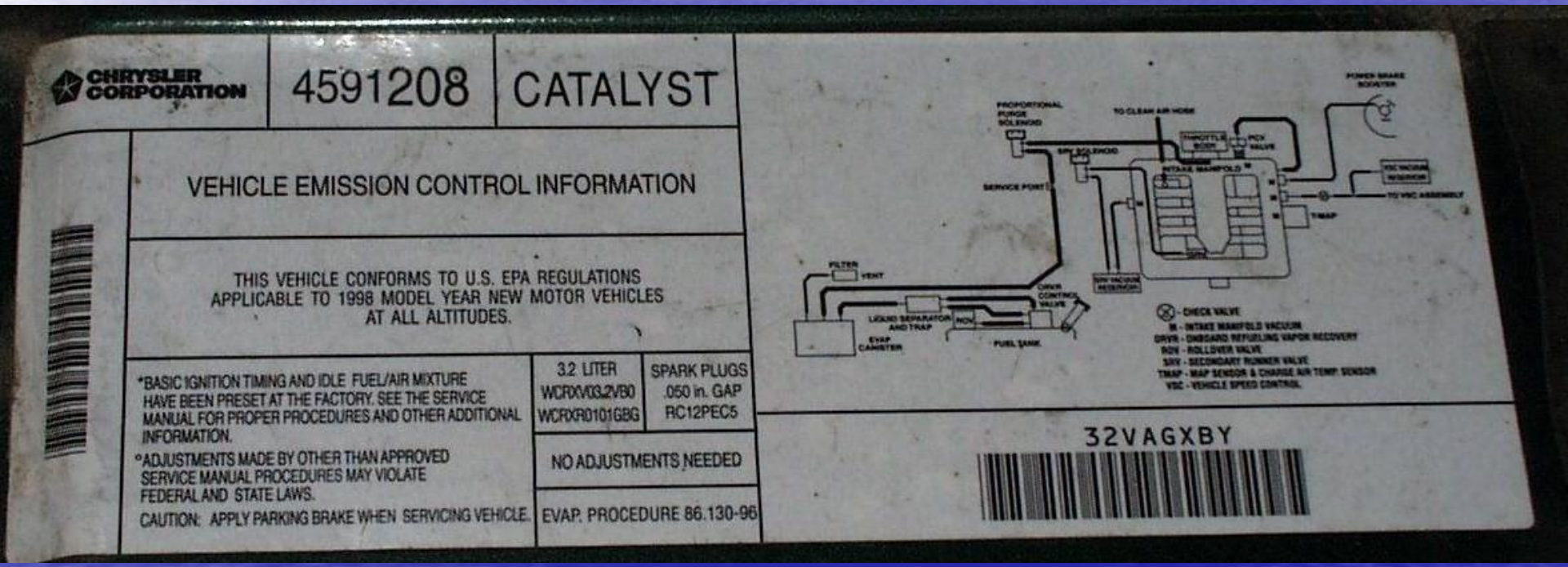
- Computer oriented.
- Printed manuals.

Where is this located?

Where is this located?

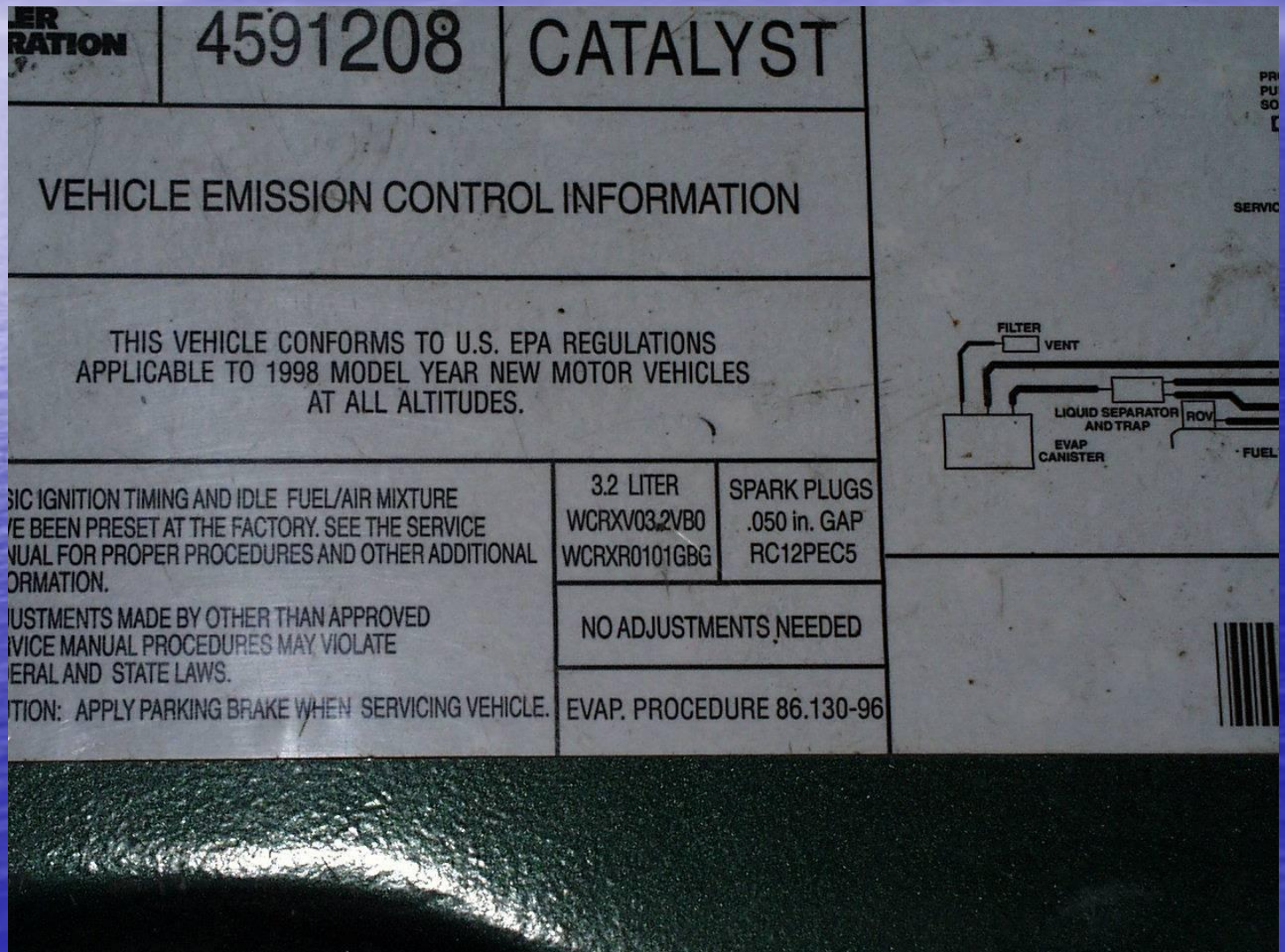


What's the spark plug gap?



Emissions Certification: Federal or California?

Year and engine size?



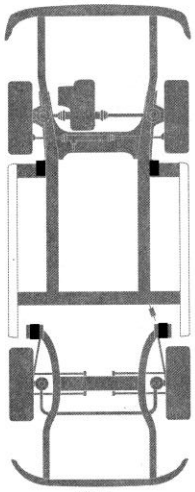
Engine size?


ZRD
5.7 LITER
*H3G5.7T5HXY7
7D0-3D
IMPORTANT VEHICLE INFOR
GENERAL MOTORS CORPORATIO
SET PARKING BRAKE AND BLOCK DRIVE WHEE
TIMING ADJUSTMENT: MAKE ADJUSTMENT WITH ENGINE AT NO
TEMPERATURE AND AIR CONDITIONING OFF (IF EQUIPPED).
1. VERIFY NO "SERVICE ENGINE SOON" LIGHT.
2. PUT EST (ELECTRONIC SPARK TIMING) IN BYPASS MODE B
THE TIMING CONNECTOR.
NOTE THIS IS A SINGLE WIRE SEALED CONNECTOR. TI
WITH A BLACK STRIPE AND BREAK OUT OF THE ENGINE
CONDUIT INBOARD OF THE BULKHEAD WIRING CONNE
DISCONNECT THE FOUR WIRE CONNECTOR AT THE DIS
3. CONNECT A TIMING LIGHT INDUCTIVE PICK-UP TO THE #

470604-0205
Properly raise and support vehicles. using jack stands and a frame contact hoist.

- Use a jack and jack stands to raise and support a vehicle.
- Use a frame hoist to raise and support a vehicle and properly use safety locks to secure the vehicle.

Chassis Lift Point Guide

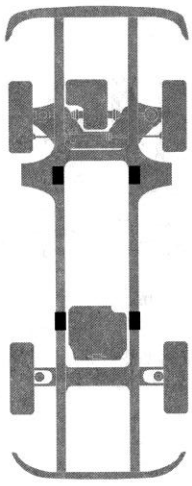


CH-6

CHRYSLER
2002-04 Neon (Canada)
2001-07 PT Cruiser

DODGE
1995-05 Neon

PLYMOUTH
1995-01 Neon

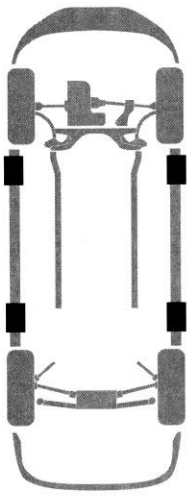


CH-7

CHRYSLER
1995-00 Cirrus
2001-07 Sebring Sedan
1996-06 Sebring Convertible

DODGE
1995-06 Stratus Sedan

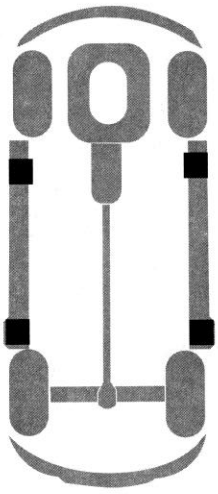
PLYMOUTH
1996-00 Breeze



CH-9

CHRYSLER
1995-2005 Sebring Coupe

DODGE
2001-05 Stratus Coupe
1995-00 Avenger

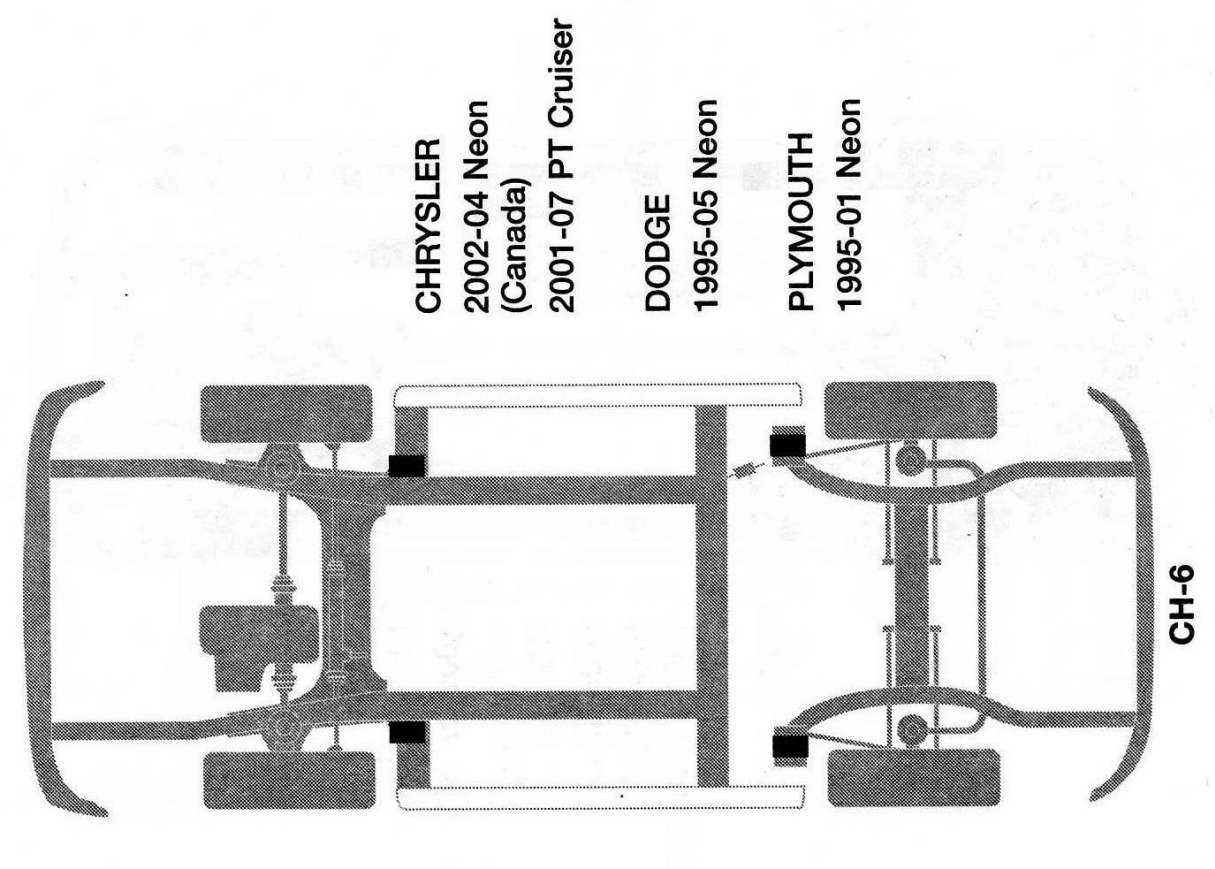


CH-10

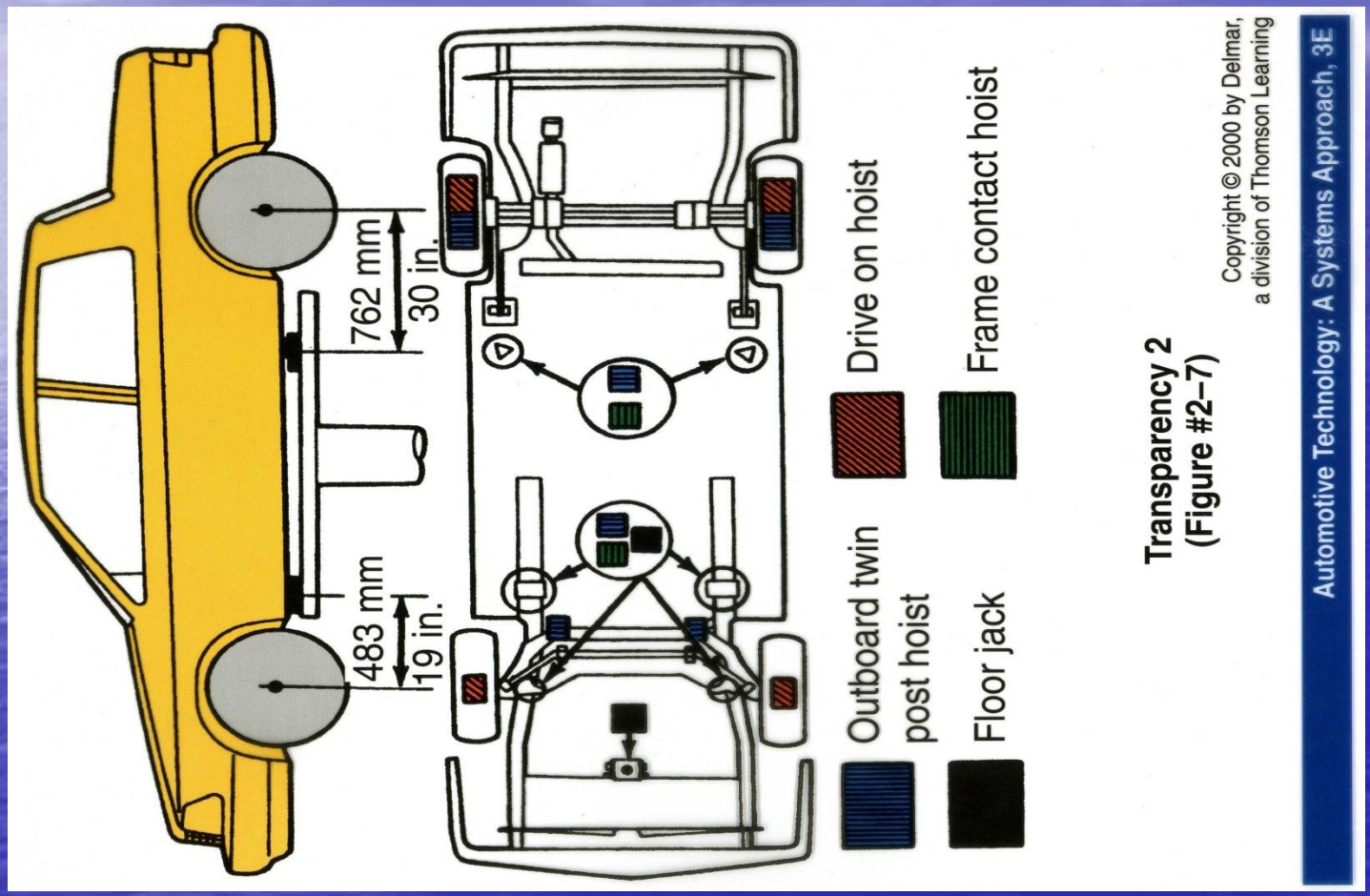
CHRYSLER
2004-06 Crossfire

What's this?

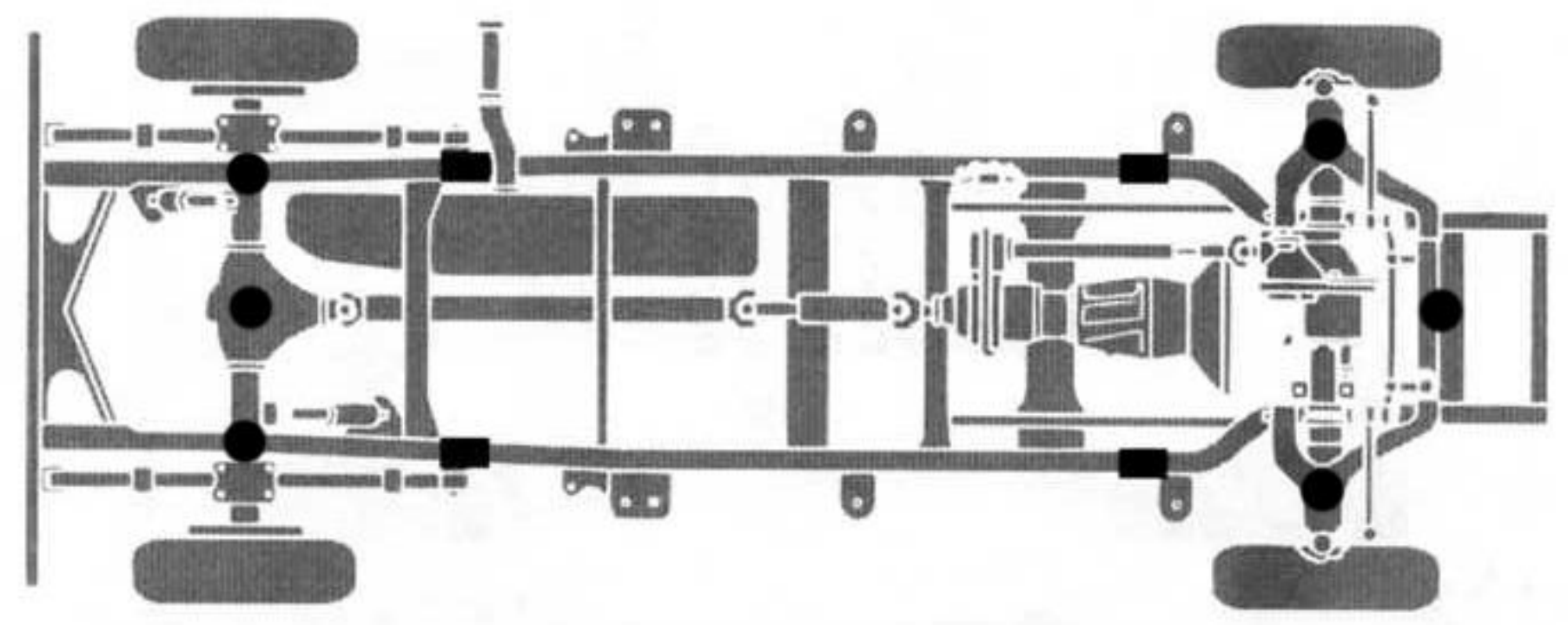
What are the black rectangles?



Floor jack placement?
Frame Hoist lift pad placement?



Where?
Floor jack, stands, hoist pads?



STANDARD 470604-03

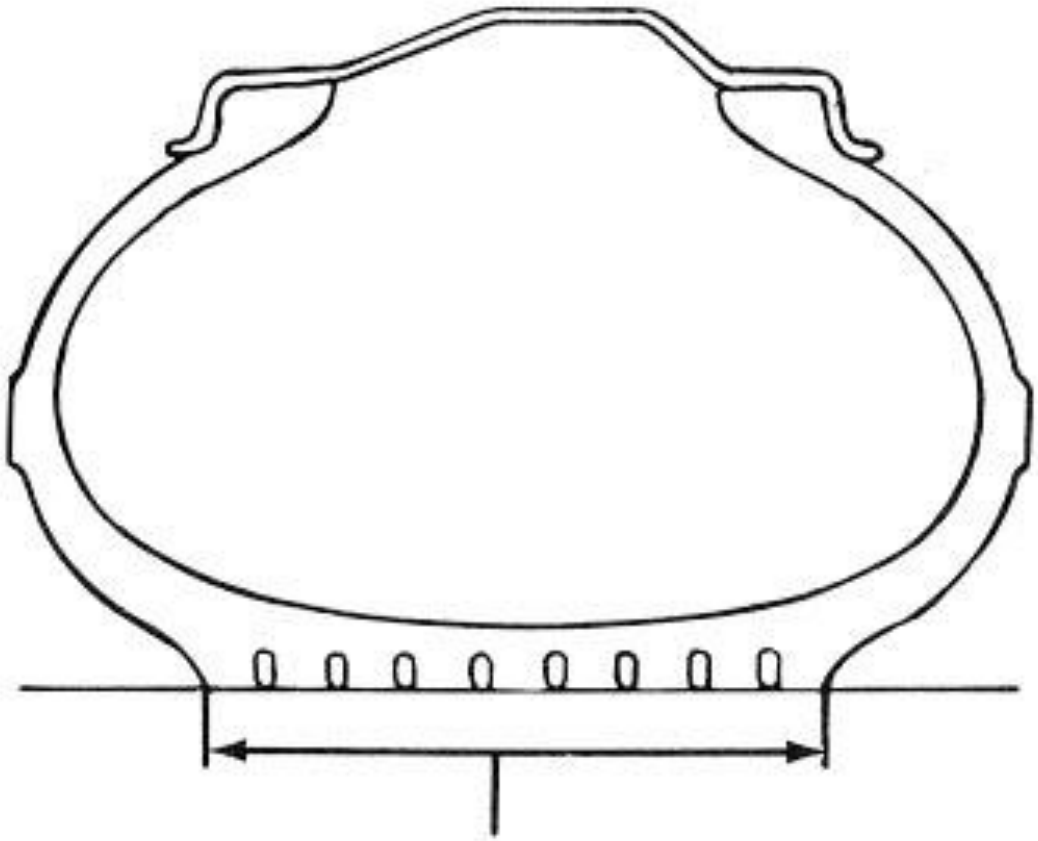
Students will be able to understand proper techniques in removal and installation of tires and wheels.

470604-0301
Inspect tires for abnormal wear.

- Proper inflation
- Mechanical problems

(no specific angles)

Proper inflation puts all the tread on the road.



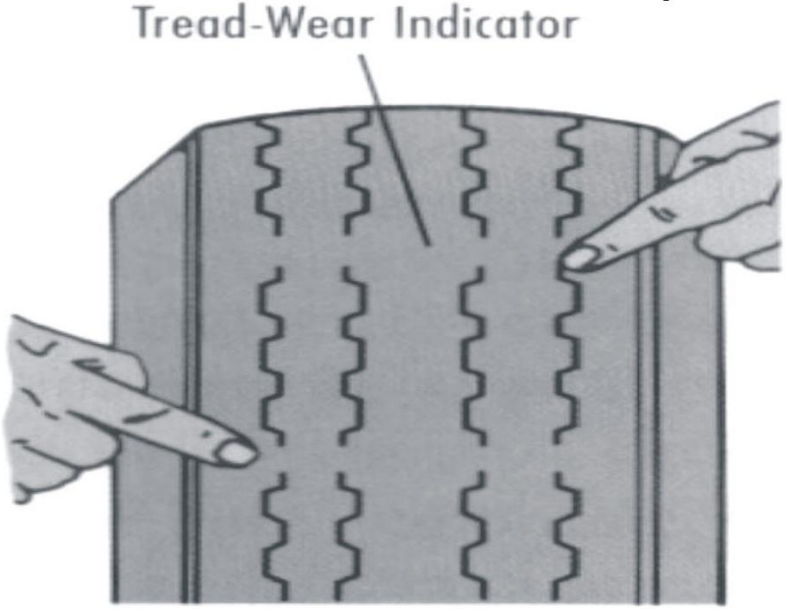
Lincoln's hair to the edge of the coin = 2/32"

Give 'em a Penny

Here's a neat tip: Give everyone who attends your National Car Care Month event a penny. Show them how to check the tread depth of their tires, using the penny. Insert the penny into the tread. If the top of Abe Lincoln's head can be seen, the tread is worn to the point of replacement. Tell them to keep the penny in their glove compartment so they will always have a tool to check tread depth.

Be Car Care Aware®

2/32” minimum tread depth



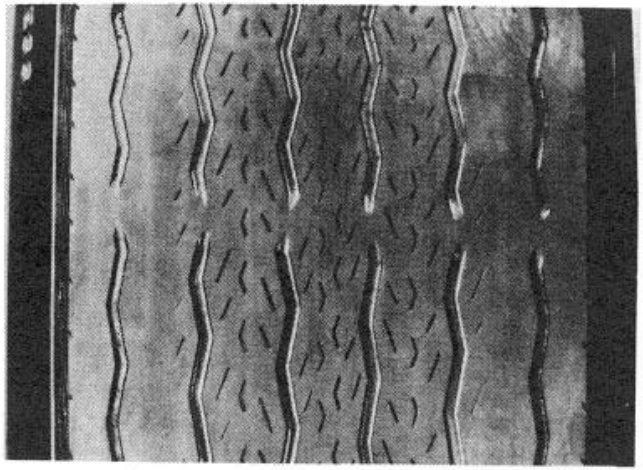
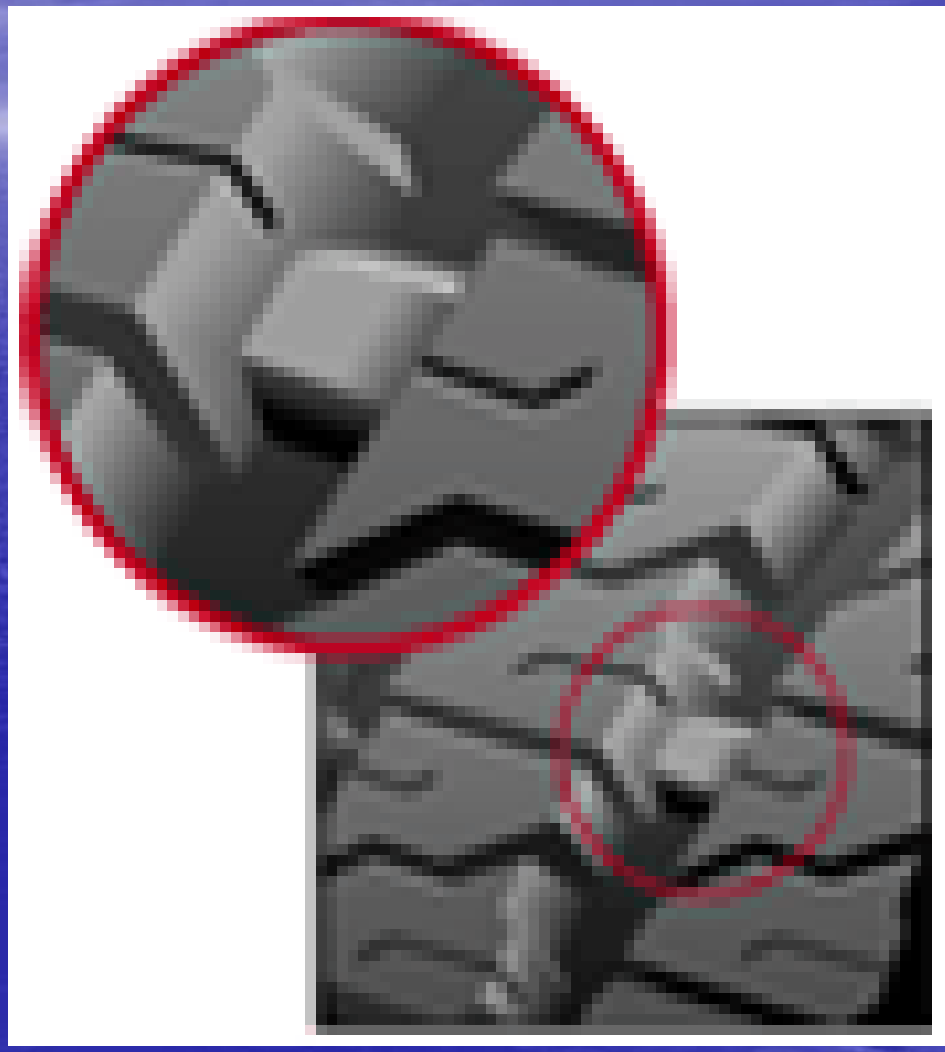
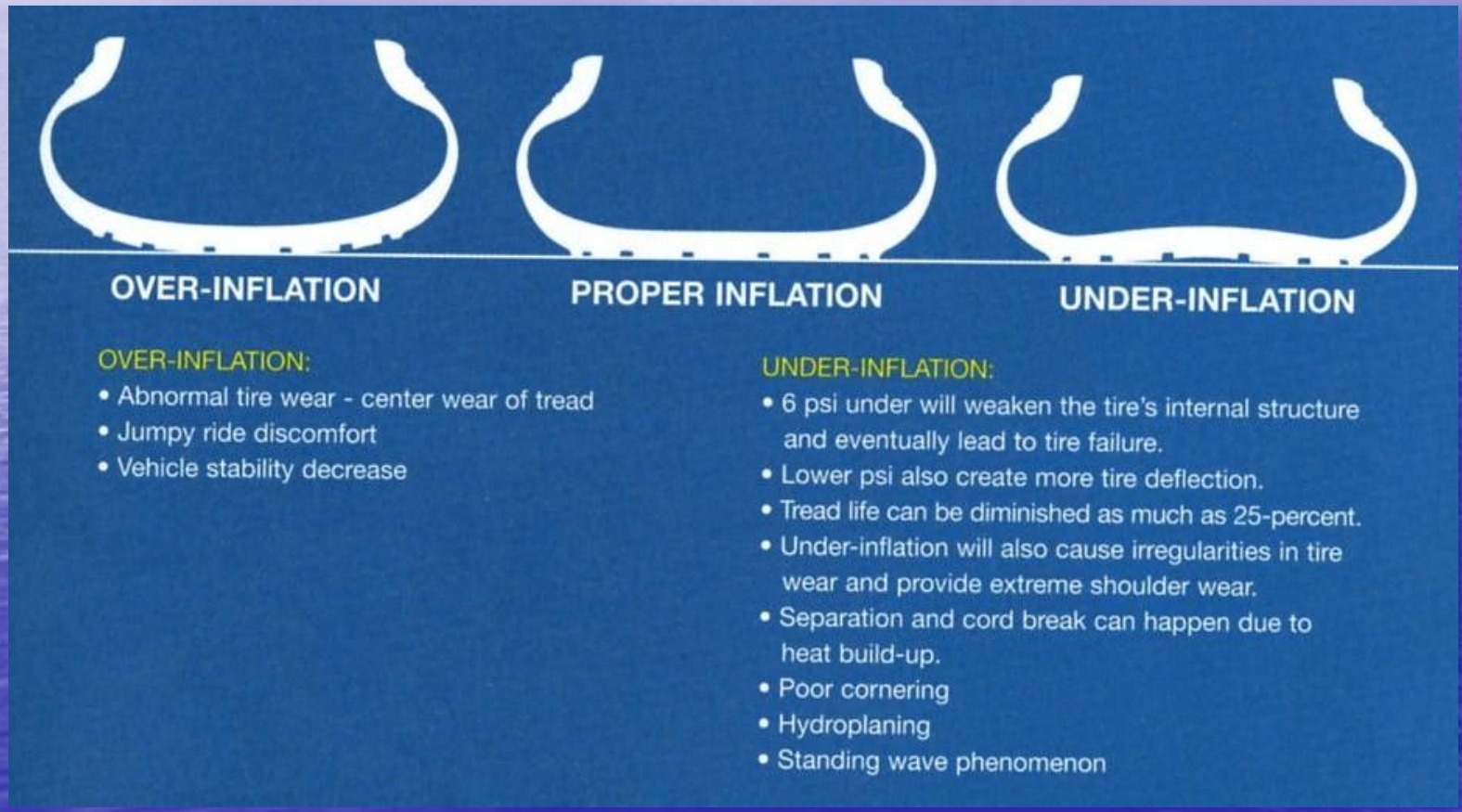


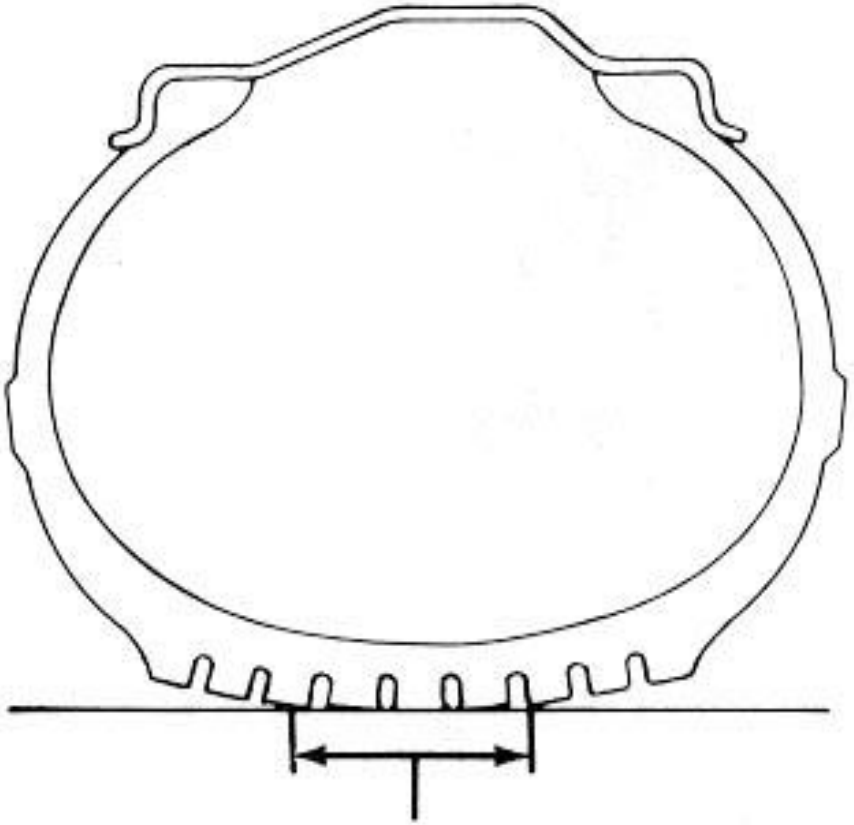
Figure 5.11 A tread wear indicator strip (courtesy Chrysler Corporation).



Can the wear reveal the problem?

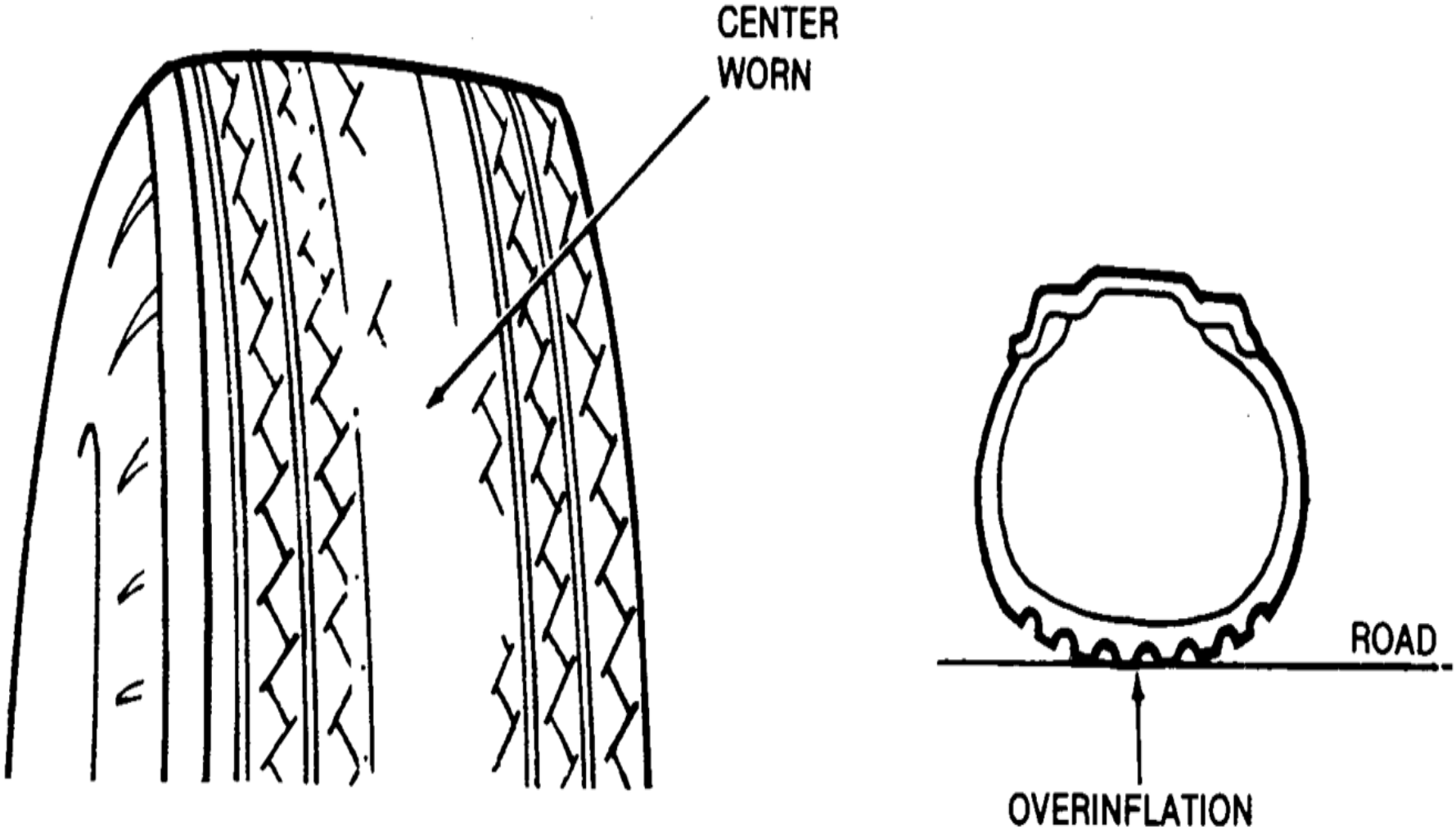


Problem?

