MODULE CONTENT

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| Unit of Competency | **DIAGNOSE AND REPAIR INTAKE AND EXHAUST SYSTEM** |
| --- | --- |
| Module Title | **DIAGNOSING AND REPAIRING INTAKE AND EXHAUST SYSTEM** |
| Module Descriptor | This unit describes the performance outcomes required  to diagnose and repair faults in the conventional intake  and exhaust systems of vehicles such as intake and  exhaust manifold, and throttle system, turbocharger and  intercooler system. It covers the knowledge, skills and  attitude required to prepare to diagnose and repair intake  and exhaust system, diagnose and repair intake and  exhaust system and complete work processes. |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and repair intake and exhaust system | |
| LO2. Diagnose intake and exhaust system | |
| LO3. Repair intake and exhaust system | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 2**

**DIAGNOSE INTAKE AND EXHAUST SYSTEM**

| **Learning Activities** | **Special Instructions** |
| --- | --- |
| Read Information Sheet 3.1-1 Diagnose intake and exhaust system | If you have some problem on the content of the information sheet don’t hesitate to approach your Trainer.  If you feel that you are now knowledgeable on the content of the information sheet, you can now answer self-check provided in the module. |
| Answer Self-Check 3.1-1 on Diagnose intake and exhaust system | Try to answer the Self-check without looking at the Answer Key  Compare your answer to Answer Key 3.1-1 |
| Observe Trainer’s demonstration on Task Sheet 3.1-1 on Diagnose intake and exhaust system | Listen carefully and attentively so that you may be able to perform a task correctly  Ask questions if are in doubt for clarification |
| Perform the Task Sheet 3.1-1 onDiagnose intake and exhaust system | Remember the step-by-step procedure of the Diagnose intake and exhaust system |
| Evaluate the performance using the Performance Criteria Checklist 3.1-1 | Repeat the task in case fail to meet the criteria |

**INFORMATION SHEET 1.1-1**

**DIAGNOSE AND REPAIR INTAKE AND EXHAUST SYSTEM**

**Learning Objectives:**

After reading this **Information Sheet**, you must be able to:

1. Determined job requirements
2. Sourced and interpreted diagnostic information.
3. Verified symptoms.
4. Identified hazards associated with the work and managed risks.
5. Selected and checked tools, equipment, and materials.
6. Reported defective and damaged tools and equipment.
7. Checked and reported availability of materials.

**INTAKE SYSTEM**

**DEFINITION:**

The system that **allows air and fuel into the engine** is known as the intake system. This system consists of the air filter, the intake manifold, and either a carburator or a throttle body along with pressurized fuel injectors depending on the engine.

**4 STROKE CYCLE OF AN ENGINE**

In order to effectively power equipment, 4-stroke engines complete and repeat the following steps:

**Intake stroke**

Piston moves down the cylinder bore from top dead center (TDC) to bottom dead center (BDC)

Intake valve is open, the exhaust valve is closed

Downward piston motion creates a vacuum (negative air pressure) that draws that air/fuel mixture into the engine via the open intake valve

**Compression stroke**

Piston moves up the cylinder bore from bottom dead center to top dead center

Both the intake and exhaust valves are closed

Upward piston motion compresses air/fuel mixture in the combustion chamber

**Power stroke**

At the end of the compression (previous) stroke, the spark plug fires and ignites the compressed air/fuel mixture. This ignition/explosion forces the piston back down the cylinder bore and rotates the crankshaft, propelling the vehicle forward.

Piston moves down the cylinder bore from top dead center to bottom dead center

Both the intake and exhaust valve are closed

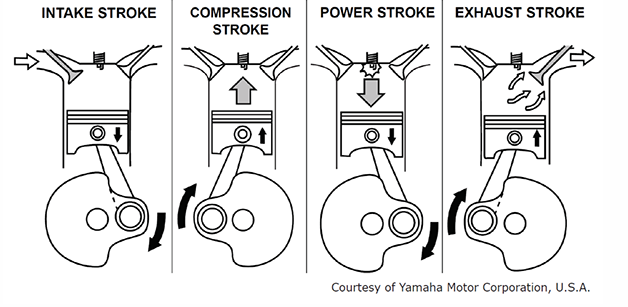
**Exhaust stroke**

Piston moves up the cylinder bore from bottom dead center to top dead center. The momentum caused by the power stroke is what continues the crankshaft movement and the other 3 strokes consecutively.

