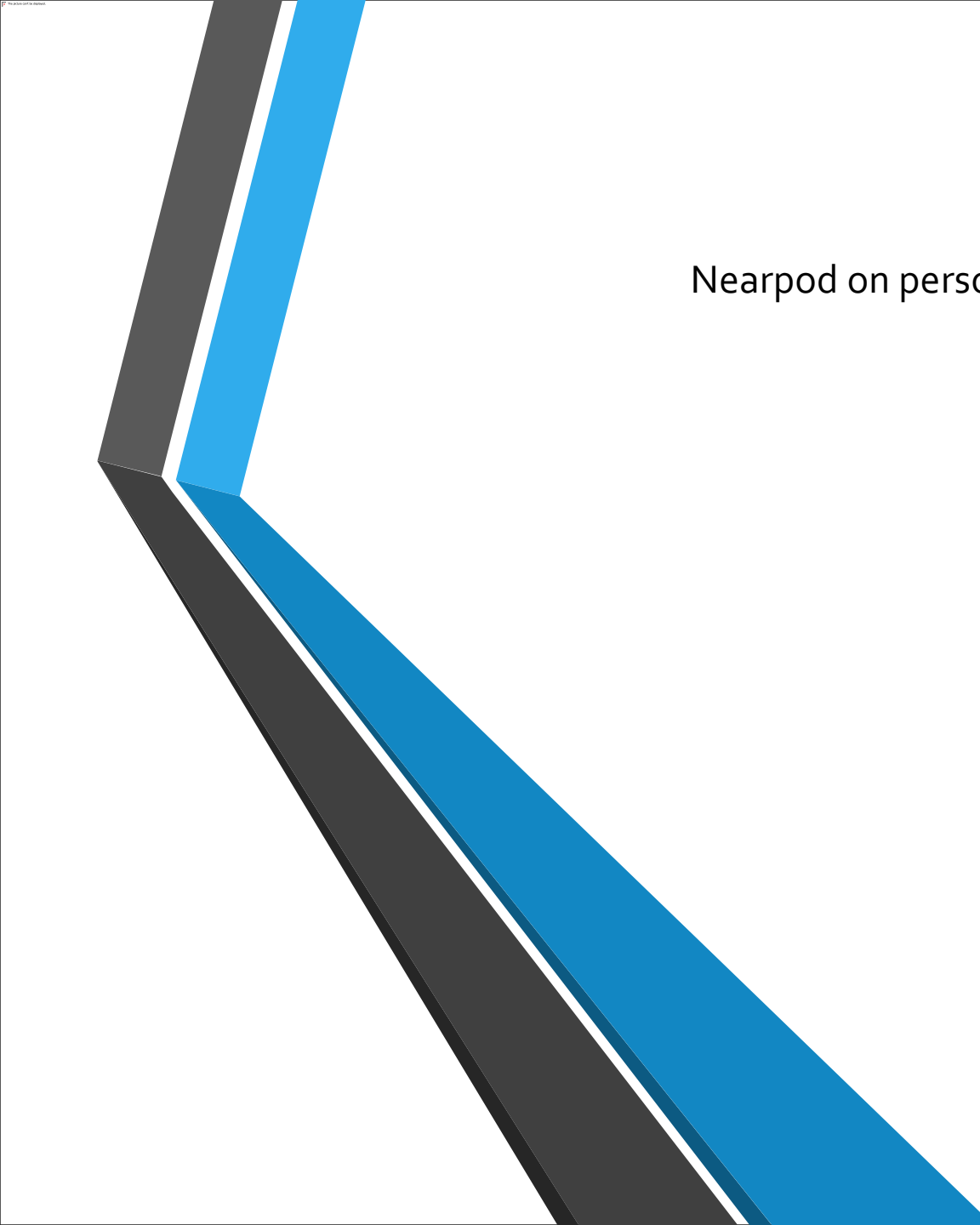


T Level resource improvement project

Teaching and learning resources for the vehicle occupational specialism, T Level Engineering and Manufacturing – air and liquid cooling system components and operation

Education and Training Foundation



Nearpod on personal email

L1MV21

Air and Liquid Cooling System Components and Operation

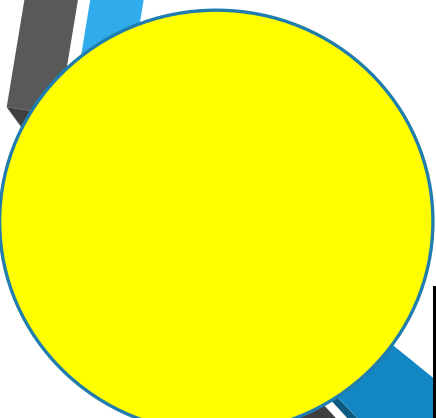
1. Brief intro to engine operation
2. Liquid Cooling system
3. Component information
4. Air cooling system

The colour codes!

When a word is highlighted in BLUE you must write down this word for your own glossary. You will need to research the meaning of these words and write a definition for each so you can develop a professional vocabulary.

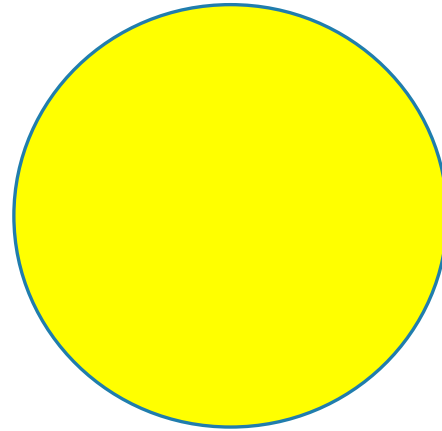
When a word or explanation is highlighted in PURPLE you must also write this down in your glossary for reference. You will not need to research definitions as they will be given.

NEW: Phrases written in GREEN are translations of complicated phrases. These will often be combined with BLUE.



This **YELLOW** circle is an indication that a task on Nearpod is next to be completed.

why do we need a cooling system?



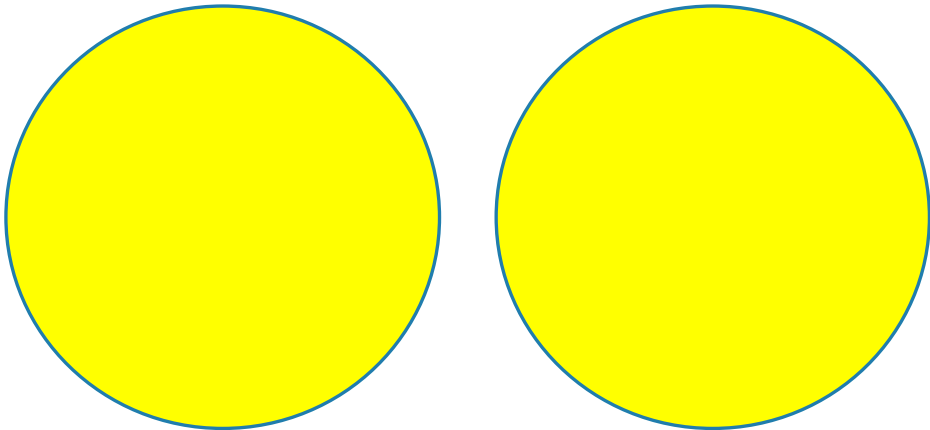
(1) Lets start with the hot stuff!