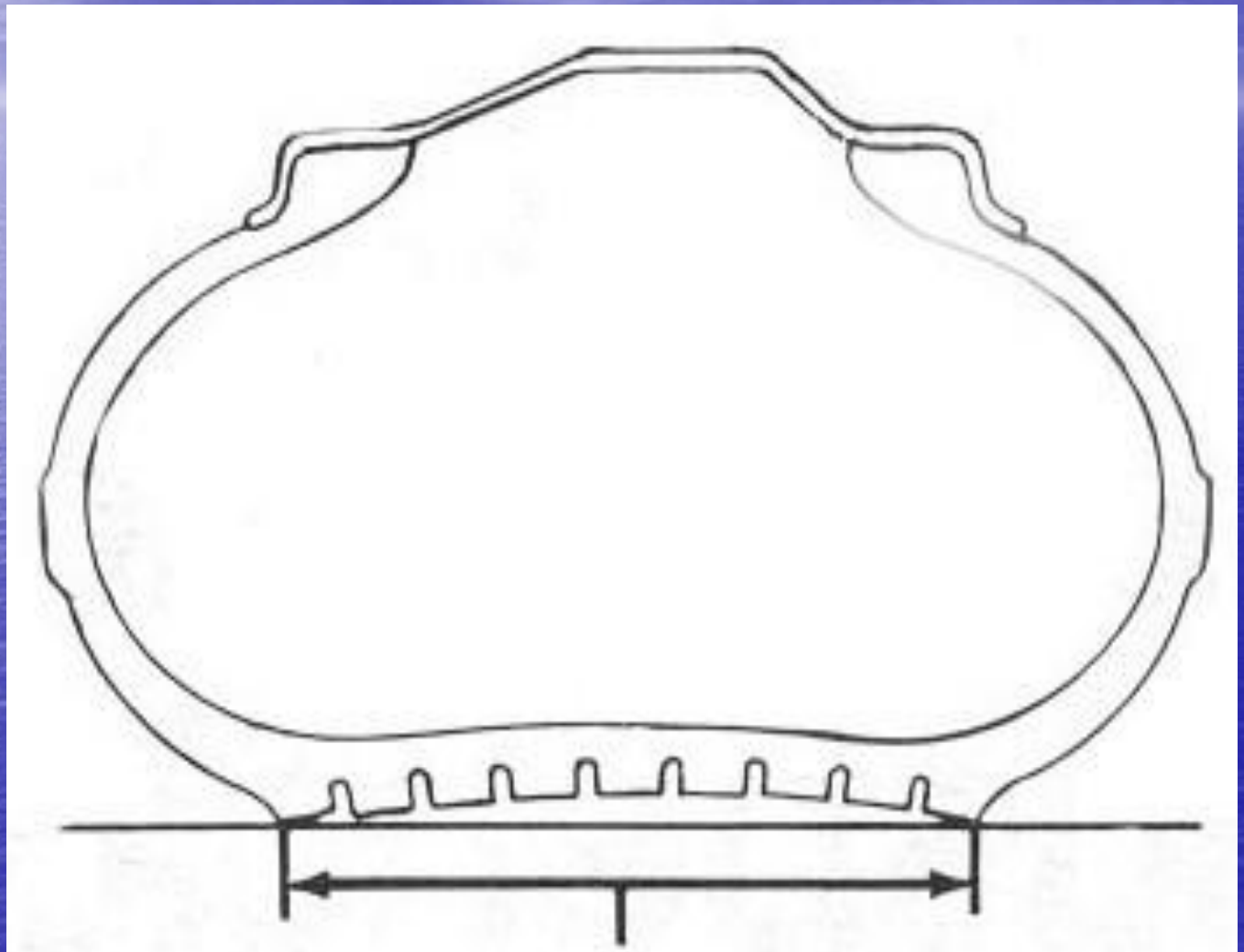


Tread contact with road

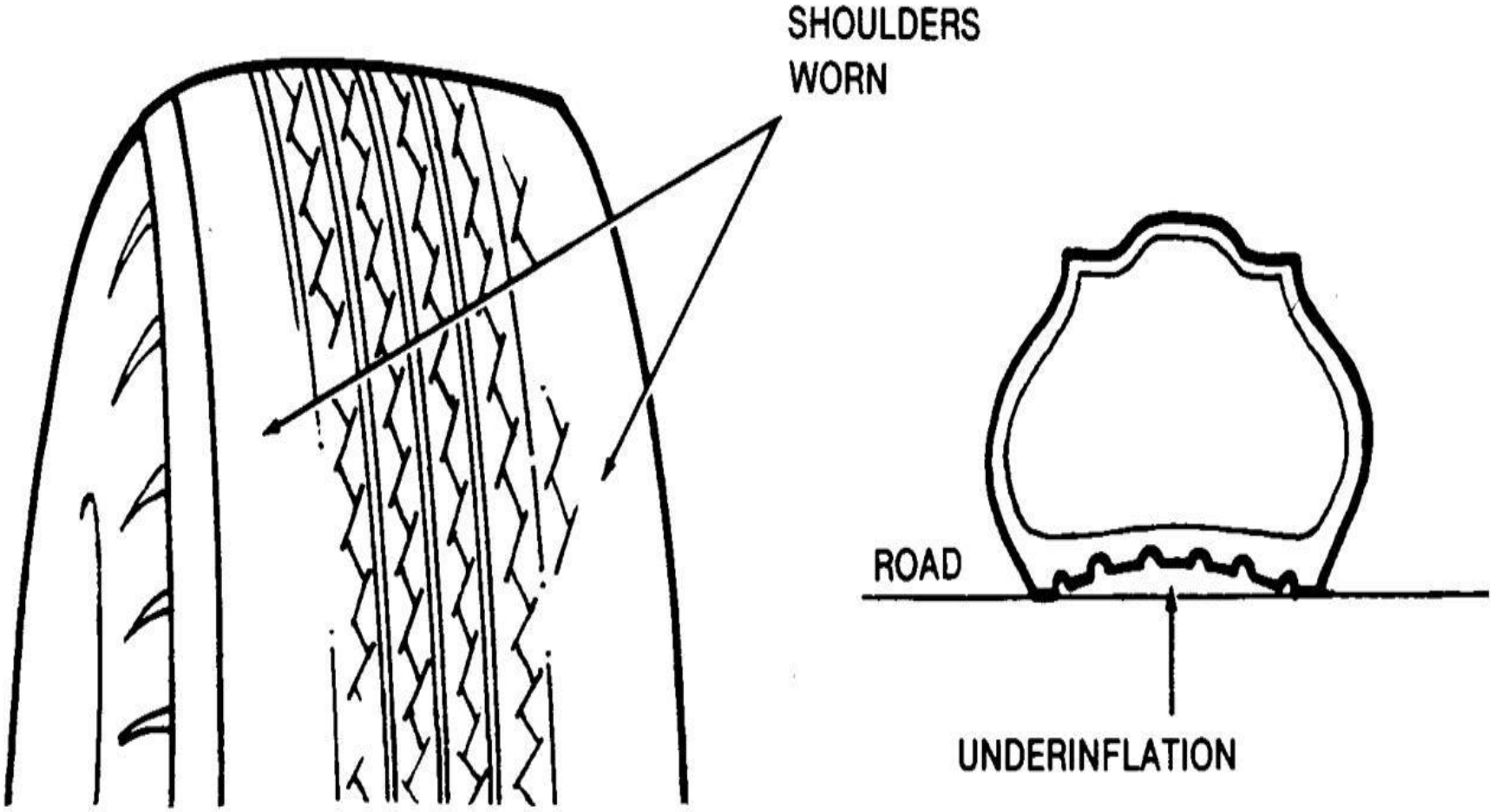
Tire wear caused by overinflation



Problem?



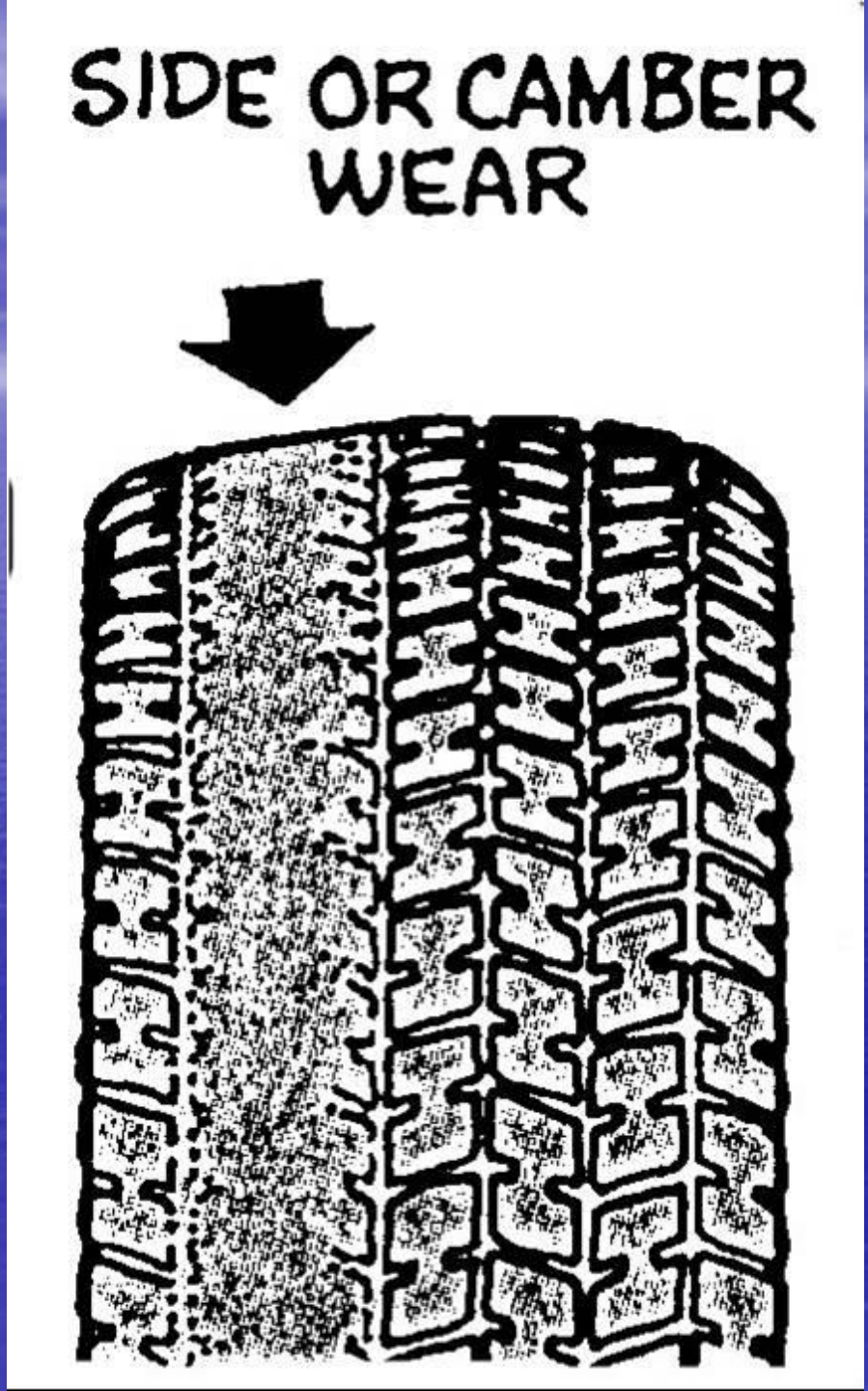
Tire wear caused by underinflation



Wheel alignment=

- Wheels straight up-and-down when loaded.
- Wheels straight ahead when moving.

Cause?

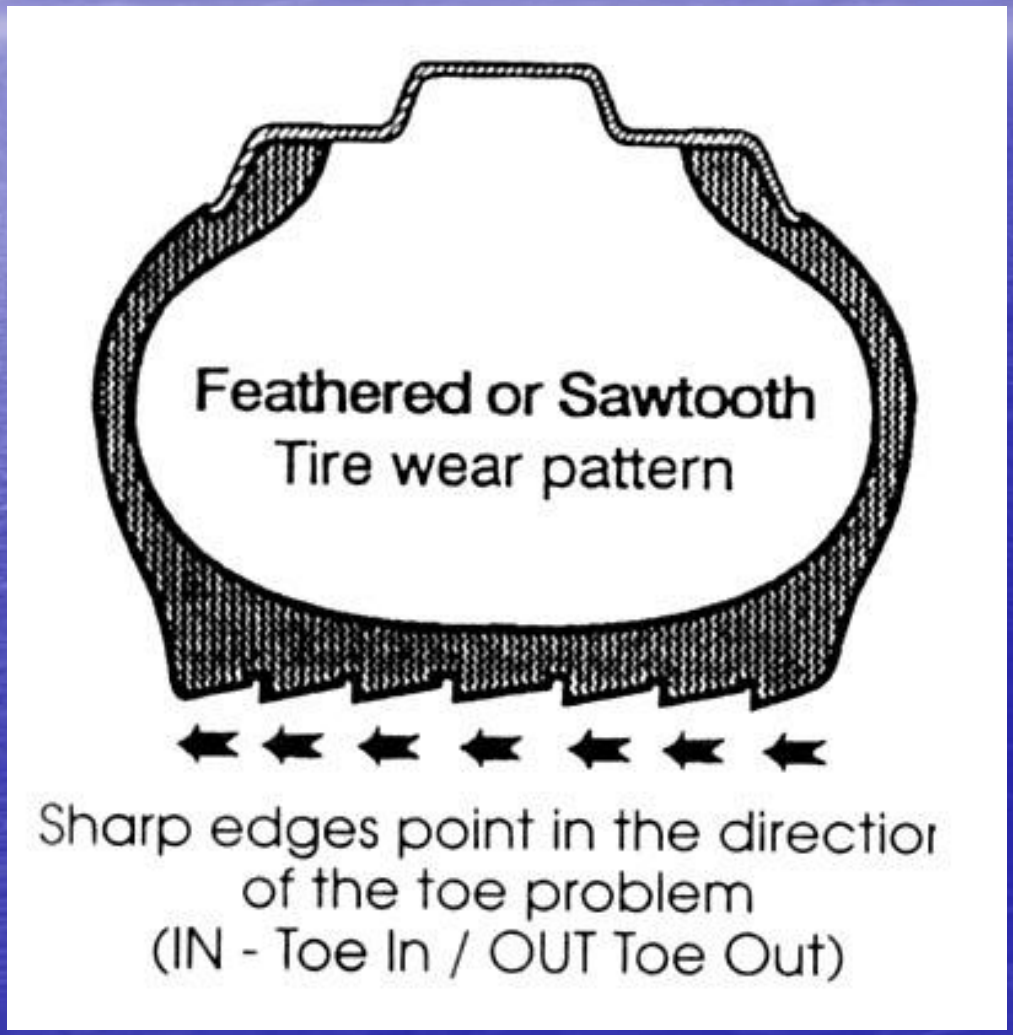


Inflation or alignment?

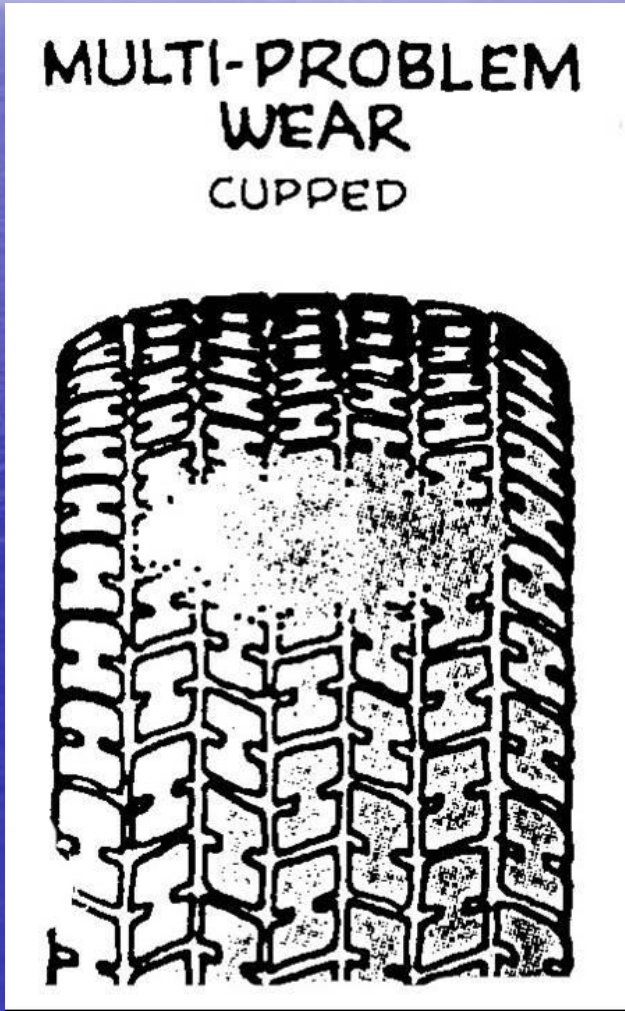
Symmetrical wear?

Advise the customer…

Rub your palm across the tread.



Why so bouncy?



Look hard…

470604-0302
Remove a tire from a wheel.

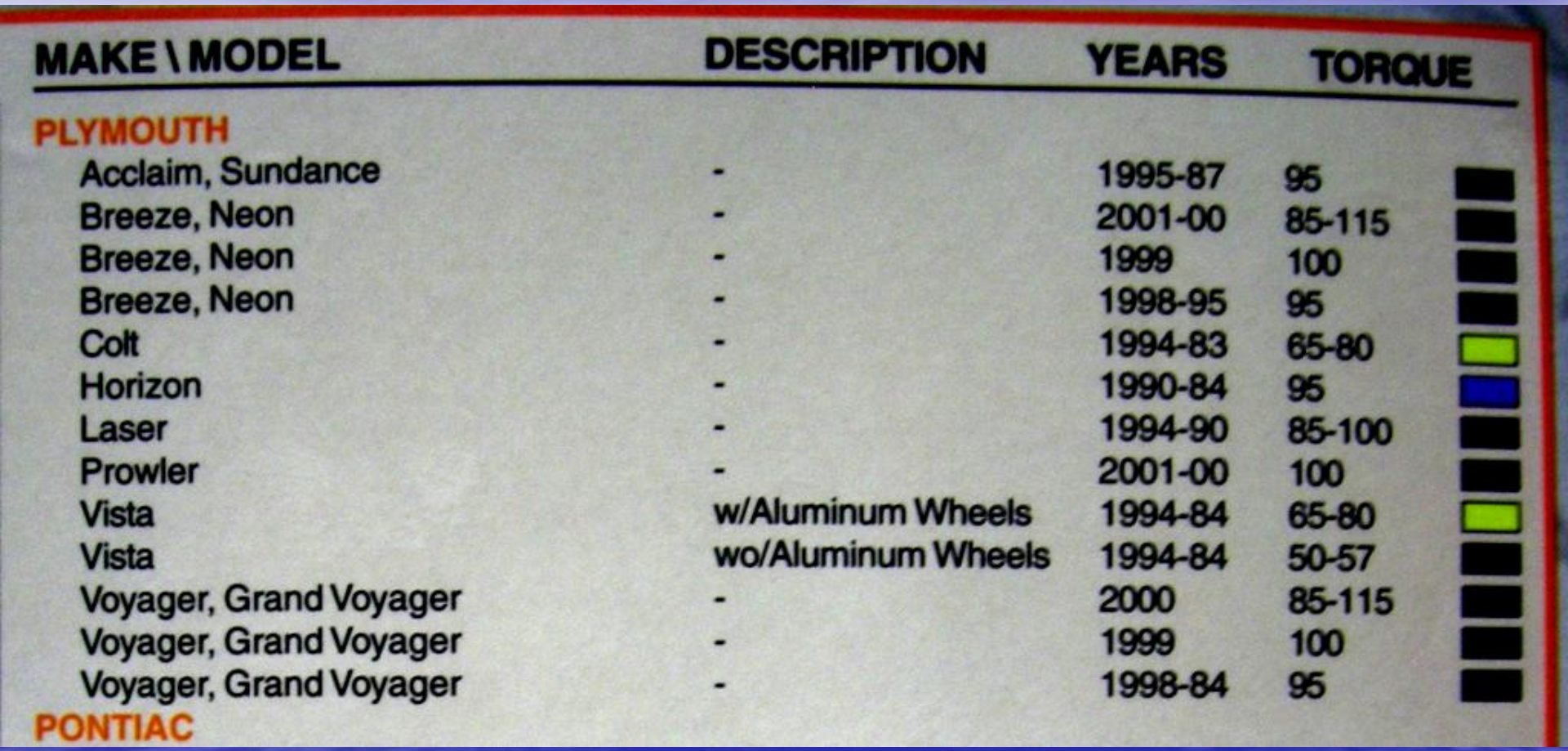
- Use the proper equipment.
- Use the correct techniques and safety precautions.

470604-0303
Properly rotate tires and reinstall using proper torque procedures.

- Use manufacturers recommended rotation method.
- Lug nuts should be tightened to the proper torque as indicated in the vehicle specifications and in a sequence of cross or star patterns depending on the number of lug nuts.

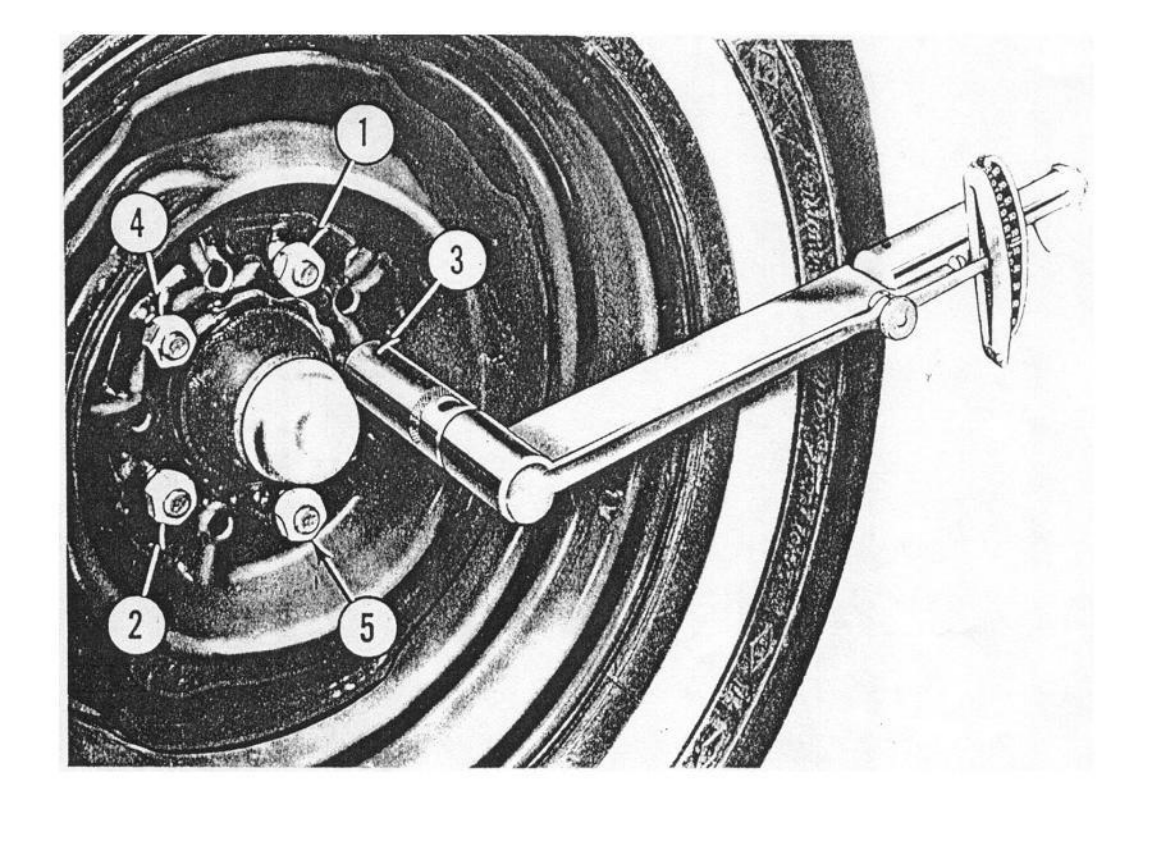
Remove lugs by pulling on the breaker bar.

What's torque spec for a 97 Neon?



MAKE \ MODEL	DESCRIPTION	YEARS	TORQUE
PLYMOUTH			
Acclaim, Sundance	-	1995-87	95
Breeze, Neon	-	2001-00	85-115
Breeze, Neon	-	1999	100
Breeze, Neon	-	1998-95	95
Colt	-	1994-83	65-80
Horizon	-	1990-84	95
Laser	-	1994-90	85-100
Prowler	-	2001-00	100
Vista	w/Aluminum Wheels	1994-84	65-80
Vista	wo/Aluminum Wheels	1994-84	50-57
Voyager, Grand Voyager	-	2000	85-115
Voyager, Grand Voyager	-	1999	100
Voyager, Grand Voyager	-	1998-84	95
PONTIAC			

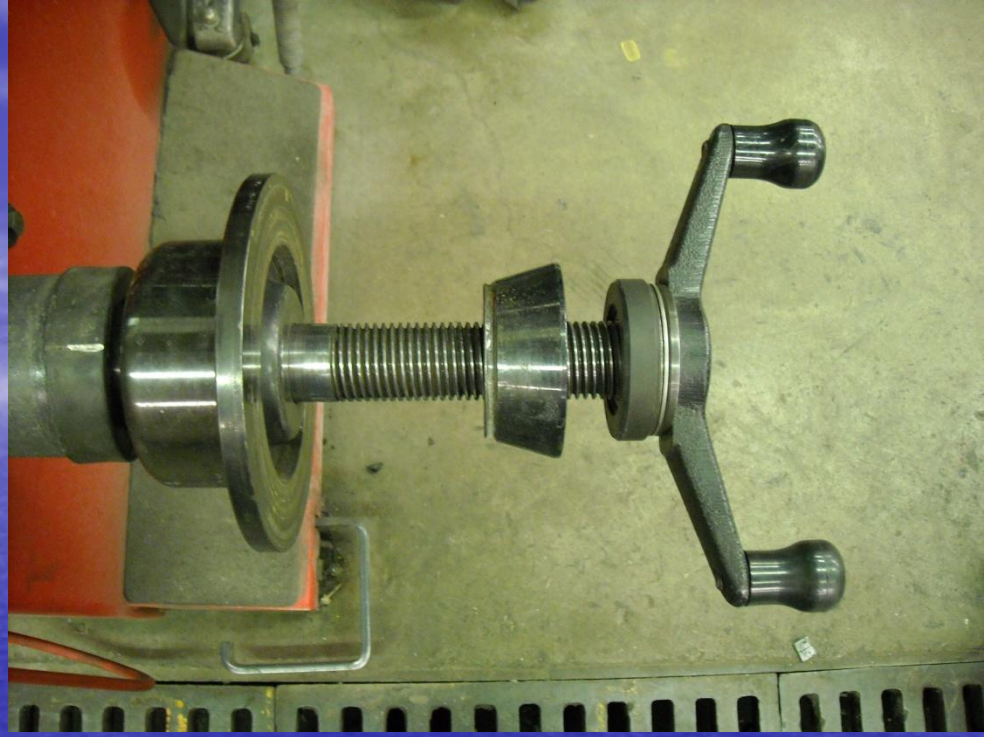
Correct torque + star pattern



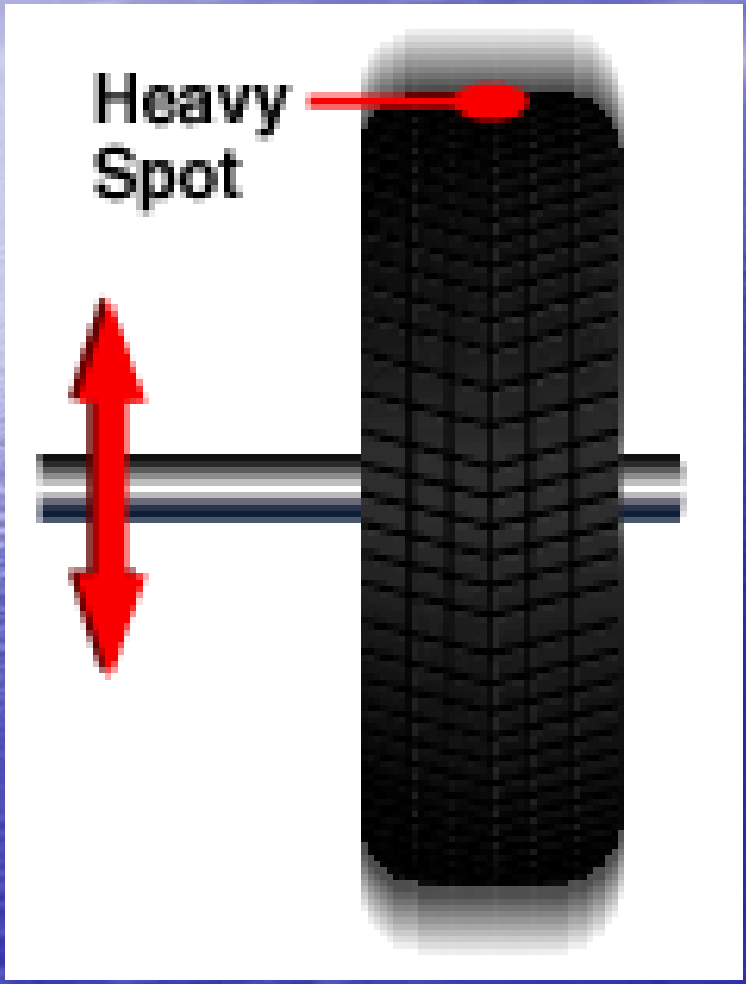
470604-0304
Use a tire balancer to balance tires of a vehicle using proper procedures.

- Correct mounting of tire and wheel assembly to balancer
- Correct balancer programming and use

Proper Coning:



Static imbalance = wheel tramp



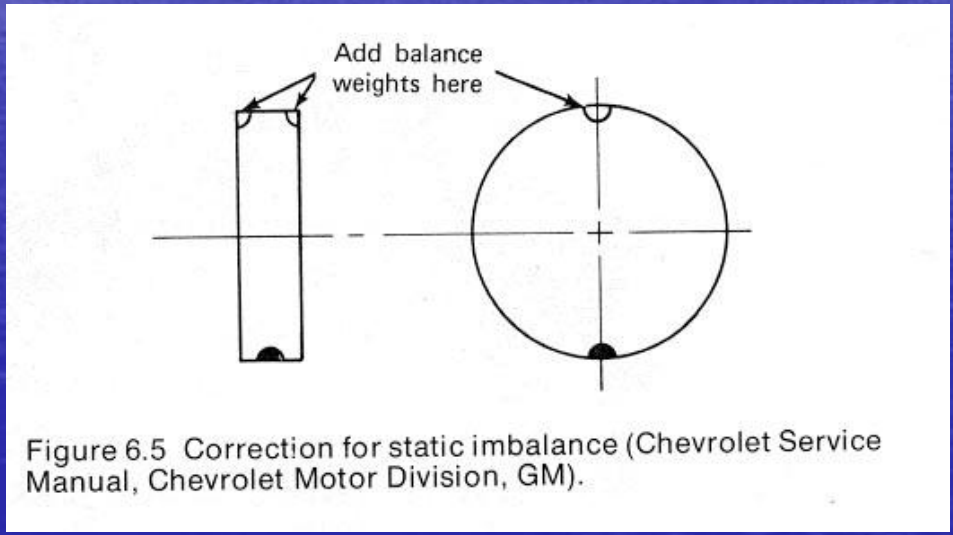
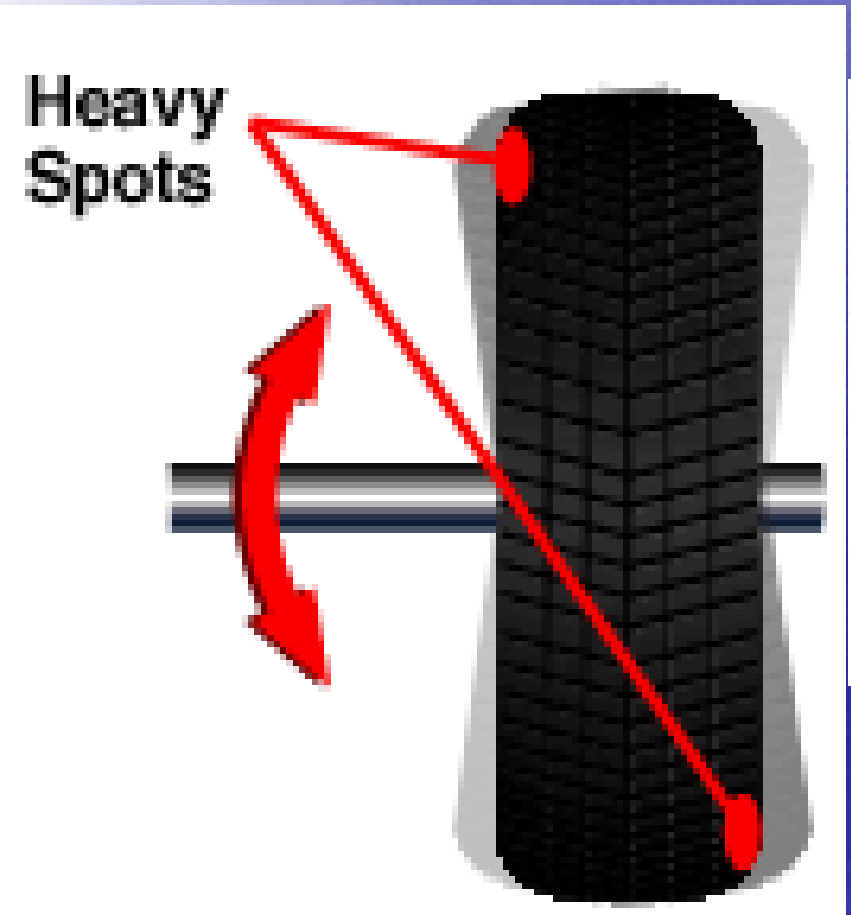


Figure 6.5 Correction for static imbalance (Chevrolet Service Manual, Chevrolet Motor Division, GM).

Dynamic imbalance = wheel shimmy



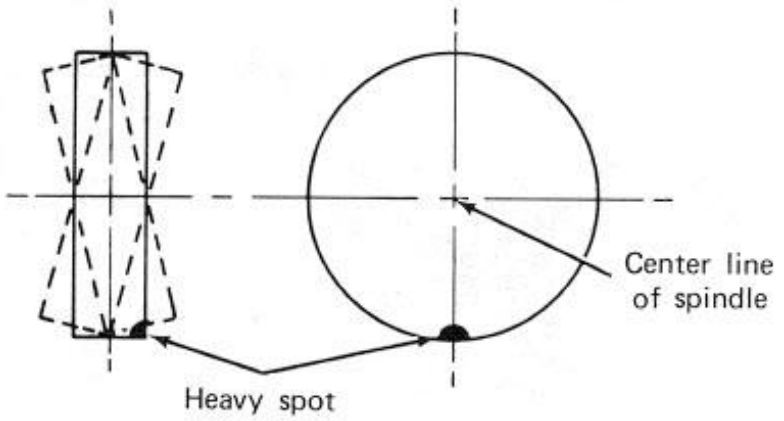
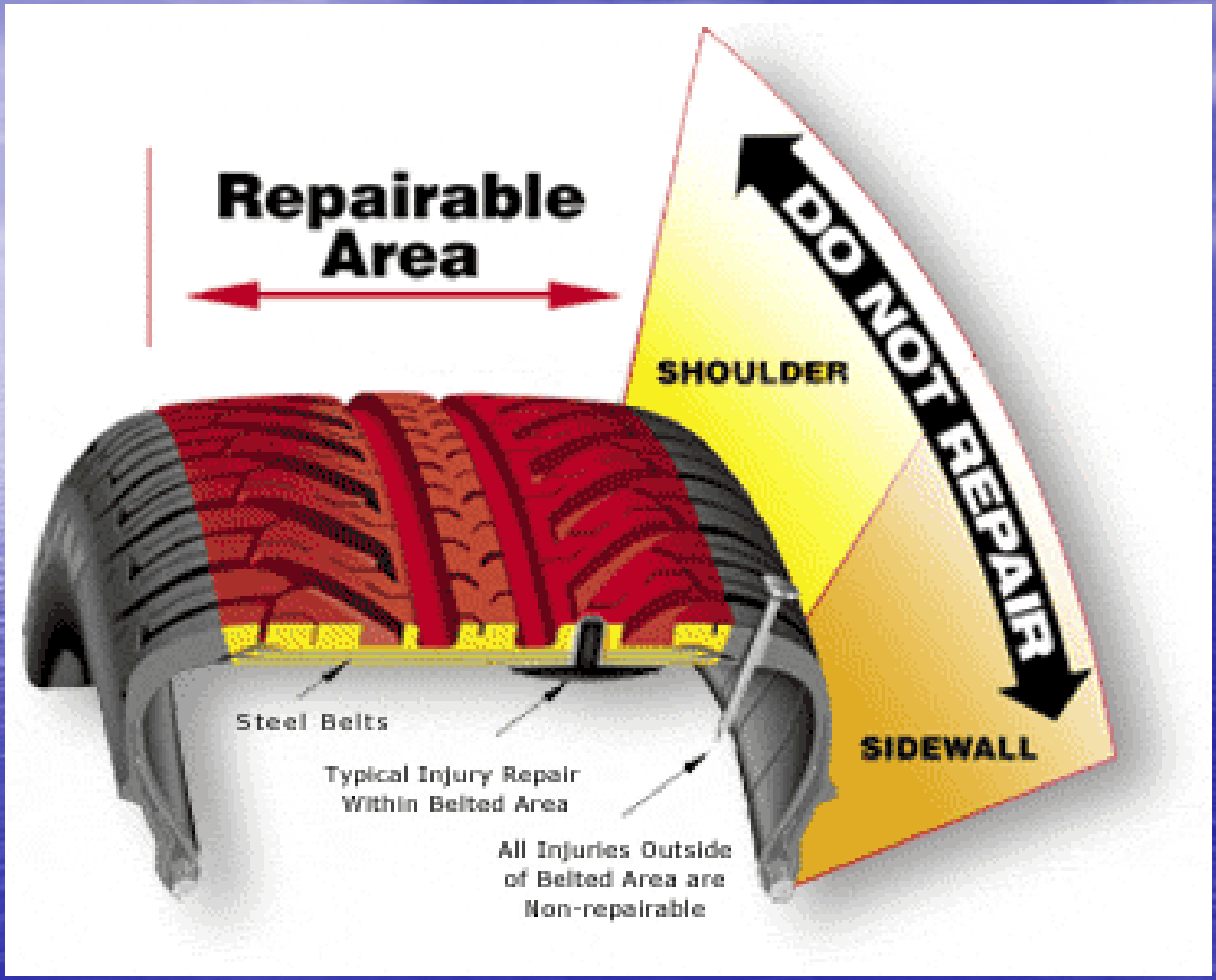


Figure 6.8 Shimmy. The heavy spot in the tire causes the wheel to shake or wobble as the wheel spins (Chevrolet Service Manual, Chevrolet Motor Division, GM).