Intake valve is closed, the exhaust valve is open

This final stroke forces the spent gasses/exhaust out of the cylinder. The cycle in now complete and the piston is ready to begin the intake stroke.

The below diagram gives a visual representation of how this process works:



**Intake stroke:** The intake valve (on the top left of each image) is open and as the piston travels downward, this suction pulls the air/fuel mixture into the cylinder.

**Compression stroke:** Both valves are now closed and the piston compresses the air fuel into a much smaller volume, preparing the mixture for ignition.

**Power stroke:** With both valves closed, the spark plug—located in the picture between the intake and exhaust valve will fire, igniting the air/fuel mixture. The resulting explosion forces the piston downward and rotates the crankshaft, which in turn propels the vehicle.

**Exhaust stroke:** The exhaust valve (on the top right of each image) is now open, allowing the piston to push the spent exhaust gasses out of the engine as it rises. The 4-strokes (1 engine cycle) are now complete, and the process repeats.

Air is compressible. When the air/fuel is compressed before ignition, combustion efficiencies are improved. Compression ratio is the relationship of total cylinder volume to compressed volume. For example, a compression ratio of 10:1 (verbally spoken as “10 to 1”) would indicate that the chamber squeezes 10 parts of air/fuel volume into 1 part of that volume at the end of the compression stroke.

Higher compression ratio can offer more power in some applications. The downsides to higher compression ratio can be decreased durability and the need to run higher-octane (expensive) gasoline.

**The Difference Between 2-Stroke and 4-Stroke Engines**

**2-stroke engines differ from 4-strokes in three key areas:**

They do not use valves

**They burn oil in the combustible mix of air and fuel**

1 power pulse for every 2 engine strokes (versus 1 power pulse for every 4 strokes as we see in 4-stroke engines)

**Ports, Not Valves**

2-strokes flow air, fuel and exhaust through the engine without the use of valves. Rather, they use ports. 2-strokes also take advantage of the airspace below the piston. Each piston stroke is pressurizing and acting upon 2 chambers simultaneously.

four stroke engine 04

The above diagram demonstrates how 2-stroke engines take advantage of the space above and below the piston. The uses of machined ports with the engine casing itself allows 2-strokes to avoid using valves.

Additionally, there is no camshaft required to open or close the valves—fewer parts means that 2-strokes are lighter and more compact than 4-stroke engines.

**Mixing Oil and Gas**

Mixing oil and gas can be either a manual process where the operator physically mixes both components in a gas can, or an automatic process using oil injection systems. Either way, 2-stroke engines burn oil to provide lubrication to moving parts.

**Power Twice as Often**

The final major differentiating characteristic of a 2-stroke engine is its ability to complete each engine cycle and have a power pulse twice as often as 4-strokes. Similar displacement 2-strokes can be almost twice as powerful as their 4-stroke counterparts.

**2-Stroke Disadvantages**

If 2-strokes are lighter, smaller and more powerful than 4-strokes, why aren’t they more common? 2-strokes have a few distinct downsides, including:

**Less fuel efficient**

Noisier and more prone to vibration

Considerably more emission pollution

2-stroke oil is expensive to purchase and mixing to the correct ratio can be challenging

**What are the components of Engine Intake System**



**INFORMATION SHEET 3.1-1**

**DIAGNOSE INTAKE AND EXHAUST SYSTEM**

**EXHAUST SYSTEM**

**DEFINITION:**

is a means whereby a material is placed between two rubbing surfaces to alleviate friction and therefore wear

**Components of Lubricating system:**

* Oil pump
* Oil filter
* Oil strainer/pump
* Oil pan
* Oil cooler
* Oil pressure relief valve

**Oil pump**

The oil pump in an internal combustion engine circulates engine oil under pressure to the rotating bearings, the sliding pistons and the camshaft of the engine.

As well as its primary purpose for lubrication, pressurized oil is increasingly used as a hydraulic fluid to power small actuators.



**Oil filter**

An oil filter is a filter designed to remove contaminants from engine oil



**Oil strainer**

The function of an Oil Strainer is to remove system debris from the refrigerant oil. Their purpose is to protect compressors and oil level regulators from damage.