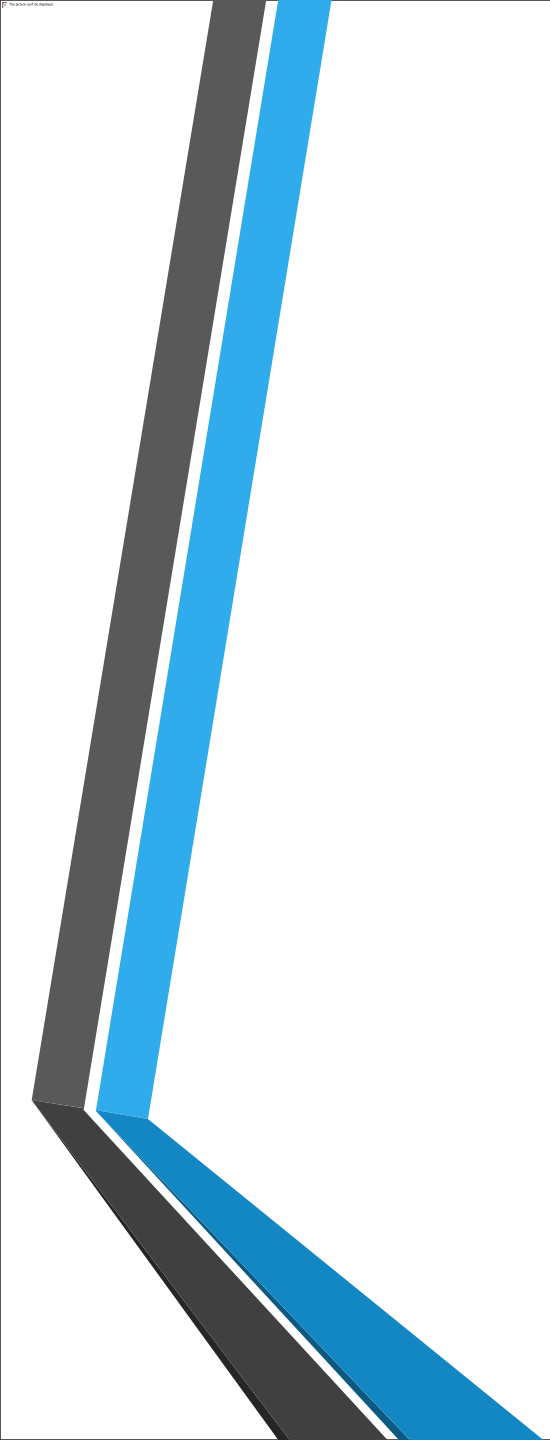
We will be going through an introduction into the way an engine runs to be able to determine the origin of heat within an engine. We will go over the engine components in further detail with unit L1MV19 spark ignition engine components.

Lets begin...



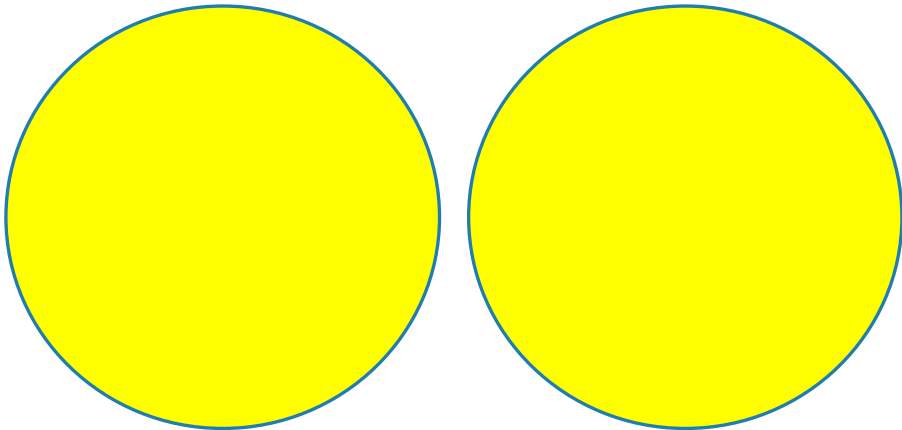
That was an overview of the engine without explanation, Now lets dive a little deeper into how the engine actually works...