470604-0305
Locate a leak. Identify proper repair procedure.

- Determine if tire is repairable
- Clean and dress the hole
- Clean and buff an area larger than the patch
- Apply the cement with a brush and allow to dry.
- Apply the plug-patch and firmly roll the patch using a stitching tool.


Repairable Area
SHOULDER
DO NOT REPAIR
SIDEWALL
Steel Belts
Typical Injury Repair Within Belted Area
All Injuries Outside of Belted Area are Non-repairable

Up to ¼” holes in the tread are repairable.

Sidewall cracks that expose cords--not repairable.

Belt separation—not repairable.

Driving on a low tire ruins the sidewalls—not repairable.

Sidewall ply separation—not repairable.

Exposed belts—not repairable

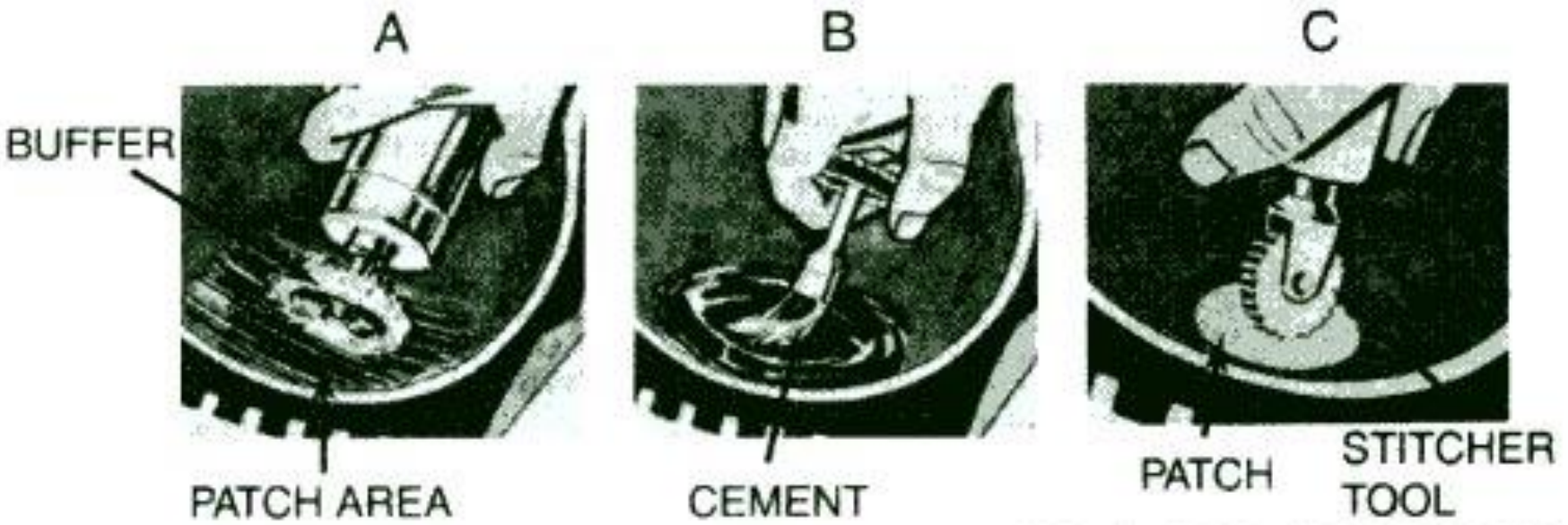
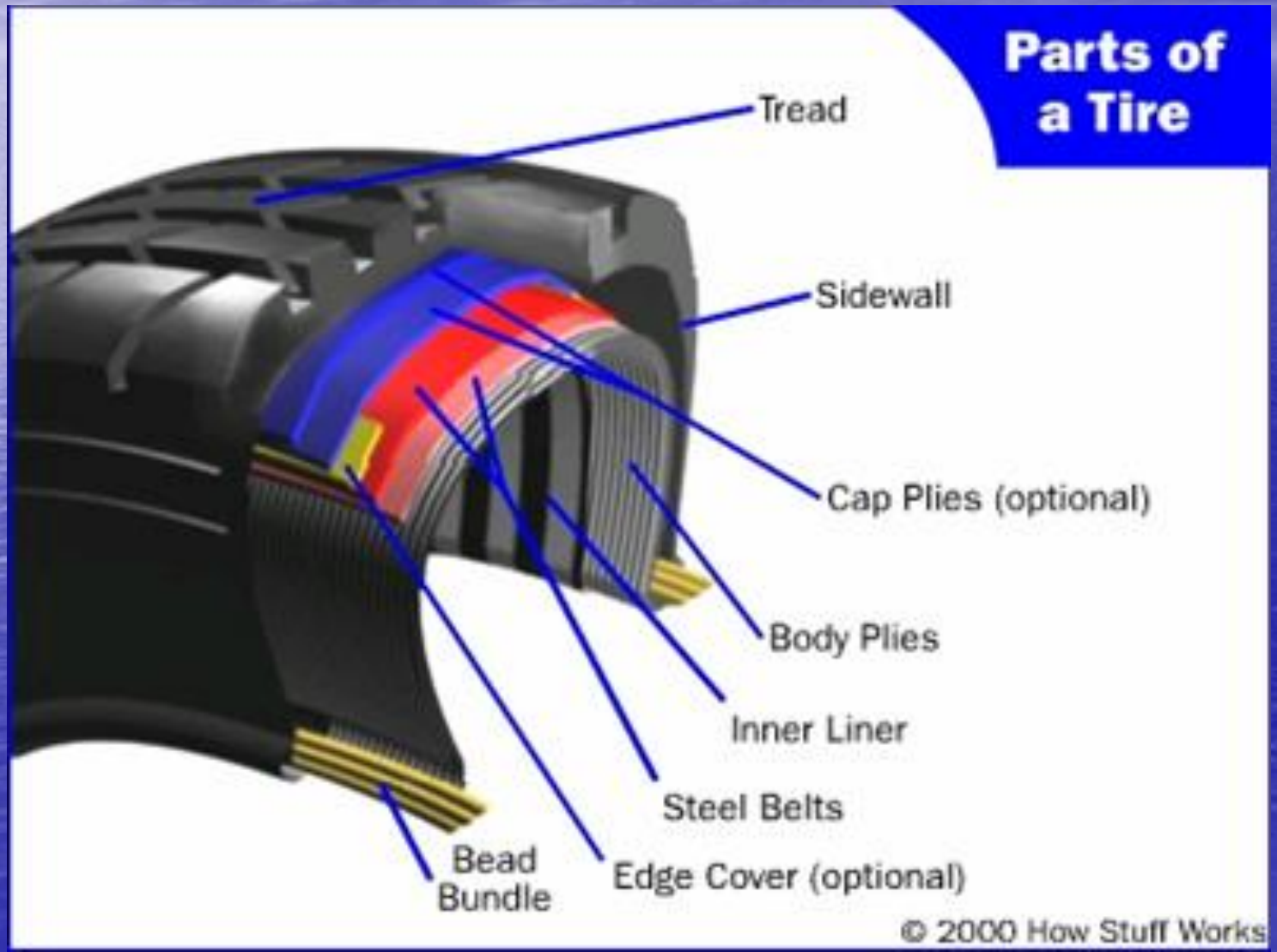


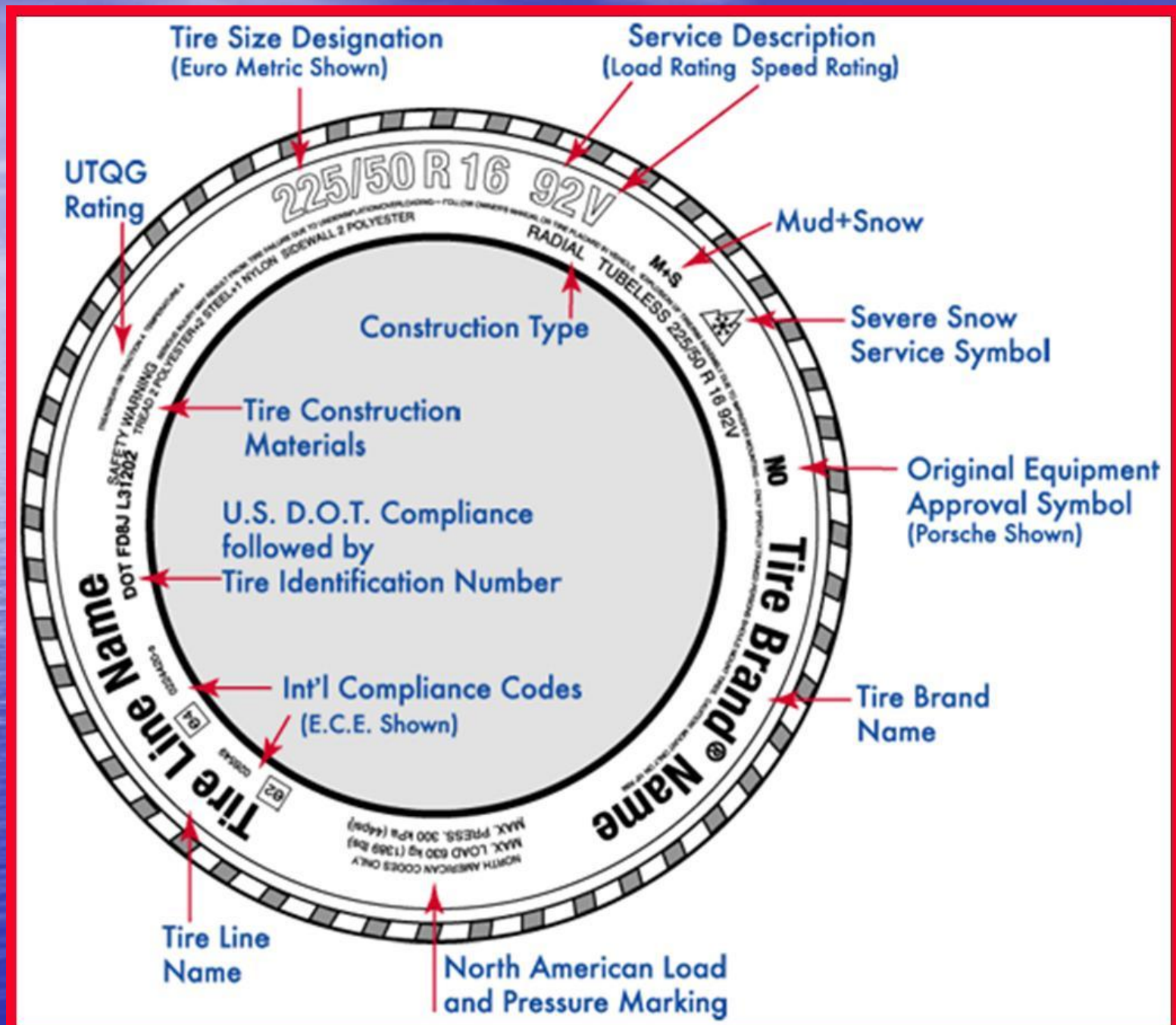
Fig. 11-4. Installing a tire patch. A — Buff an area slightly larger than the patch and clean the buffed area thoroughly. B — Apply the cement with a brush (allow for recommended drying time.) C — Install the patch. Use the stitcher tool to firmly roll the patch into contact with the cement. Roll over the entire surface of the patch.

470604-0306
Interpret tire sidewall markings: size, inflation, and load.

- Tire type.
- Section width in millimeters
- Aspect ratio
- Speed rating
- Construction type
- Rim diameter

This tire has **radial** body plies:




Tire Size Designation
(Euro Metric Shown)
Service Description
(Load Rating Speed Rating)
UTQG
Rating
225/50 R 16 92V
RADIAL TUBELESS 225/50 R 16 92V
M+S
Mud+Snow
Severe Snow
Service Symbol
Construction Type
Tire Construction
Materials
Original Equipment
Approval Symbol
(Porsche Shown)
U.S. D.O.T. Compliance
followed by
Tire Identification Number
DOT FD8J L31202
Int'l Compliance Codes
(E.C.E. Shown)
Tire Brand
Name
Tire Line Name
Tire Line
Name
North American Load
and Pressure Marking

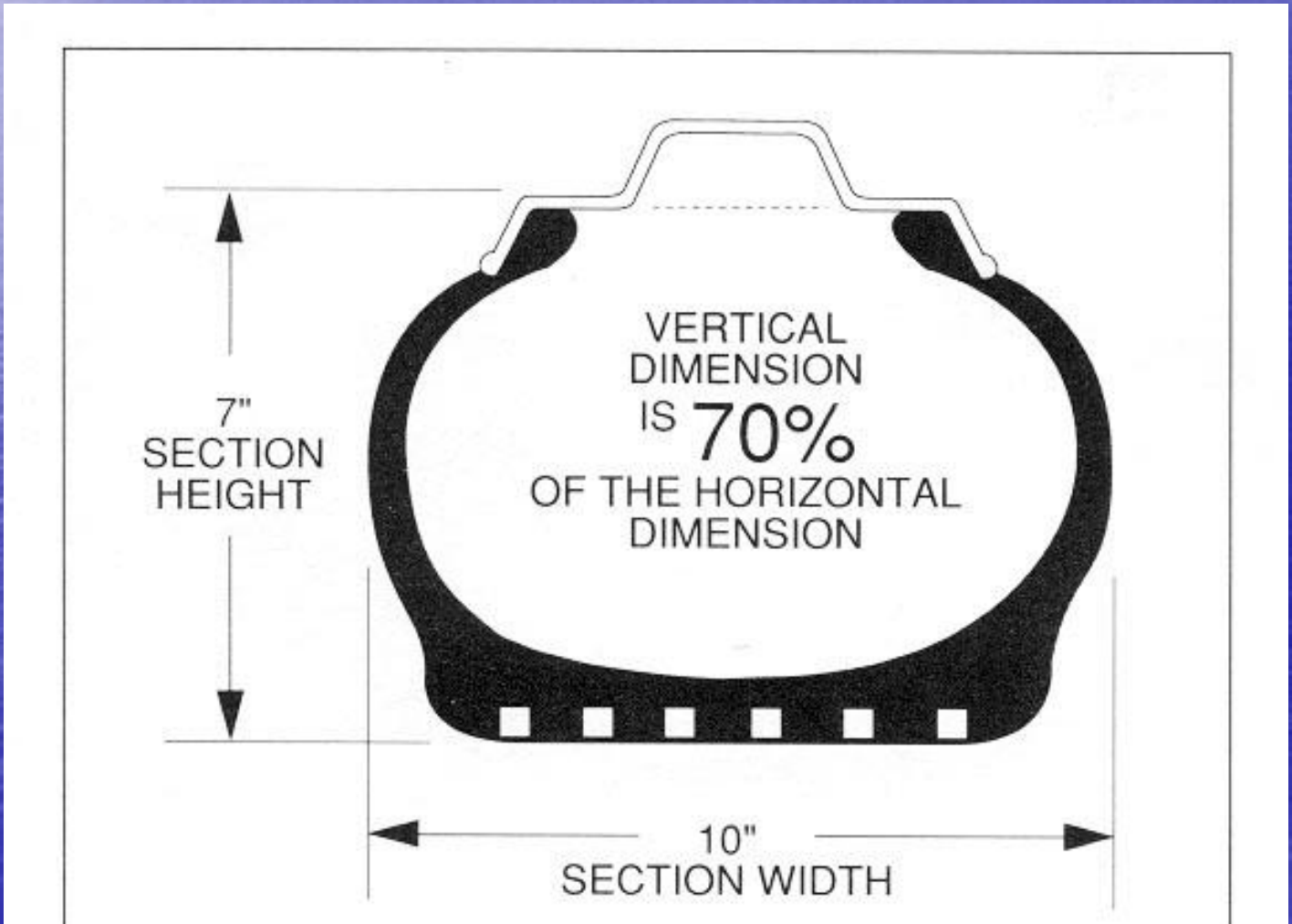

Maximum Pressure
MAX. LOAD 650
MAX. PRESS. 280
(41 P.S.I.)

One inch equals about 25 millimeters
(dia. of a quarter) (25 cents)

If 25.4 millimeters = 1 inch

Then 10 inches = 254 millimeters

P255/70R16 95H
Section width



P255/70R16 95H

Aspect Ratio

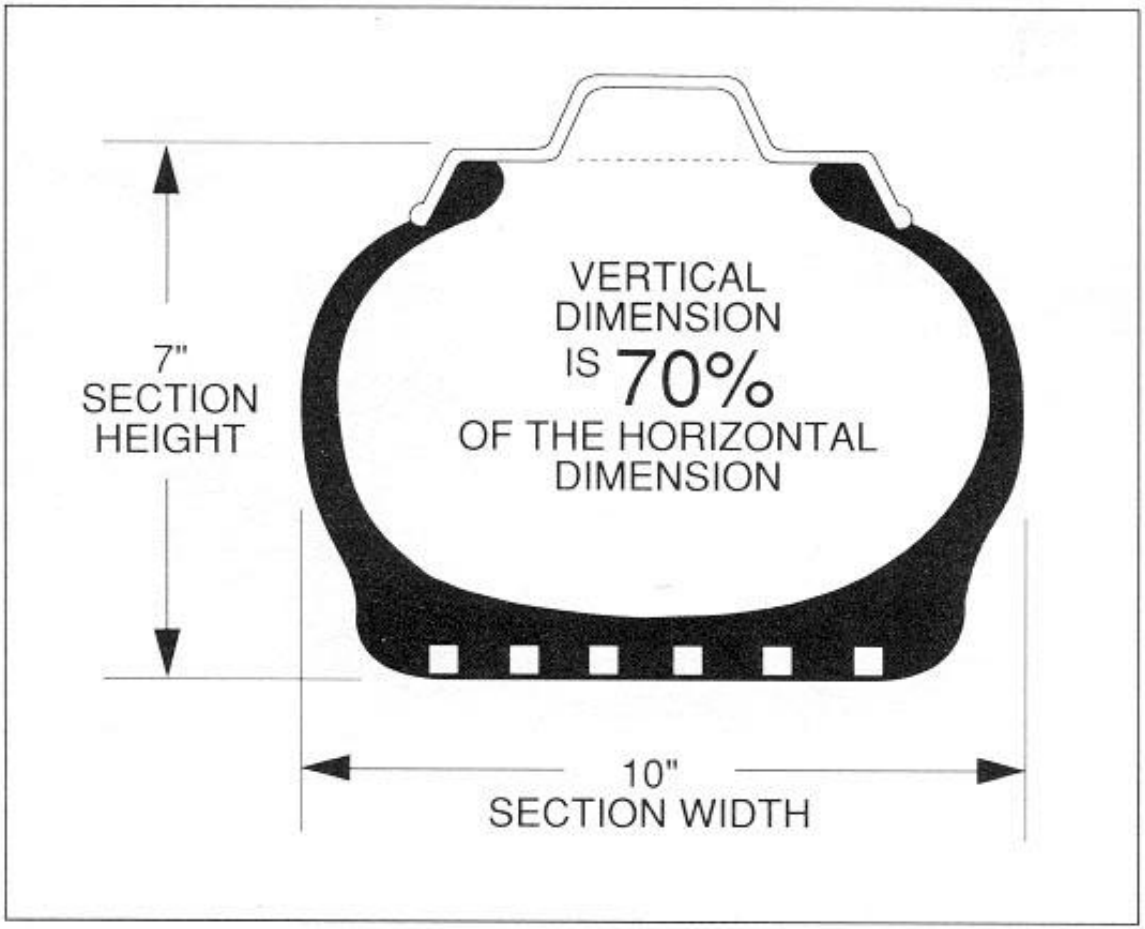
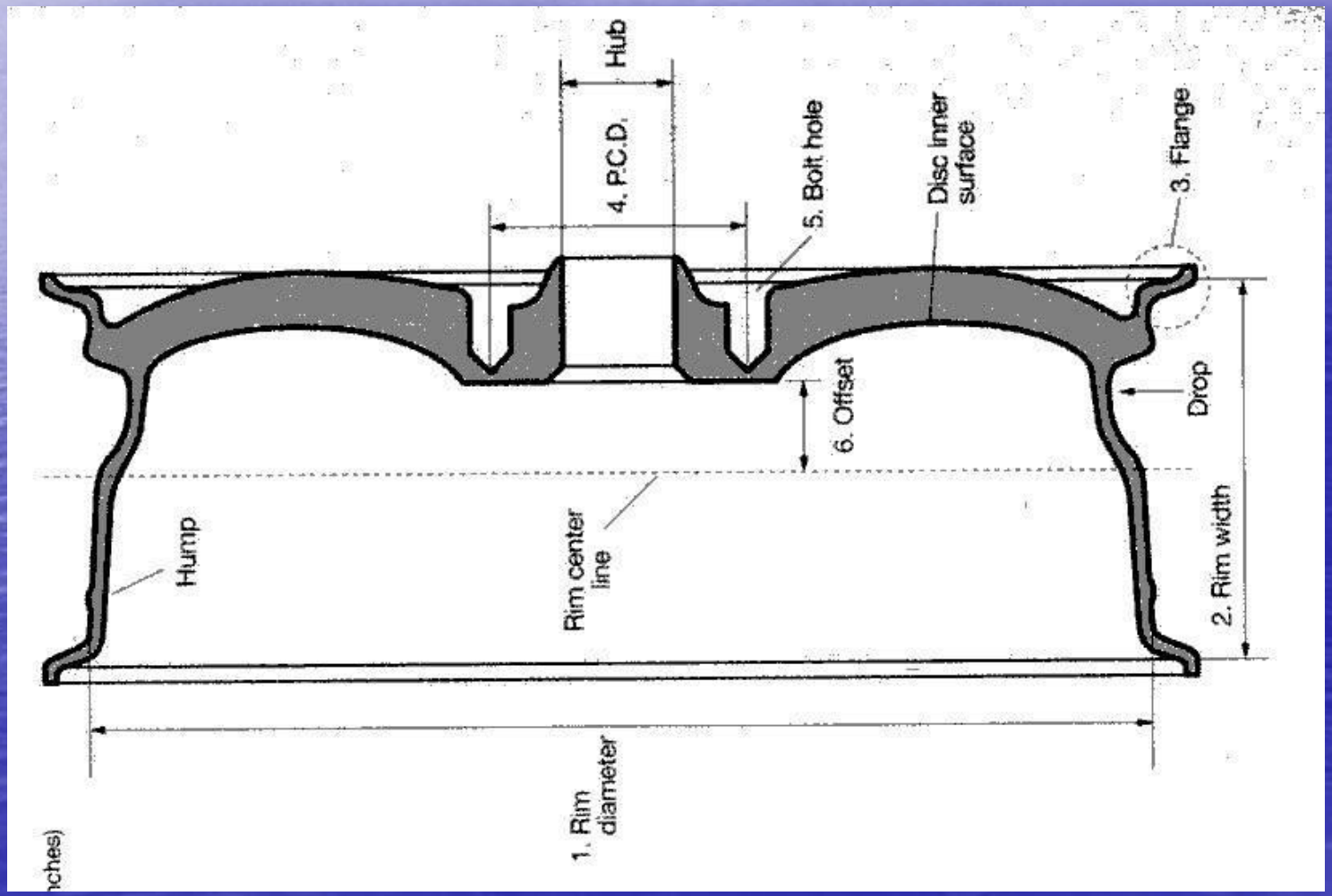


Figure 2-9 TIRE ASPECT RATIO

P255/70R 16 95H

Rim diameter

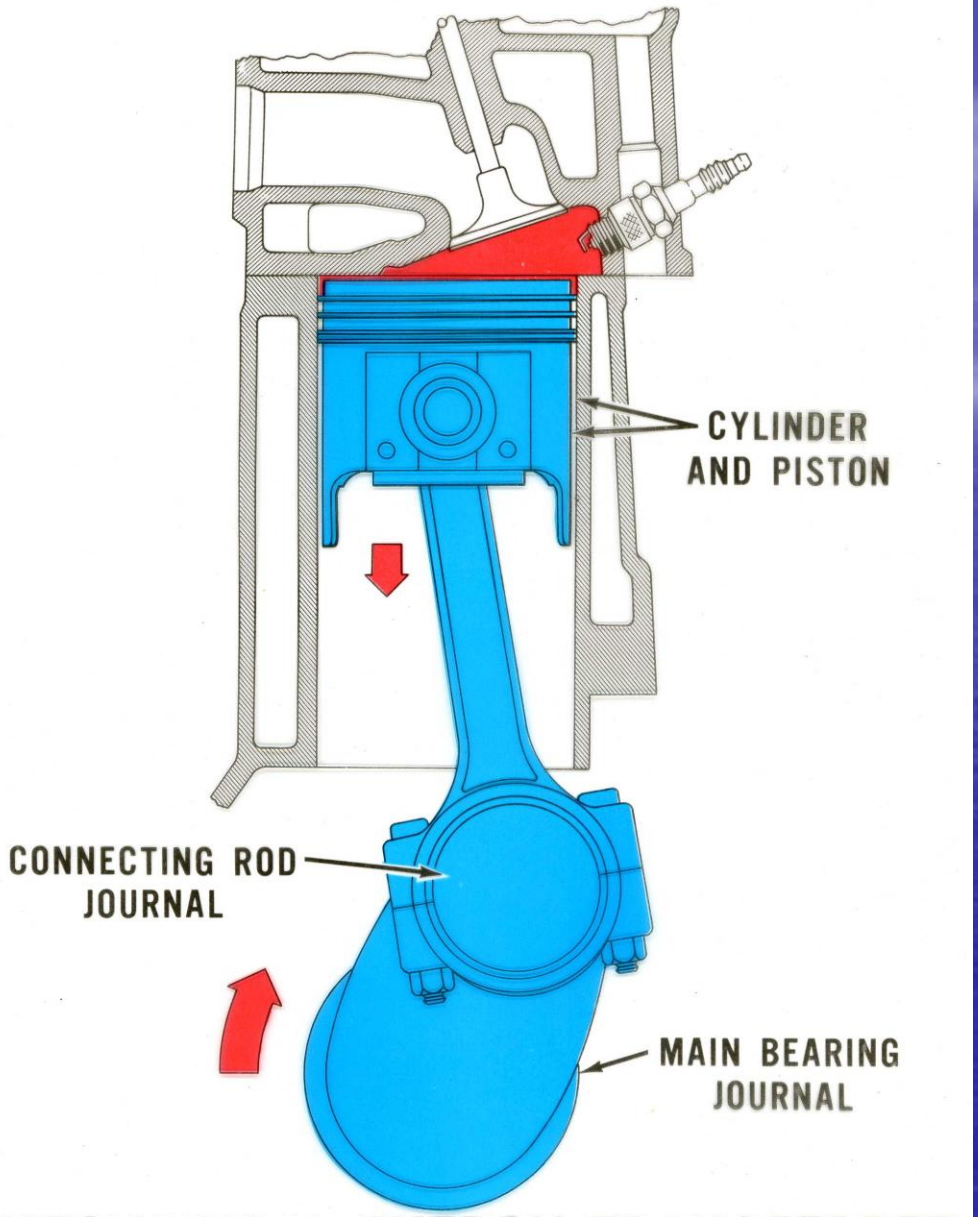


STANDARD 470604-04

Students will be able to identify and perform basic services on a vehicle.

470604-0401
Locate and identify basic automotive parts.

- Identify engine parts.
  - Block, crankshaft, camshaft, piston, cylinder head, connecting rod, valve train, timing components
  - Fuel systems: injector, filter, lines, pump, tank.
  - Ignition systems: spark plugs, coil(s).
  - Cooling systems: radiator, pump, thermostat



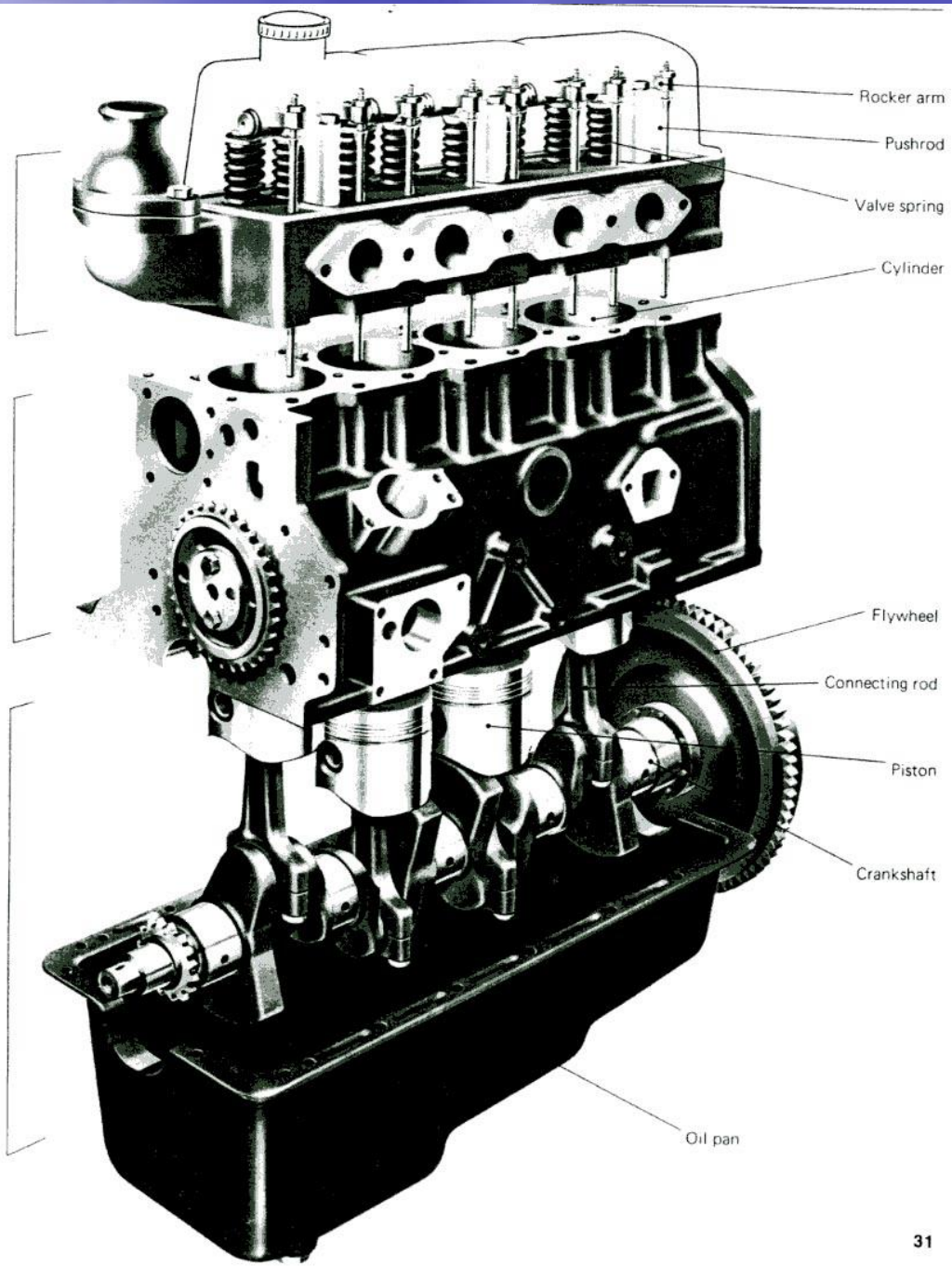
MECHANICAL ENERGY TRANSFERRED THROUGH CONNECTING ROD AND CRANKSHAFT

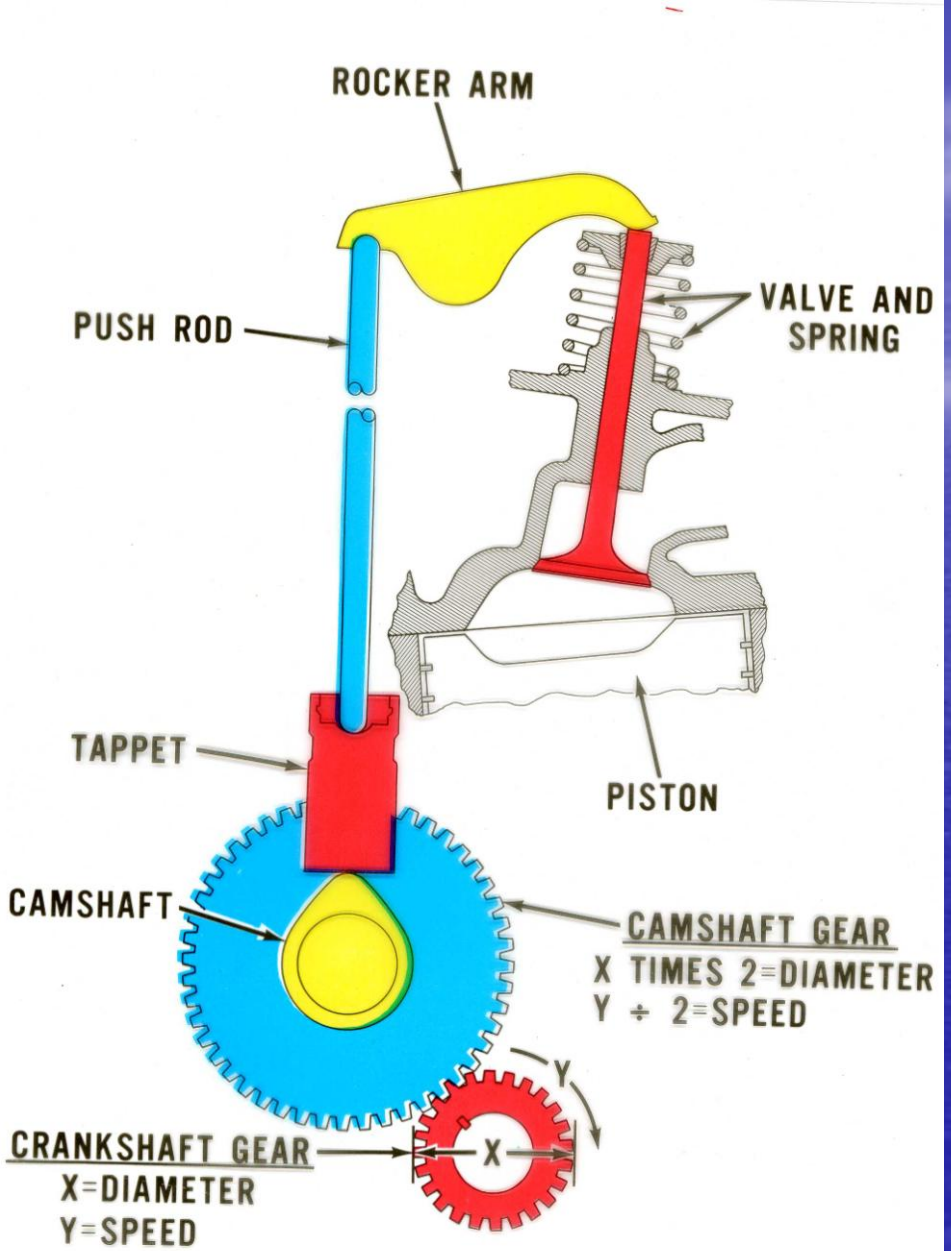
6000.1-6

Cylinder head contains the valves, the rocker arms that open them, and the springs that close them. The head also contains the intake and exhaust passages and the combustion chambers.

Cylinder block is the largest part of an engine. It has cylinders, or *bores*, for the pistons to move up and down in, passages for fluid that cools the engine, galleries that carry lubricating oil to the various moving parts, and holes for the pushrods (on engines that use pushrods to open the valves).

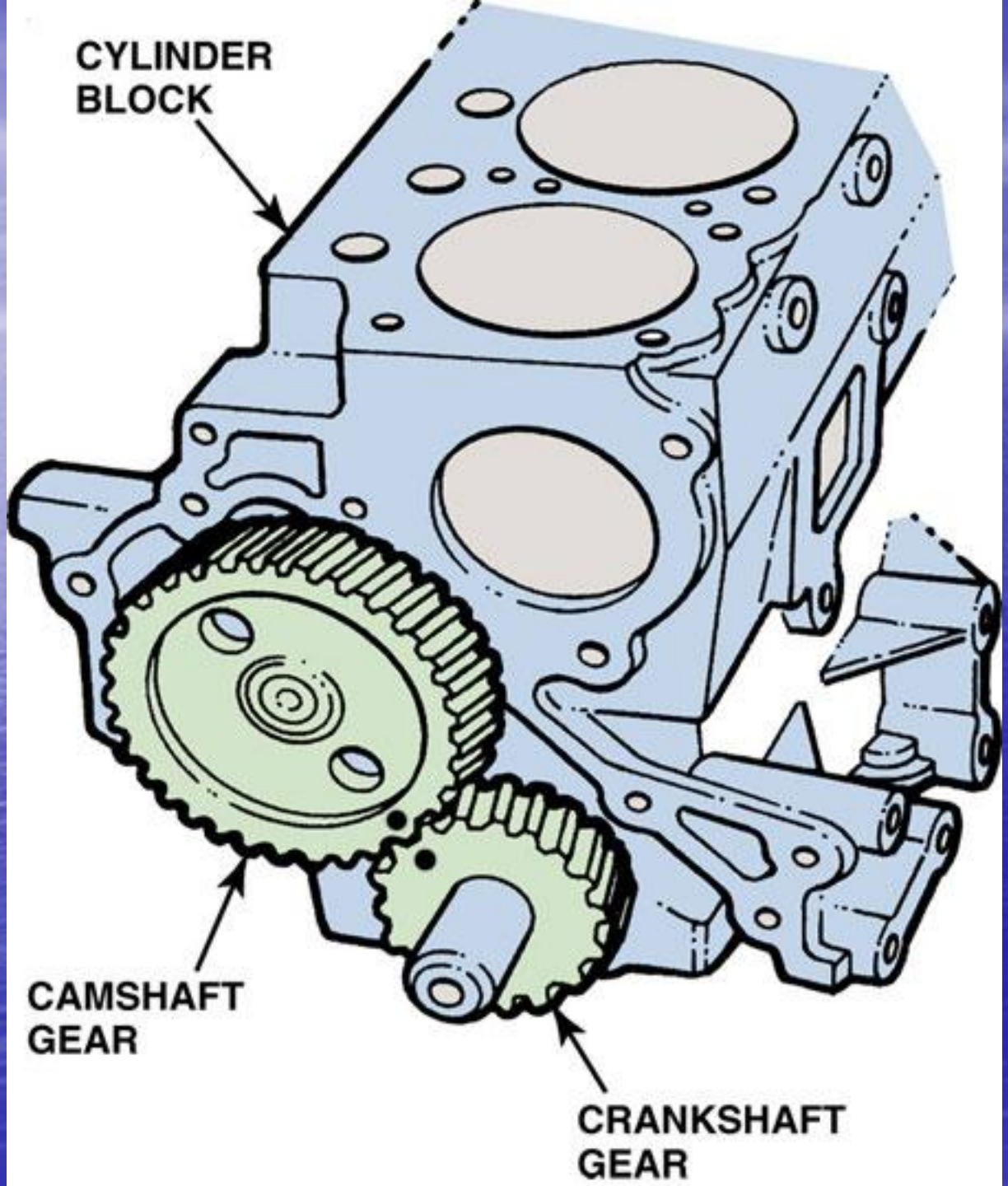
Crankcase was a separate part on older engines. On modern engines the area enclosed by the oil pan and the bottom of the cylinder block is still referred to as the *crankcase*. The crankshaft is carried in main bearings attached to the base of the cylinder block. The connecting rods cause the crankshaft to rotate as the pistons move up and down. The heavy flywheel at one end of the crankshaft helps to smooth out the power impulses from the individual cylinders. A pulley (not shown) attached to the forward end of the crankshaft drives a V-belt to operate the alternator, water pump, and fan.



