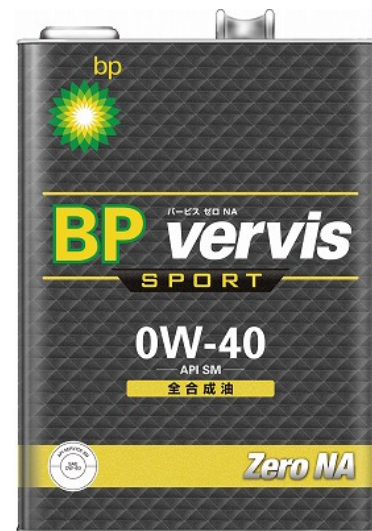


MECHANICAL POWER

Engine Lubrication System

Chimangeni Kamanga

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Functions of engine lubrication oil

a) Reduces friction

Effects of friction

- causes wear and tear
- generates heat
- reduces power output of an engine

b) Acts as a cushioning agent between parts in contact when heavy loads are imposed on the bearings.

c) Protects engine parts against acids and moisture

- c) Cools the engine by absorbing heat from pistons, cylinder walls, valves etc. and dissipating it through the oil sump.
- d) Form a gas tight seal between piston rings and cylinder walls, hence reducing compression losses (blowby).
- f) Cleans inside an engine - as it circulates through the engine, the oil picks up metal particles and carbon, and brings them to the pan.
- g) Reduces noise by preventing metal to metal contact.

Properties of Lubricants

Oiliness: refers to the ability of a lubricant to adhere or stick to metal surfaces.

Viscosity is a measure of oil's resistance to flow.

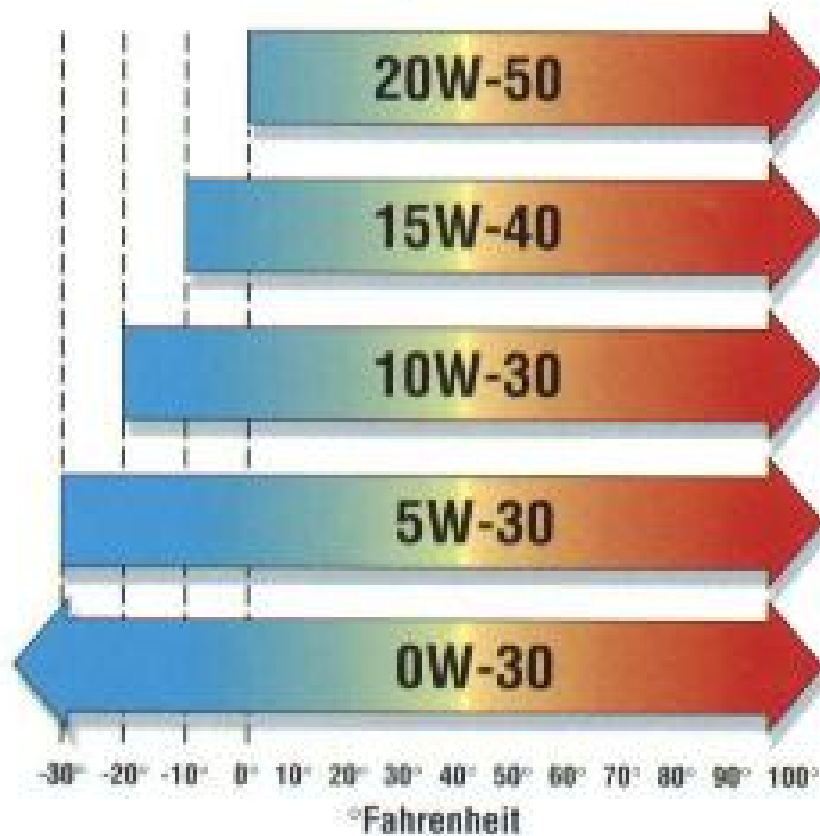
- A low viscosity oil is thin and flows easily
- A high viscosity oil is thick and flows slowly
- As oil heats up it becomes less viscous (*becomes thin*)
- If the oil is too thin (*has very low viscosity*) it will be forced out from between the moving parts, resulting in rapid wear.

- If the oil is too thick (*has very high viscosity*) it will flow very slowly to engine parts, especially when the engine and the oil are cold, resulting in rapid wear

Viscosity Index (VI): the ability of an oil to resist changes in viscosity as the temperature change.

- It's a measure of how much the viscosity of an oil changes with temperature.
- It's an empirical number
- The higher the VI, the lower will be the change of viscosity with temperature.

SAE Viscosity Grade and Outdoor Temperature



Classification of Lubricants

a) SAE (Society of Automotive Engineers) or Viscosity Classification

Classifies lubricants in terms of viscosity only and is identified by an SAE number.