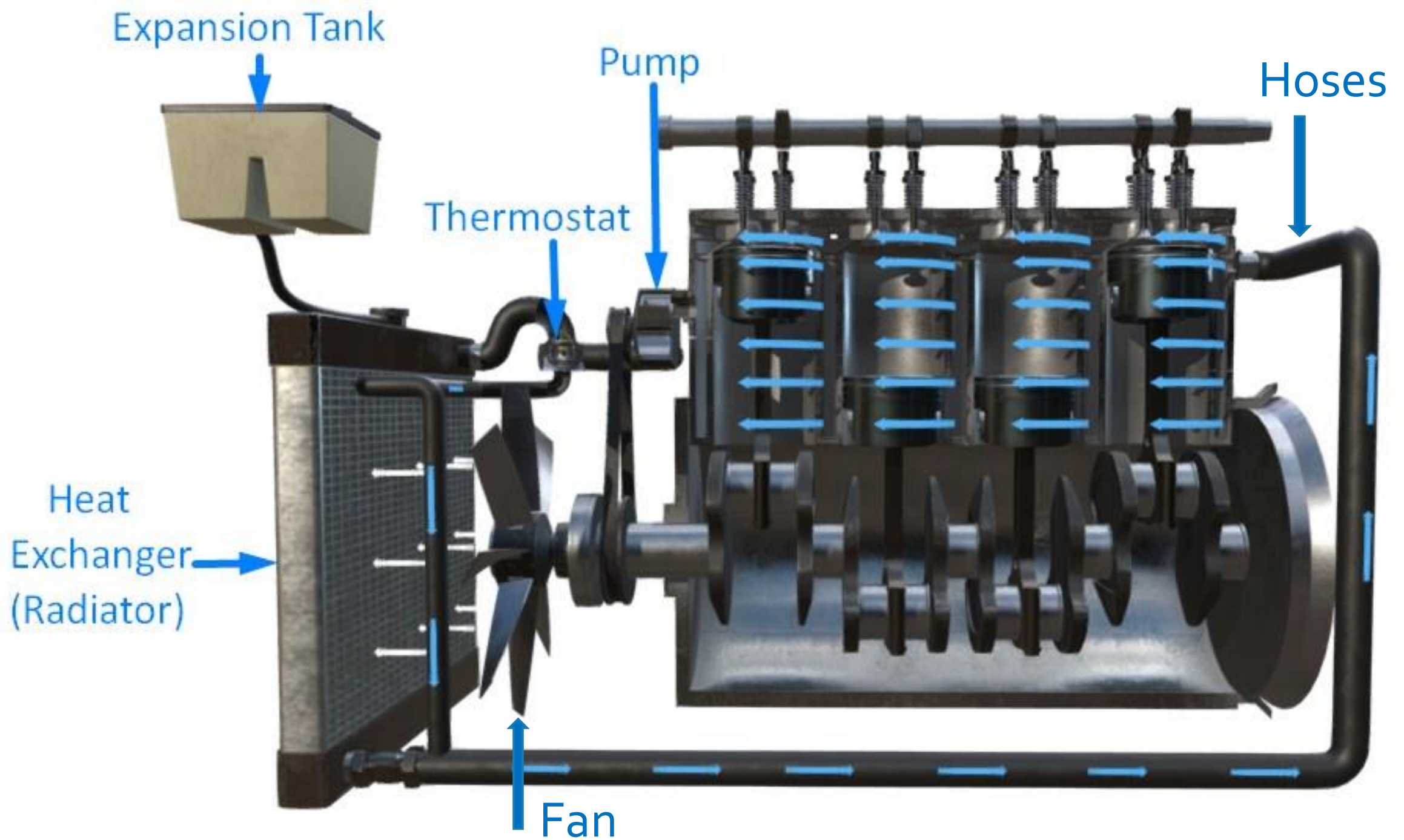


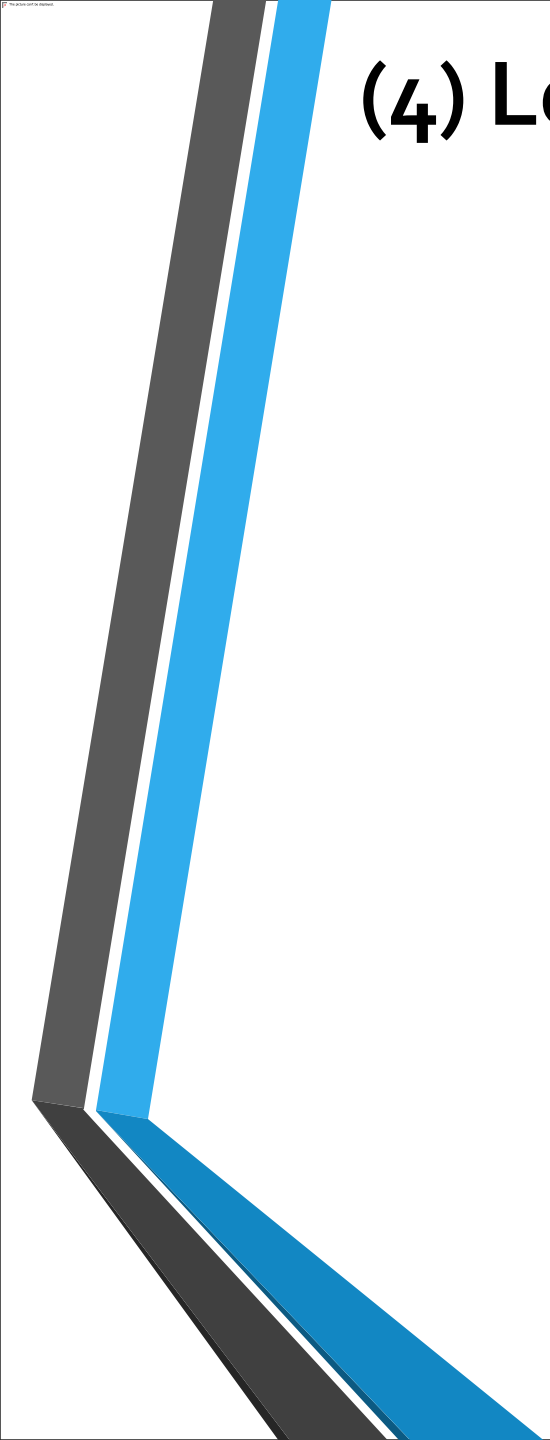


Why we need to cool the engine?

(1) Now we know where the heat comes from lets take a look at the cooling system...







(4) Lets take a deeper look into each component!

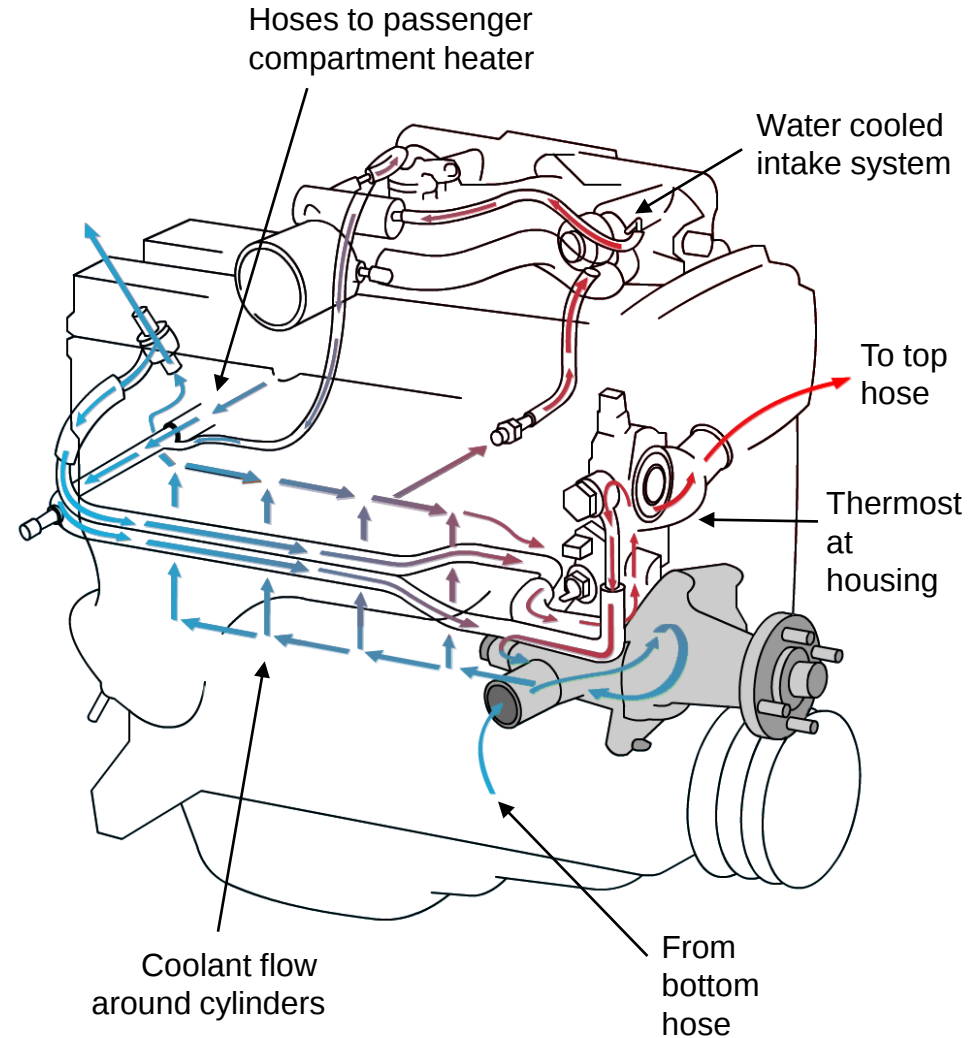
Water Flow

Conventional coolant flow passes upward past the cylinders as hot liquid rises.

It flows from the cylinder head through the top hose and is cooled as it passes through the radiator.

The water pump draws coolant from the bottom of the radiator and forces it back through the engine block.

Reverse flow cooling is unusual, but is in the opposite direction from that described above.



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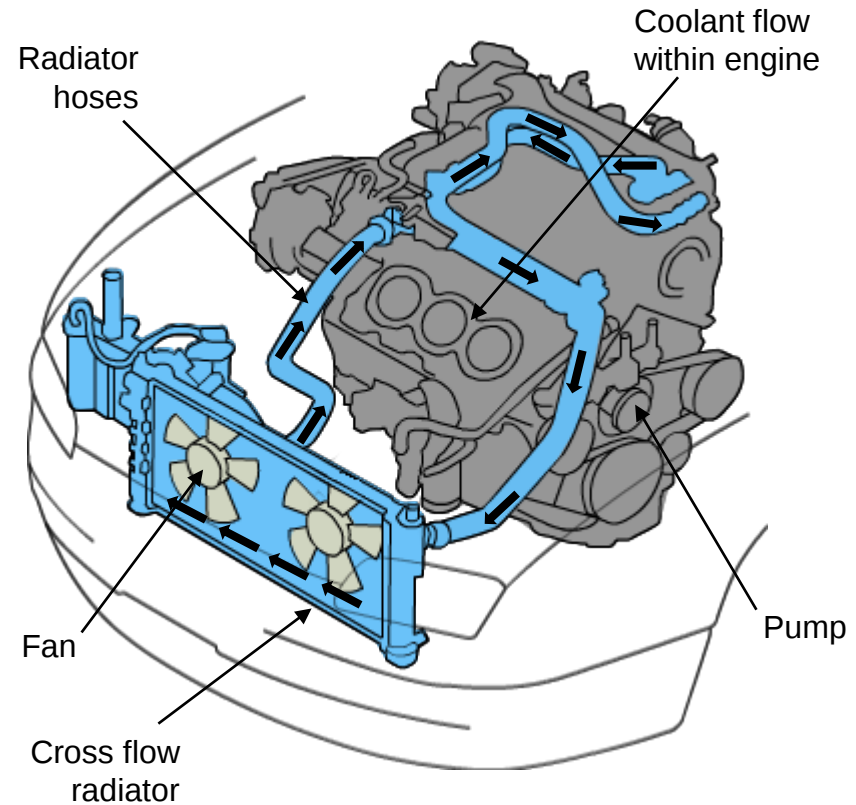
Radiator

The radiator transfers unwanted heat energy from the coolant to the atmosphere.