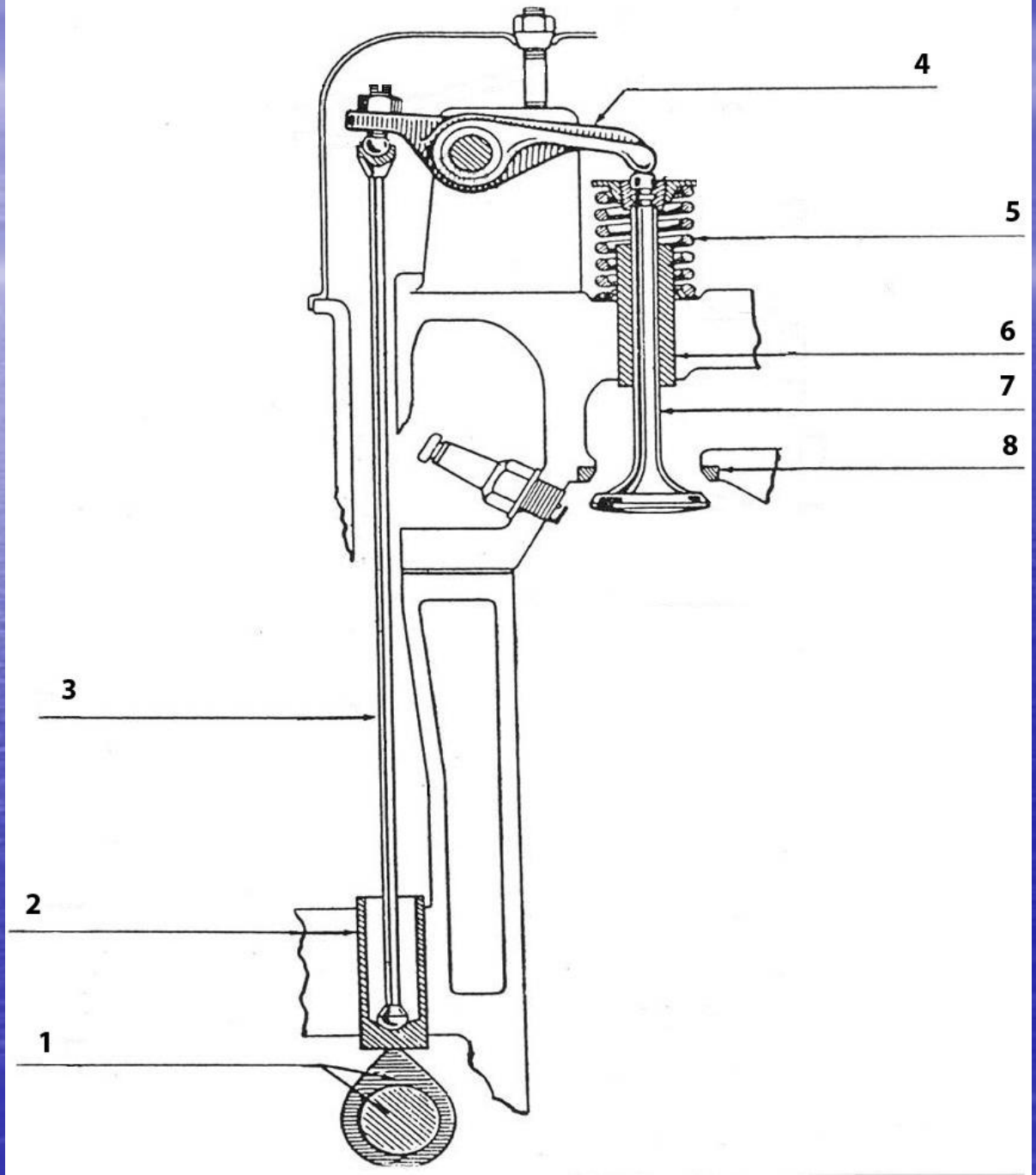


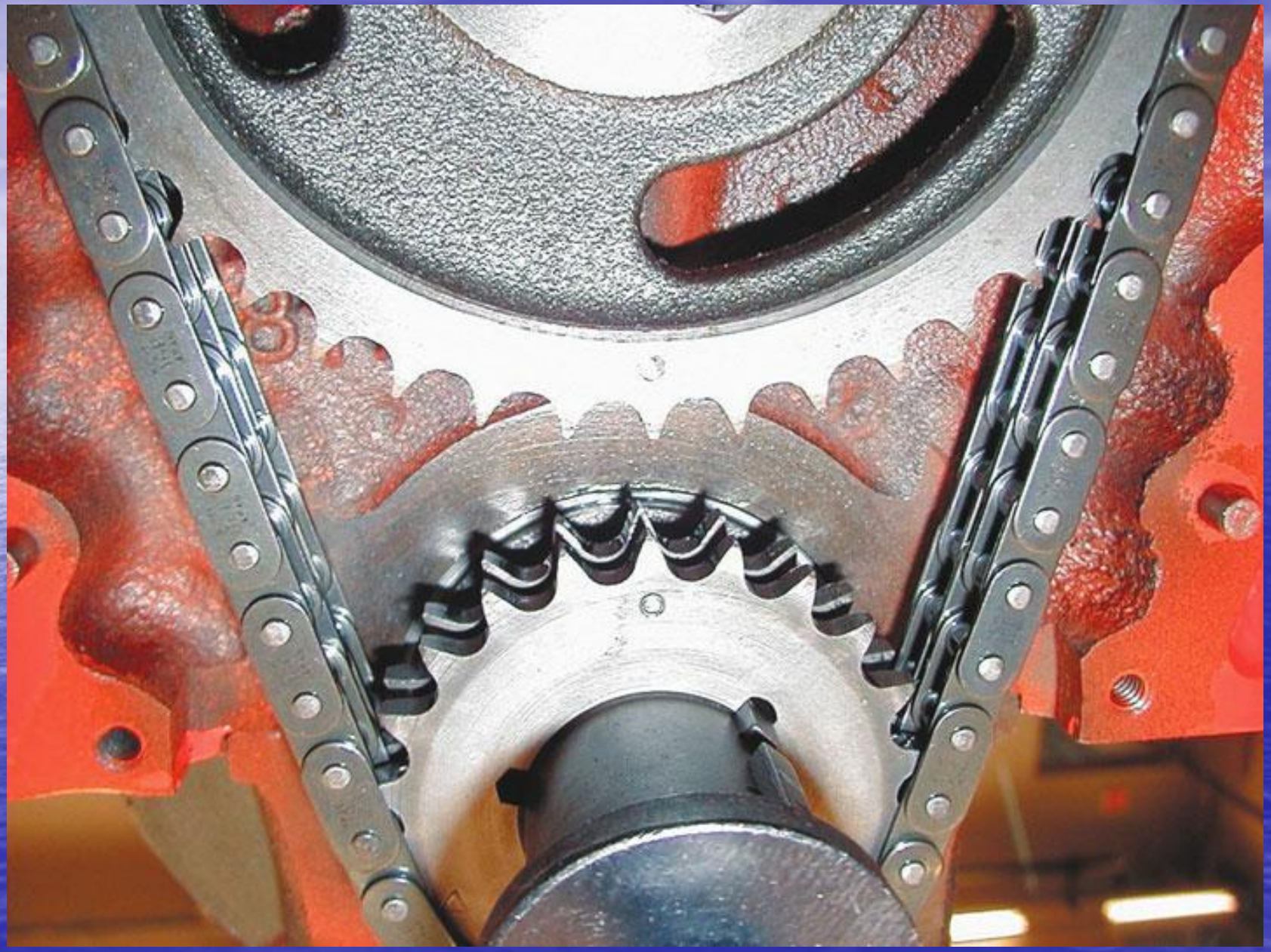
CAMSHAFT DRIVE AND VALVE LINKAGE

6000.1-8

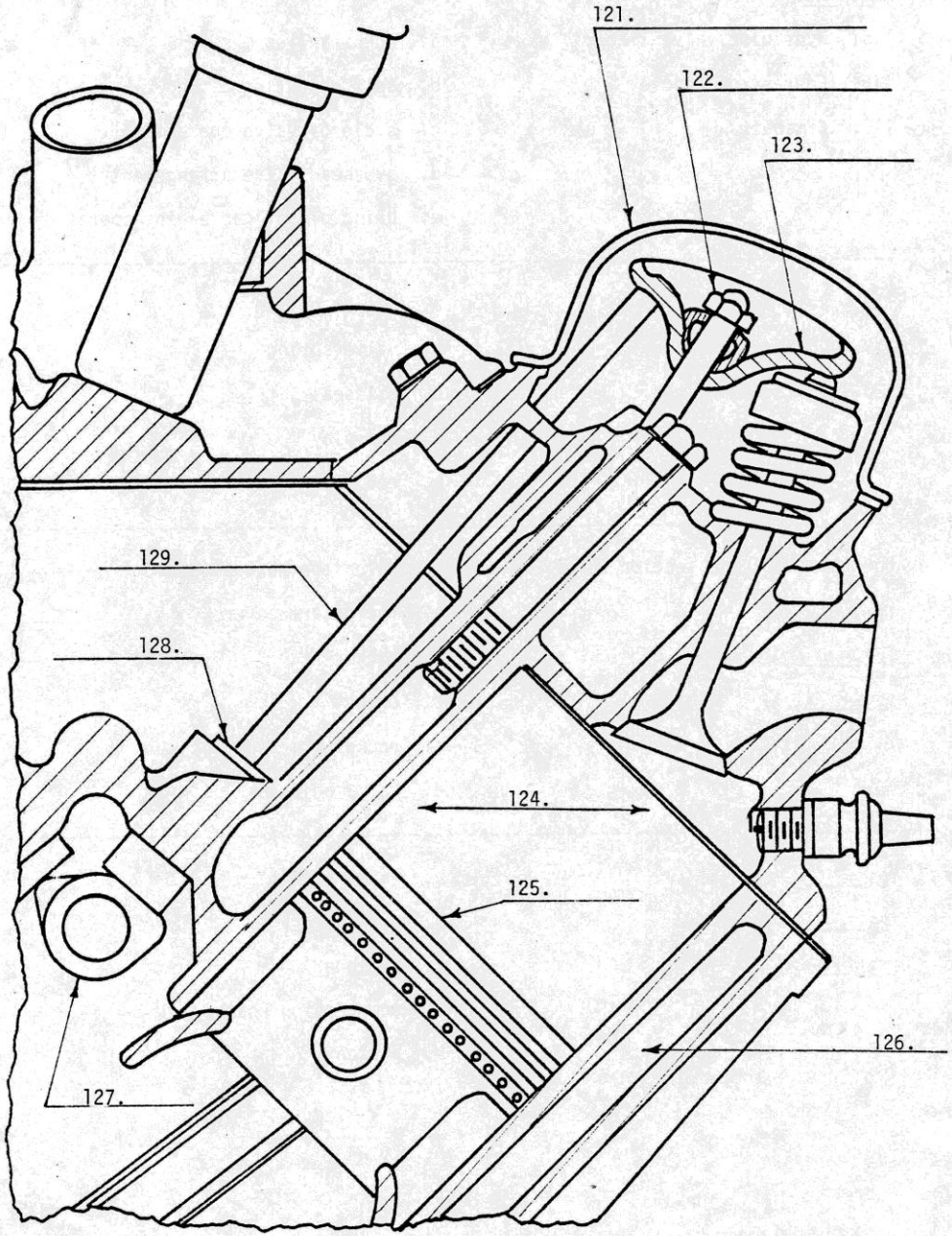

CYLINDER
BLOCK
CAMSHAFT
GEAR
CRANKSHAFT
GEAR

Overhead Valve Assembly

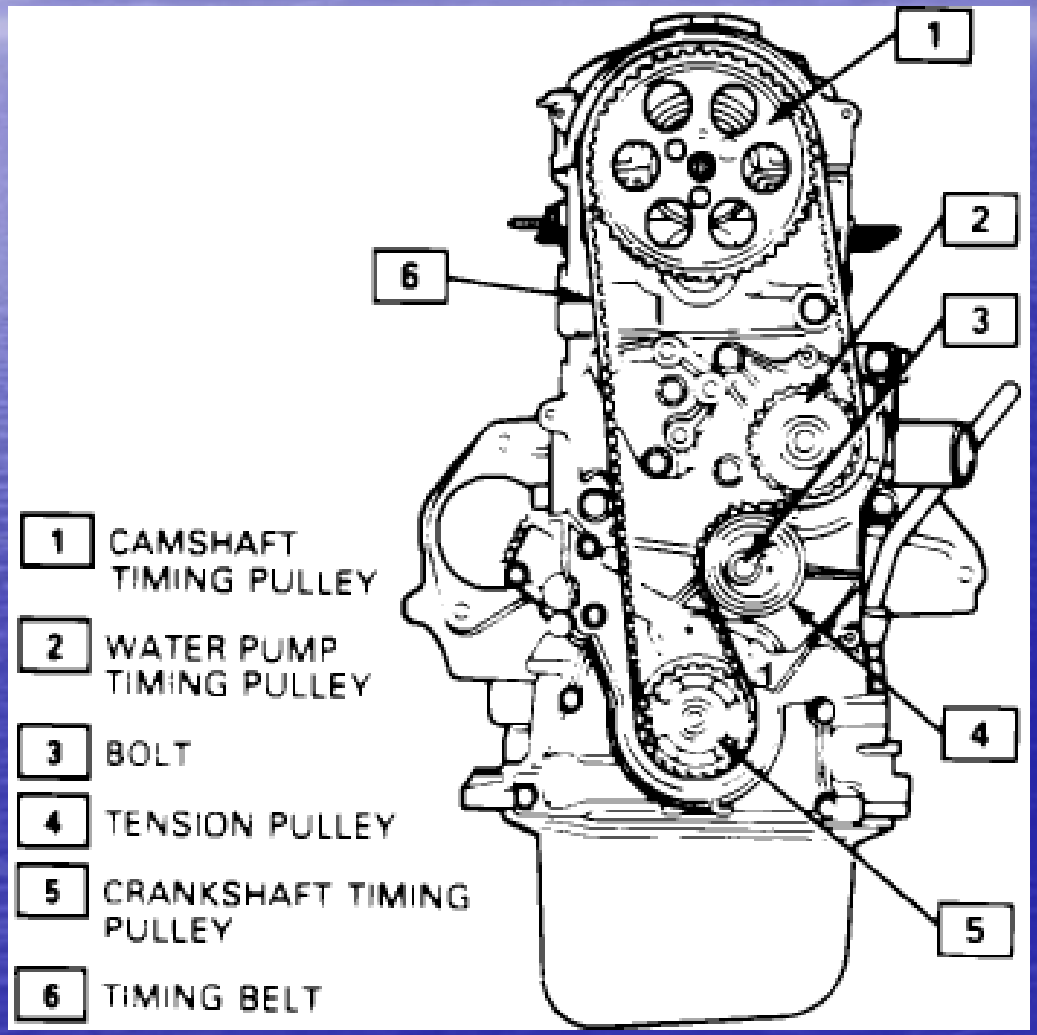


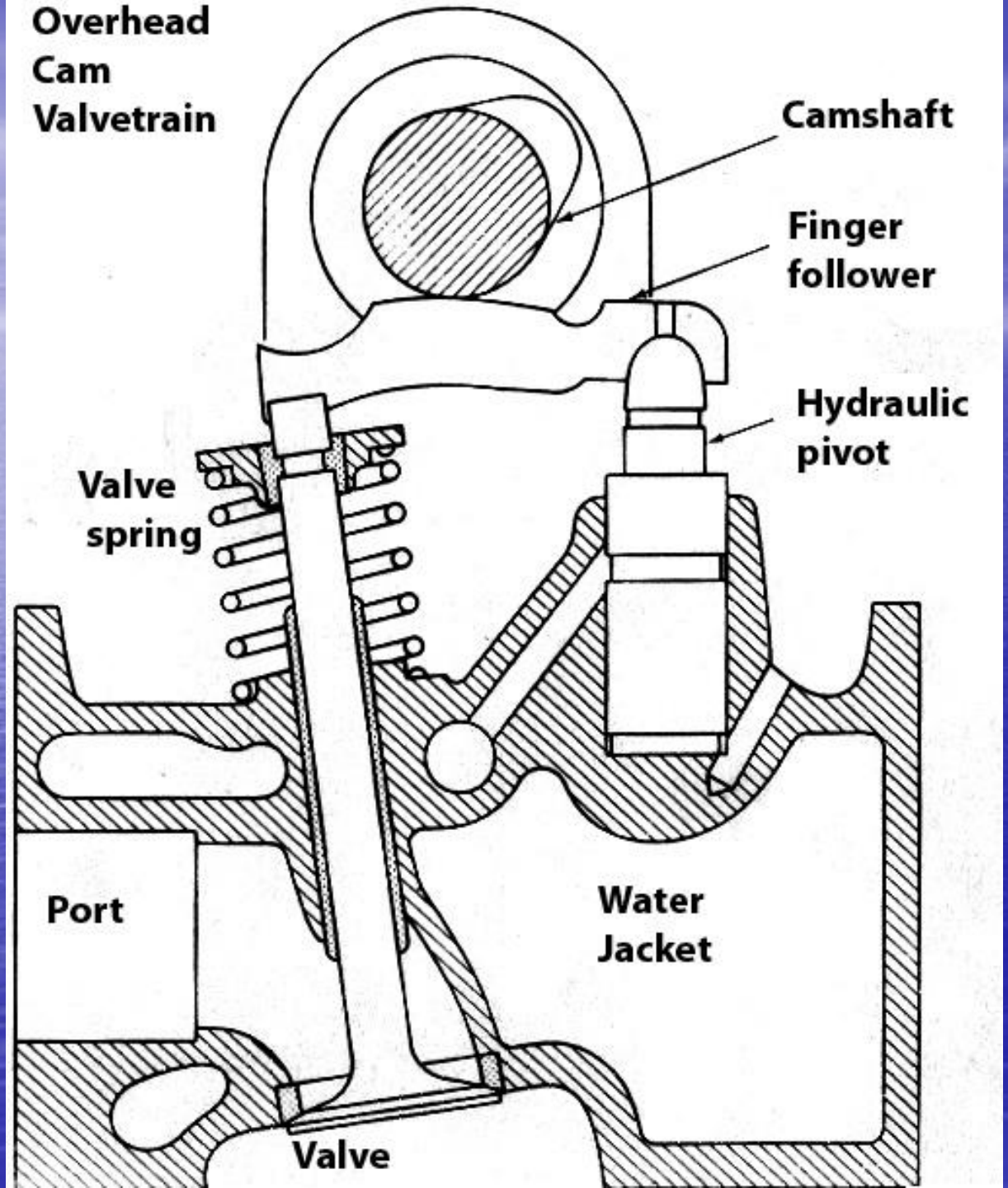


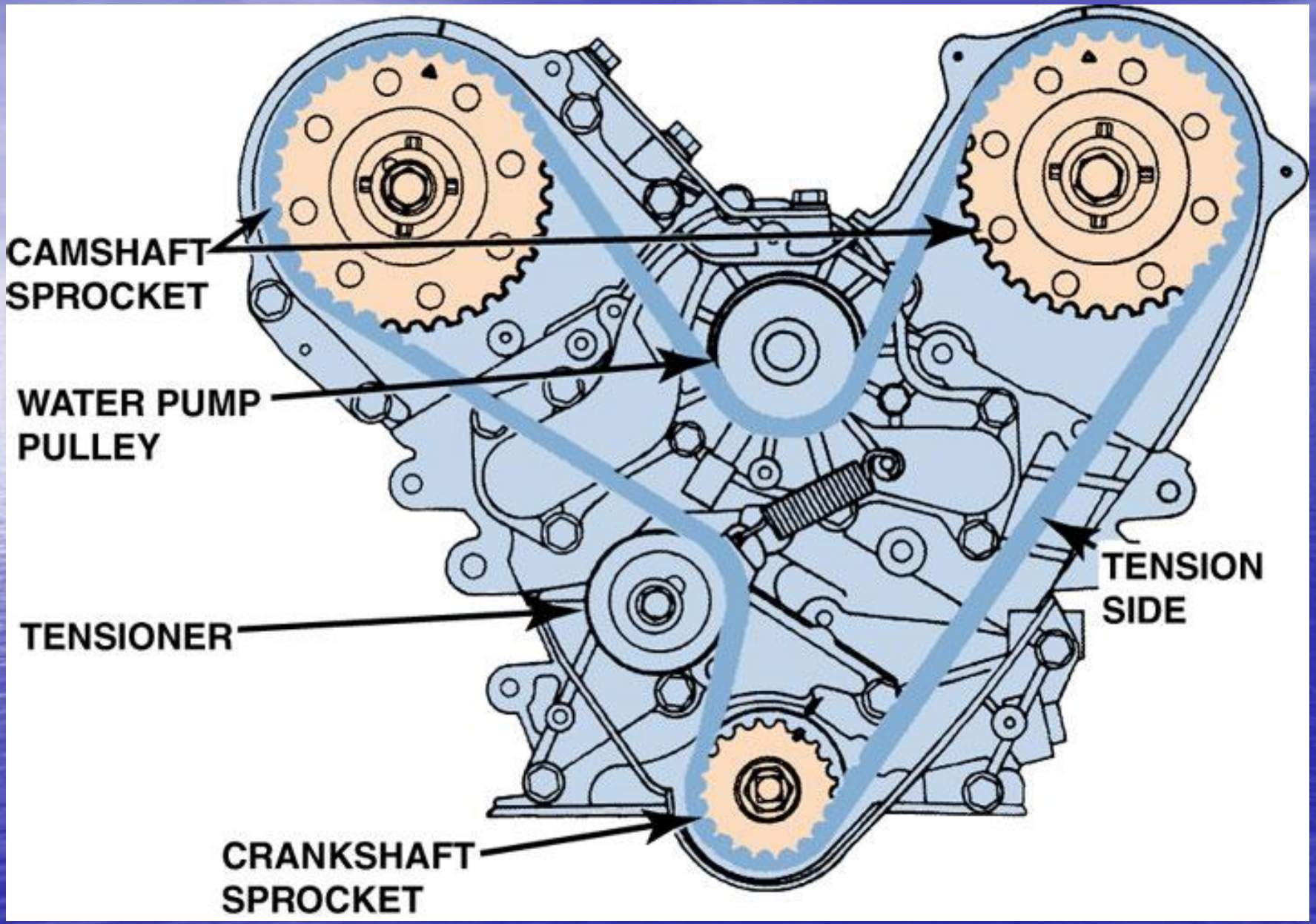
ENGINE SECTION

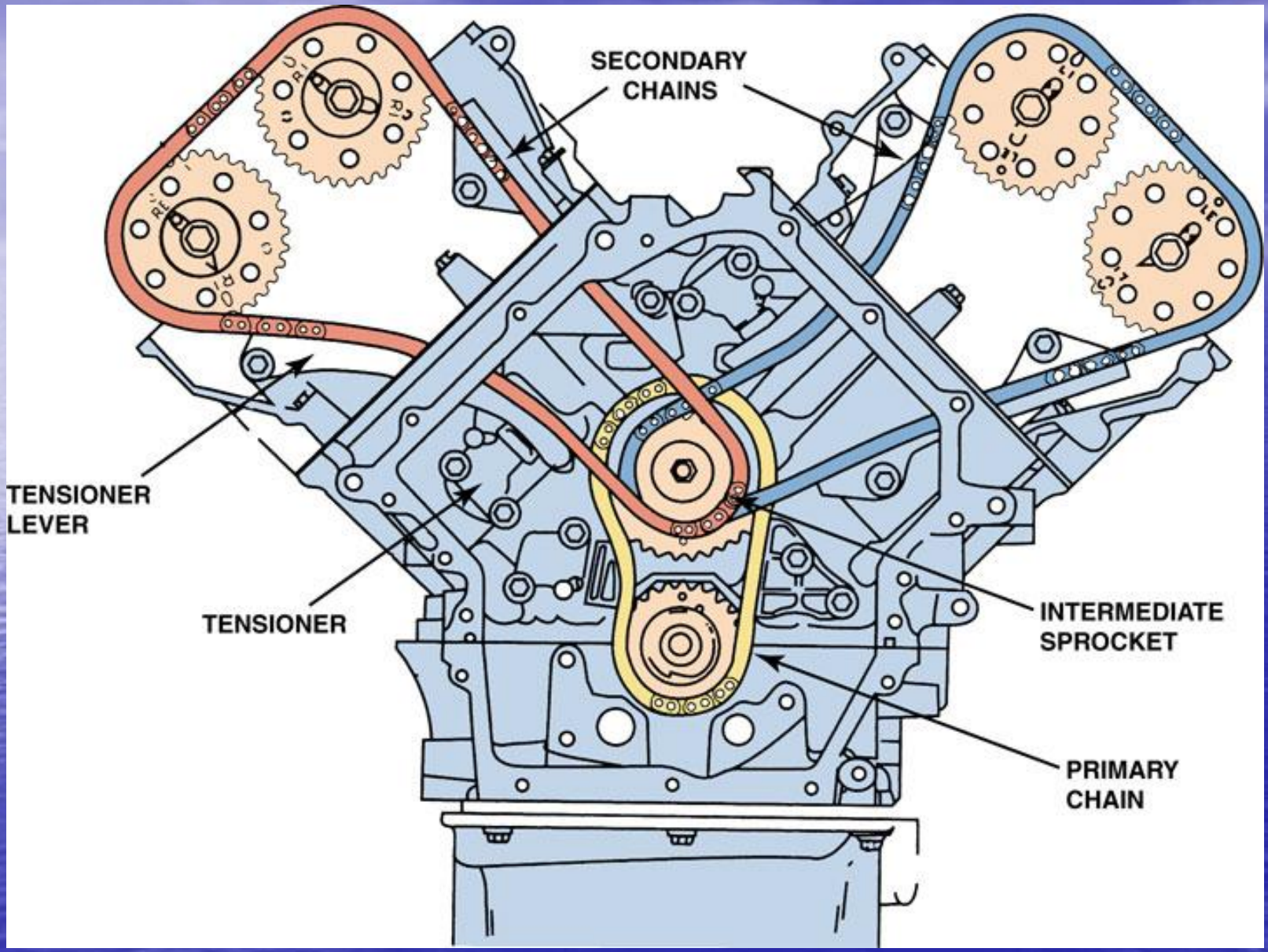


Timing belt: change around 60,000 miles, broken belt can allow pistons to hit valves.

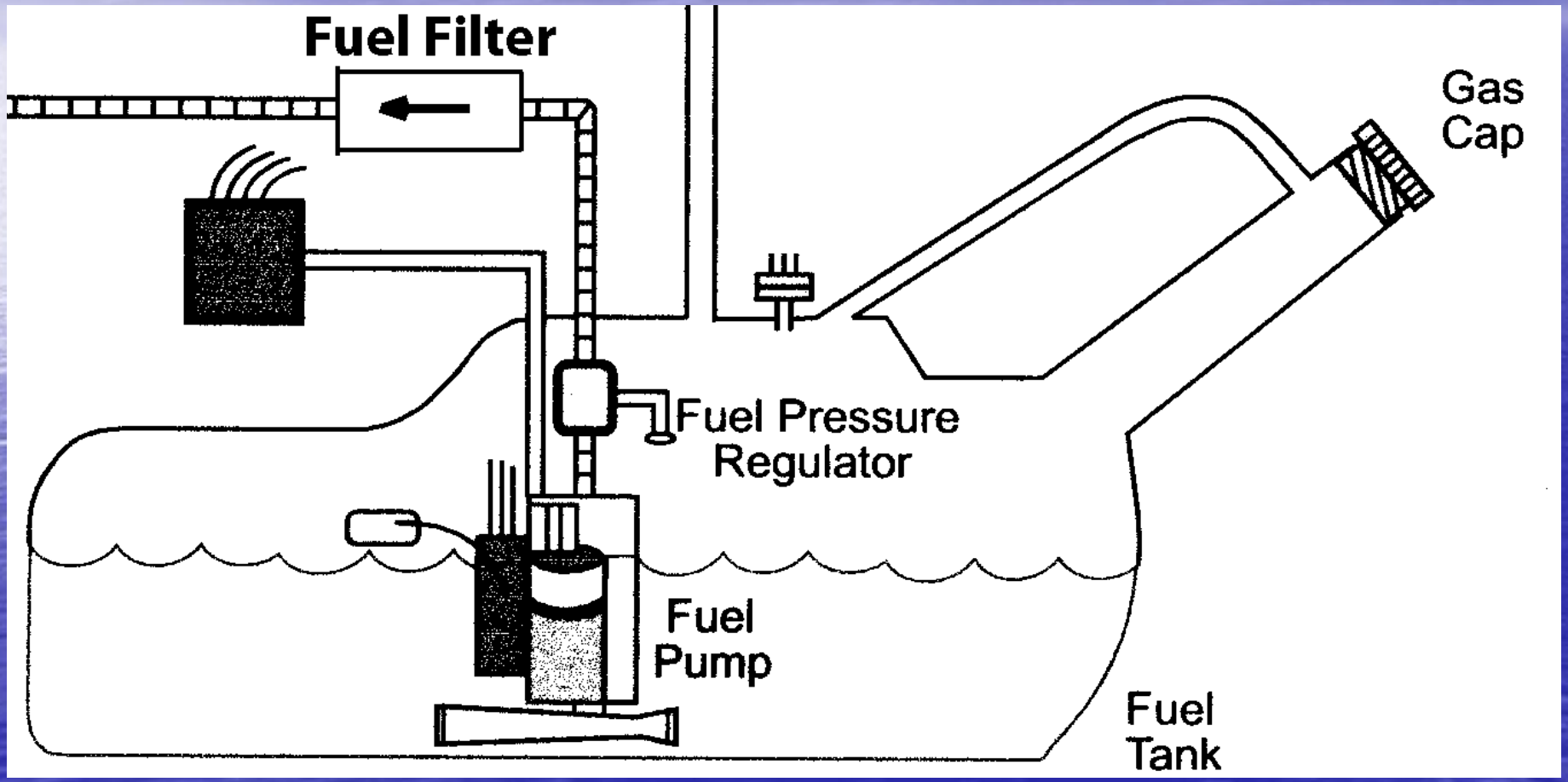


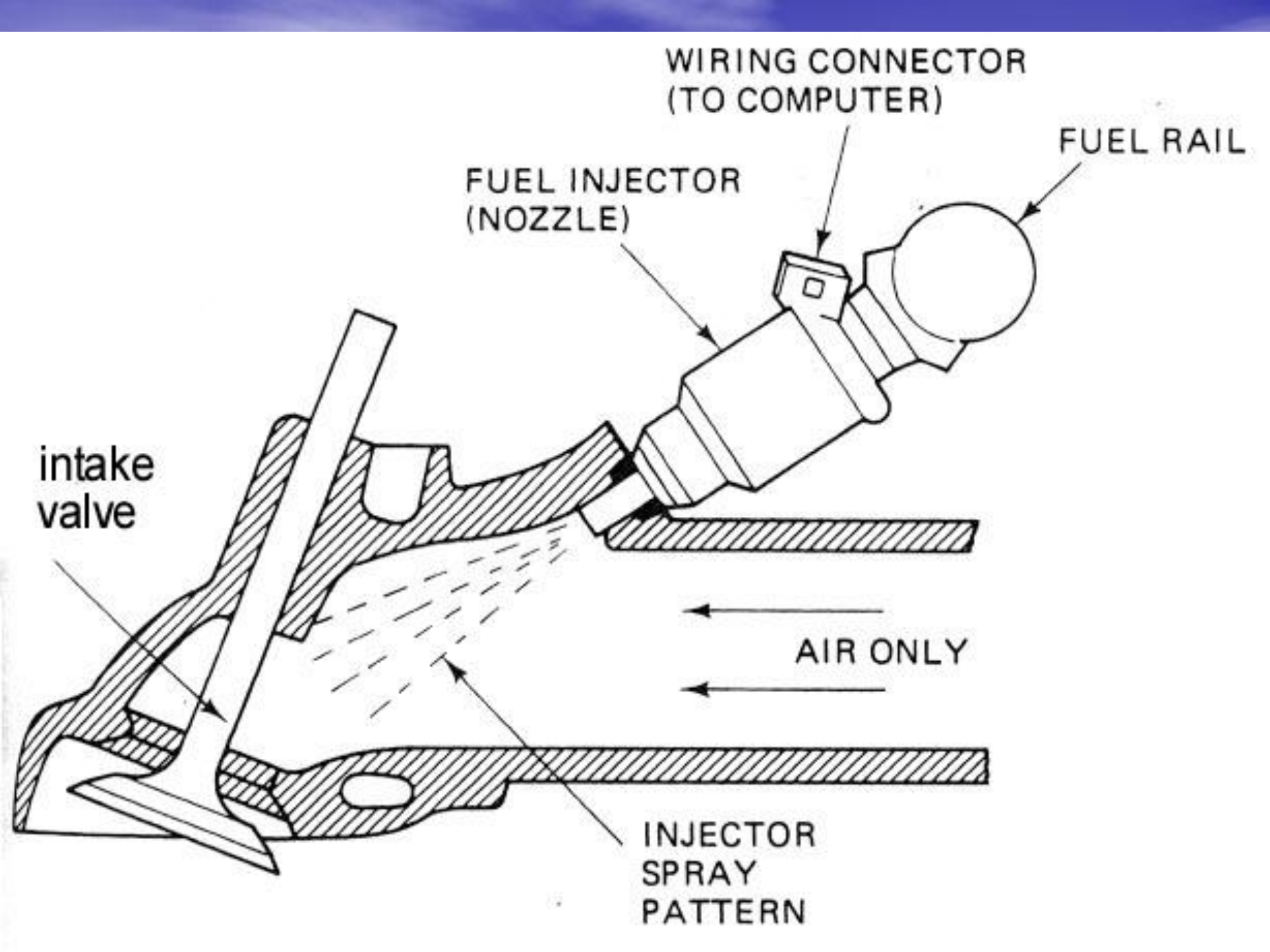

Overhead
Cam
Valvetrain
Camshaft
Finger
follower
Hydraulic
pivot
Valve
spring
Port
Water
Jacket
Valve