- The higher the number the higher the viscosity (*thickness*) of oil
- **SAE number with a W** denotes viscosity was measured at -18°C , e.g. **SAE 10W**

They are meant for:

- low temperature application
- colder areas/regions e.g.
- SAE 0W, SAE 5W, SAE 10W, SAE 15W, SAE 20W

SAE number without W indicates viscosity was measured at 99°C, e.g. **SAE 20**

They are meant for:

- high temperature application
 - Warmer areas/regions
- SAE 20, SAE 30, SAE 40, SAE 10, SAE 50, SAE 60

Multigrade oils: are formulated to meet the viscosity limits of one grade of oil at -18°C and also meet the requirements of an oil with a higher SAE number at 99°C , e.g. **SAE 10W-30**. They are formulated for all year round use.

Low Viscosity oils used

- High speeds
- Low pressure
- Low temperature

High Viscosity oils used

- Low speeds
- High pressure
- High temperature

American Petroleum Institute (API) or Service Classification

Classifies lubrication oils according to service.

Two things are considered;

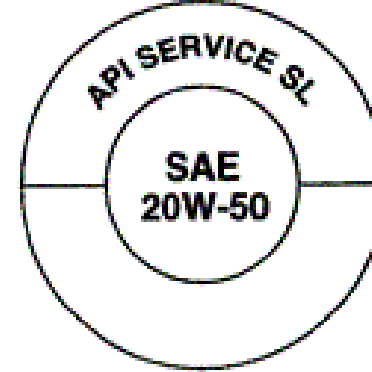
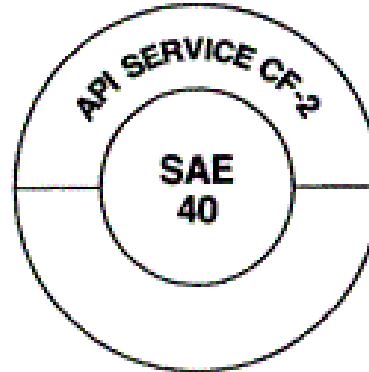
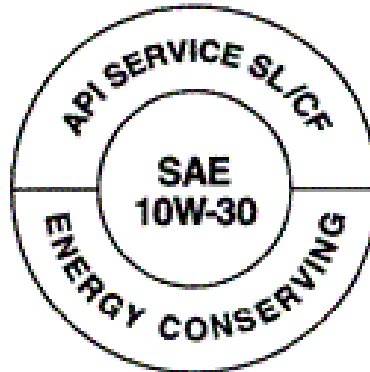
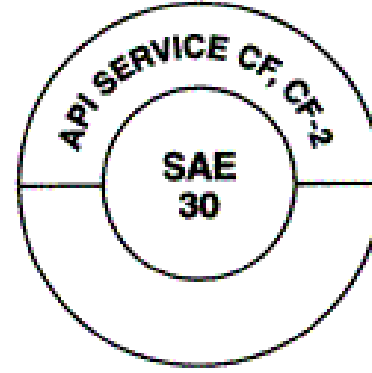
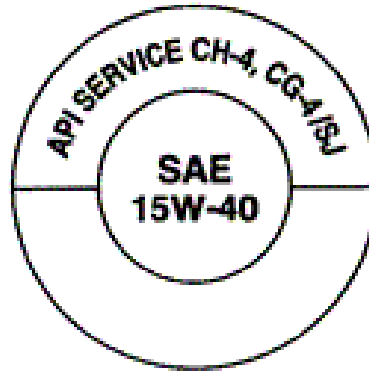
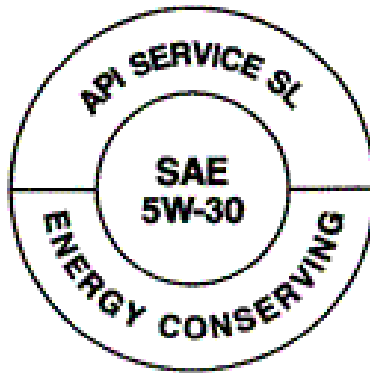
- a) type of service (type of engine fuel used) and
- b) the quality of the oil which is determined by the number and amounts of additives.

First letter of API Classification indicates type of service

- S-series oils are for use in spark ignition engines
- C-series oils are for use in compression ignition engines

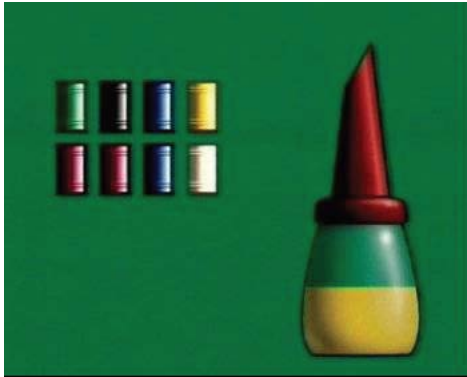
Second letter of API Classification designates the quality of engine oil.