Hoses connect the radiator to the engine block water jacket and the passenger compartment heater matrix.

Fans draw air through the radiator to increase the air flow and improve cooling.

A thermostat controls flow during warm-up, so the engine reaches operating temperature quickly.



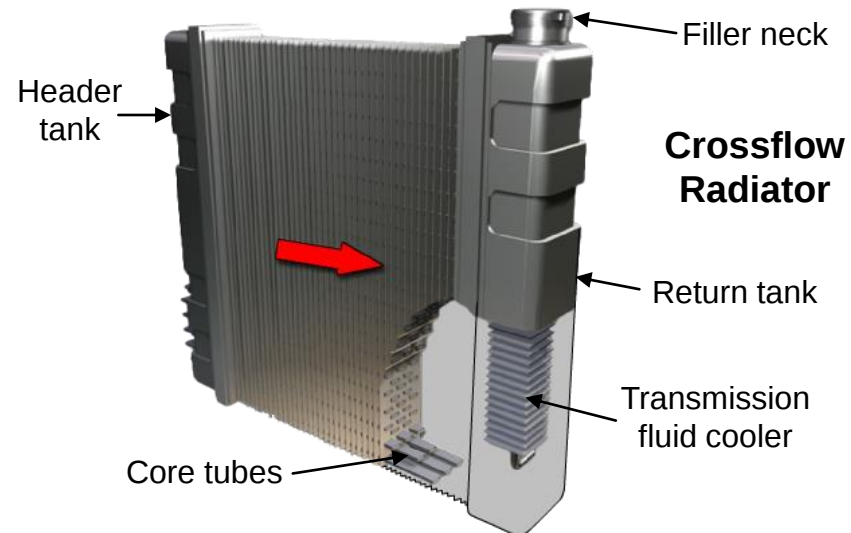
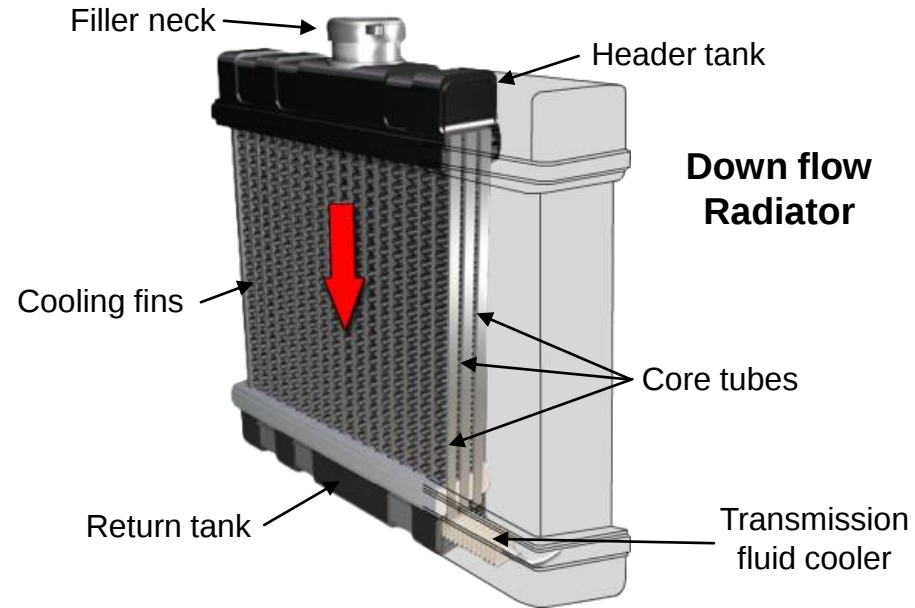
Radiator Construction

Radiators can use a down- or cross-flow configuration.

Coolant enters through the header tank and flows through core tubes, which have fins to aid heat dissipation.

It then flows out of the return tank back to the engine via the pump.

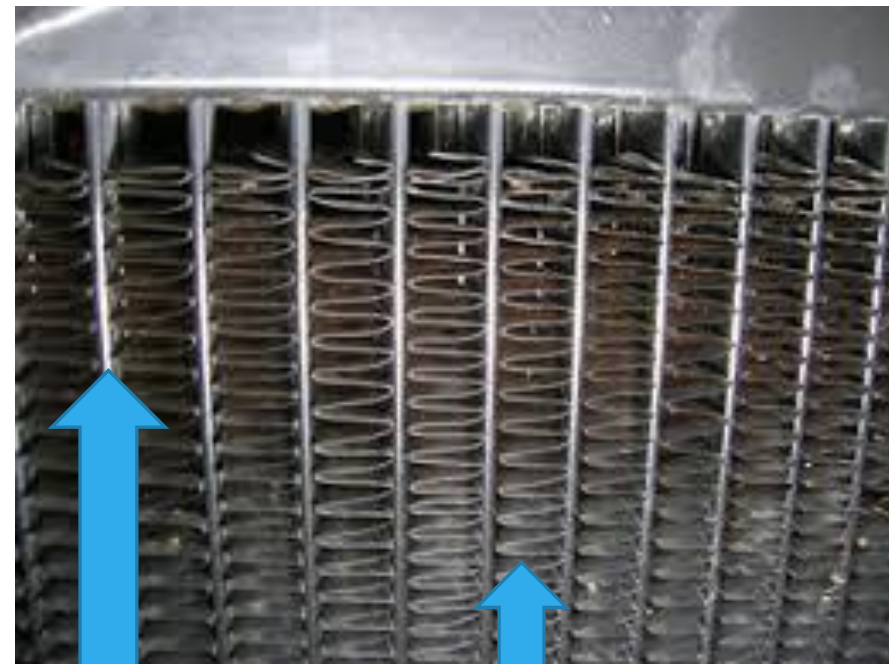
Some vehicles with automatic transmission have the transmission fluid cooler in the return tank, so that its heat is transferred to the coolant.



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The heater core transports coolant through the radiator as it cools.



The fins on a radiator act as heat sinks the same way as described in the video. Instead of cooling a chip we are dissipating heat from the core tubes.

Thermostat Operation

When the engine is cold the thermostat closes, opening the bypass port and cutting off coolant flow to the radiator.

Coolant circulates through the water jacket until a set temperature is reached.

As the engine and coolant warm up, the thermostat opens and the bypass port closes.

Coolant is allowed through to the radiator and then back to the engine, maintaining the optimum temperature.



Radiator Cap

When the temperature of the coolant rises, the pressure in the cooling system increases.