CAMSHAFT SPROCKET
WATER PUMP PULLEY
TENSIONER
CRANKSHAFT SPROCKET
TENSION SIDE

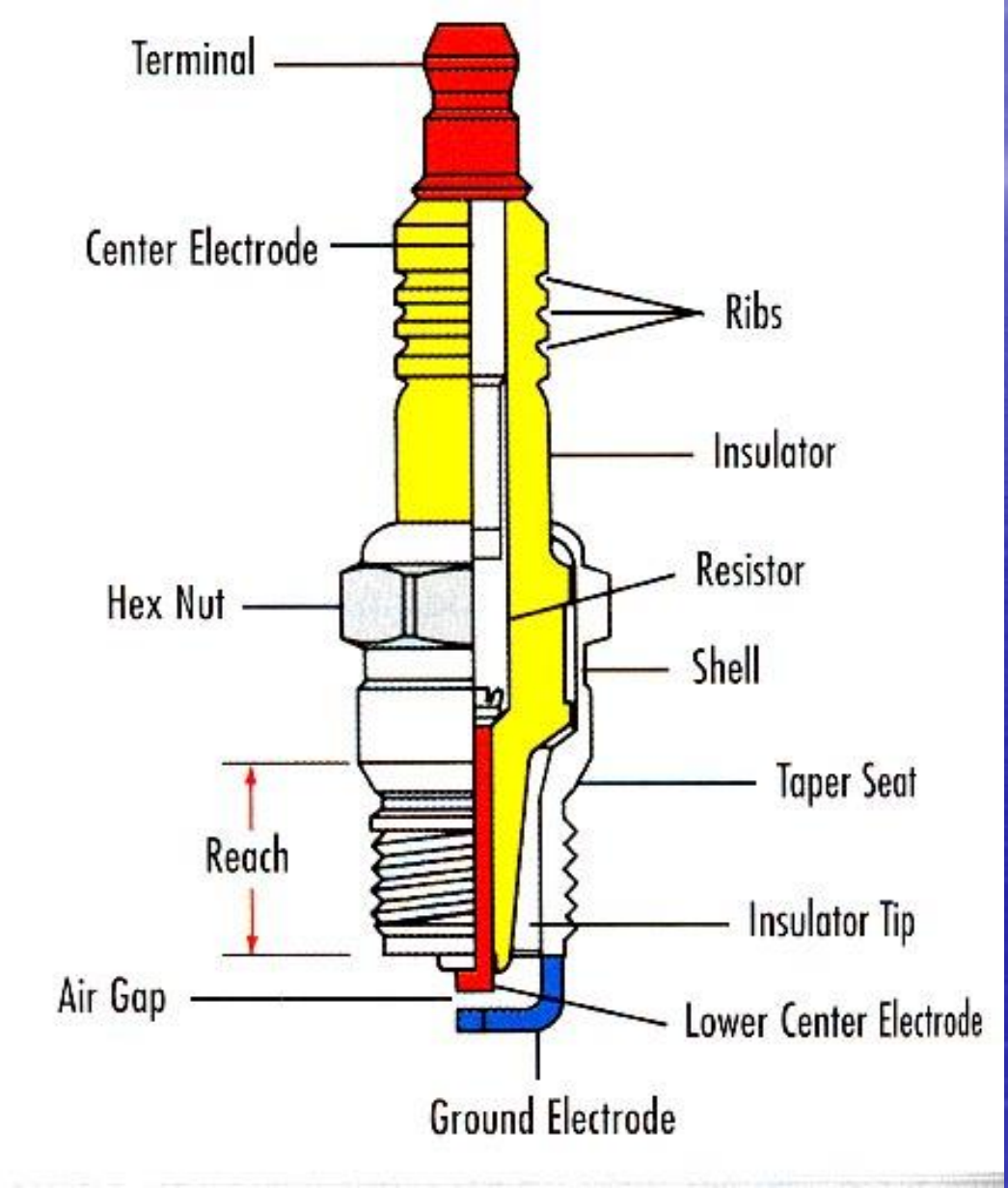

SECONDARY CHAINS
TENSIONER LEVER
TENSIONER
INTERMEDIATE SPROCKET
PRIMARY CHAIN

Fuel supply system

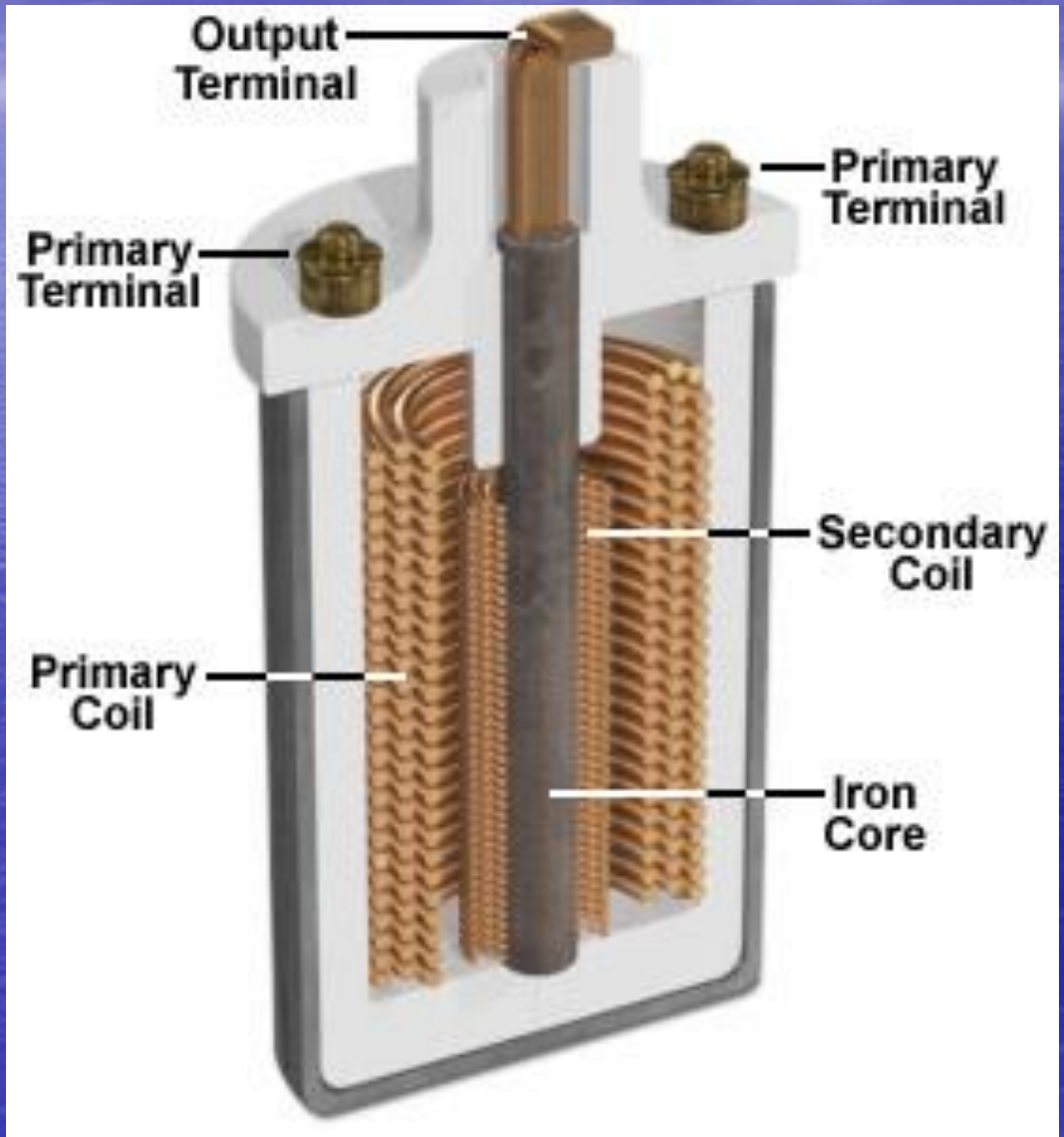



WIRING CONNECTOR
(TO COMPUTER)
FUEL RAIL
FUEL INJECTOR
(NOZZLE)
intake
valve
AIR ONLY
INJECTOR
SPRAY
PATTERN

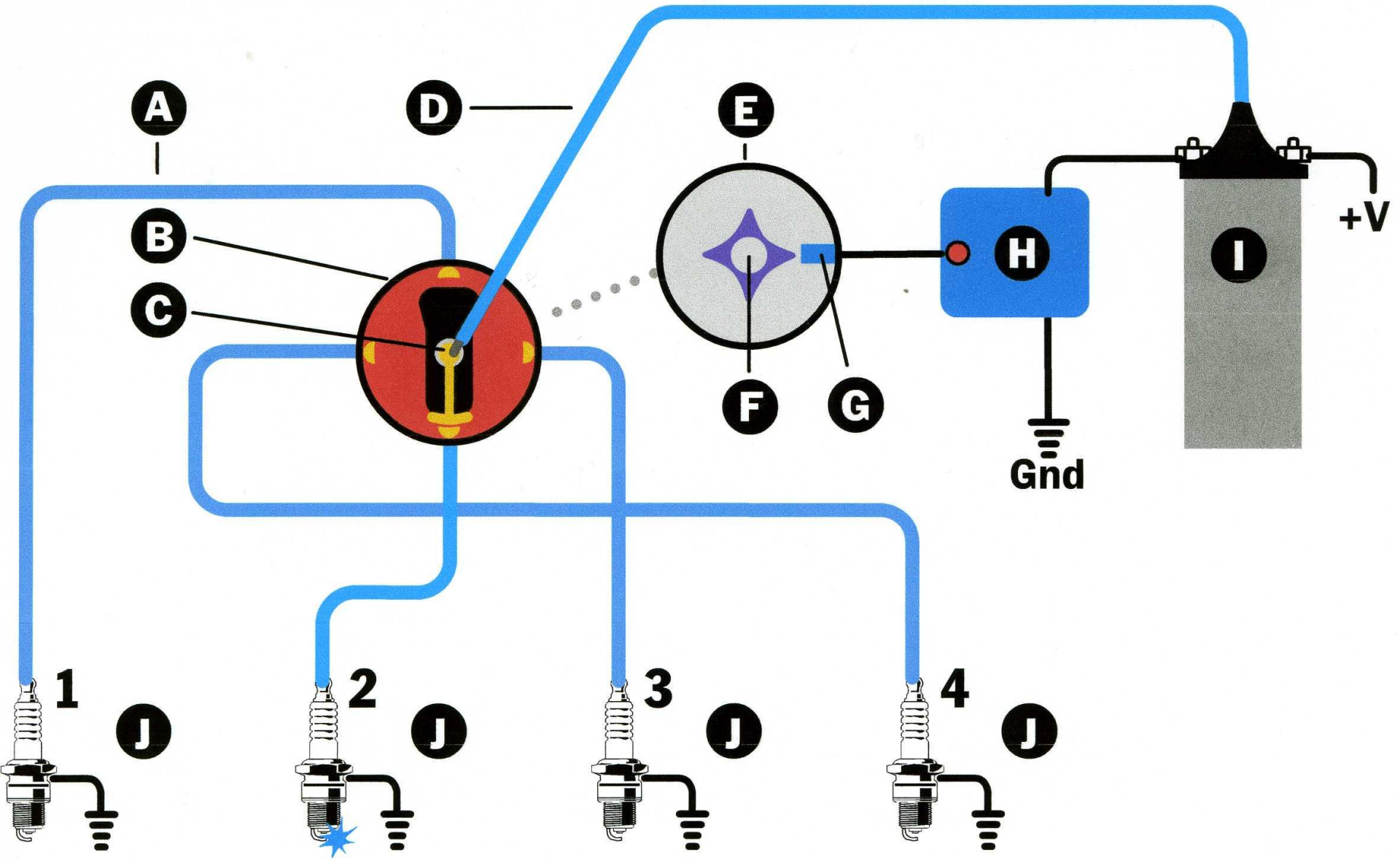
Spark plug


Terminal
Center Electrode
Ribs
Insulator
Hex Nut
Resistor
Shell
Taper Seat
Reach
Insulator Tip
Air Gap
Lower Center Electrode
Ground Electrode

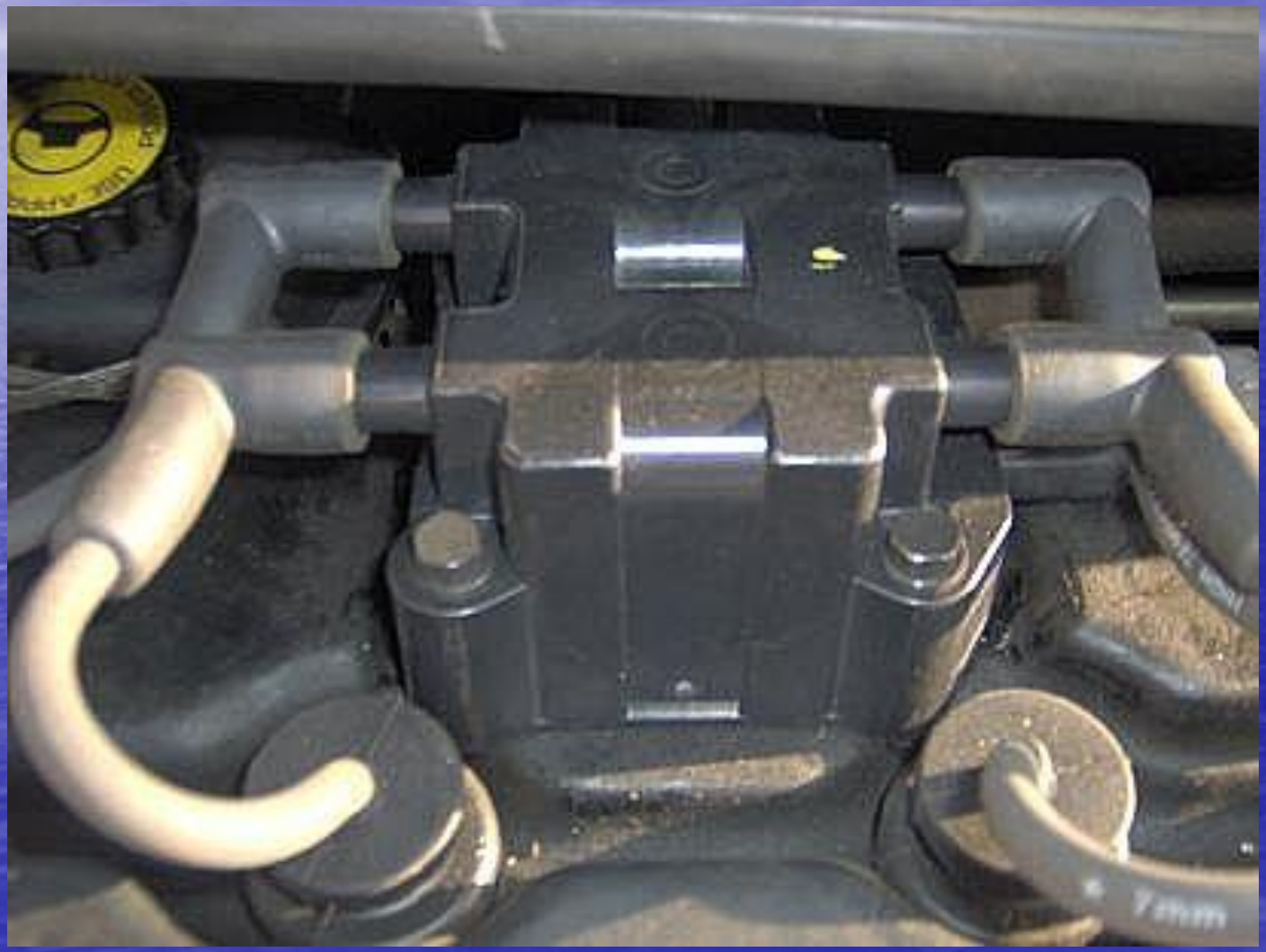
Ignition coil:
12V transforms to 25,000V+



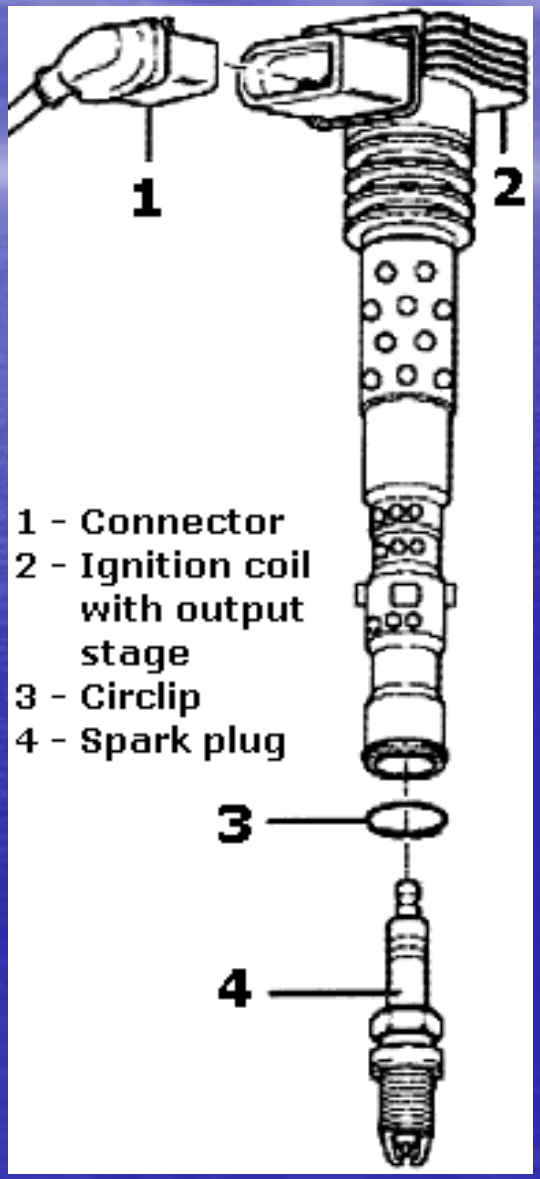
Distributor Ignition



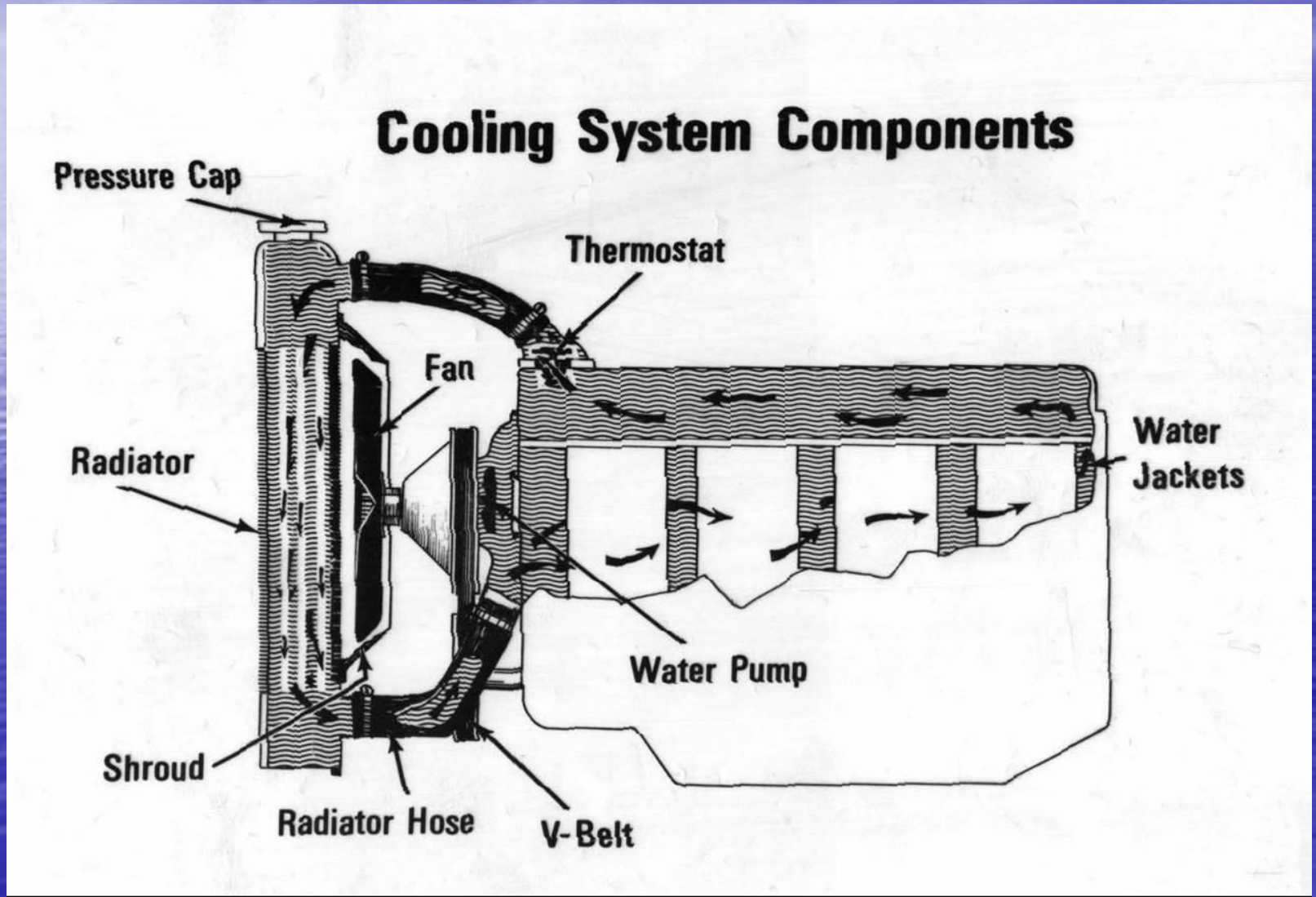
Coilpack



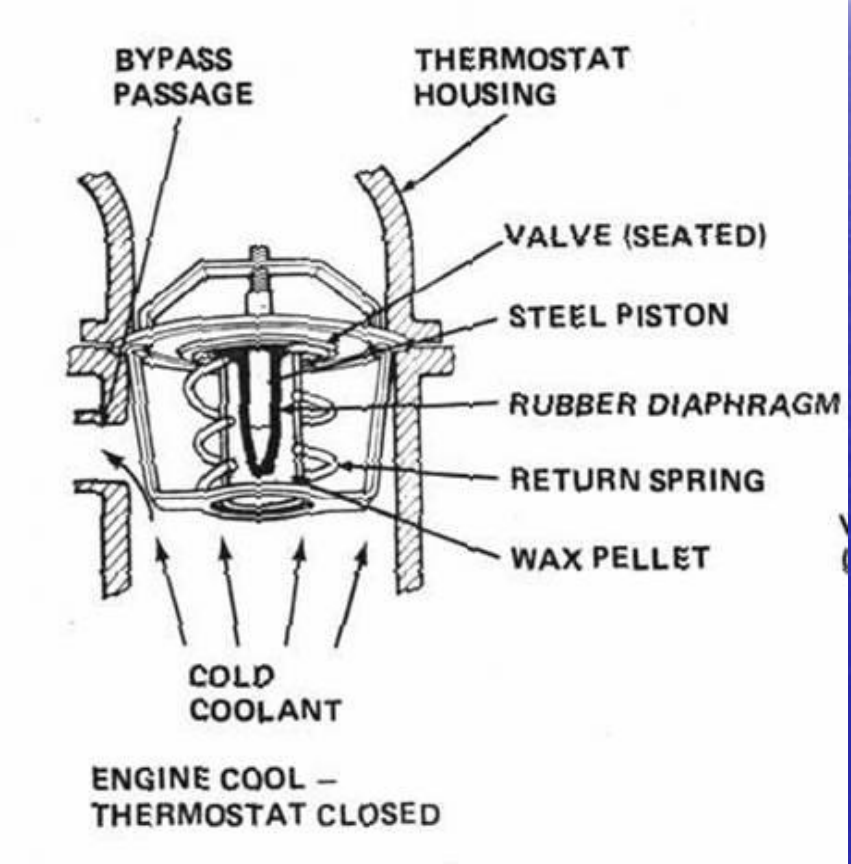
Coil-on-plug ignition

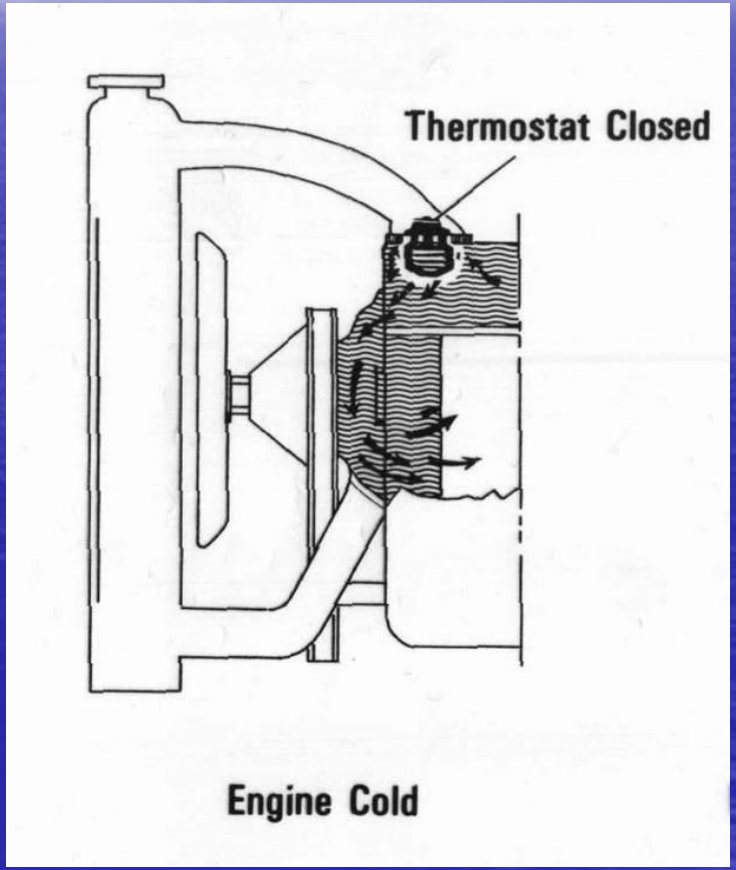


Upper hose comes from the thermostat
Lower hose goes to the water pump

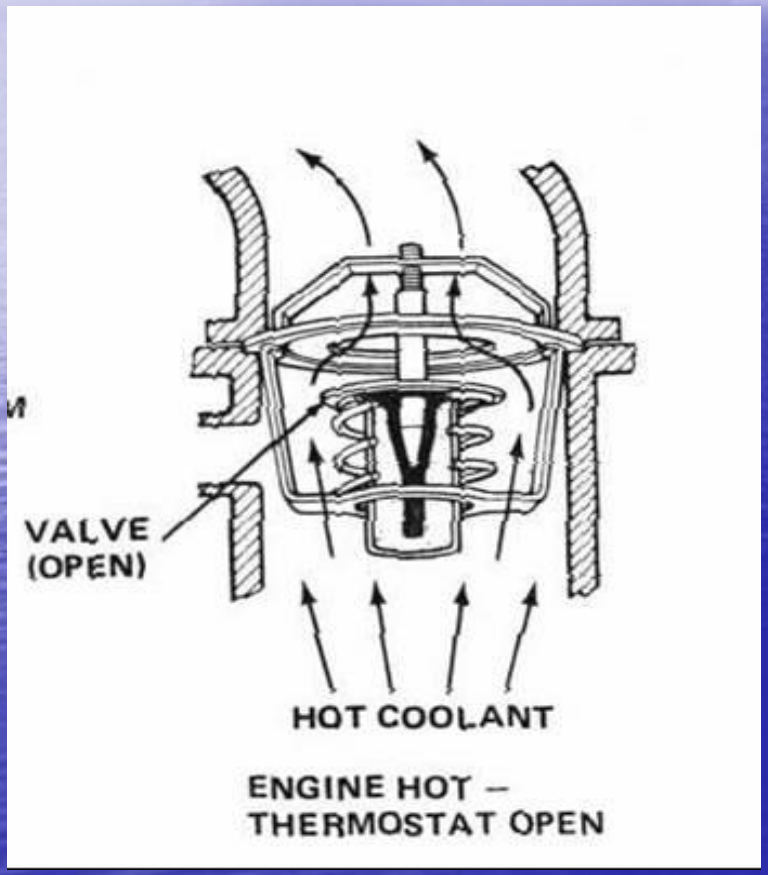


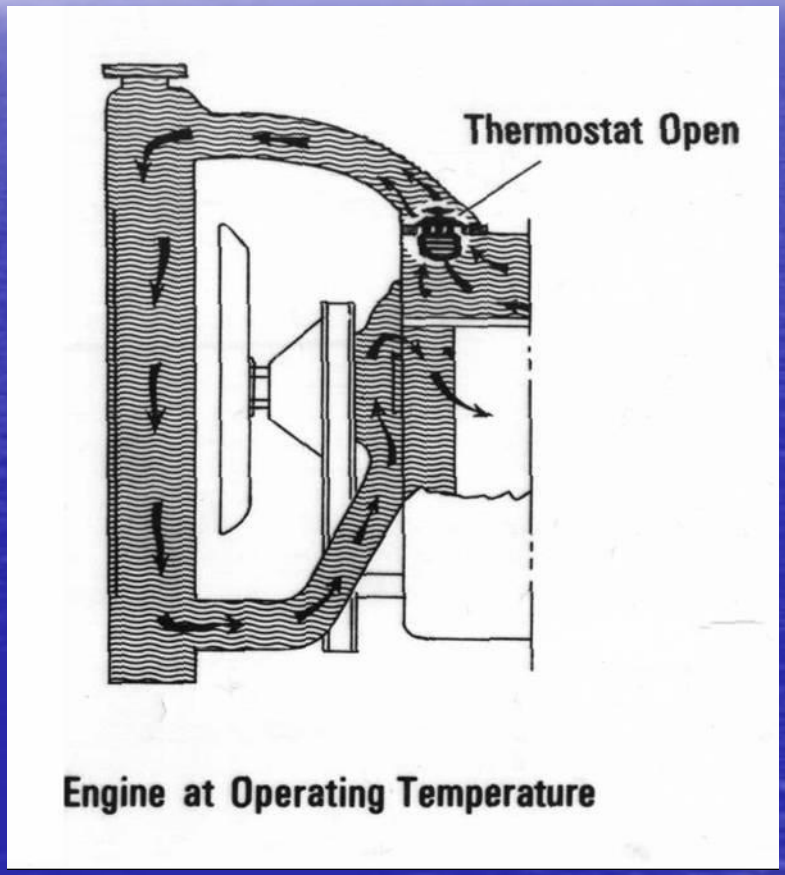
Thermostat is closed below 195 degrees Fahrenheit

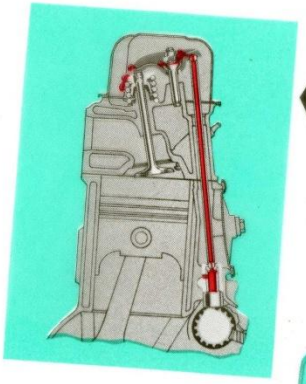




Thermostat is open above 195 degrees Fahrenheit

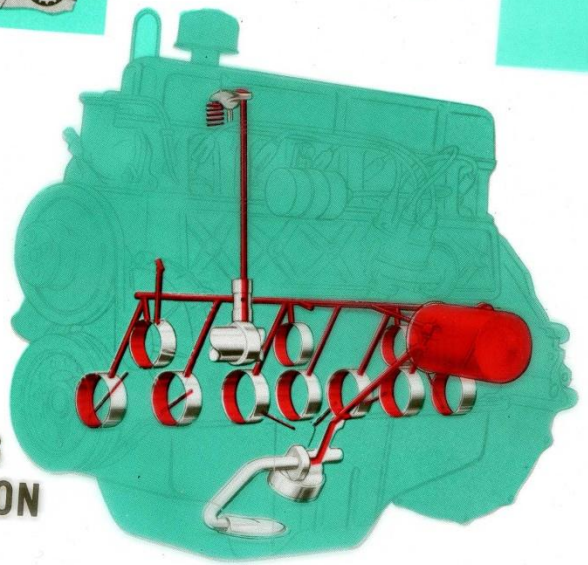






VALVE TRAIN LUBRICATION

DISTRIBUTOR AND GEAR LUBRICATION



BEARING LUBRICATION SYSTEM

OIL PUMP AND FILTER

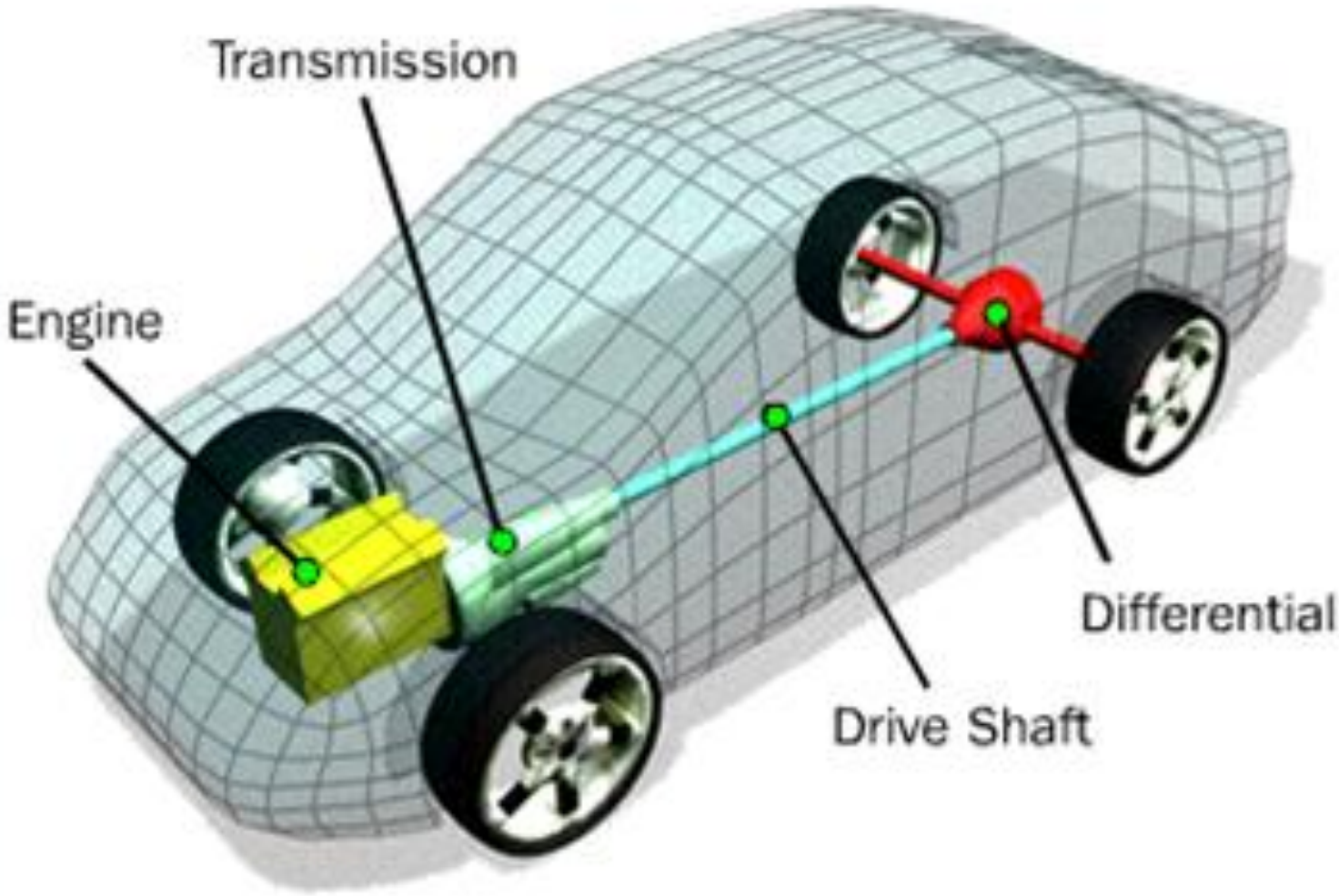
TYPICAL LUBRICATION SYSTEM

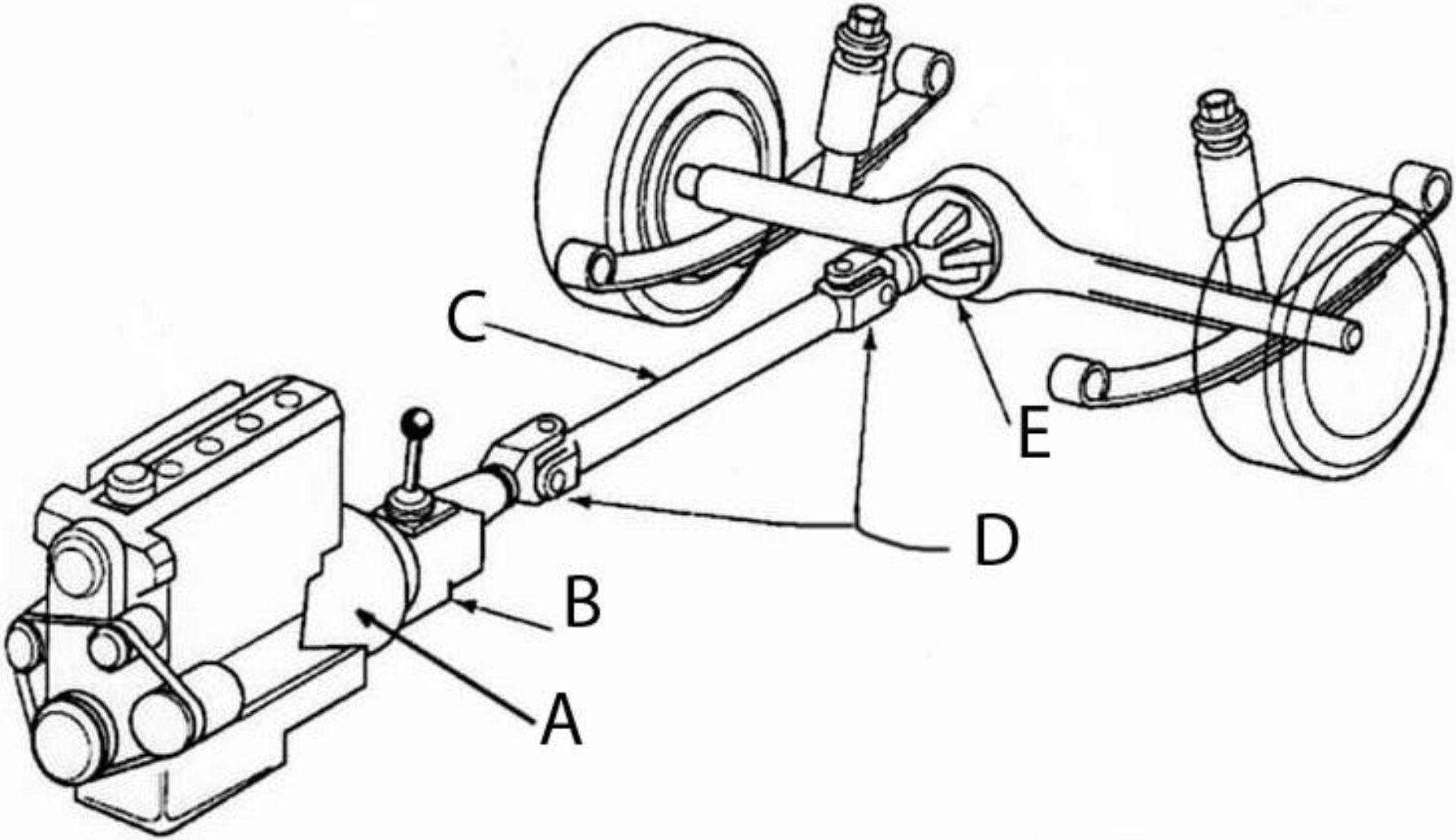
6000.1-14

470604-0401
Locate and identify basic automotive parts.