- **A** for low quality oil, often meant for very light duty. Little or no additives used.
- **E** for example is a very high quality oil that can be used under very severe conditions.



API OIL SERVICE RATINGS

OIL ADDITIVES



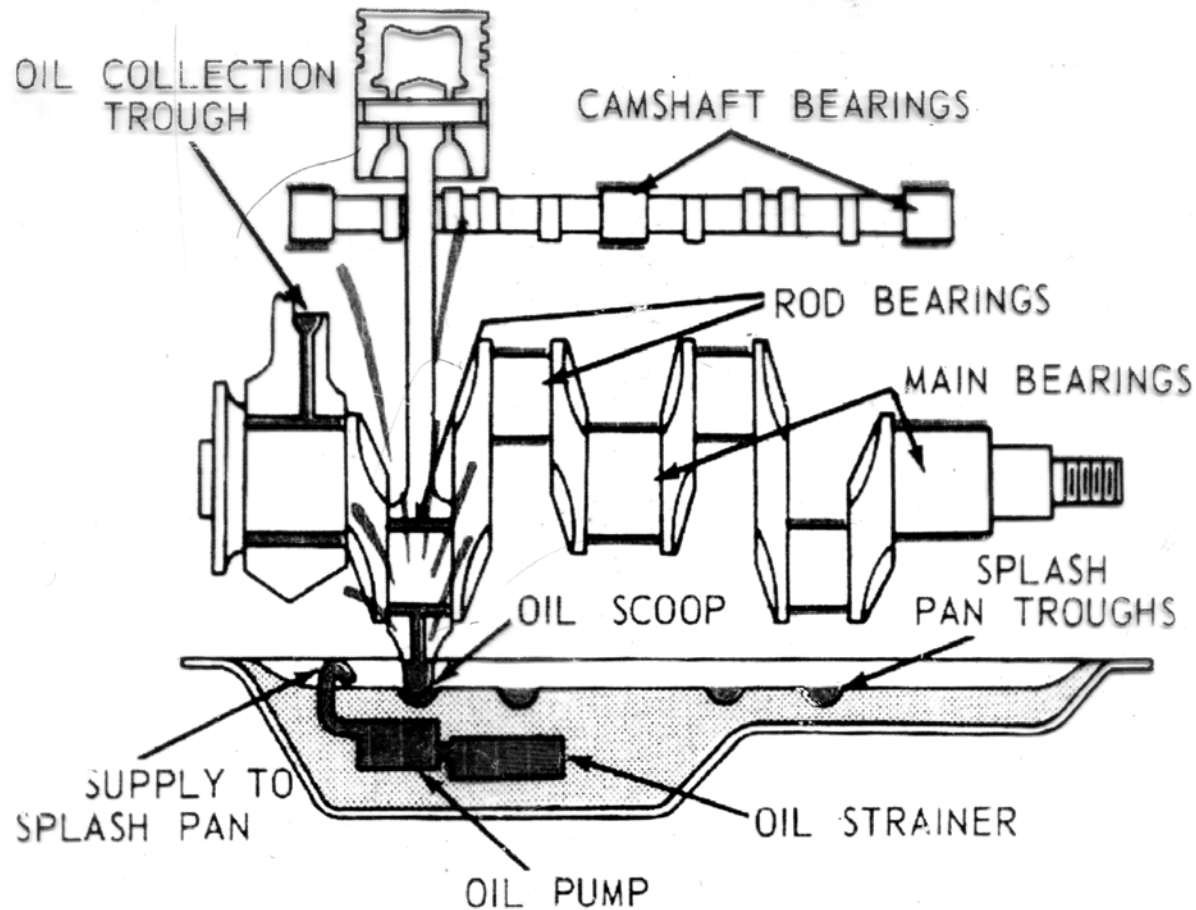
- **Oil additives are chemical compounds added to base oil in order to improve the lubricant performance**
- They are vital for proper lubrication and prolonged use of engine oil in modern internal combustion engines.
- Without many of these, the oil would become contaminated, break down, leak out, or not properly protect engine parts at all operating temperatures.

- a) **Detergent - Dispersant:** help maintain engine cleanliness by keeping oil-insoluble material in suspension so that it can be removed when the oil is changed.
- b) **Viscosity Index Improver:** lowers the rate of change of viscosity with temperature
- c) **Oxidation Inhibitors:** stop very hot oil combining with oxygen in air to produce a sticky material like tar which clogs galleries
- d) **Corrosion Inhibitor:** help stop acids forming that cause corrosion of bearing surfaces and other engine parts.