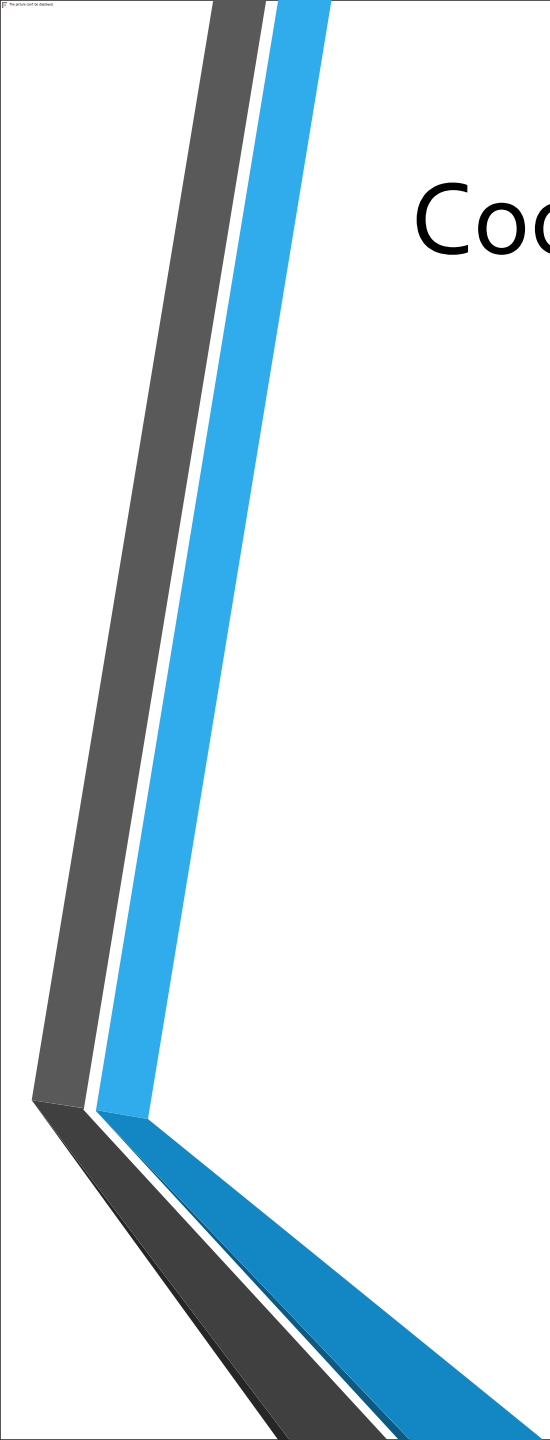
This raises the boiling point of the coolant to about 125 °C, which prevents the production of steam.

A spring-loaded valve in the filler cap regulates system pressure.

When the pressure rises above 0.7 - 1 bar, it opens to allow excess coolant to escape.

Radiator filler cap





Cooling systems, pressure and boiling point

Hoses

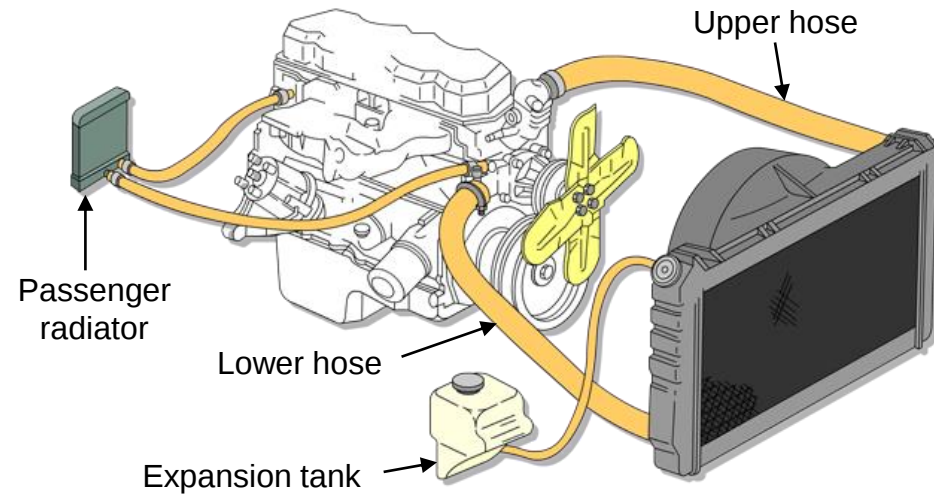
Rubber hoses carry coolant around the cooling system.

They are flexible, to allow for engine vibrations without damaging components.

The upper hose carries water to the radiator from the cylinder head, and the lower hose connects the radiator back to the water pump.

Smaller hoses carry hot coolant to the passenger compartment radiator.

An expansion tank reservoir is used to keep the system topped up.



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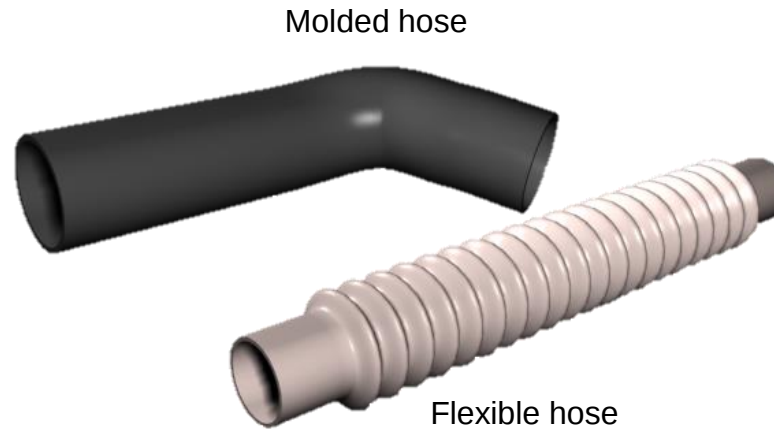
Types of Hoses

Hoses are constructed using synthetic yarn, styrene rubber and other synthetic materials.

These produce a tough, flexible hose, resistant to damage from coolant, abrasion, flexing, UV light and dilute acids.

A support spring can be fitted in the radiator hose, preventing collapse under low pressure when the engine is cold.

Molded hoses are typically pre-formed for a particular make and model of vehicle.



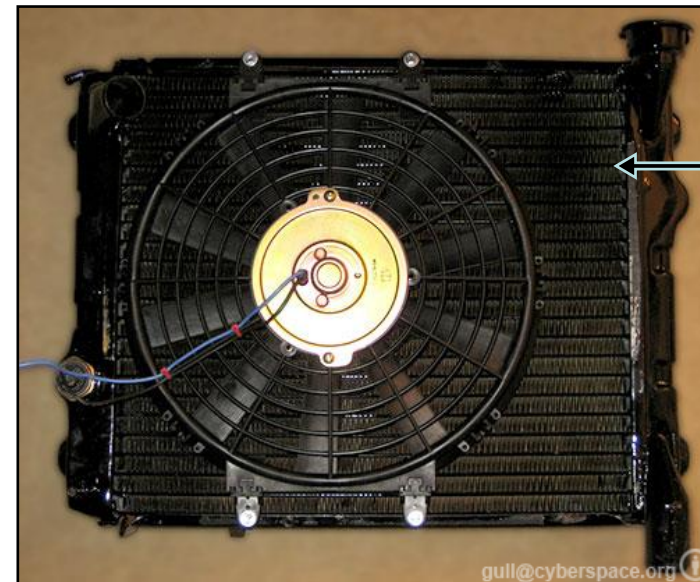
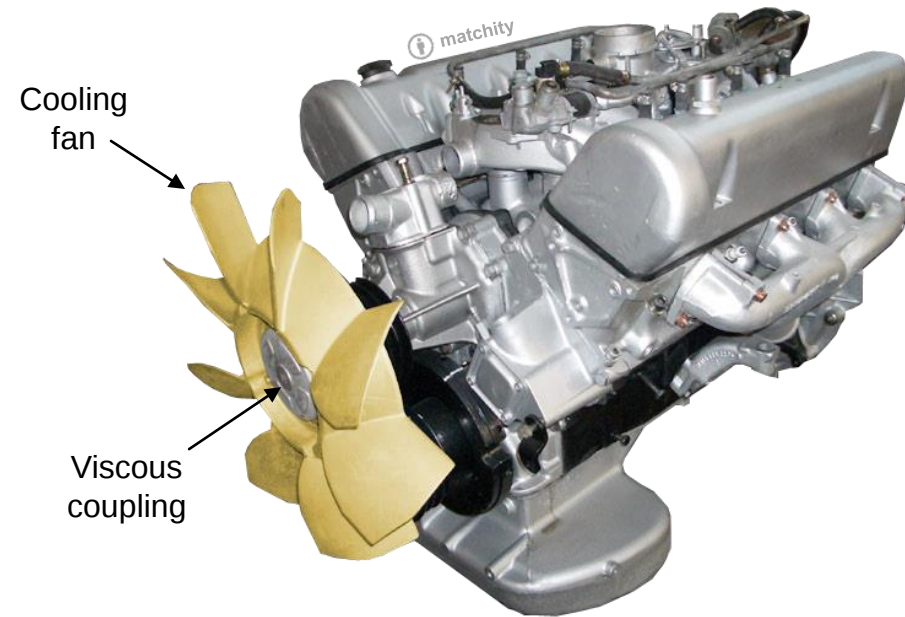
The Cooling Fan

The main purpose of the cooling fan is to generate air flow across the radiator.