**Oil pan**

The oil pan is attached to the bottom of the engine with bolts and is the reservoir for oil that gets pumped throughout the engine to lubricate, clean and cool moving parts.



**Oil cooler**

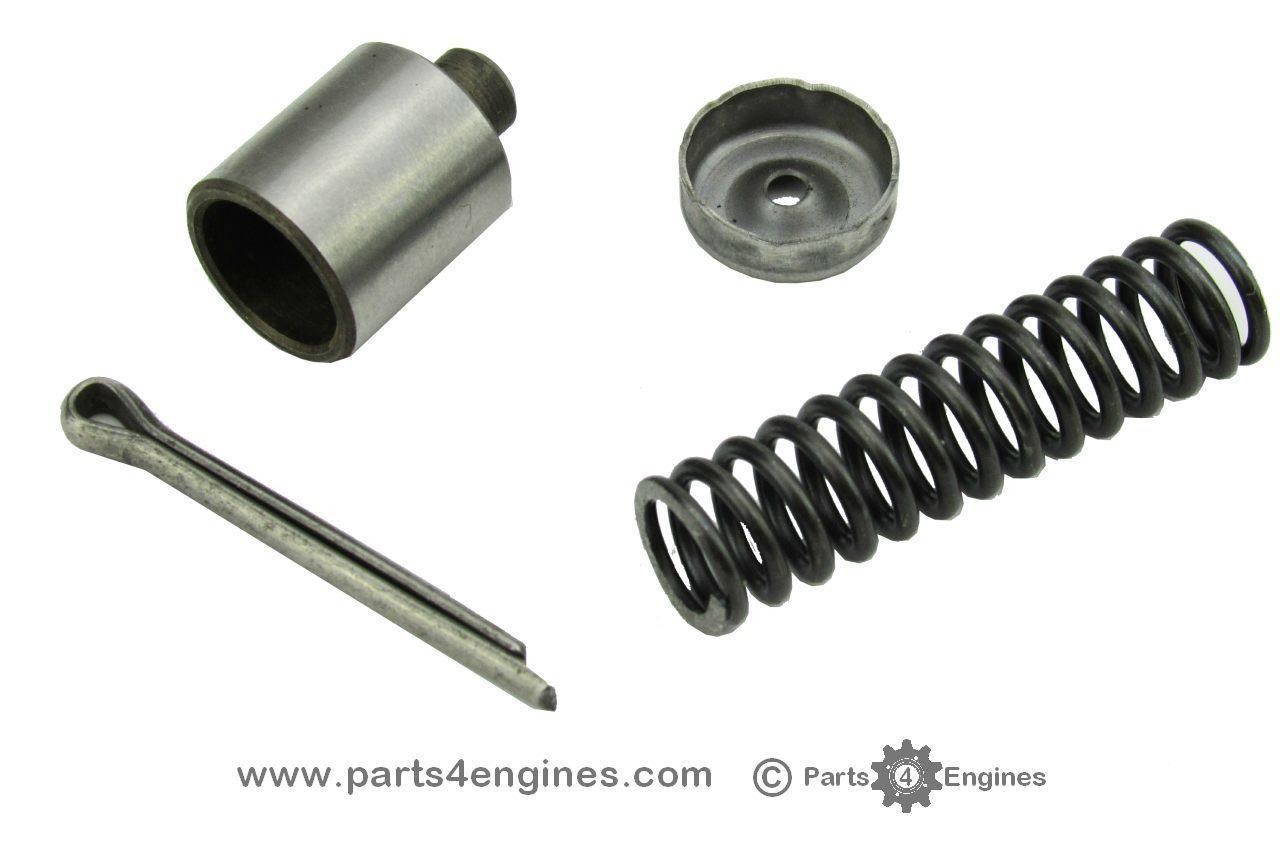
The purpose of the engine oil cooler is to allow the engine's cooling system to remove excess heat from the oil. These types of coolers are usually of the water-to-oil type of heat exchanger.

The oil then flows through the tubes of the cooler while the engine coolant flows around the tubes.