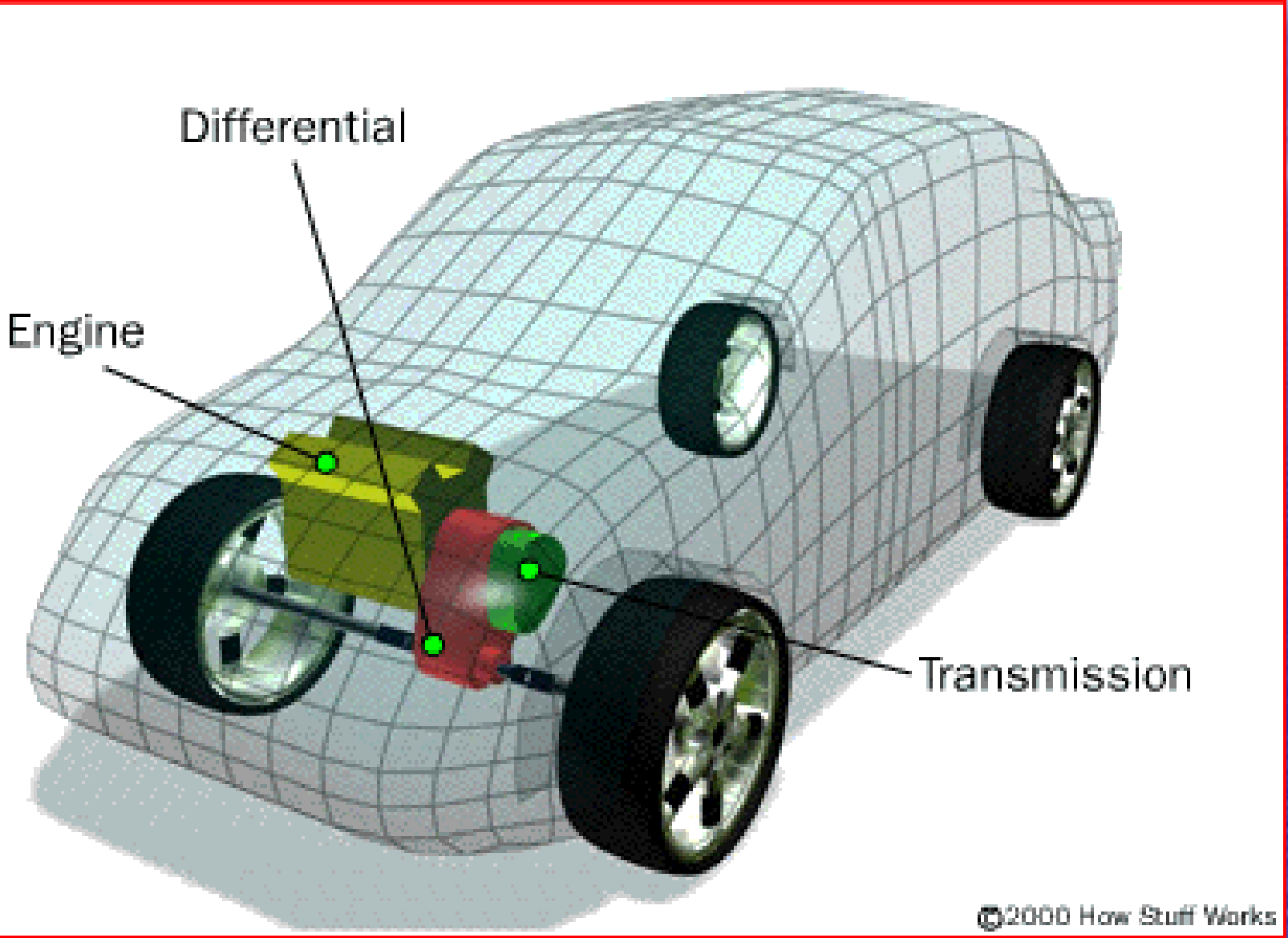
- Identify drive train parts.
  - Manual Transmission
  - Automatic Transmission
  - Drivelines
  - Drive Axles

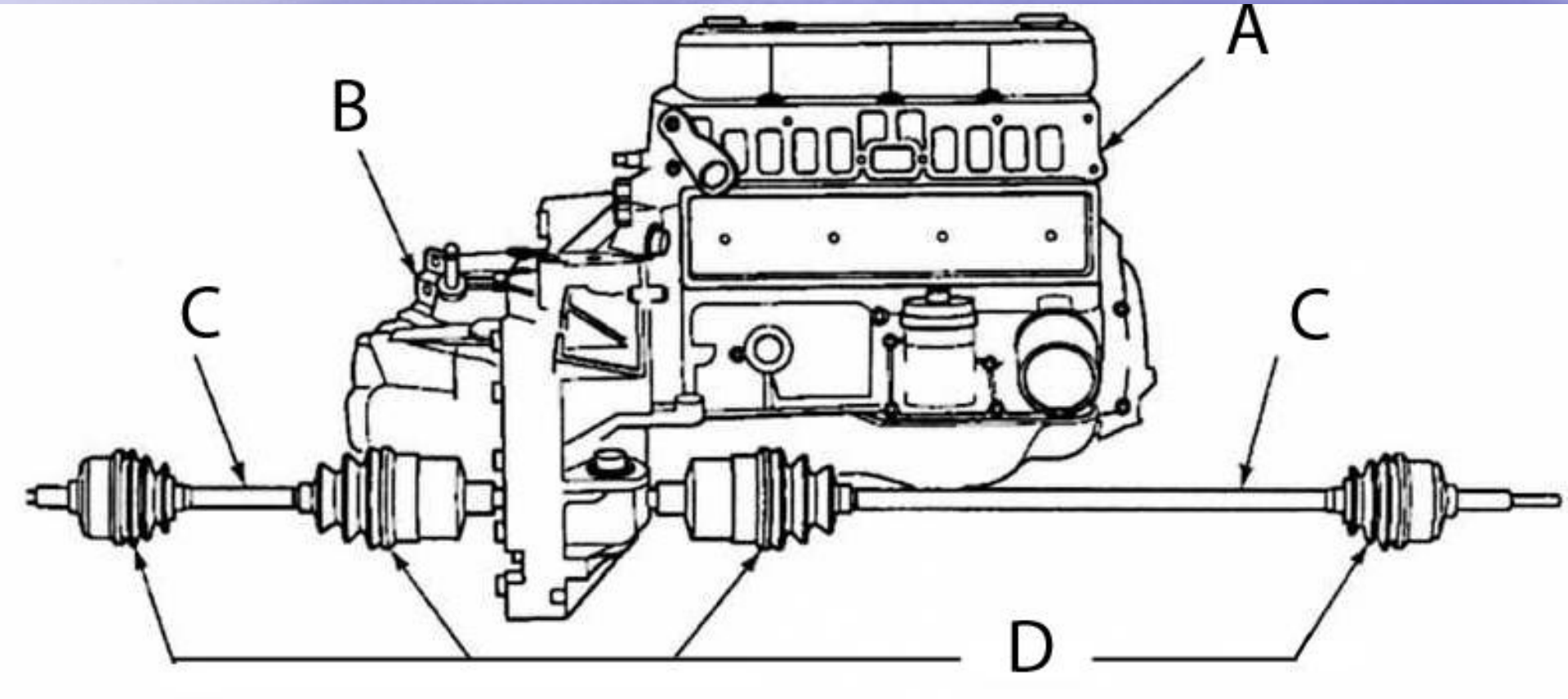
Rear-Wheel Drive



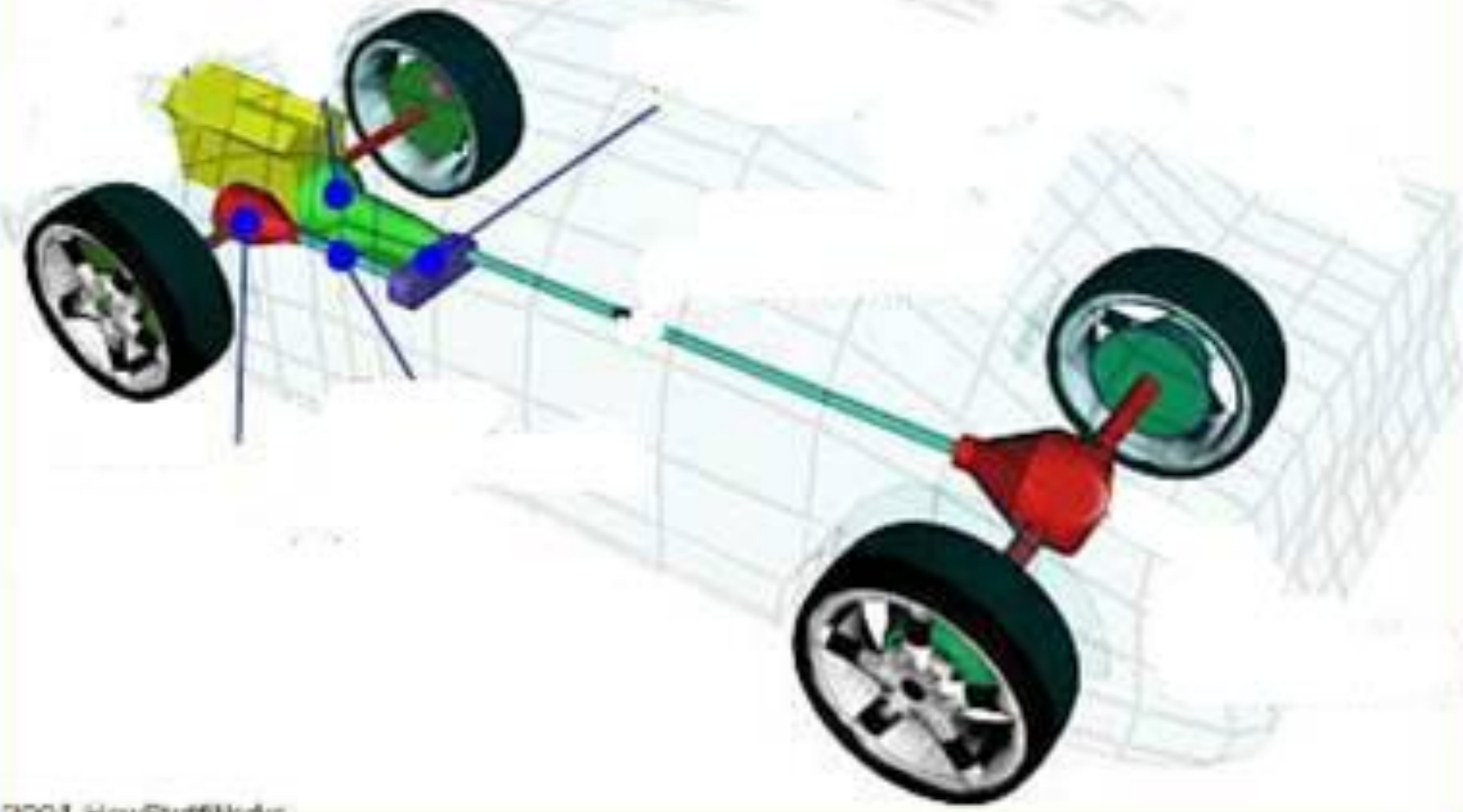

C
E
D
B
A

Front-Wheel Drive




A
B
C
C
D

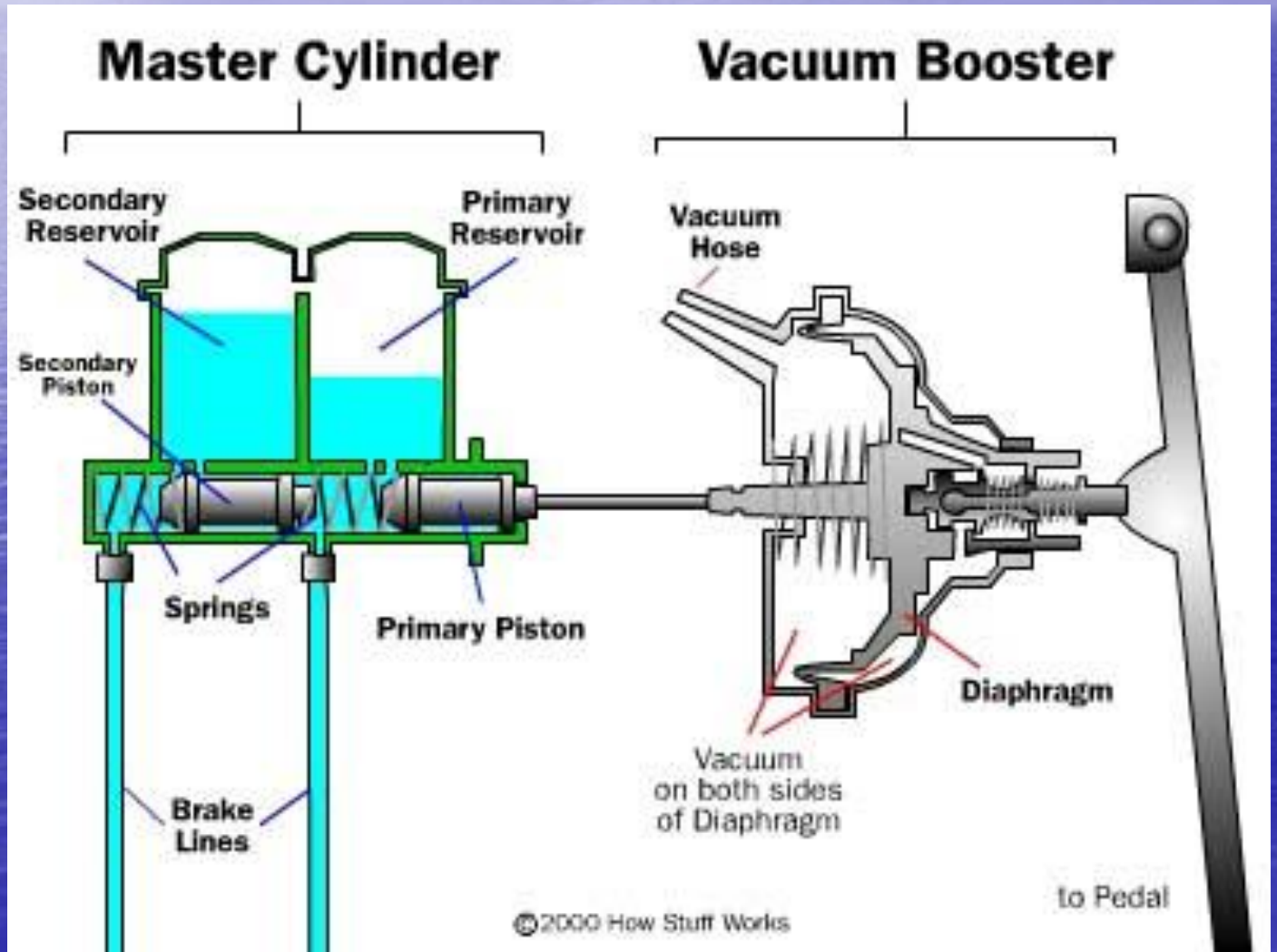
How Four Wheel Drive Works



470604-0401
Locate and identify basic automotive parts.

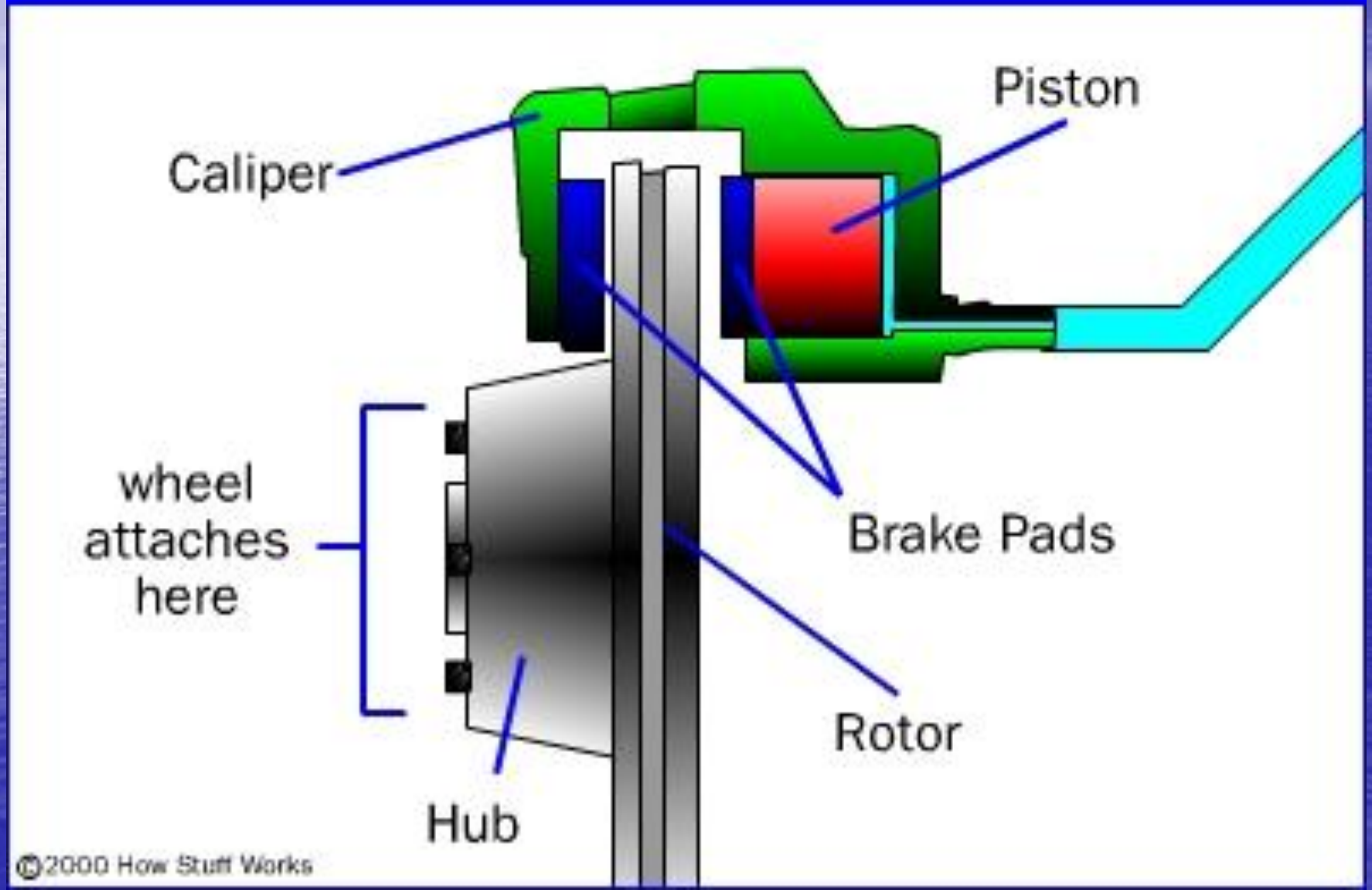
- Identify brake parts.
  - Master cylinder, lines, caliper, rotor, drum, wheel cylinder, pads, shoes

The brake master cylinder converts the motion of your foot on the pedal to hydraulic brake fluid pressure to stop the vehicle.

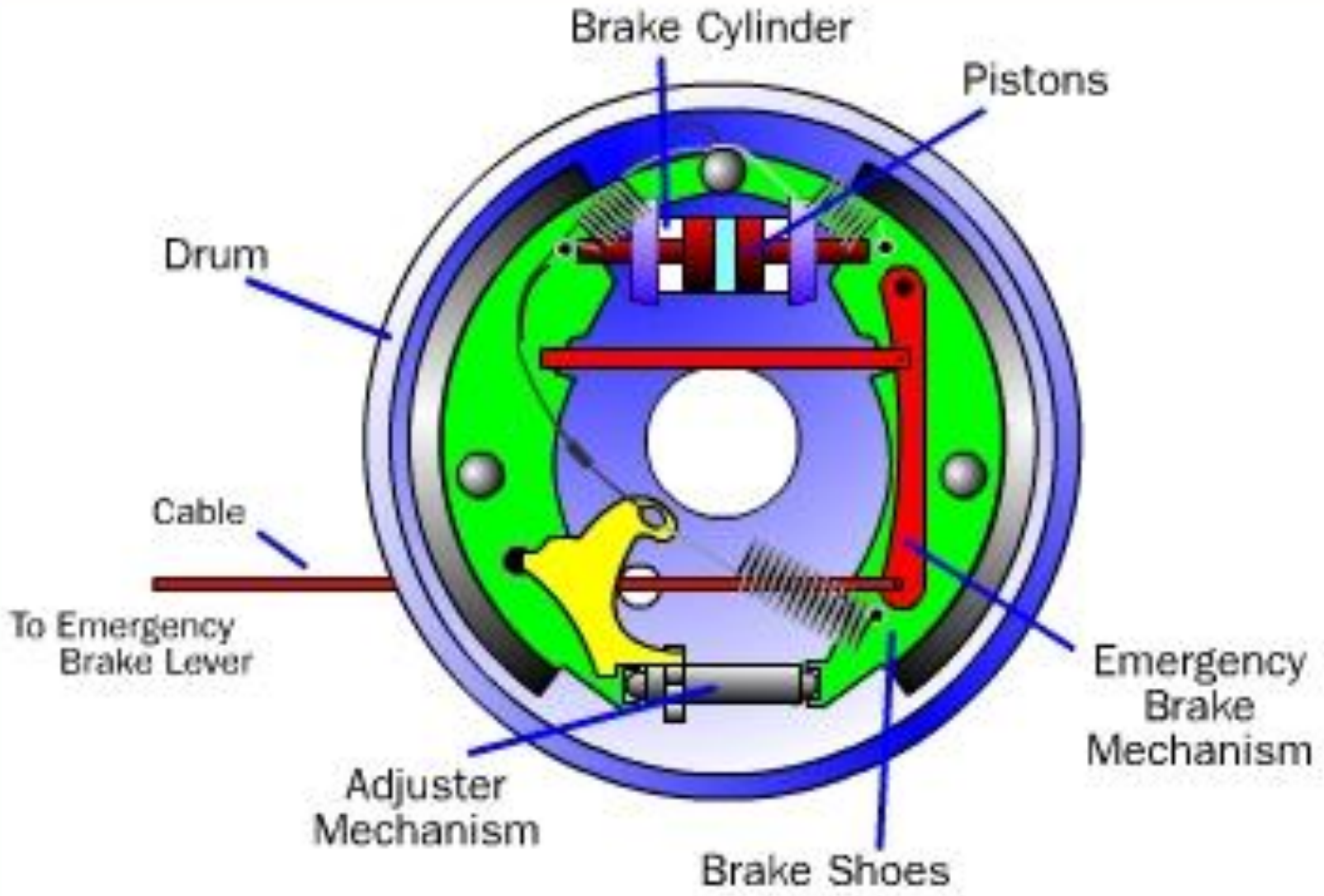


Brakes change kinetic energy to heat energy

How a Disc Brake Works



Drum Brake


Brake Cylinder
Pistons
Drum
Cable
To Emergency
Brake Lever
Emergency
Brake
Mechanism
Adjuster
Mechanism
Brake Shoes
©2000 How Stuff Works

470604-0401
Locate and identify basic automotive parts.

- Identify steering and suspension parts.
  - Steering gear: worm gear vs. rack and pinion
  - Tie-rod
  - Shocks / Struts
  - Springs: leaf, coil, torsion bar, air

Parallelogram steering:

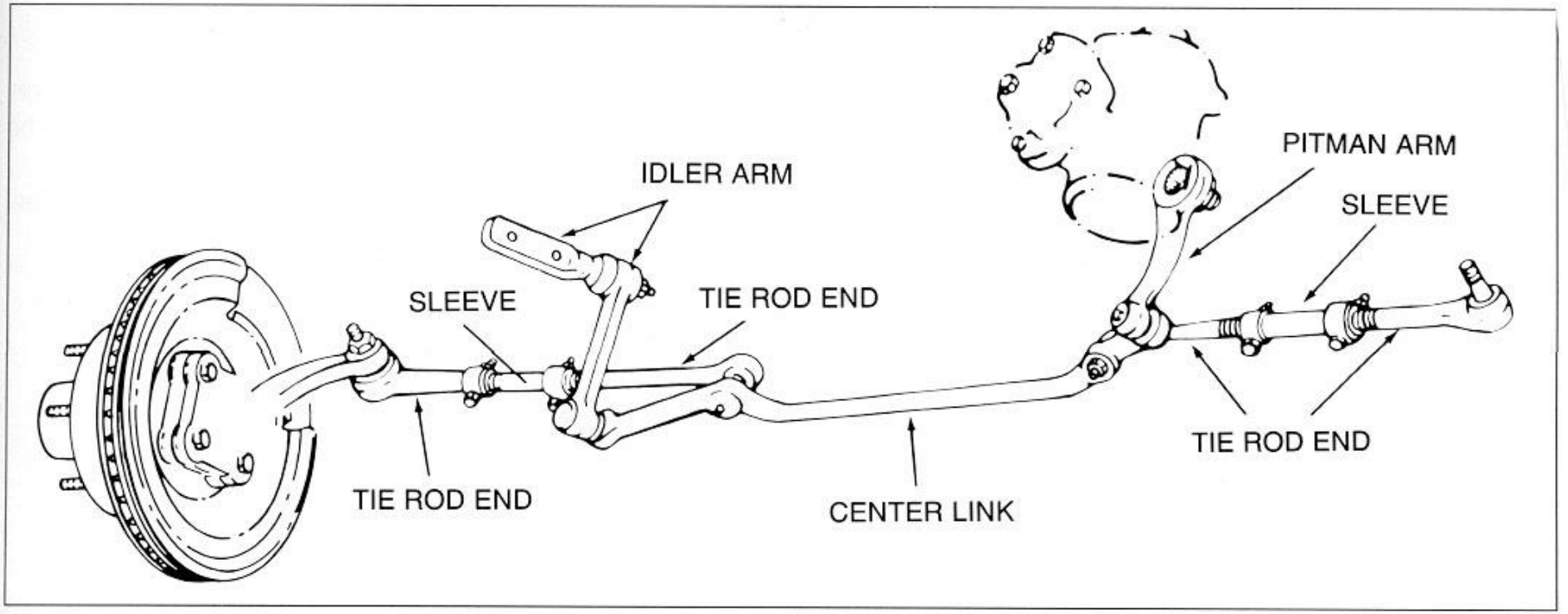
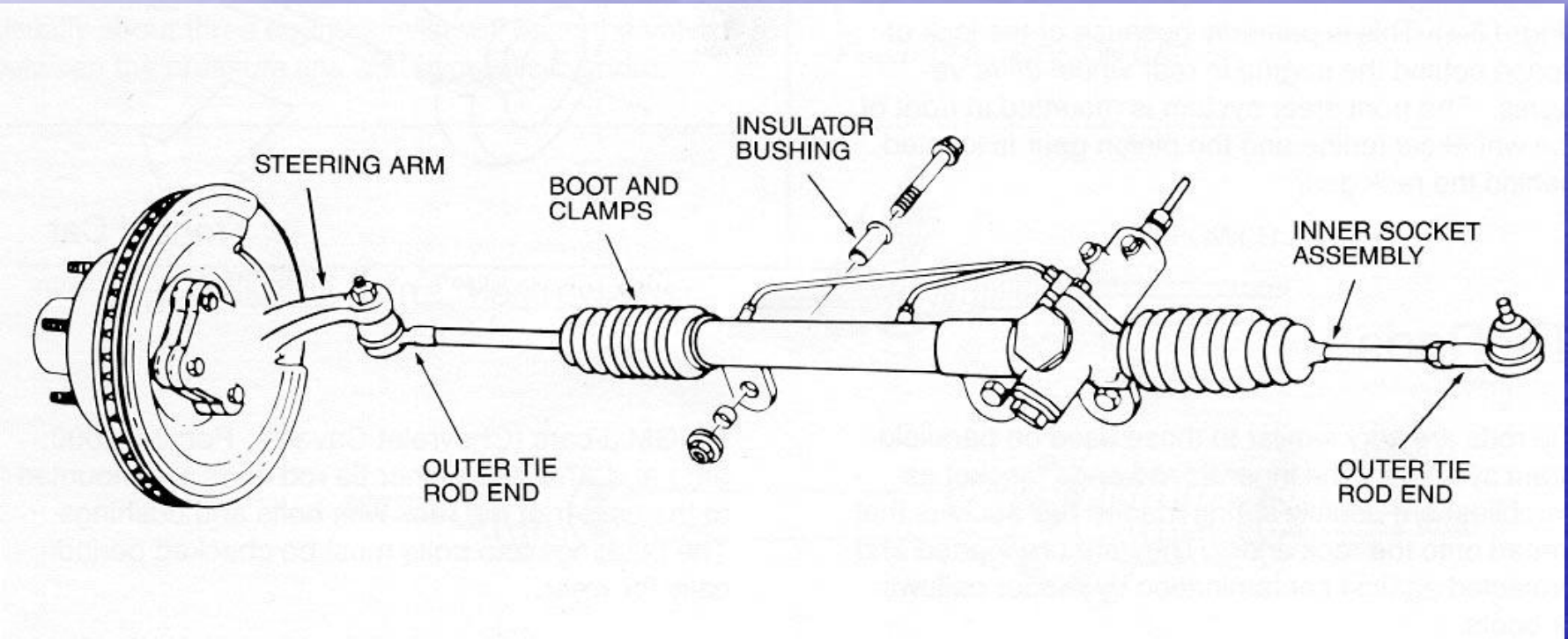


Figure 11-1 PARALLELOGRAM STEERING

Rack and pinion steering:



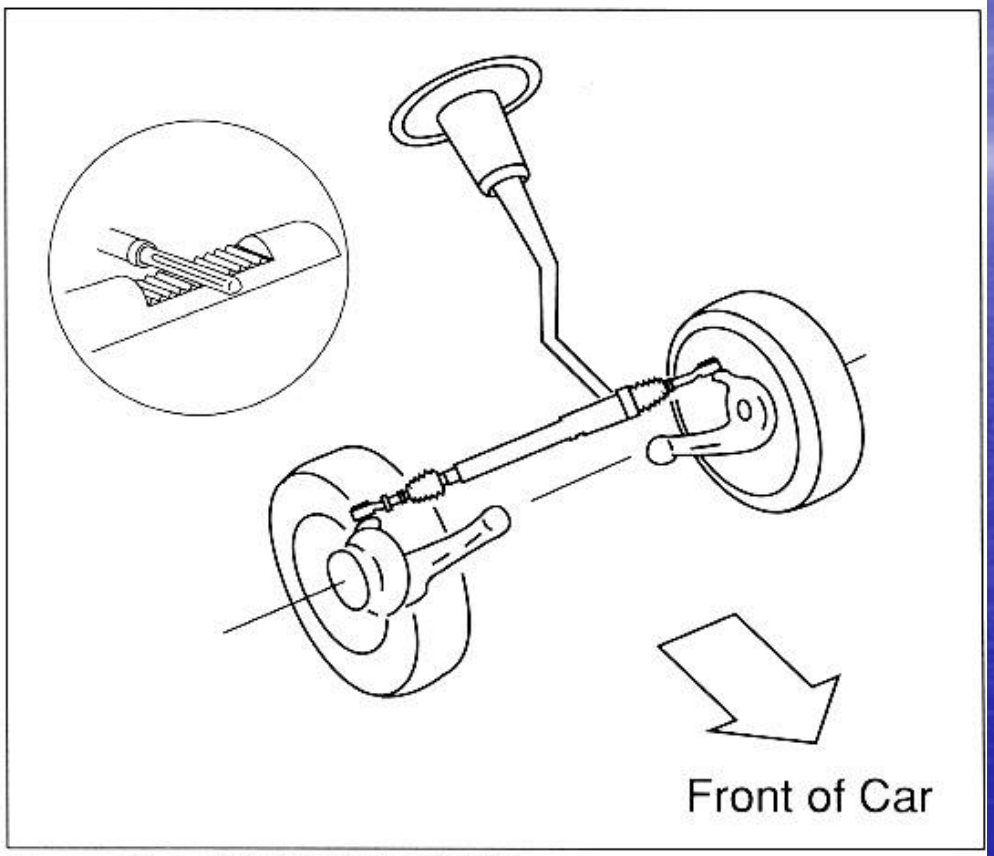
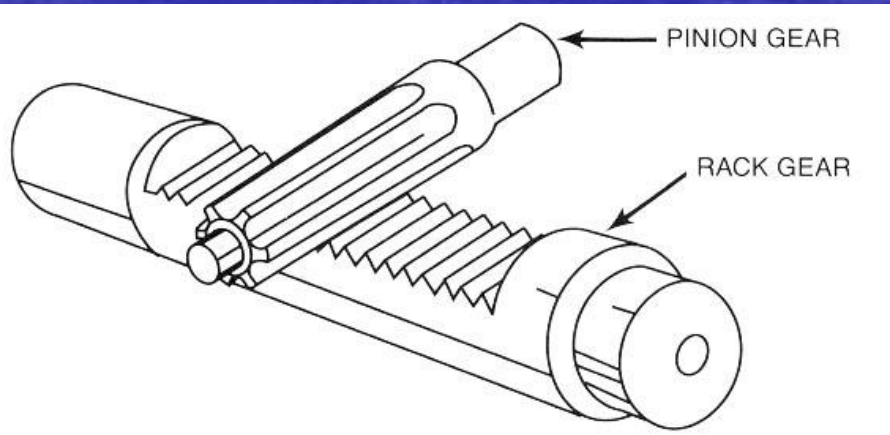
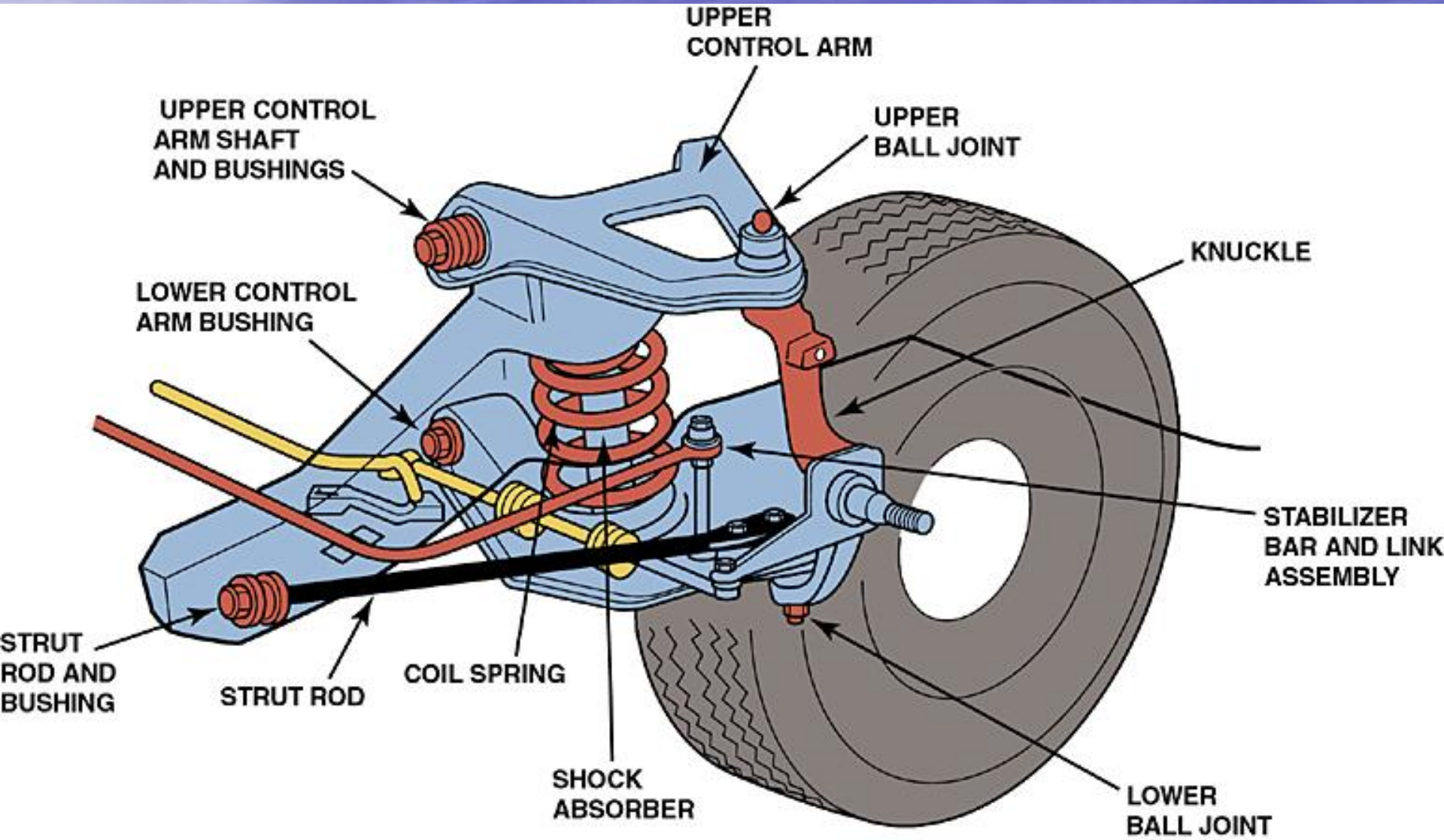


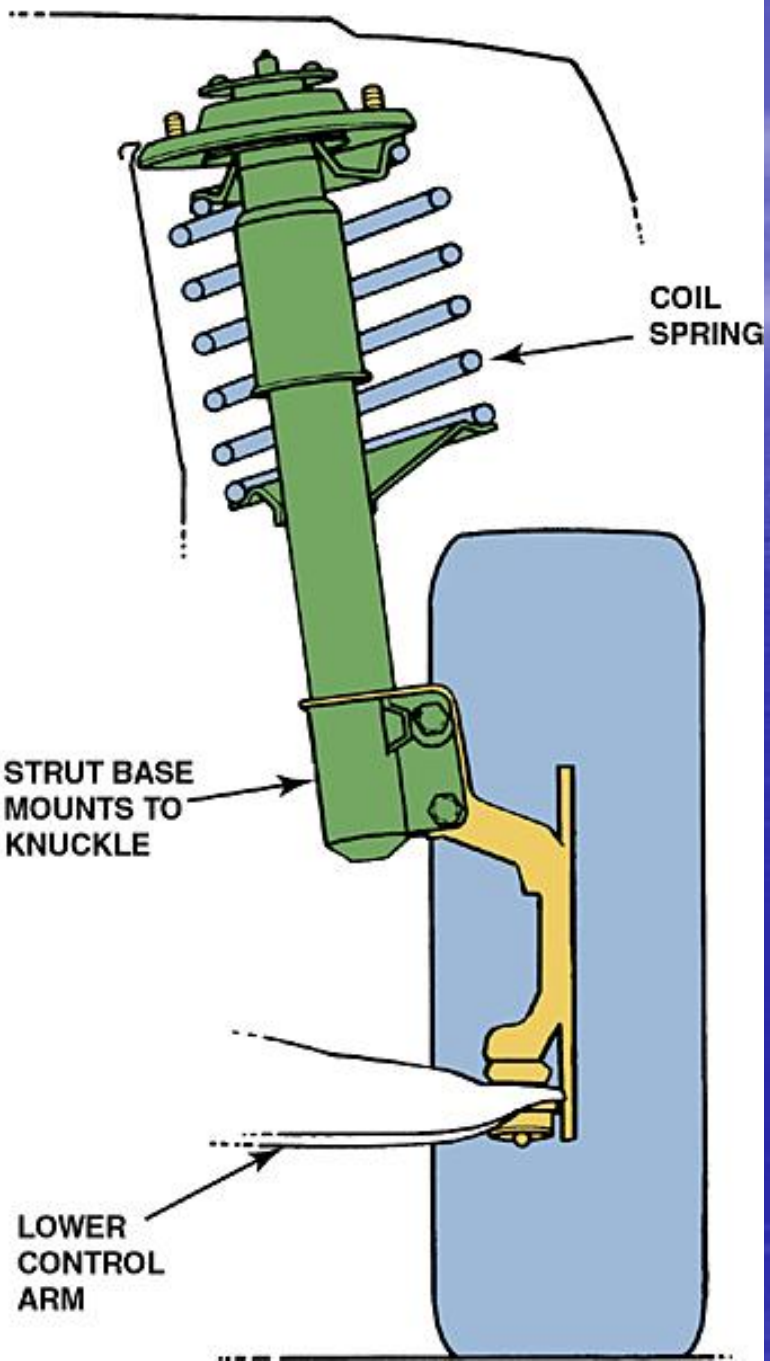
Figure 12-3 FWD REAR STEER



Short long arm suspension:

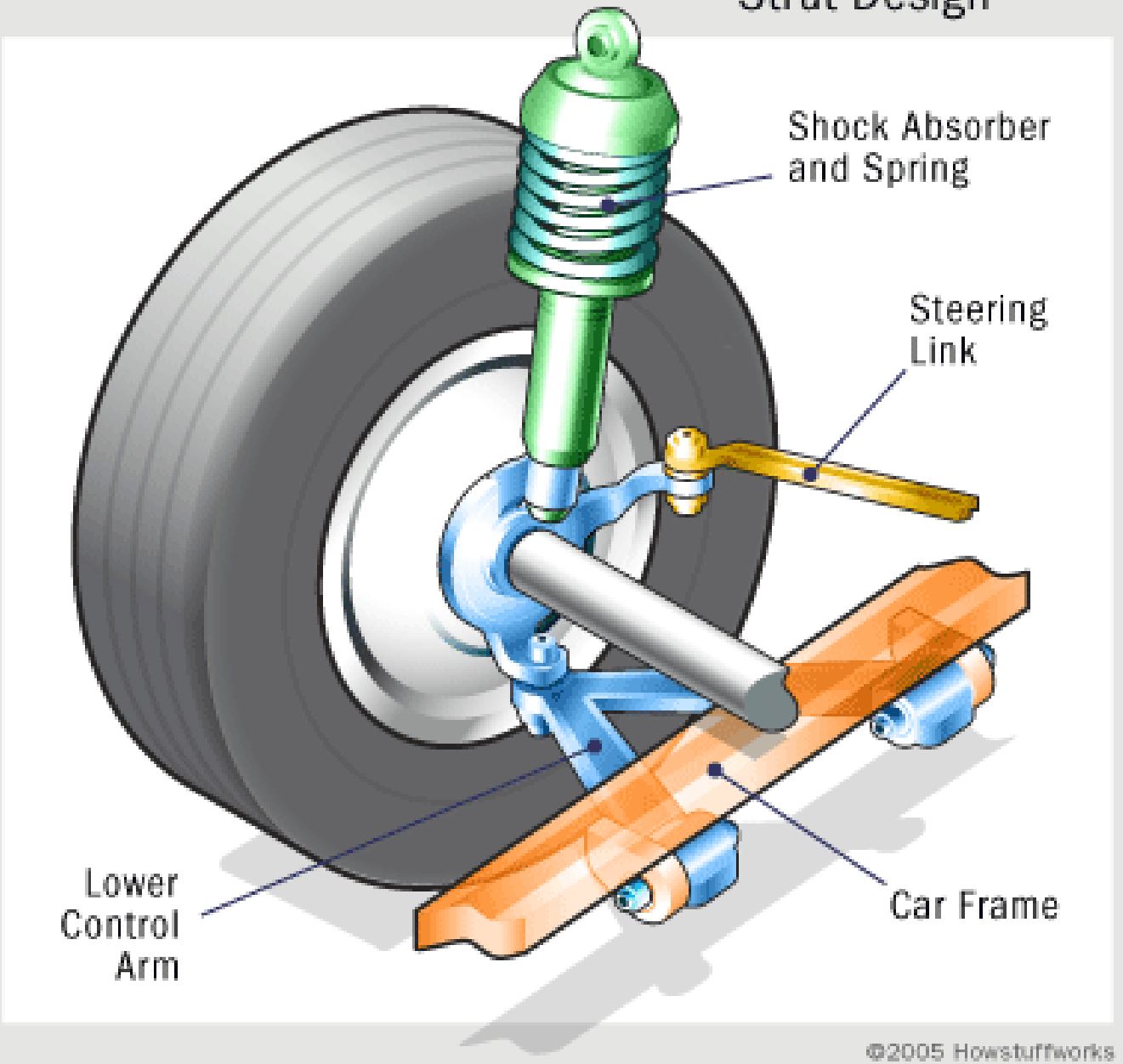


MACPHERSON STRUT

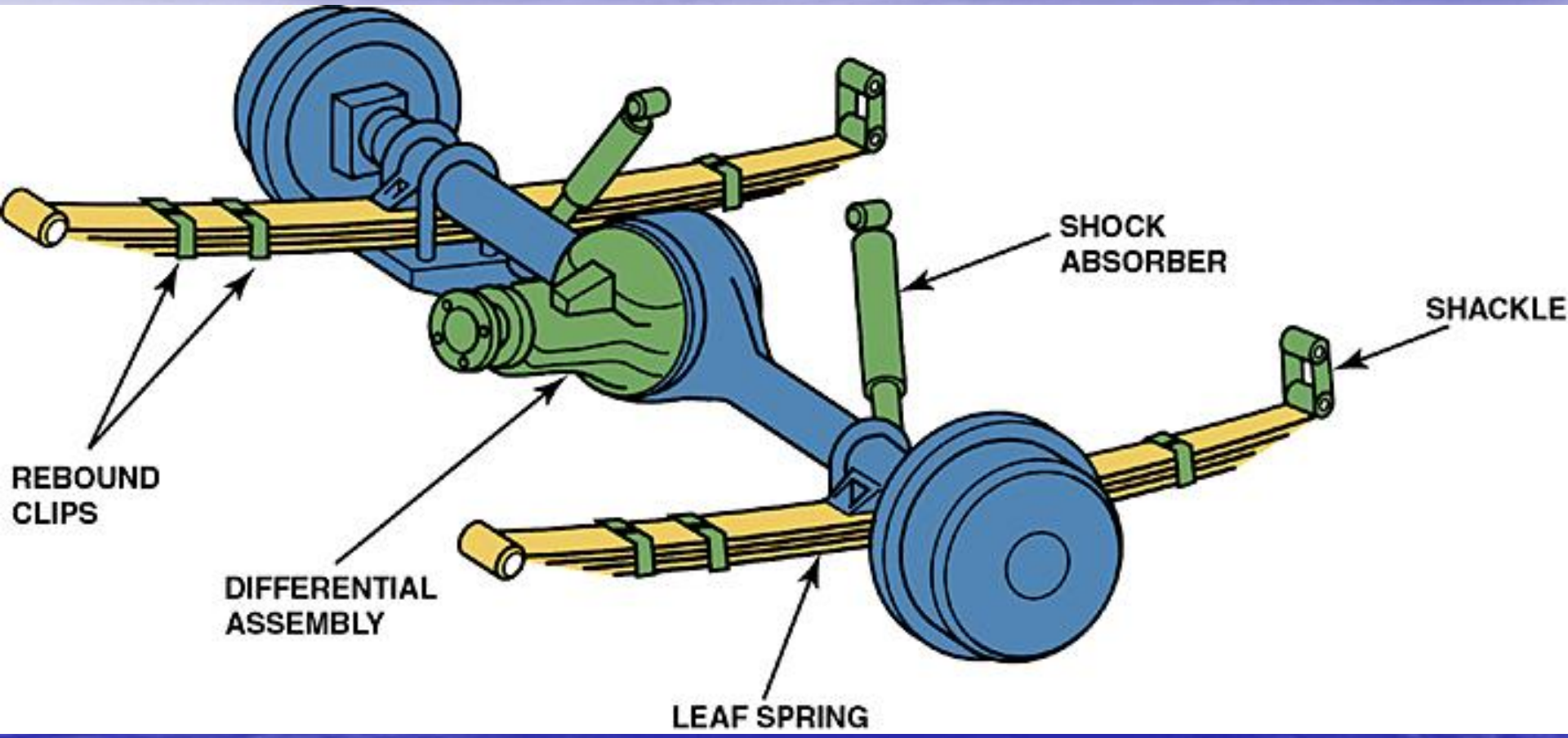


HOW CAR SUSPENSIONS WORK

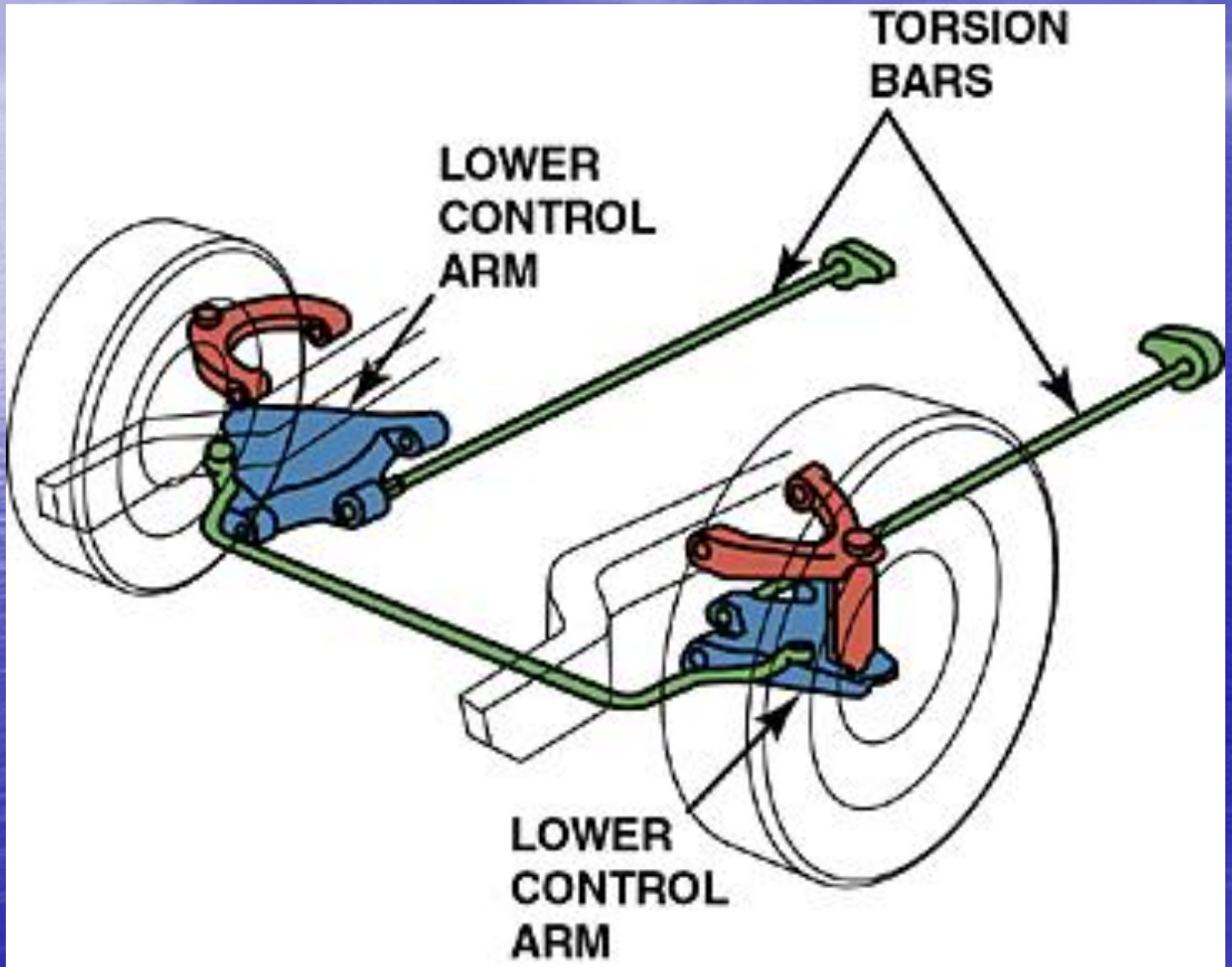
Basic MacPherson Strut Design



Leaf spring suspension:



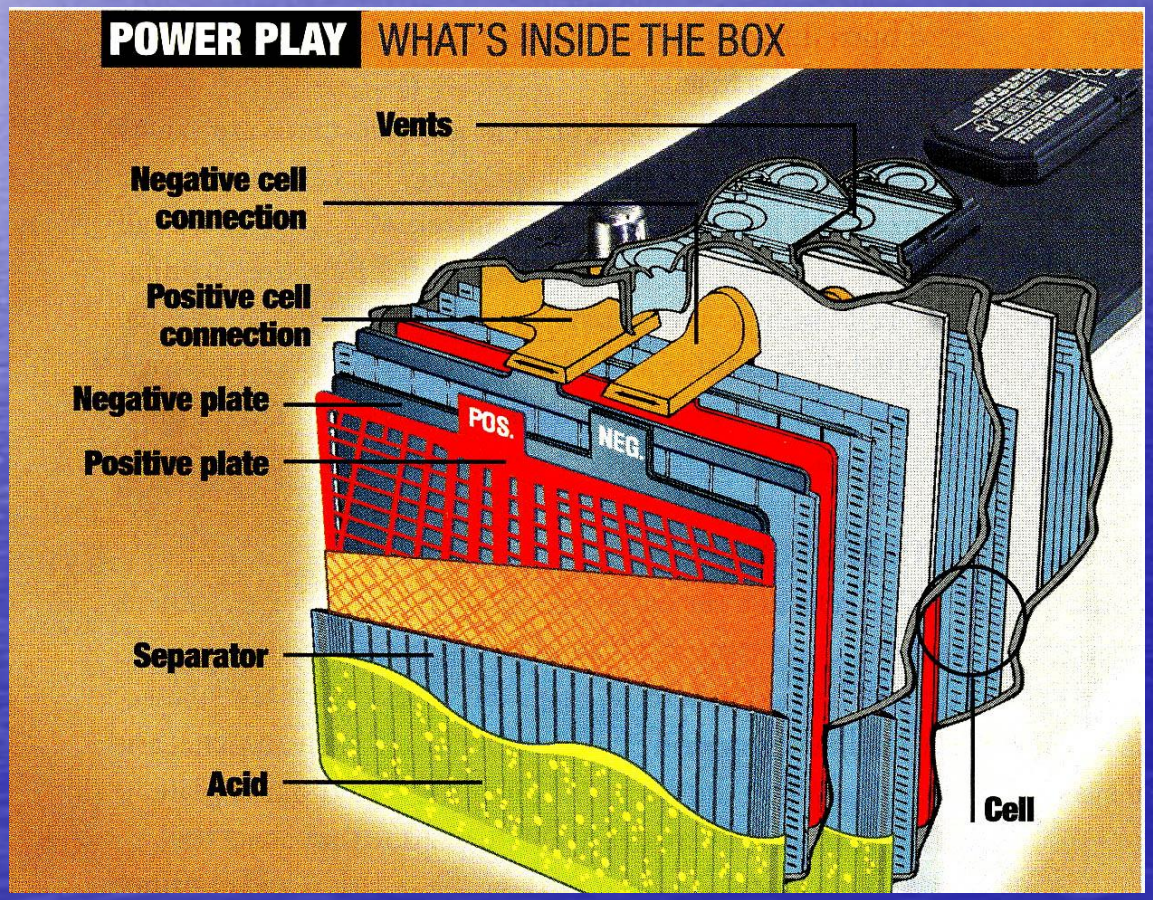
Torsion bar suspension:



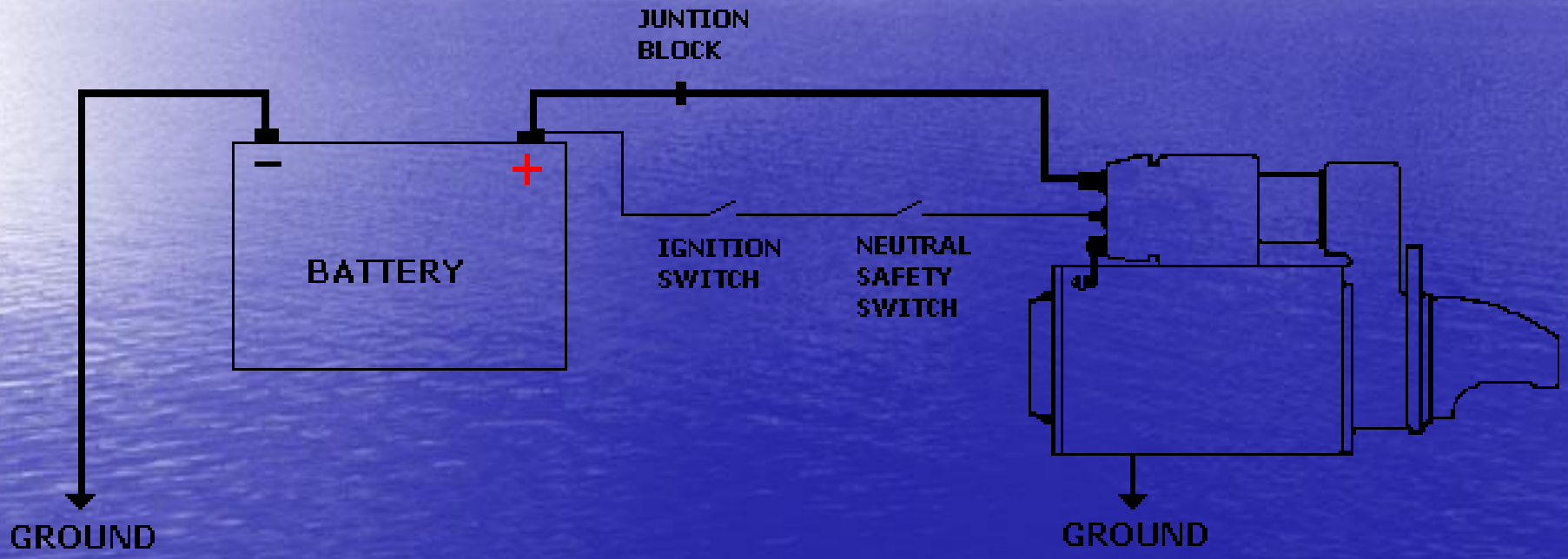
470604-0401
Locate and identify basic automotive parts.

- Identify electrical parts.
  - Battery
  - Alternator
  - Starter
  - Circuit protection: fuse, breaker

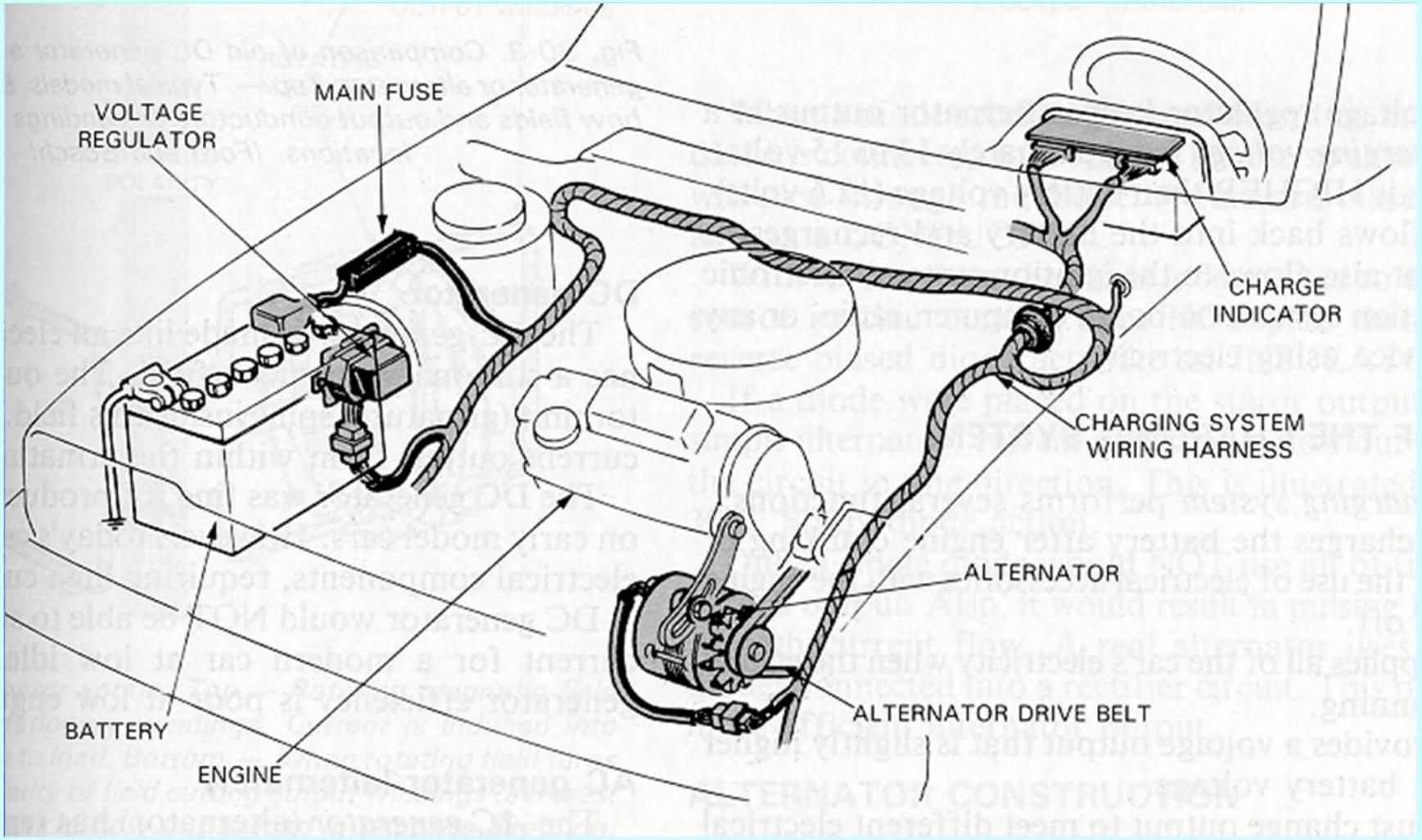
The vehicle battery provides power for the starter. With the engine off, a fully charged battery should have 12.6 Volts.



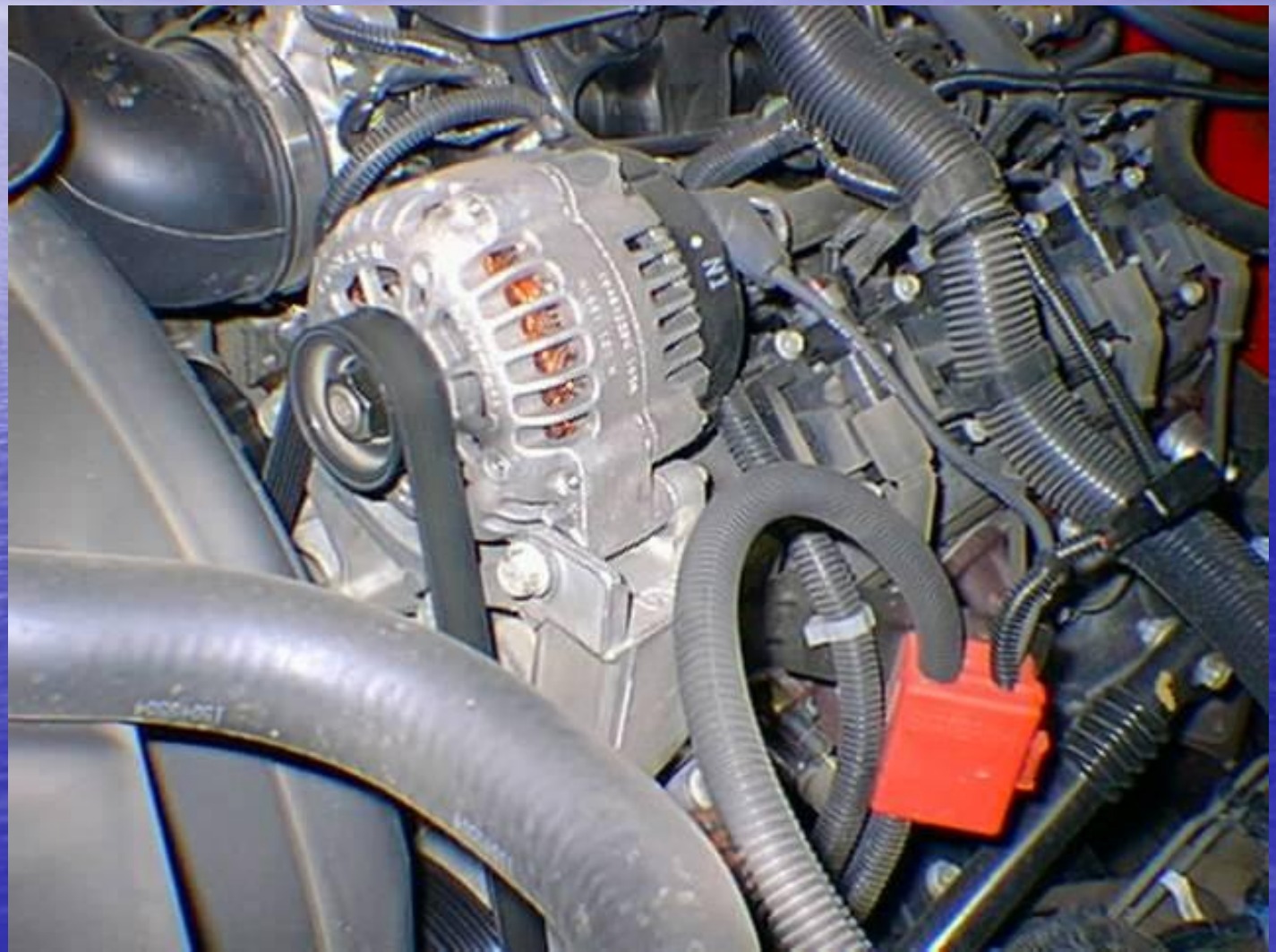
While the starter is cranking, the battery voltage should stay above 9.6 Volts.



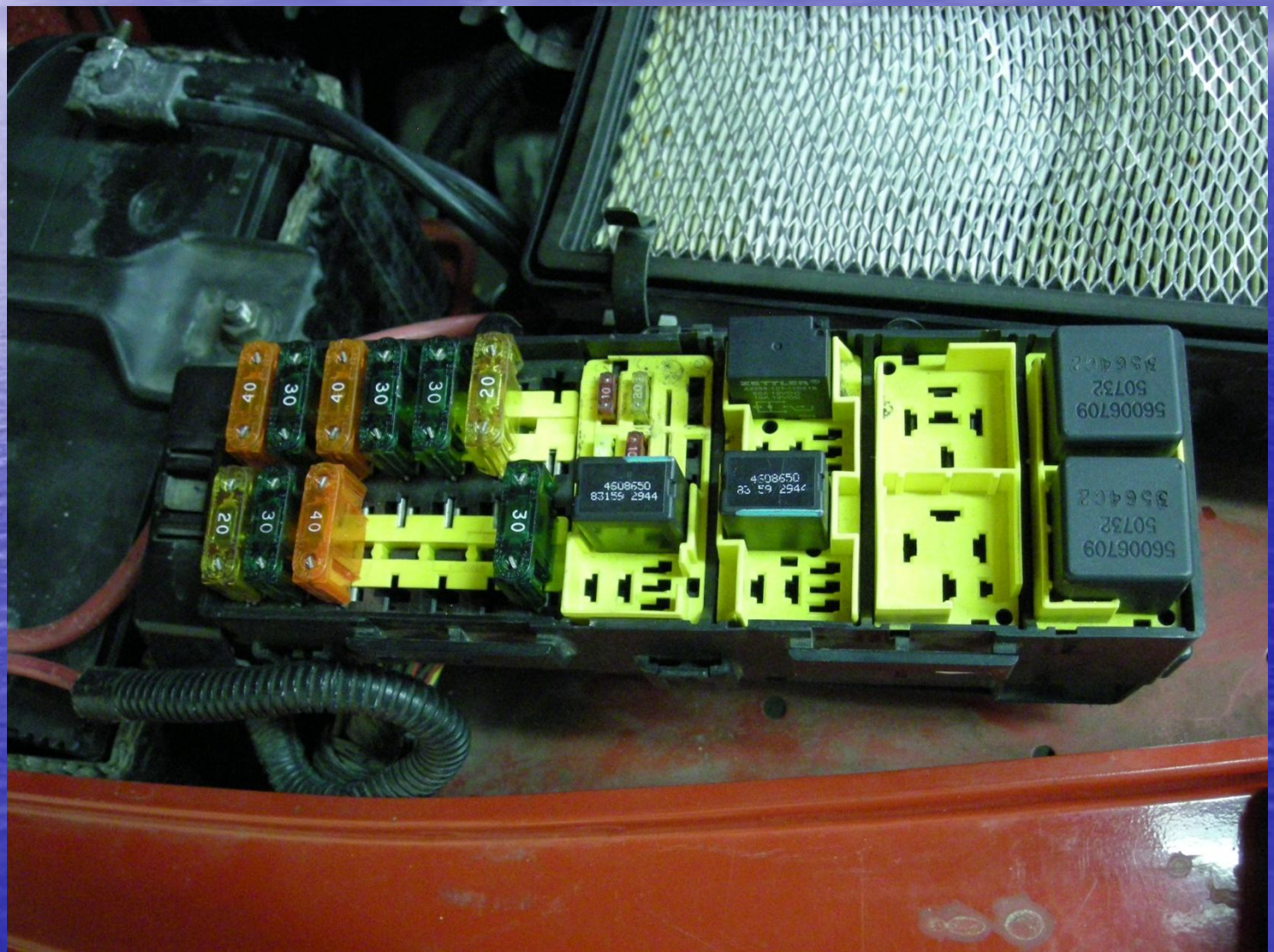
With the engine running, the generator (alternator) should supply about a 14 Volt charge to the battery and power all electrical accessories.



Find the generator.



Fuses melt to protect the circuit



470604-0402
Based on the manufacture's specifications, check and adjust all vehicle fluid levels.

- Check belt tension and condition
- Check condition of hoses
- Check coolant strength and leaks

470604-0403
Change engine oil and filter on a vehicle. Use proper disposal methods for waste oil.

- Lubricate chassis
- Check air filter

470604-0404
With a voltmeter, check battery voltage with the engine running and with the engine off.

- Properly jump start a vehicle

Dead car engine ground last! (unpainted bolt or bracket) (not a fuel line or tube!)

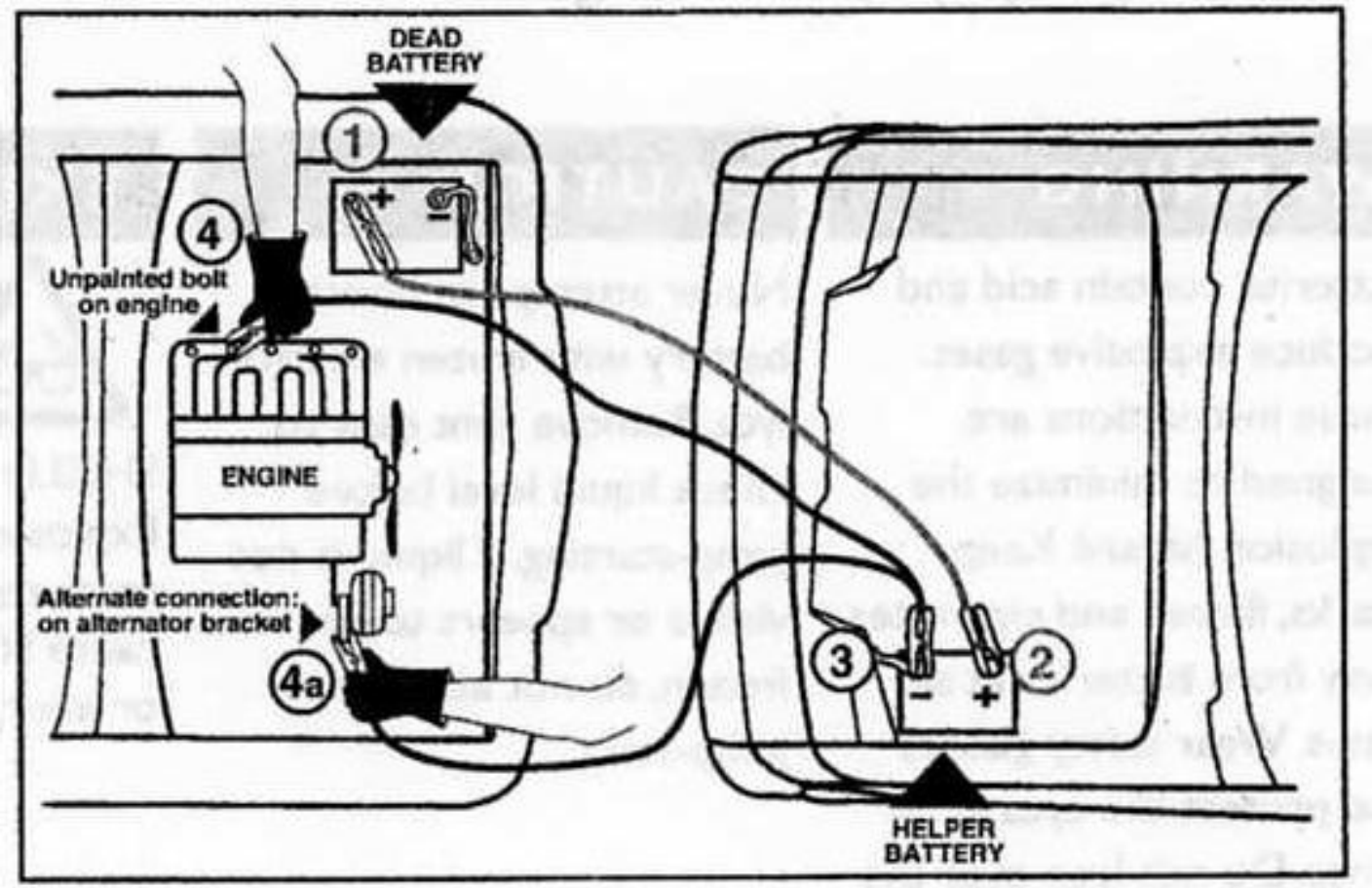
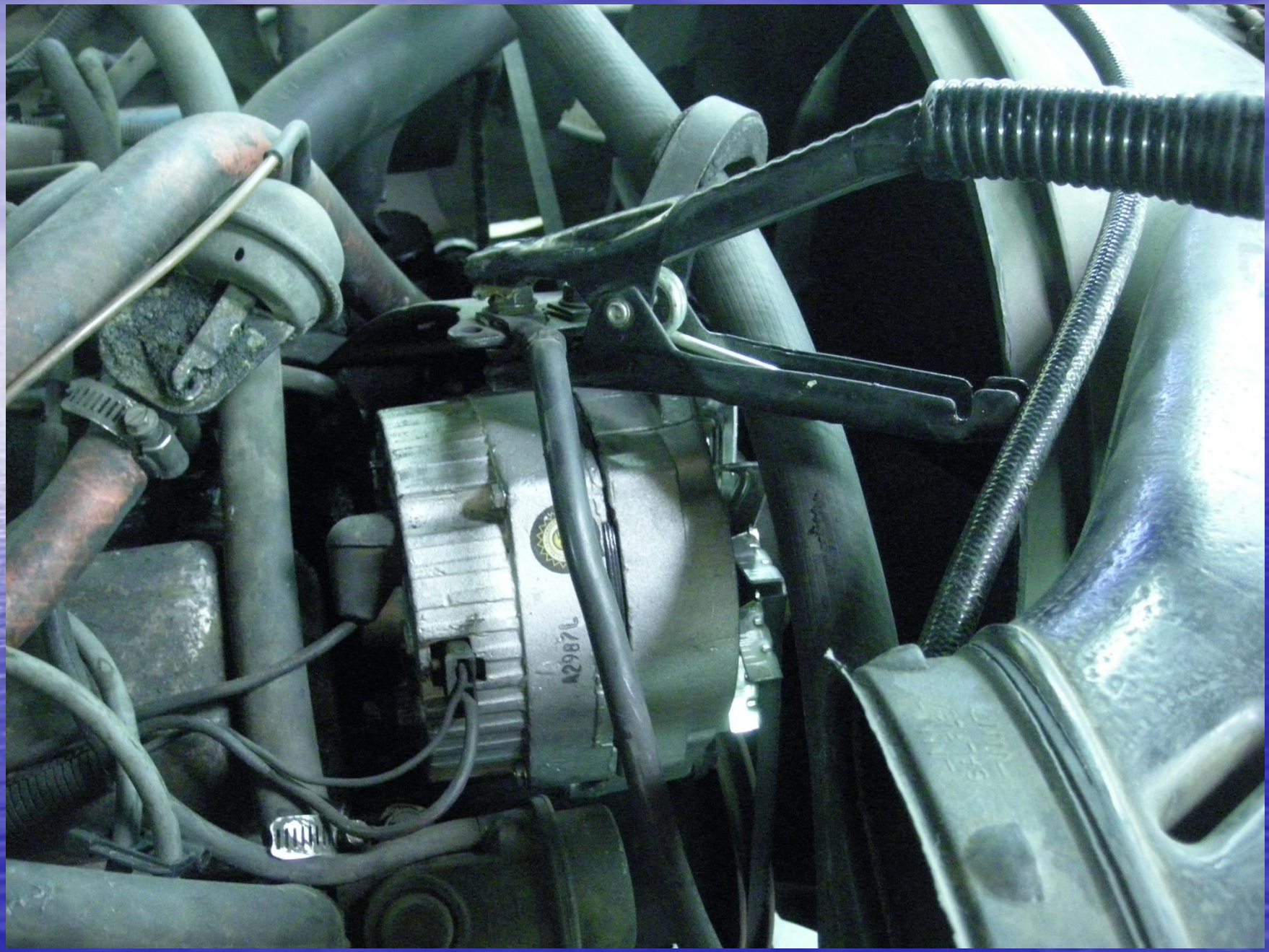


Fig. 1: Proper order for jump-starting car

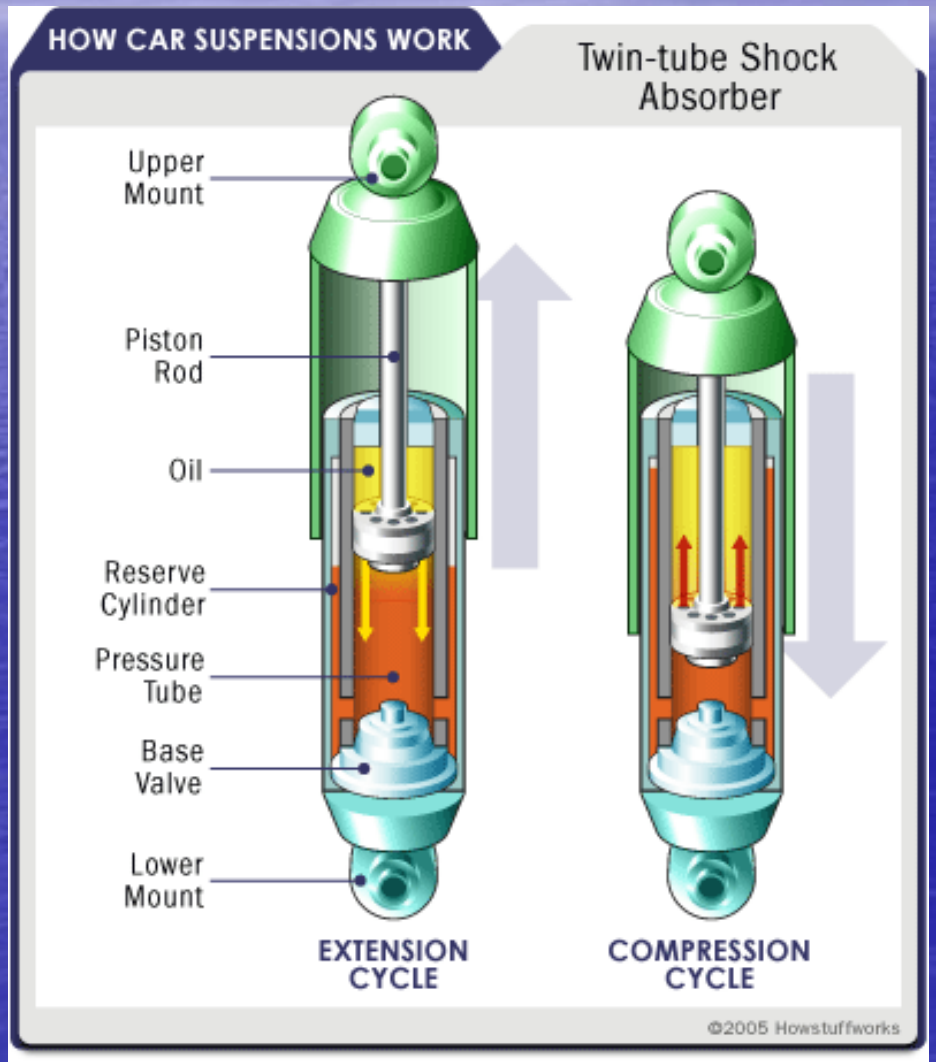

928



470604-0405
Check shocks or struts.

- Check for leakage.
- Check for proper operation.

Shock checks include: road test, visual inspection, and jounce test.