Engine-driven fans are usually regulated by a viscous coupling which slips and limits the maximum fan speed.

Electric fans are controlled by a thermostatic switch or the engine control unit.

They are able to provide good airflow at low engine speeds or when the vehicle is stationary.



Radiator

Coolant

Coolant is usually a 50/50 mixture of water and ethylene glycol (antifreeze).



This mixture lowers the freezing point of the water in the cooling system, prevents rust and corrosion.

It also lubricates the water pump, helps to transfer heat from the engine to the radiator and the heater matrix in the passenger compartment.



Different types of antifreeze

Antifreeze is generally comprised of one of two types of glycol:

Ethylene glycol antifreeze: Until recently, the most common glycol in antifreeze was ethylene glycol, a toxic material that can cause birth defects, reproductive damage or even death if ingested and requires very specific handling. Ethylene glycol antifreeze has a sweet odor and flavor, which makes it dangerously appealing to animals and/or small children.

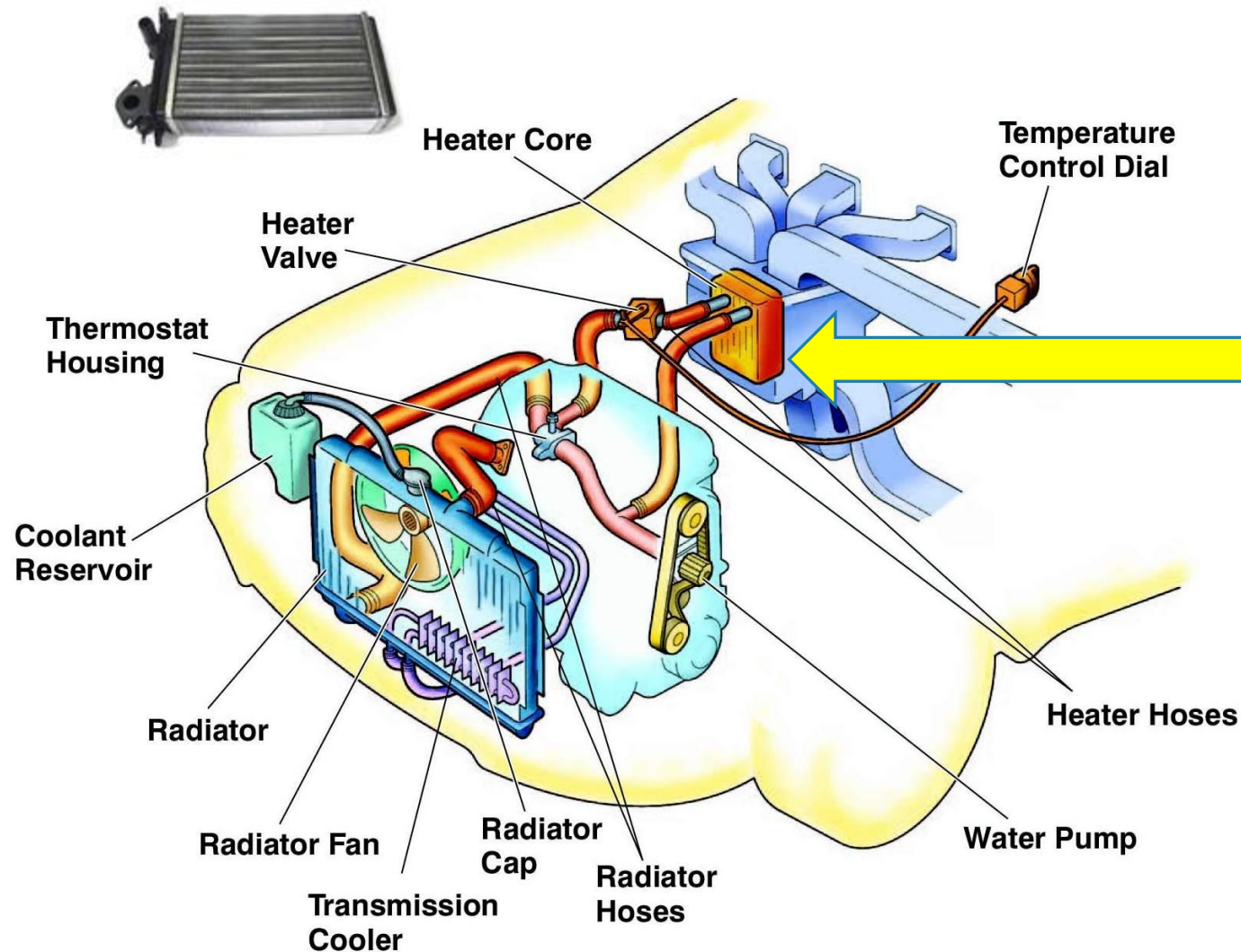
Propylene glycol antifreeze: An alternative antifreeze base is propylene glycol. There is very little difference in the performance of either substance – the advantage is the toxicity level. Propylene glycol antifreeze is significantly less toxic than ethylene glycol. This doesn't mean children or pets can ingest it without harm, but, like alcohol, propylene glycol is not toxic at low levels.

Disposing of coolant and contaminated products!

You MUST contact a local disposal company that is authorised to remove and dispose of hazardous waste. Each borough of the UK will have different procedures but all will include using authorised disposal methods to avoid contaminating the natural environment. Coolant is poisonous to human and animal wildlife.

Heater Matrix and heater core

Engine Cooling and Vehicle Heating Systems



The cooling system includes the heater matrix which is what allows for engine heat to be used to heat the vehicle cabin.

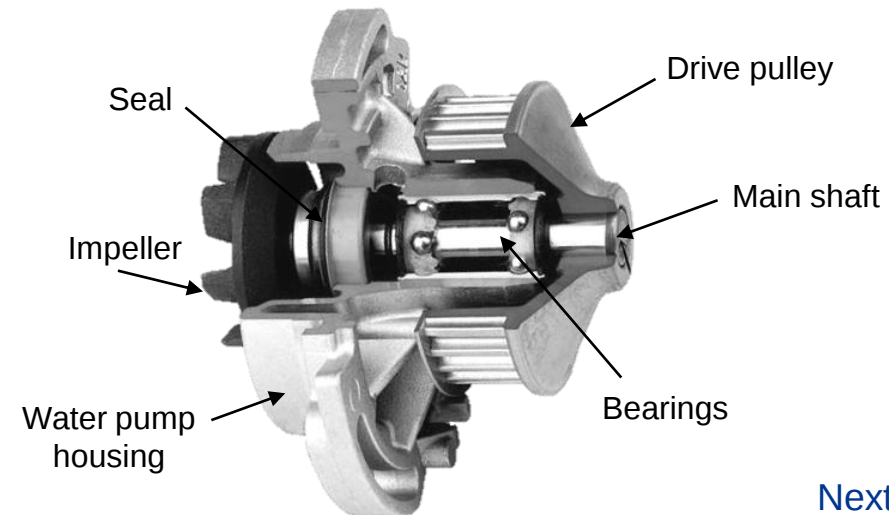
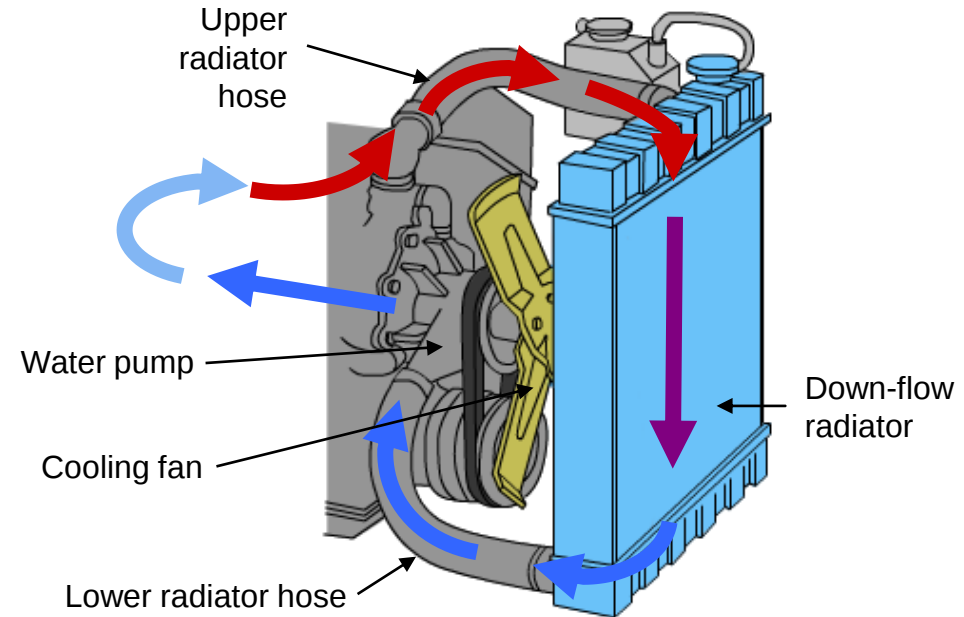
Water Pump