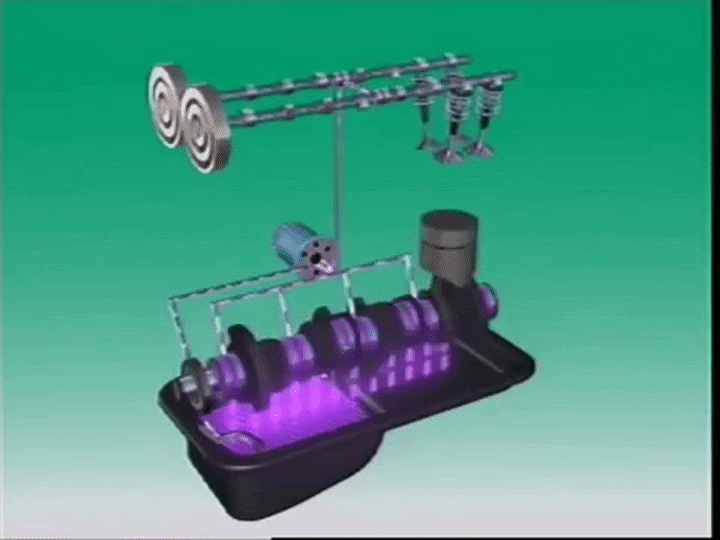


**Oil pressure relief valve**

The oil pressure relief valve is usually located at the pulley end of the engine, right around the oil pump. When the engine is cold, the oil becomes cold and thick. It is at this time that the oil pressure relief allows oil to flow directly to the bearings from the oil pump.



**OIL CYCLE**



| Unit of Competency | **DIAGNOSE AND REPAIR ENGINE COOLING AND LUBRICATION SYSTEM** |
| --- | --- |
| Module Title | **DIAGNOSING AND REPAIRING ENGINE COOLING AND LUBRICATION SYSTEM** |
| Module Descriptor | This unit describes the performance outcomes required to diagnose and repair faults in the cooling systems of  vehicles such as radiator, water pump, and thermostat  and lubrication systems such as oil pump, oil cooler,  hoses and oil pressure switch. It covers the knowledge,  skills, and attitudes required to prepare to diagnose and  repair engine cooling and lubrication systems, diagnose  and repair engine cooling and lubrication system and  complete work processes. |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and repair engine cooling and lubrication systems | |
| LO2. Diagnose engine cooling and lubrication system | |
| LO3. Repair engine cooling and lubrication system | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 1**

**PREPARE TO DIAGNOSE AND REPAIR ENGINE COOLING AND LUBRICATION SYSTEMS**

| **Learning Activities** | **Special Instructions** |
| --- | --- |
| Read Information Sheet 3.1-1 Prepare to diagnose and repair engine cooling and lubrication systems | If you have some problem on the content of the information sheet don’t hesitate to approach your Trainer.  If you feel that you are now knowledgeable on the content of the information sheet, you can now answer self-check provided in the module. |
| Answer Self-Check 3.1-1 on Prepare to diagnose and repair engine cooling and lubrication systems | Try to answer the Self-check without looking at the Answer Key  Compare your answer to Answer Key 3.1-1 |
| Observe Trainer’s demonstration on Task Sheet 3.1-1 on Prepare to diagnose and repair engine cooling and lubrication systems | Listen carefully and attentively so that you may be able to perform a task correctly  Ask questions if are in doubt for clarification |
| Perform the Task Sheet 3.1-1 on Prepare to diagnose and repair engine cooling and lubrication systems | Remember the step-by-step procedure the Prepare to diagnose and repair engine cooling and lubrication systems |
| Evaluate the performance using the Performance Criteria Checklist 3.1-1 | Repeat the task in case fail to meet the criteria |

**INFORMATION SHEET 1.1-1**

**PREPARE TO DIAGNOSE AND REPAIR ENGINE COOLING SYSTEM**

**Learning Objectives:**

After reading this **Information Sheet**, you must be able to:

1. Determined job requirements
2. Sourced and interpreted diagnostic information.
3. Verified symptoms.
4. Identified hazards associated with the work and managed risks.
5. Selected and checked tools, equipment, and materials.
6. Reported defective and damaged tools and equipment.
7. Checked and reported availability of materials.

**ENGINE COOLING SYSTEM**

**DEFINITION:**

A system that keeps air cool and dry.