- e) **Extreme Pressure Additive:** coat parts with a protective layer so that the oil resists being forced out under heavy load. They bond to metal surfaces, keeping them from touching even at high pressure
- f) **Rust Inhibitor:** prevents rusting of ferrous engine parts during storage and from acidic moisture accumulated during cold engine operation.
- g) **Foam Inhibitor:** prevents the formation of stable foam

Engine Lubrication Systems

a) Splash Systems



- Dipper attached to the bottom of connecting rods splash oil to moving parts. Dippers may either dip into the sump itself or dip into shallow trays. An oil pump may still be used to keep oil trays full all the time

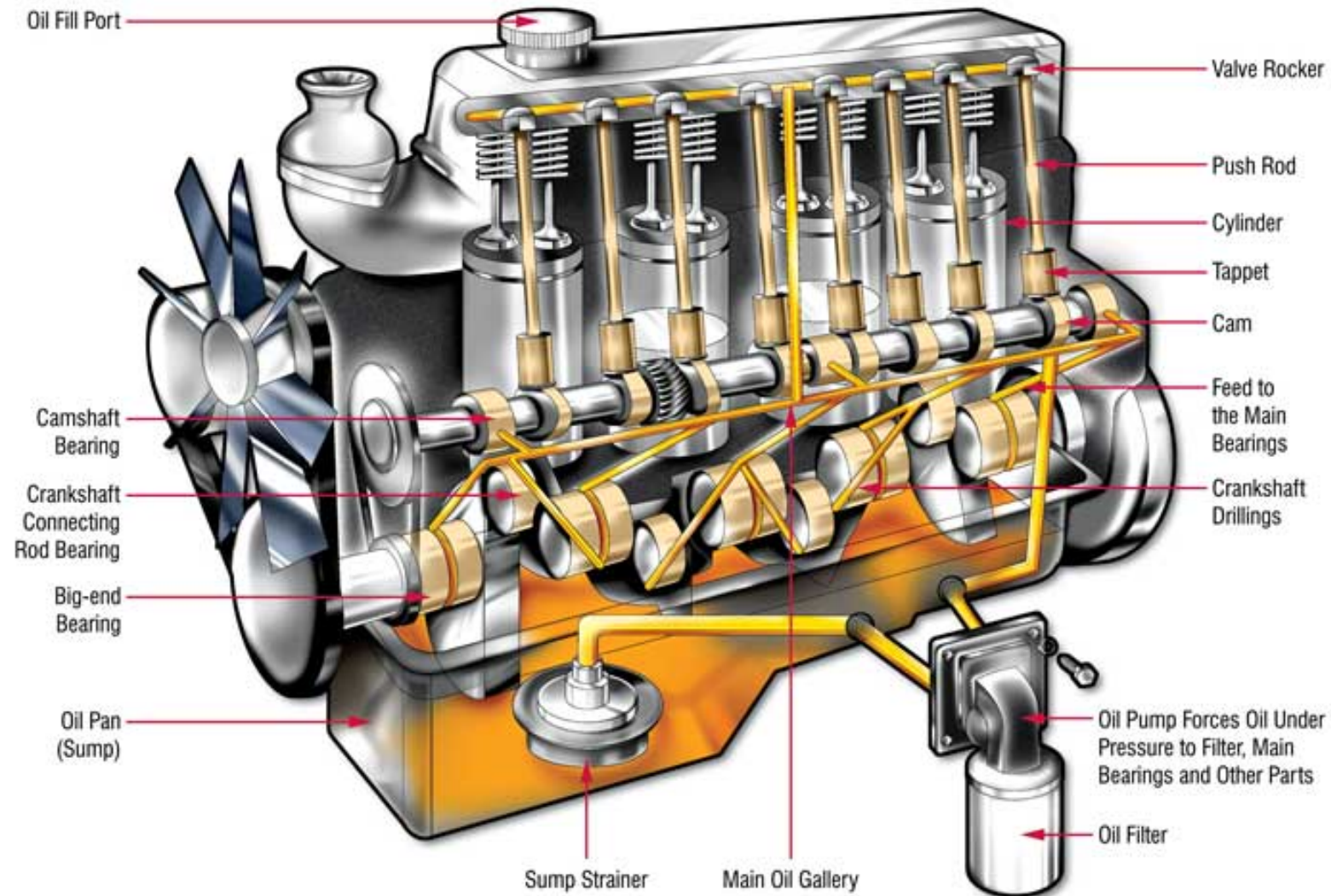
b) Oil Mist Lubrication

- Predominantly used in two stroke cycle petrol engine
- Oil is mixed with fuel, and this creates an oil mist which lubricates moving parts
- Typical Fuel/Oil ratio: 20 parts of petrol to 1 part oil. Check instruction manual for correct mix for a given engine.

c) **Pressure / Force Feed Lubrication System**

- Uses an oil pump to draw oil from the oil sump (pan) and forces it through special passages to the crankshaft and camshaft journals, valves, etc.
- The crankshaft is drilled to allow oil to flow to connecting rod journals.

Pressure Feed



Lubrication System

Oil is held in the sump.