The water pump forces coolant through passageways in the engine.

Coolant is drawn into the centre of the water pump via the lower hose of the radiator.

If an engine-driven cooling fan is used, it is often attached to the water pump hub.

Rotation of the water pump impeller throws the liquid out at the edge and into the engine block.



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All types of pumps essentially do the exact same thing but look different because of manufacturing requirements

This side would be bolted directly onto the engine and draw water from the engine to pump around.



This part of the pump would have a pulley attached. This would allow a serpentine belt to spin this pump.

You can see here the pulley installed with the 3 bolts securing the pulley to the pump enabling the belt to be used to spin the pump.



Pump with pulley removed

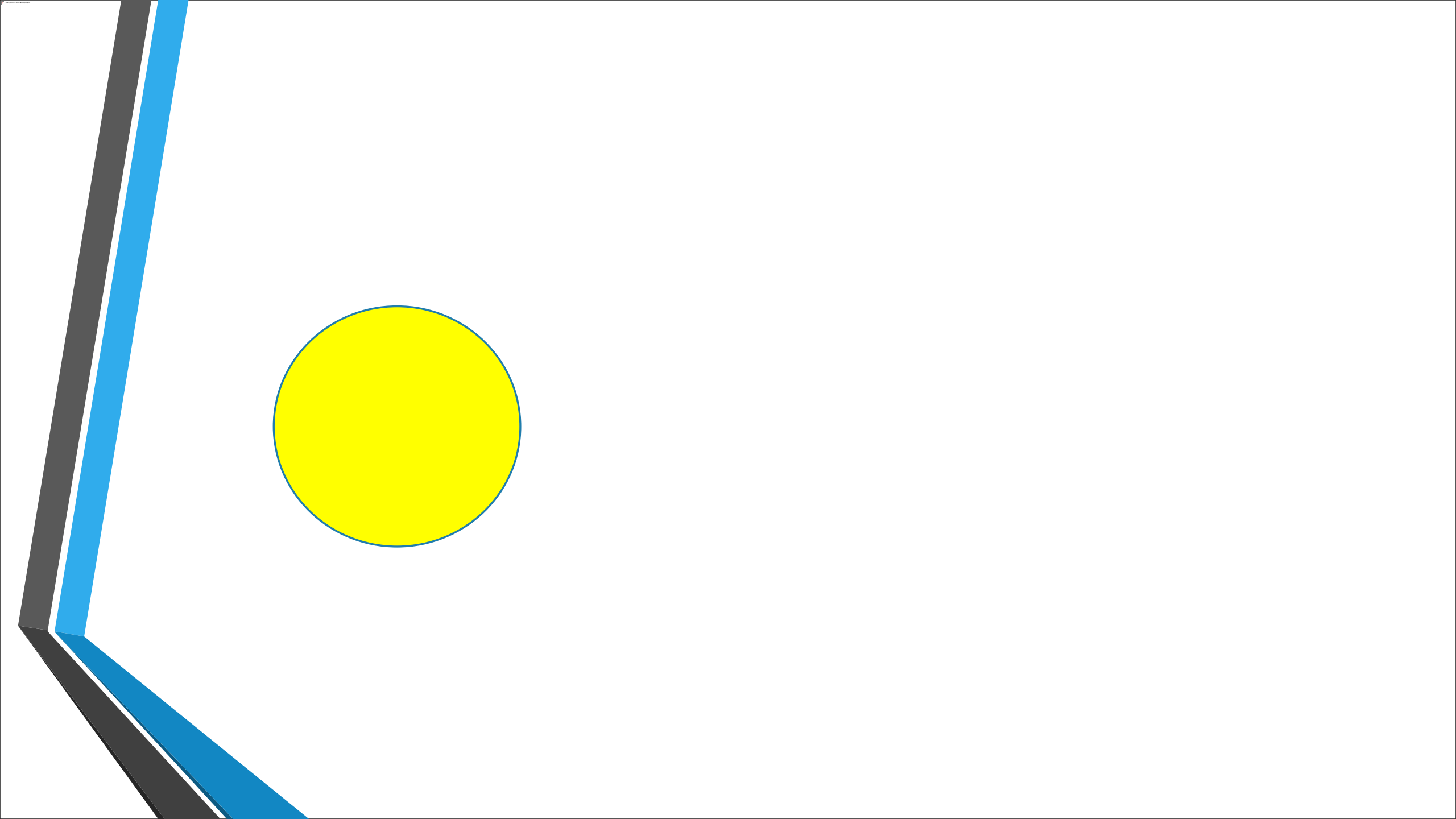


Pulley on its own removed

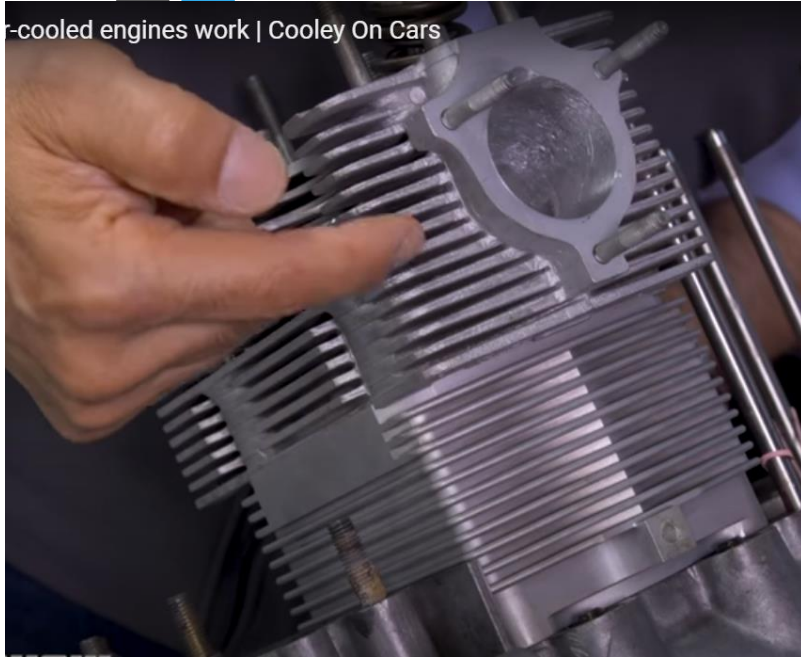
Expansion Tanks

When the pressure builds to a high enough point, the radiator cap allows that pressure to escape into the coolant reservoir through a small hose, called an overflow hose connected by the neck of the radiator to the expansion tank. Most of the coolant is forced into the expansion tank where it remains until the system cools and the coolant is then given room to leak back into the system or circulated.