**Purpose:**

* The purpose of the engine’s cooling system is to removed excess heat from the engine.
* To keep the engine up to the correct temperature as soon as after starting.

Two kinds of Cooling System

1. Air cooling system
2. Water cooling system

**Air cooling system**

This is the standard method of cooling system used method to dissipate heat.

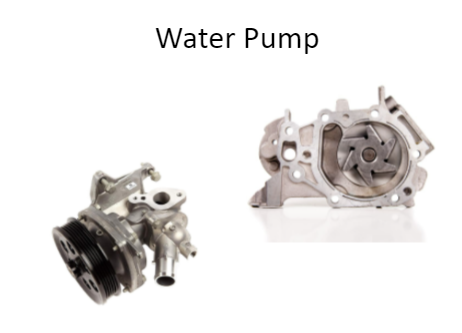
* The object being cooled will have a flow of air moving over its surface
* Usually a combination of fans and heat sinks.
* Contrast liquid/water cooling system.

**Water cooling system**

A water cooled engine blocks and cylinder head have interconnected coolant channels running through them.

**Components of a water engine cooling system**

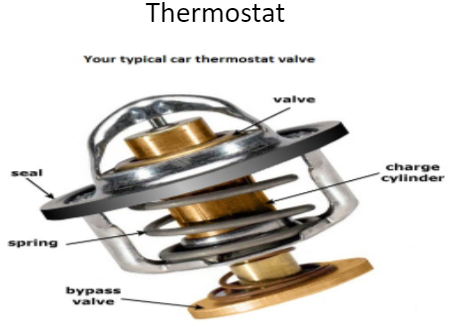
* Water Pump
* Freeze Plugs
* Thermostat
* Radiator
* Cooling Fan
* Heater Core
* Pressure Cap
* Over Flow Tank
* Hoses
* Antifreeze



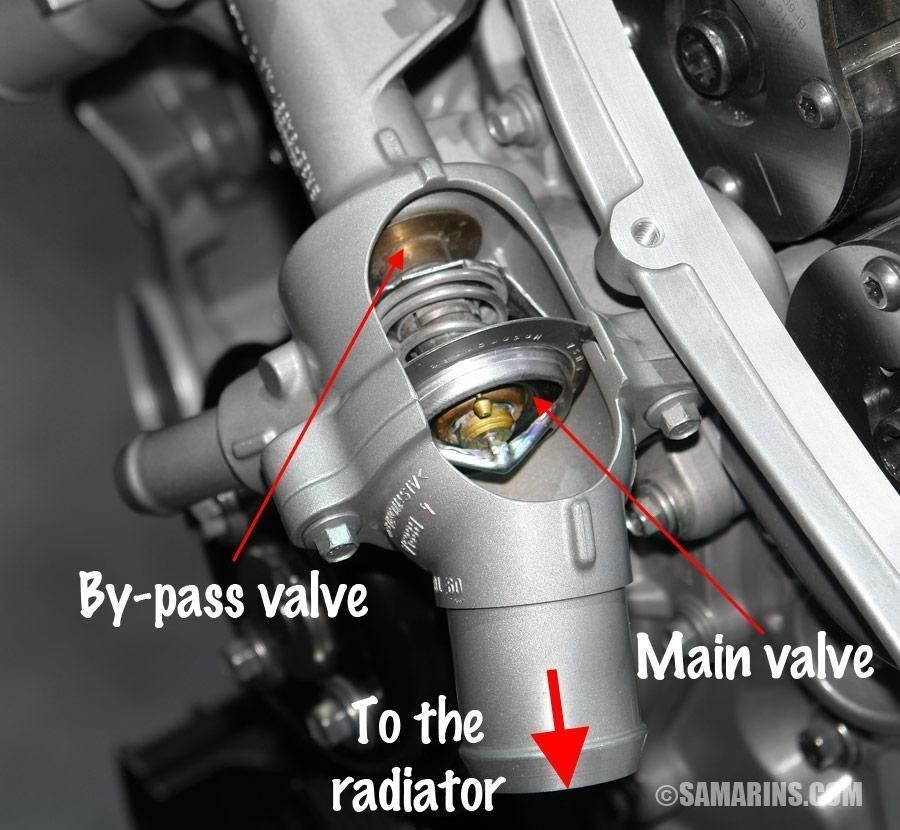
A water pump is vital to a car engine's operation because it ensures the coolant keeps moving through the engine block, hoses and **radiator**, and maintains an optimum operating temperature. It is driven by a serpentine belt (aka accessory belt or auxiliary belt) from the **crankshaft pulley**.