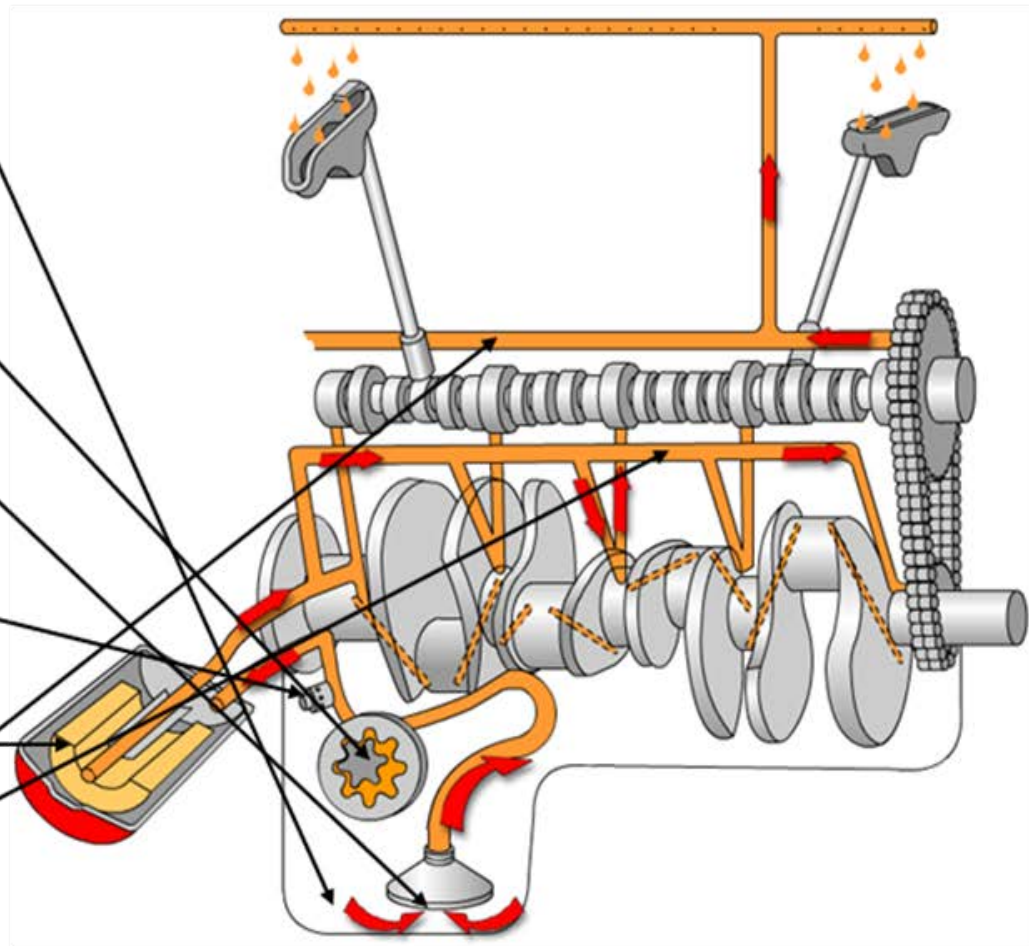
Drawn into engine through the pickup.

Forced round by a pump.