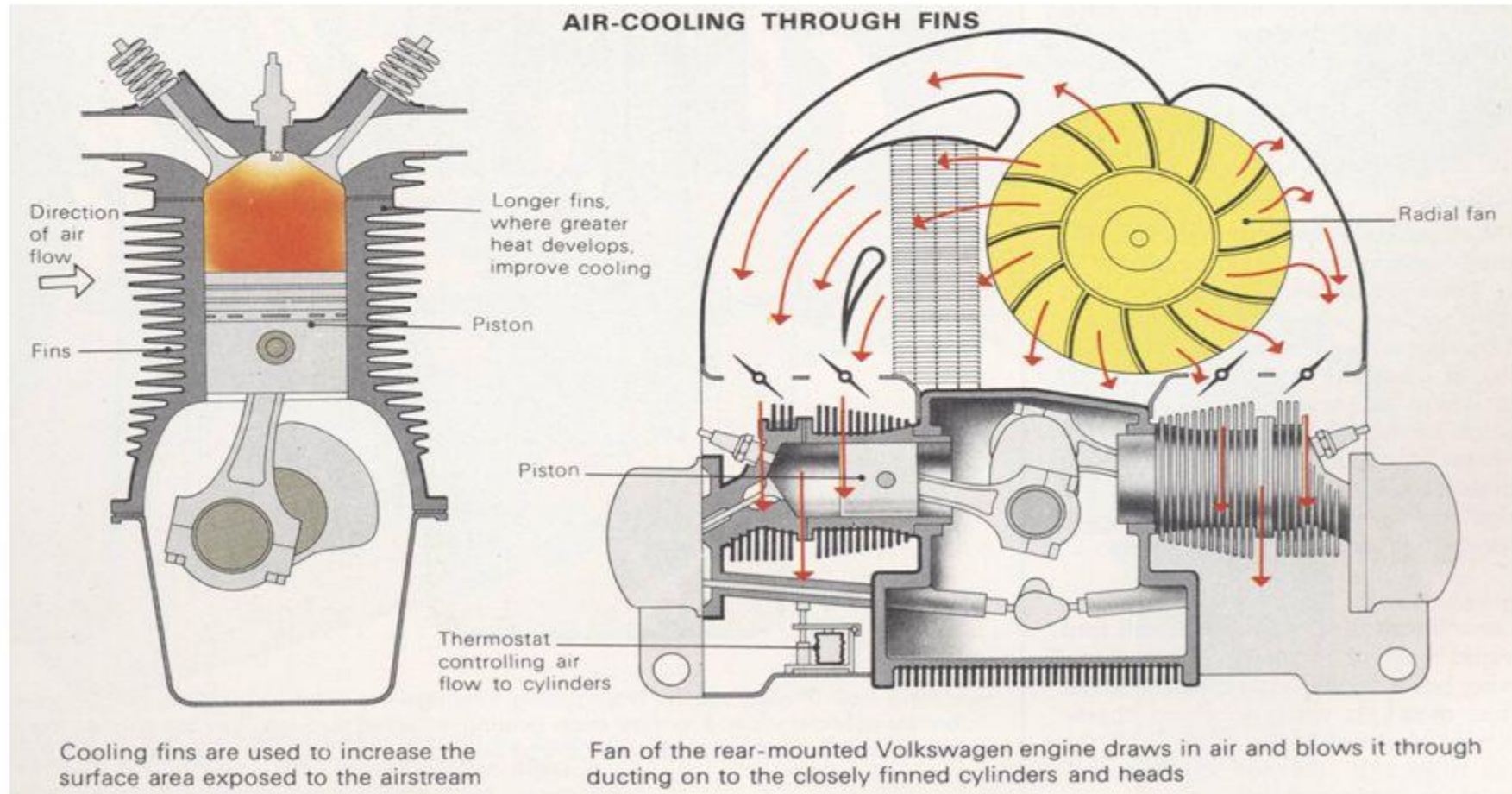


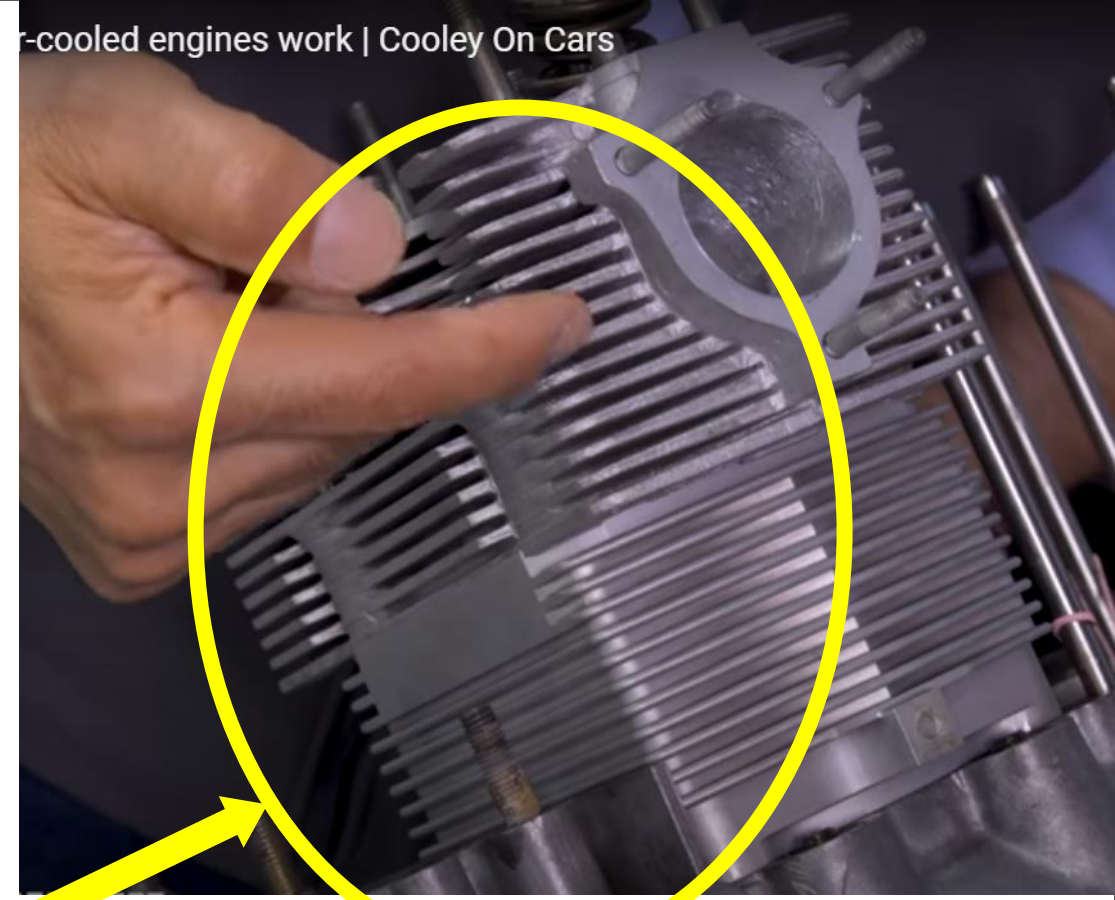
(4) Air cooled system!



The Air Cooling System

- Advantages-system is simpler and lighter in weight (less parts), no coolant leaks, works in all climates.
- Disadvantages-Greater engine noise due to no water jackets, not suitable for in-line engines due to heat build up, cooling fan absorbs or uses a significant amount of engine power, car interior heating difficult to arrange





This is essentially an arrangement of heat sink. The fins draw heat away from the engine cylinders.

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