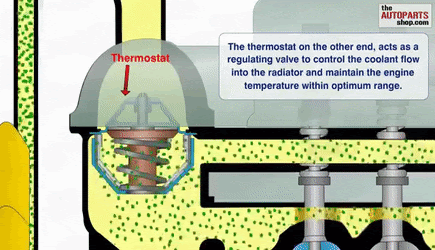


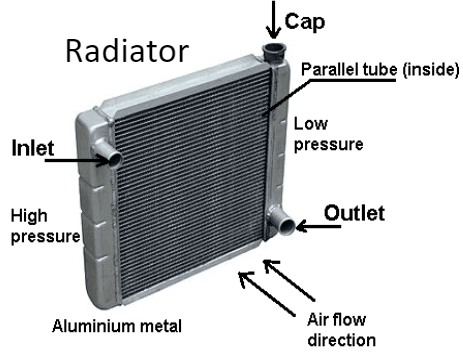
**Freeze plugs** are usually aluminum or brass **plugs** pressed into holes in the water jacked of your engine block. In some cases, as the water freezes and expands in your block, the **freeze plugs** will push out relieving the pressure of the freezing water and partially draining your cooling system.



* A **car thermostat** is a small device that sits between the radiator and the engine of a liquid-cooled **car**.
* Its principal function is to regulate the flow of engine coolant from the engine to the radiator. When closed, engine coolant cannot flow into the radiator which can lead to a rapid increase in engine temperature.







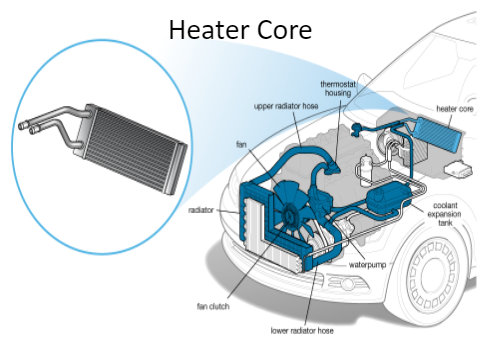
A **radiator** is a type of heat exchanger. It is designed to transfer heat from the hot coolant that flows through it to the air blown through it by the fan. Most modern **cars** use aluminum **radiators**. These **radiators** are made by brazing thin aluminum fins to flattened aluminum tubes.



The radiator pressure cap prevents coolant loss and increases the cooling systems boiling point. It contains a spring that holds pressure in the system until it reaches a specified pressure. The radiator cap also allows the engine's coolant to expand and contract without allowing air to enter the cooling system.



The engine **cooling fan** is designed to move air through the **radiator** when the vehicle is at slower speeds or stopped. This air flow removes heat from the coolant created by the engine using the **radiator** as a conductor. An engine **cooling fan** is temperature controlled to only run when needed.



A **heater core** is a small radiator located under the dashboard of the vehicle, and it consists of conductive aluminum or brass tubing with cooling fins to increase surface area. Hot coolant passing through the **heater core** gives off heat before returning to the engine cooling circuit.



The **overflow tank** typically has one or sometimes two ports. The hot **coolant** is transferred back and forth between the **tank** depending on the pressure emitted from the hot **coolant**.

An **overflow tank** can also be referred to as a recovery **tank** and is the simpler system of the two.



**Coolant** is the fluid that absorbs heat from the engine and then dissipates it through the radiator.



**INFORMATION SHEET 3.1-1**

**PREPARE TO DIAGNOSE AND REPAIR ENGINE LUBRICATING SYSTEM**

**LUBRICATING SYSTEM**

**DEFINITION:**

is a means whereby a material is placed between two rubbing surfaces to alleviate friction and therefore wear

**Components of Lubricating system:**

* Oil pump
* Oil filter
* Oil strainer/pump
* Oil pan
* Oil cooler
* Oil pressure relief valve

**Oil pump**

The oil pump in an internal combustion engine circulates engine oil under pressure to the rotating bearings, the sliding pistons and the camshaft of the engine.