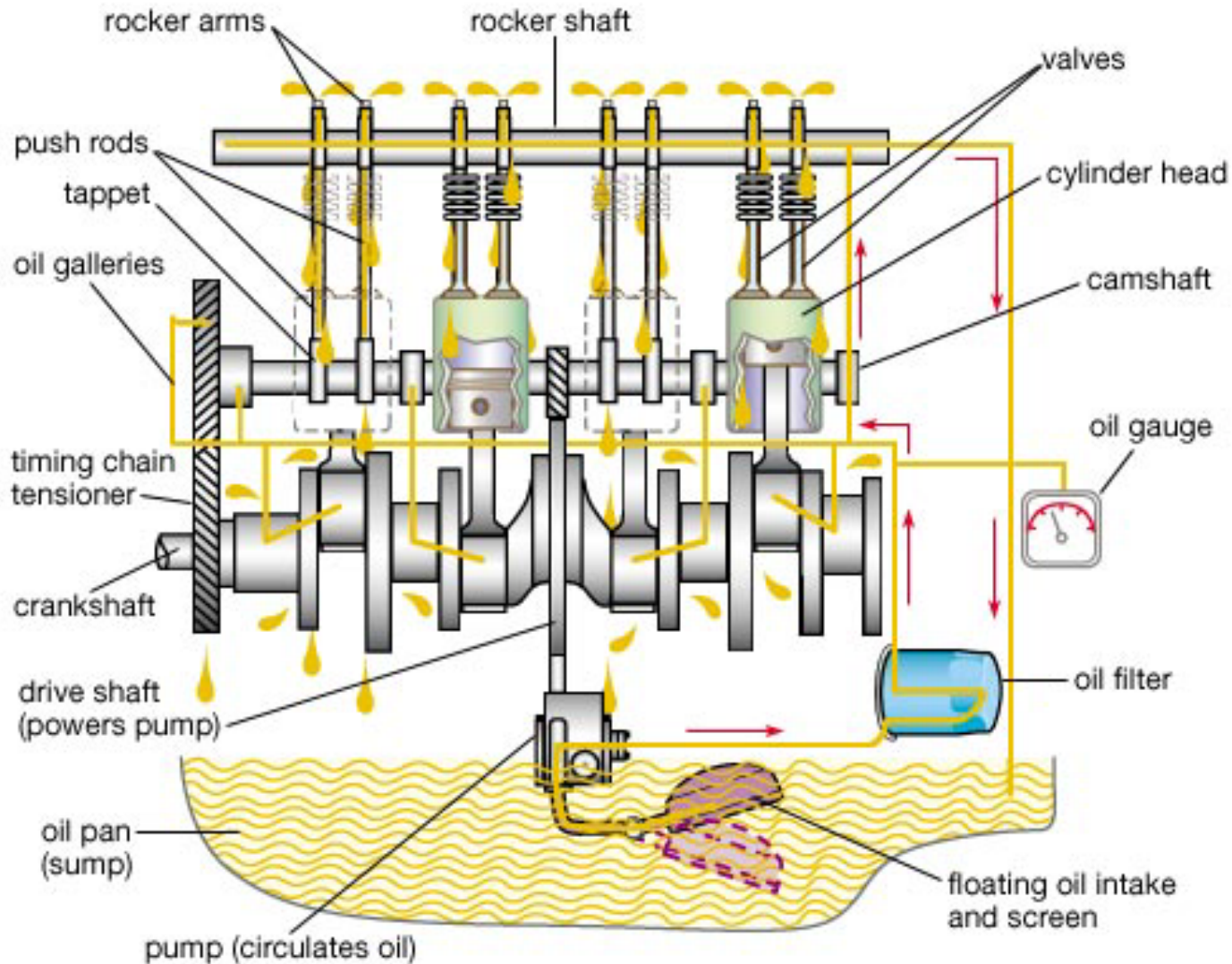
Protected by a pressure relief valve.

Particulates removed by a filter.

Carried around in galleries.



Components of Engine Lubrication System



1. **Sump:** is the base of an engine. It can be used for oil storage in a “wet sump system”.
2. **Oil collection pan:** used in “dry sump systems” prior to being returned to an oil tank.
3. **Oil Tank:** is part of the dry sump lubrication system and is used for oil storage.
4. **Oil pressure relief valve:** used to limit the pressure of the lubrication system, preventing damage to the engine due to excessive pressure.
5. **Oil Indicators:** used to check the oil levels in an engine.

6. **Oil filters:** helps to clean the oil in the system. If the filter clogs, a valve opens and directs unfiltered oil to the engine. Most oil-filters on diesel engines are larger than those on similar gasoline engines.
7. **Spurt holes and galleries:** deliver oil from the oil pump to bearings and various components in the engine.
8. **Oil cooler:** cools oil prior to its reuse in the engine.
9. **Oil pump:** delivers oil under pressure to the internal engine parts

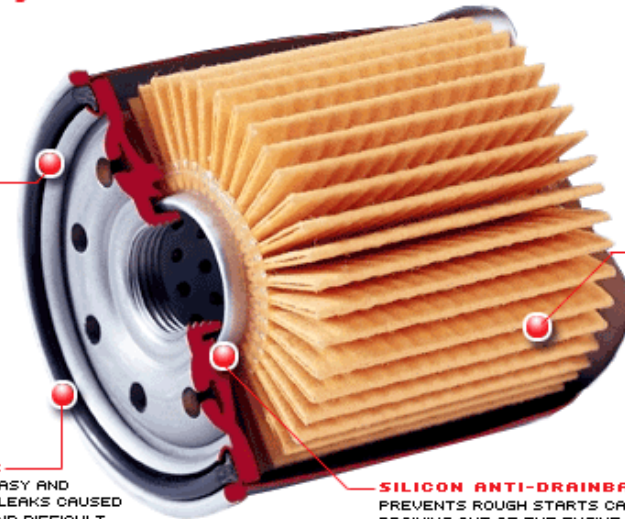
OIL FILTERS



Oil Filter Cutaway

PRE-LUBRICATED MOLDED O-RING
SEALS BETTER THAN GASKETS USED BY OTHER BRANDS

TORQUE STOPPER
MAKES INSTALLATION EASY AND ACCURATE. PREVENTS LEAKS CAUSED BY UNDER-TORQUING AND DIFFICULT REMOVAL CAUSED BY OVER-TORQUING



EFFICIENT PAPER
PROTECTS ENGINE AGAINST CONTAMINANTS

SILICON ANTI-DRAINBACK VALVE
PREVENTS ROUGH STARTS CAUSED BY OIL DRAINING OUT OF THE ENGINE WHILE VEHICLE IS TURNED OFF

- Removes solid particles from the oil
- There are two types of filters:

Surface filters: have a single surface that catches and removes dirty particles larger than the openings in the filter. They are made of accordion - pleated paper.