Road test/jounce test:

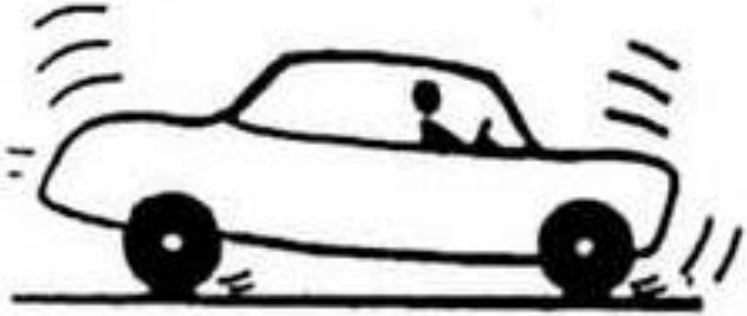
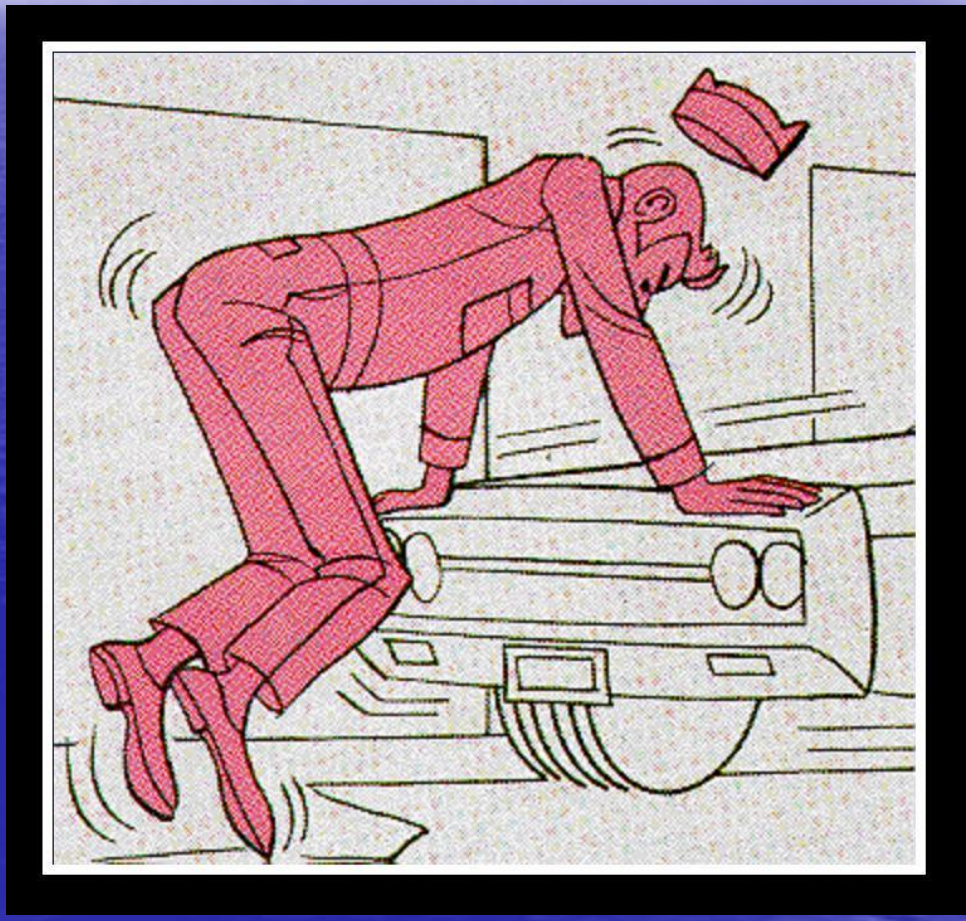


FIGURE II-120 Action of car as brakes are being applied in the road test. (Courtesy of Monroe Auto Equipment Co.)



Visual inspection/mileage:

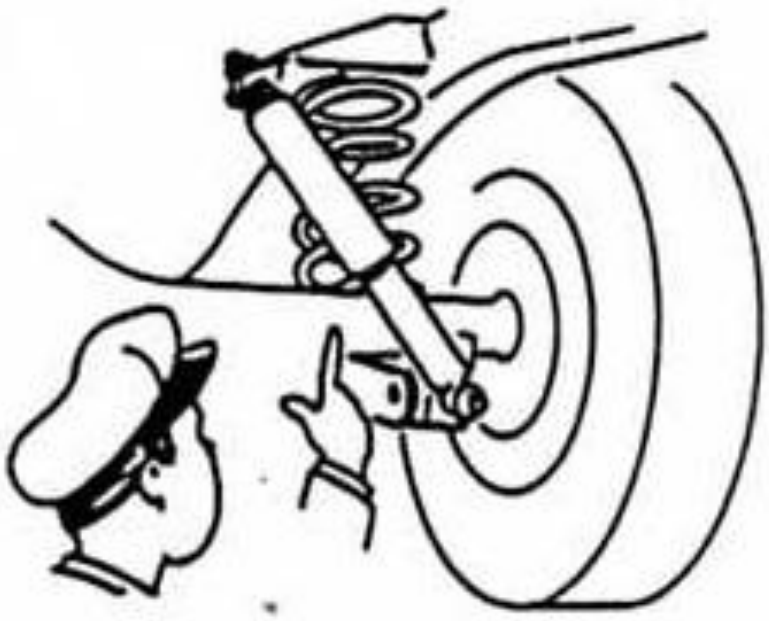
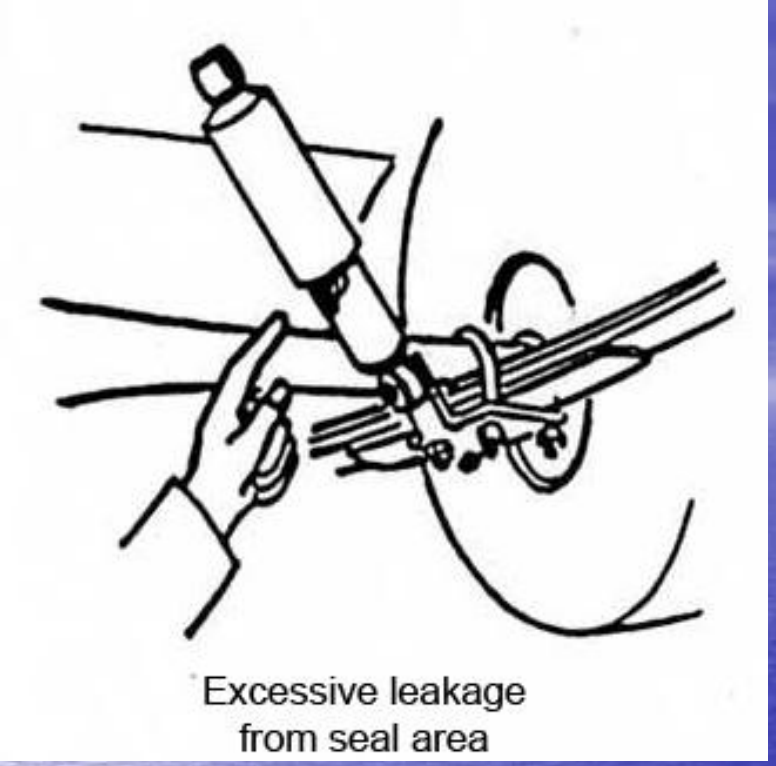
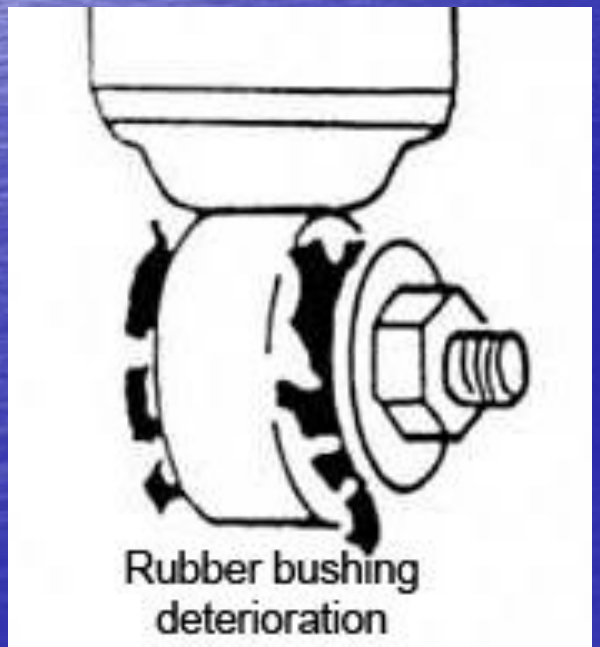


FIGURE II-121 Visual inspection of shock absorber. (Courtesy of Monroe Auto Equipment Co.)



Excessive leakage
from seal area



Rubber bushing
deterioration

Rusted or bent
piston rod

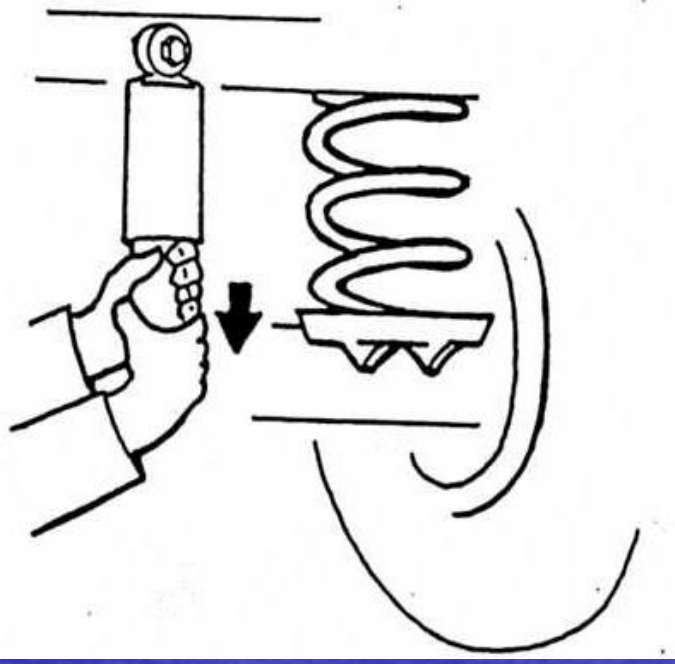


FIGURE II-127 Physically test a shock absorber by disconnecting one end and pushing and pulling to check for resistance of movement. (Courtesy of Monroe Auto Equipment Co.)

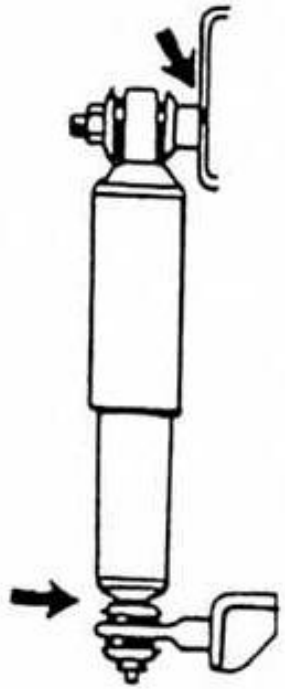
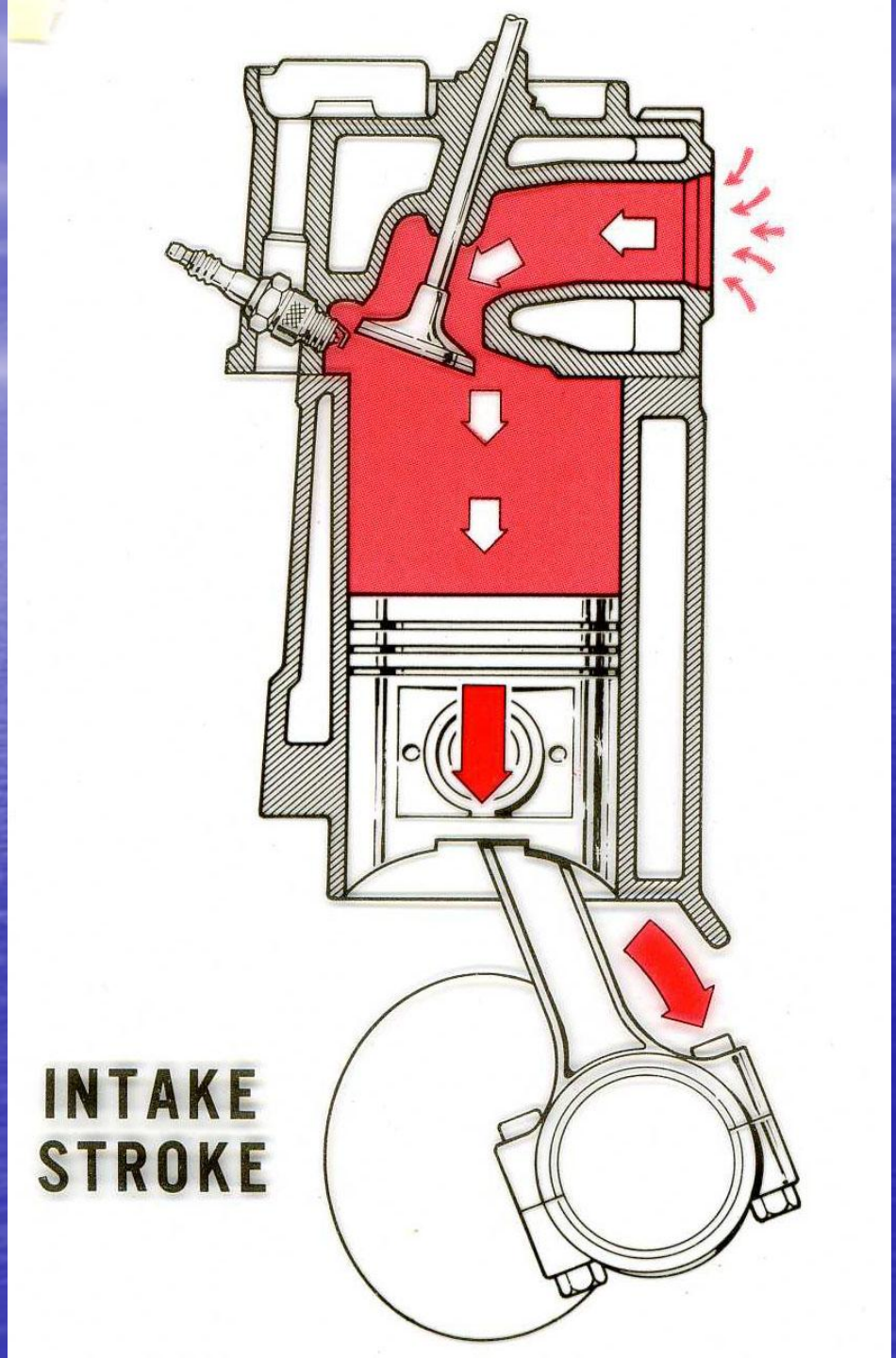
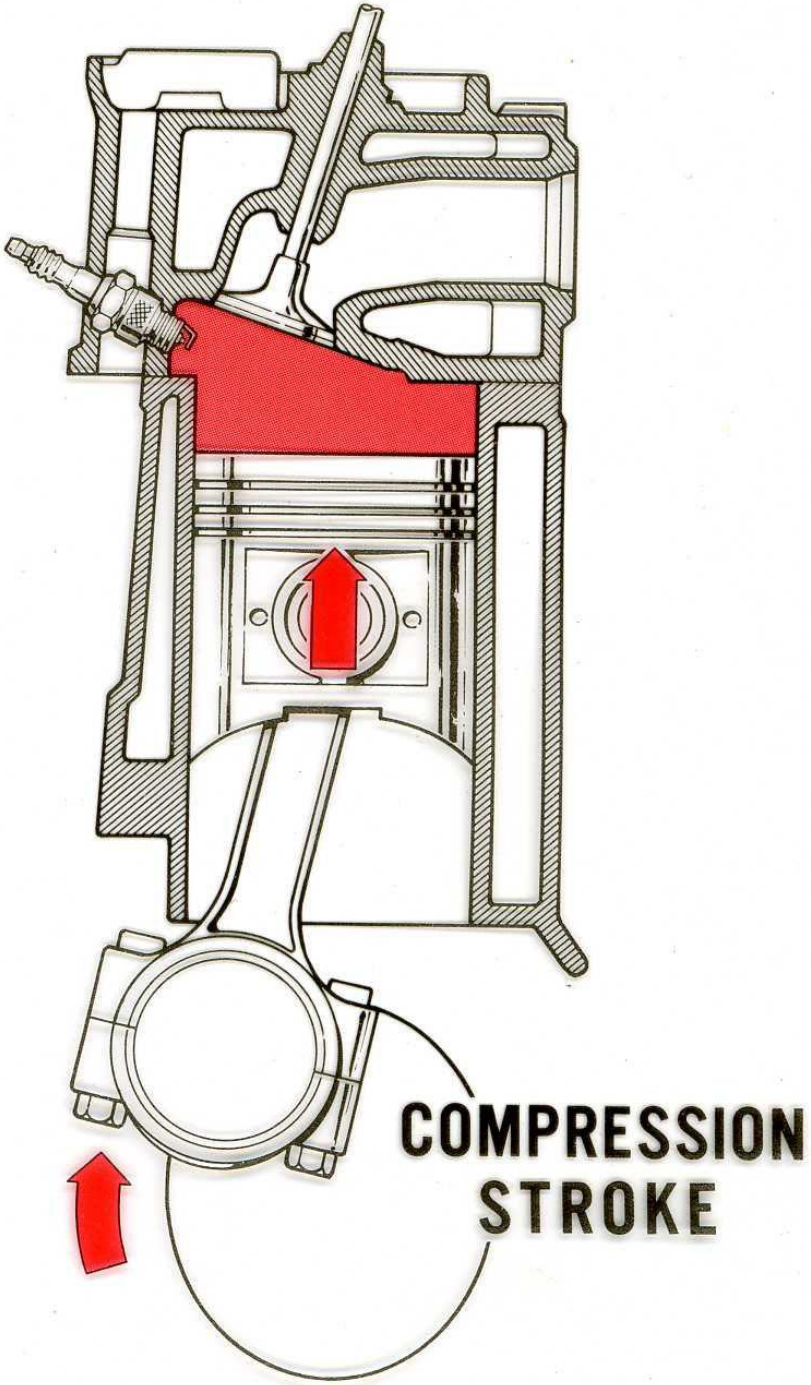


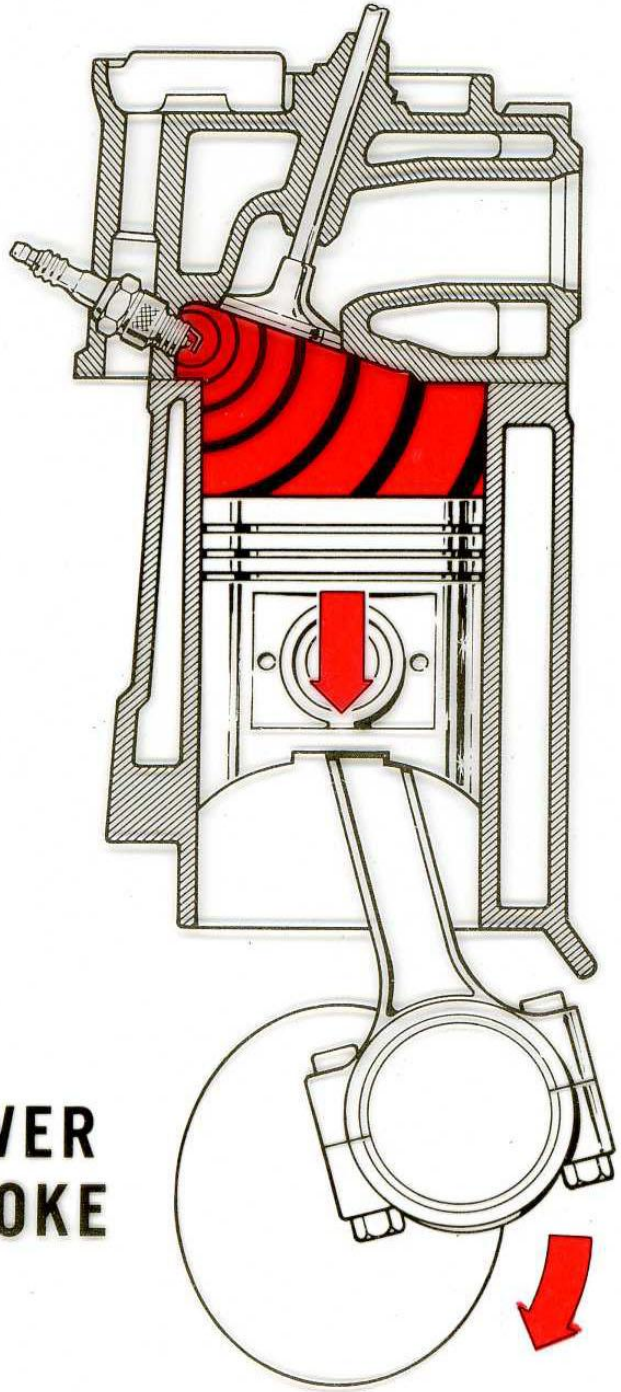
FIGURE II-123 Areas to inspect visually where mounting parts and brackets usually malfunction. (Courtesy of Monroe Auto Equipment Co.)

470604-0406
Understand the four stroke cycle.

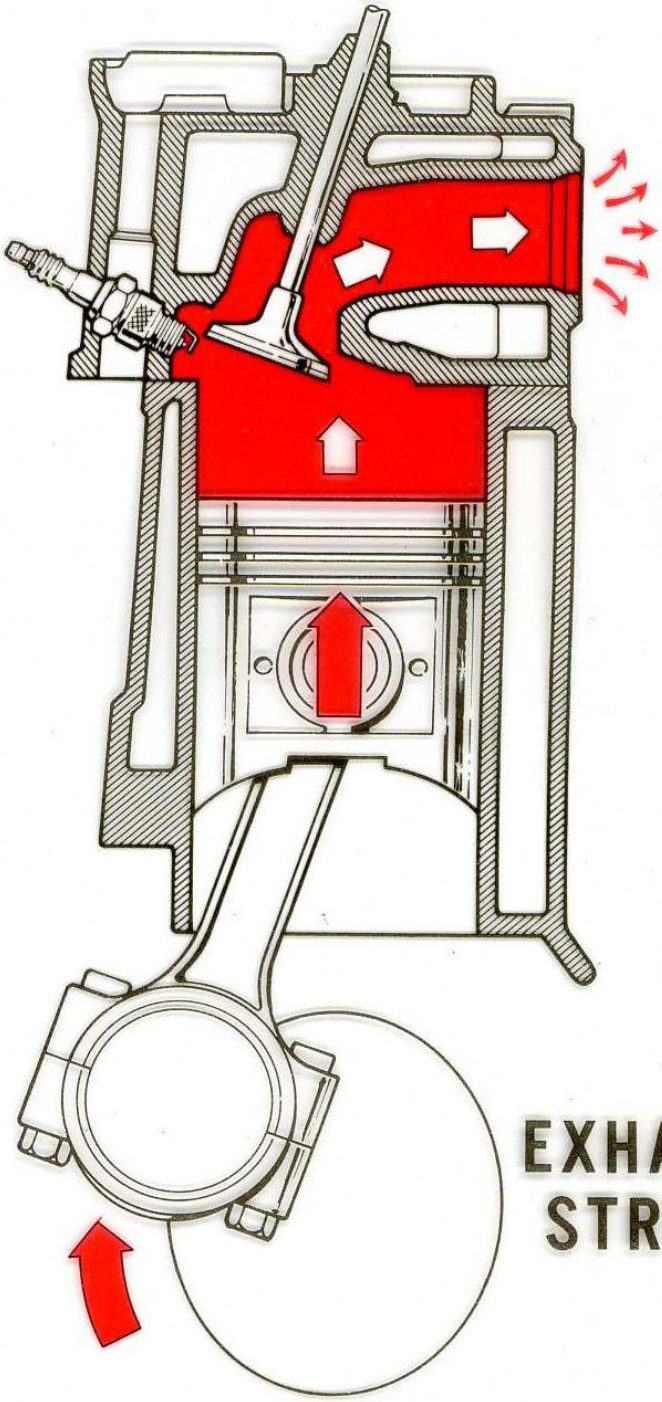
- Intake
- Compression
- Power
- Exhaust


INTAKE
STROKE


COMPRESSION
STROKE

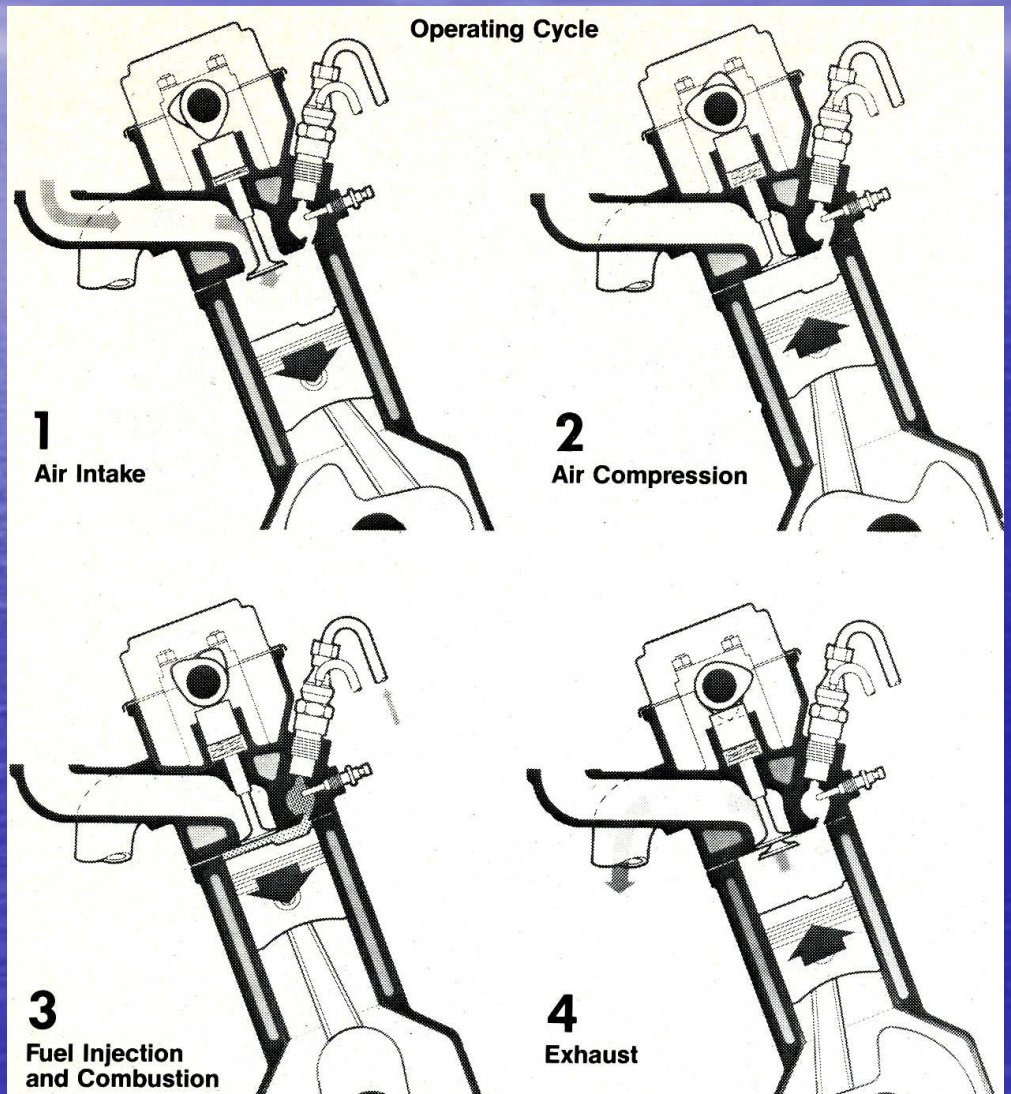


POWER
STROKE



EXHAUST
STROKE

Four stroke Diesel engine



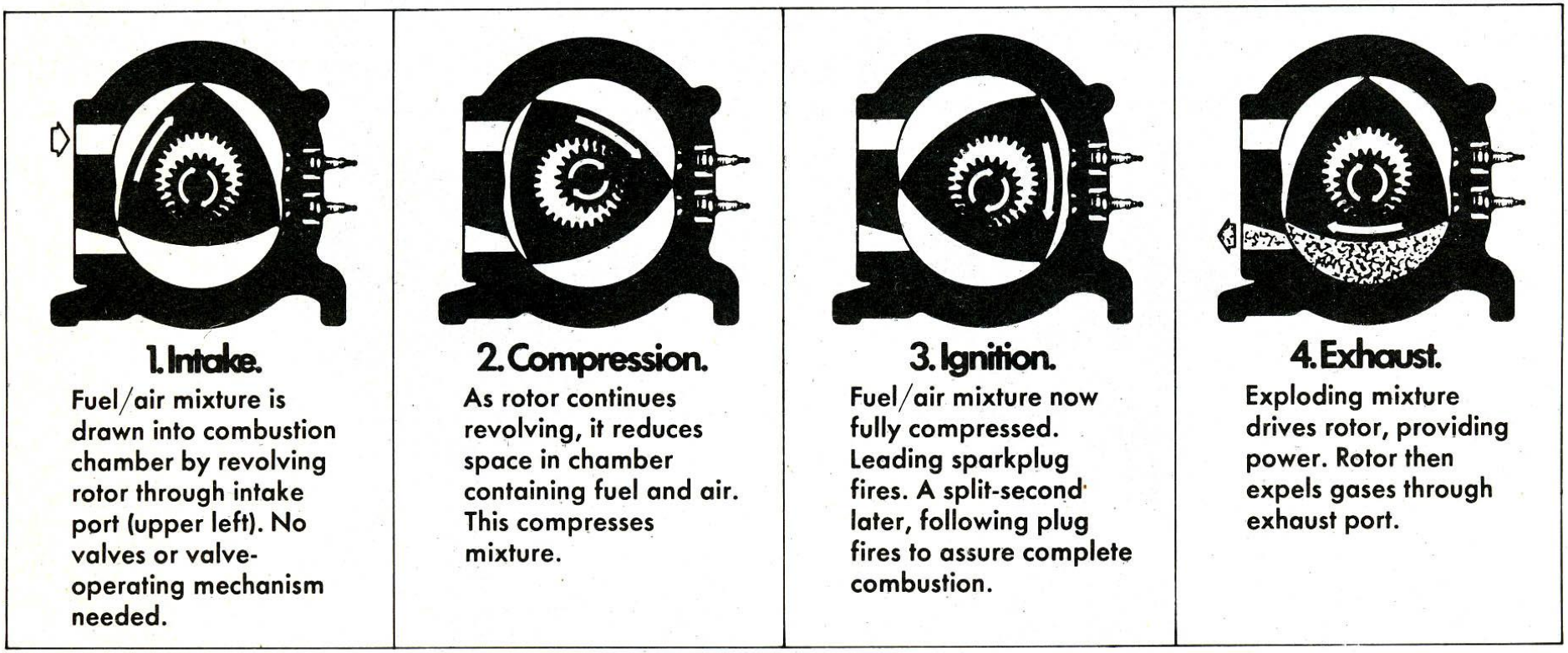


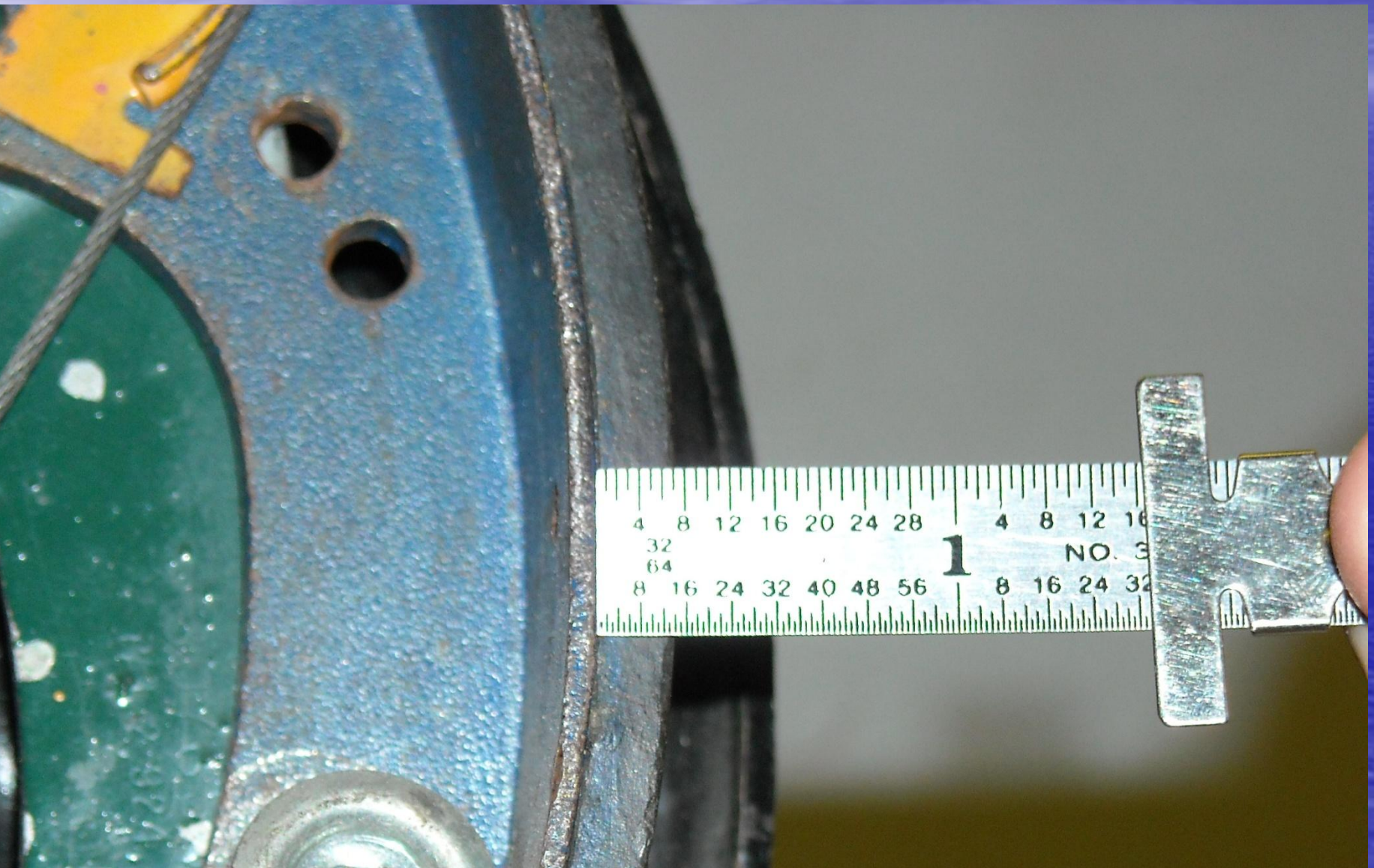
Figure 10. Four-Stroke Operating Cycle of the Mazda Rotary Engine

470604-0407
Check brakes.

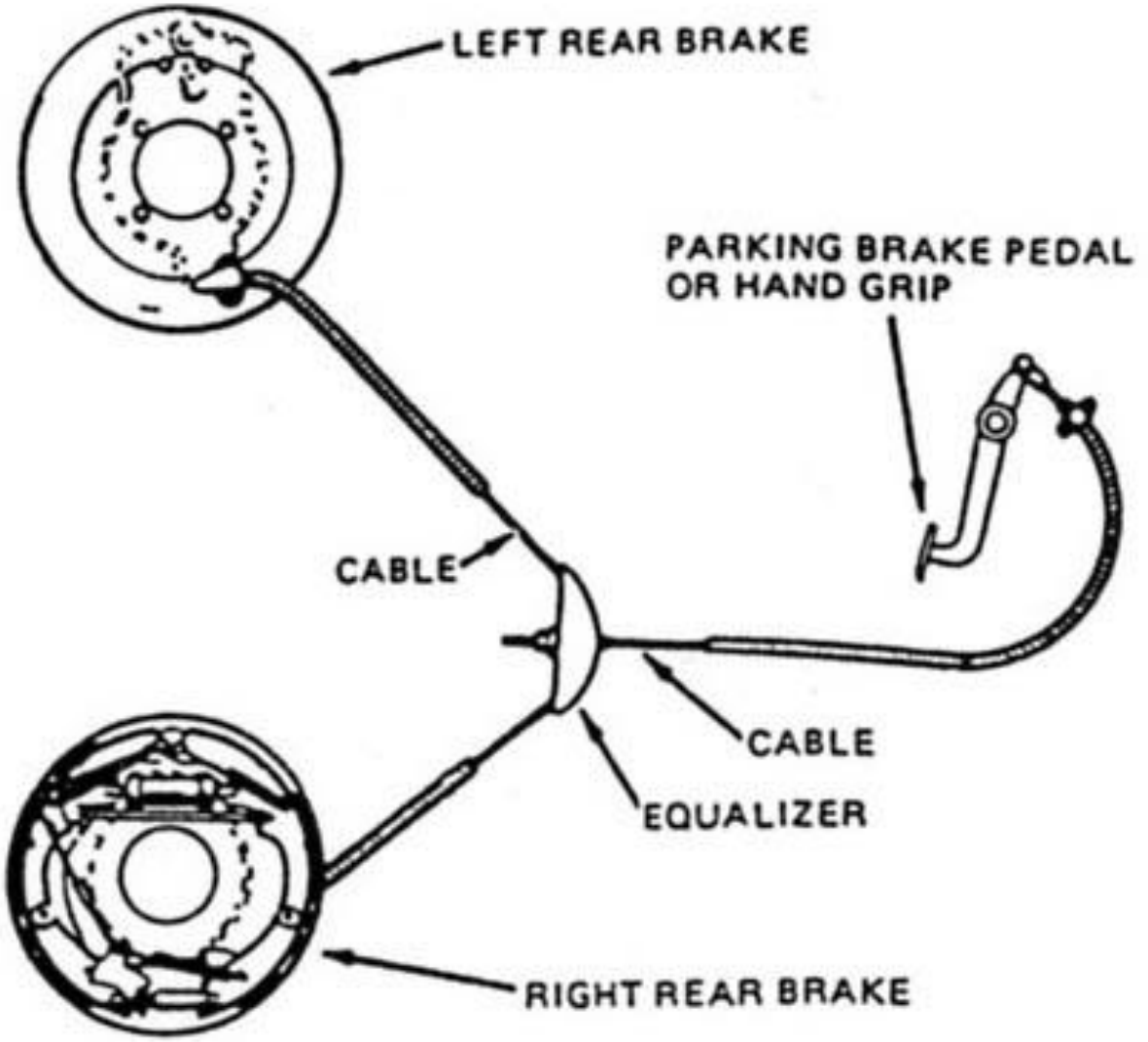
- Lining thickness
- Fluid leaks
- Park brake function

How much lining on this brake pad?

How much lining on this brake shoe?



Parking brake parts:



Courtesy of Wagner Division, Cooper Industries, Inc.

470604-0408
Check lights.

- Replace light bulbs as needed.

STANDARD 470604-06

Students will be able to solve basic mathematical equations related to automotive.

470604-0601
Solve whole number problems with two- and three-digits.

- Addition
- Subtraction
- Multiplication
- Division

470604-0602
Solve fraction problems.

- Addition
- Subtraction
- Multiplication
- Division

470604-0603
Solve decimal problems with two- and three-digits.

- Addition
- Subtraction
- Multiplication
- Division

470604-0604
Solve conversion problems.

- Fraction-to-decimal
- Decimal-to-fraction
- Decimal-to-percent
- Percent-to-decimal

470604-0605
Solve basic ratio-to-proportion problems.

470604-0606
Solve basic linear-measurement problems.

- Measuring using the Imperial system.
- Measuring using the Metric system.

The End

finally