As well as its primary purpose for lubrication, pressurized oil is increasingly used as a hydraulic fluid to power small actuators.



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An oil filter is a filter designed to remove contaminants from engine oil



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The function of an Oil Strainer is to remove system debris from the refrigerant oil. Their purpose is to protect compressors and oil level regulators from damage.



**Oil pan**

The oil pan is attached to the bottom of the engine with bolts and is the reservoir for oil that gets pumped throughout the engine to lubricate, clean and cool moving parts.



**Oil cooler**

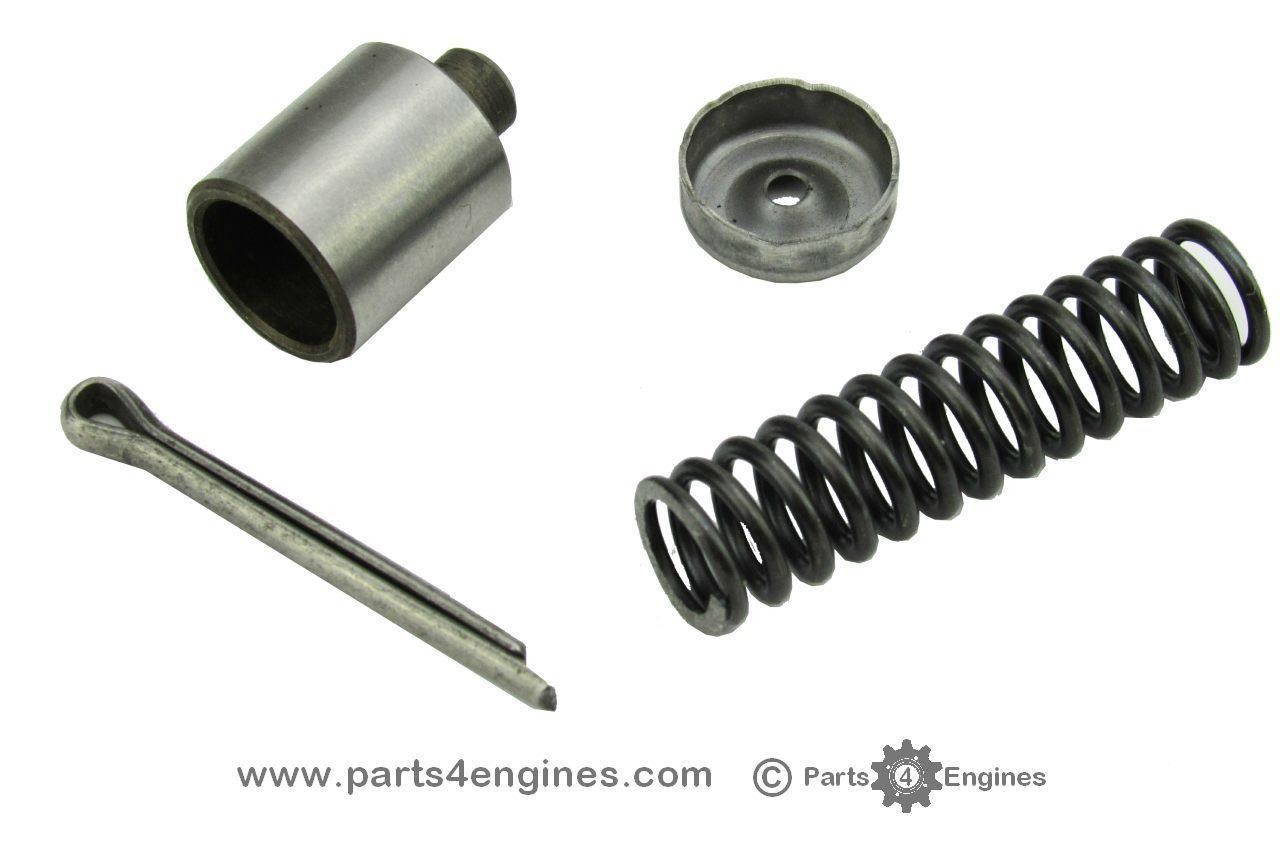
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**OIL CYCLE**