Depth filter: use large volume of filter material other than absorber cotton or material to trap contaminants as the oil flows through.

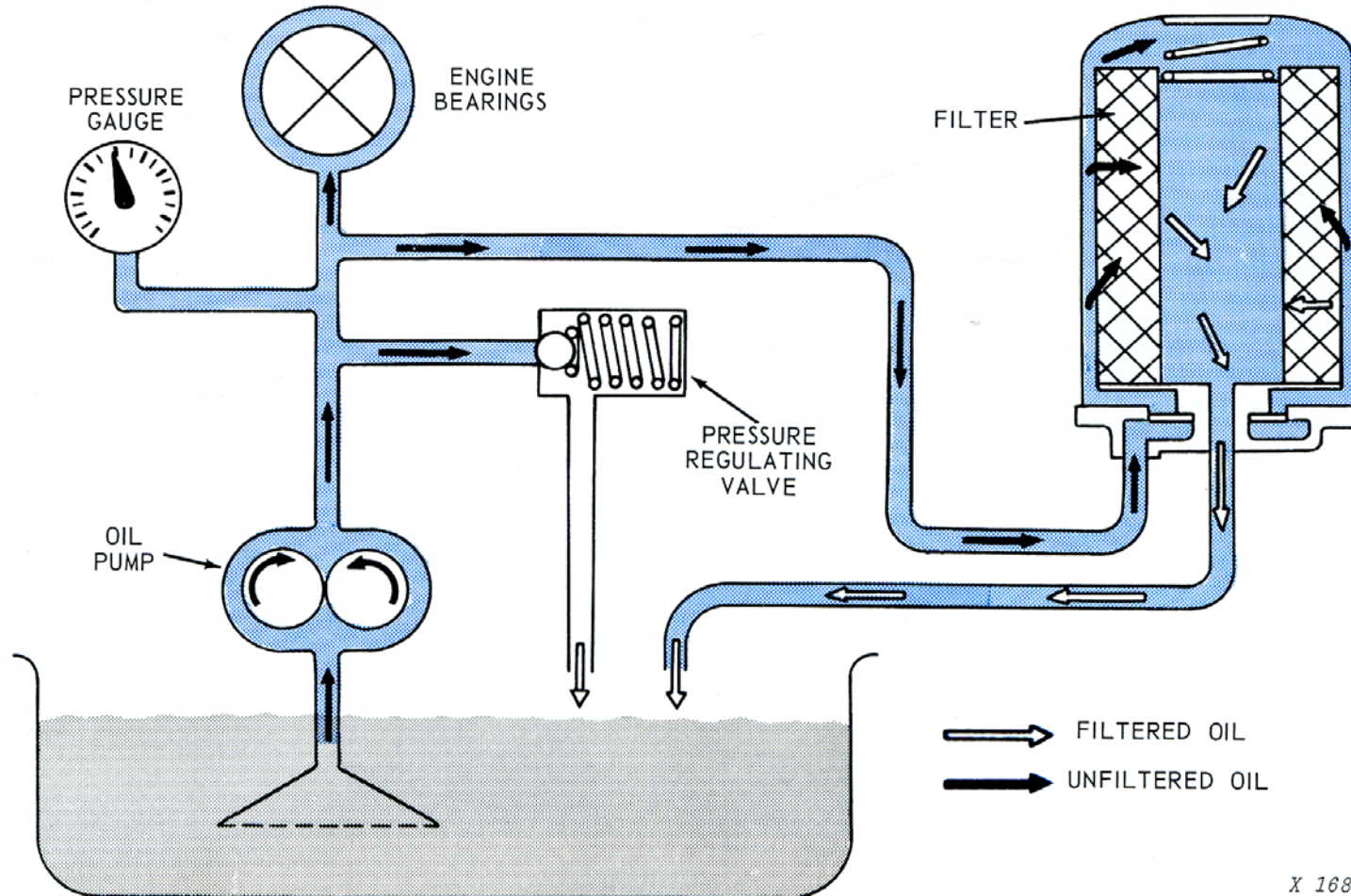
Filtering Systems

Oil filtering systems can be classified as:

- a) **full-flow**
- b) **bypass systems.**

OIL FILTRATION SYSTEMS

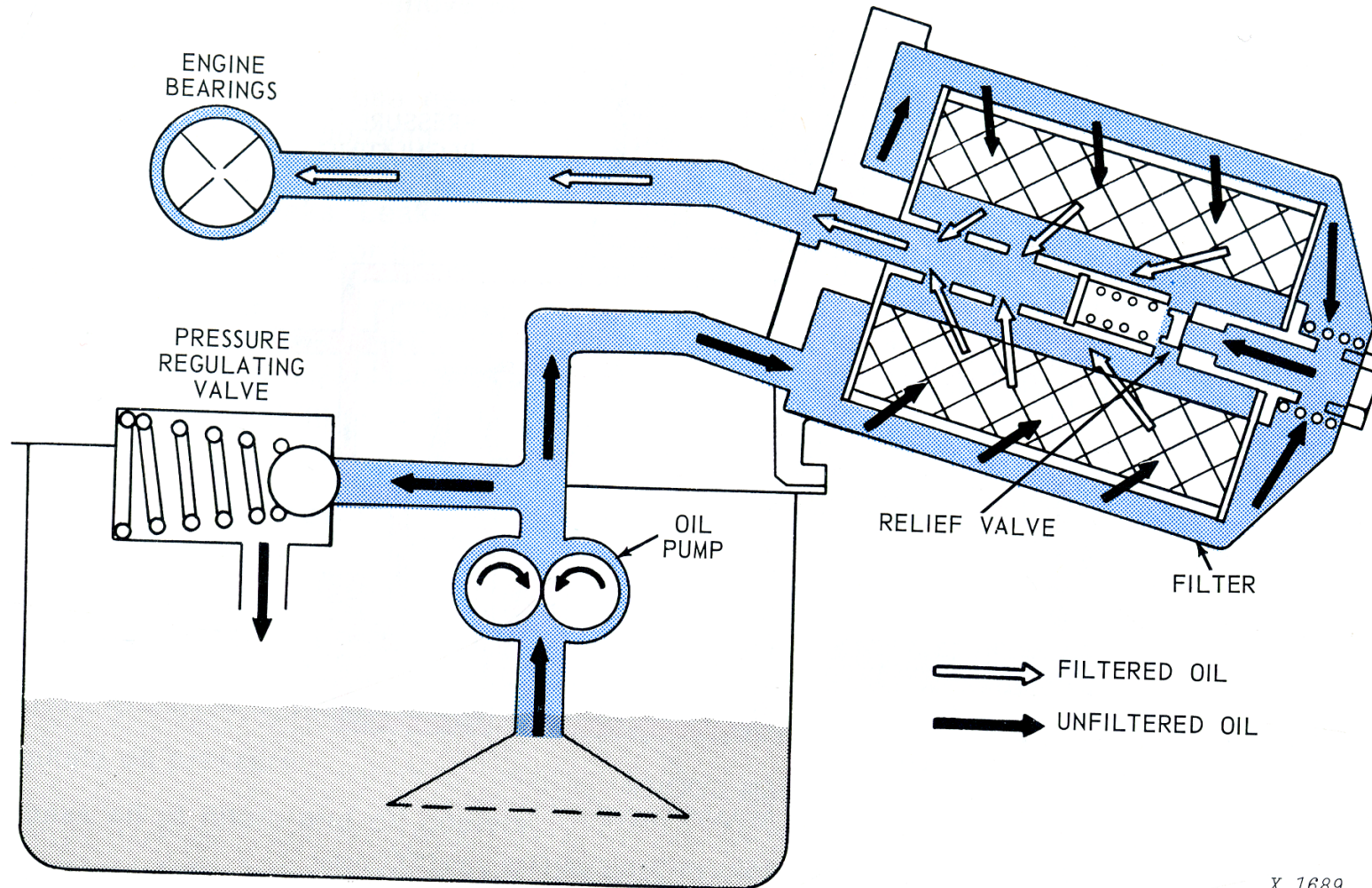
Bypass filtration system



Bypass filtration system:

- has two separate oil flows, one to the bearing and another to the filter.
- 5 to 10% of oil delivered by the pump is by-passed to the filter and the rest goes to bearings.
- After filtering, the oil is returned to the crank case.
- Bypass method allows filtering particles as small as 1 micron from the oil, but not all the oil is filtered at once.

Full-flow filtration system



Full-flow filtration system

- All the oil from the pump passes through the filter and then to the bearing.
- The full-flow filter must be coarse to allow full-flow.
- It must also include a bypass valve which should open to ensure a continuing supply of oil to the bearings when the filter is blocked.

MONITORING ENGINE LUBRICATION SYSTEM

- i) Dipstick:** indicates the level of lubricating oil in the sump. It is mounted through a special opening in the engine block and extends down into the oil sump.
- ii) Oil Pressure Gauge:** indicates whether the oil pump is delivering pressurised oil to the oil galleries. In some cases a pressure switch is used instead and it turns on a red light if the oil pressure falls below a safe level.