WATER PUMP GUIDE
A KEY ELEMENT OF THE ENGINE’S COOLING SYSTEM
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WHAT IS A WATER PUMP AND HOW DOES IT WORK?

WHY DOES AN ENGINE NEED A WATER PUMP?

When an engine is started, the first thing it needs to do is reach its optimal operating temperature. Once there, it needs to maintain that temperature and avoid overheating. This is made possible by circulating coolant through two different circuits.

Until the engine reaches its operating temperature, the coolant circulates through the first circuit, which is kept closed by the thermostat. In this phase the coolant is not being cooled, so that the engine temperature can rise to the normal operating temperature as quickly as possible. Once the engine is at operating temperature and as combustion continues, the engine needs some extra help to keep its ideal temperature and prevent overheating.

Therefore the thermostat opens up the second circuit to allow the now-warm coolant to flow through the radiator and dissipate the heat. It is the water pump that circulates the coolant through the cooling system.

HOW IS A WATER PUMP ABLE TO COOL DOWN AN ENGINE?

The water pump circulates coolant through the engine's coolant circuit. It’s usually mechanically driven by a toothed- or V-belt, or gears.

To enable this circulation, the flange of the water pump is mounted on the same bearing shaft as the impeller. This allows the impeller to spin when the flange is being driven, pumping the coolant throughout the system.

As the engine is at operating temperature & the thermostat opens up, the coolant runs through the entire coolant system, ready to dissipate heat. At this point, the coolant obviously must somehow be able to give off the absorbed heat. So, the heated coolant is pumped to the radiator, and cooled off by a cooling fan or by the air passing through the engine bay. The cooled liquid is then pumped back into the engine and repeats the same cycle over and over again.
THE PARTS OF A WATER PUMP AND THE DIFFERENT TYPES THAT EXIST

A water pump consists of a water pump housing (1), inside which, the following parts are found:
- a shaft with a flange (2);
- the bearing (3), into which the shaft is fitted;
- the impeller (4), which is attached to the bottom of the shaft;
- two ceramic seals.

The water pump is mounted on the engine block where the coolant flows through.

The bearings and seals are two of the most important parts of the water pump. They must be strong enough to withstand:
- large temperature fluctuations (-40°C to approx. 120°C);
- varying speeds (500–8000 rpm);
- pressure values up to 3 bar.
TYPES OF HOUSING (CASTING)

The housing of water pumps comes in different shapes and sizes. The shape and size depend on the machine type and make. Another important difference between them is the type of casting:

▶ Iron casting is mostly used for heavy-duty applications or older pumps.
▶ Aluminium casting is the most common type.

TYPES OF DRIVE

The method used to drive the water pump depends on its placement. The options include:

▶ V-belts
▶ Toothed V-belts
▶ Gears

The way the water pump is connected to the crankshaft depends on the pump type. A pump that has a flange [1] requires a pulley. Some water pumps come with their own pulleys, for example, a toothed belt pulley [2], V-belt pulley [3] or with gears [4].

TYPES OF BEARINGS

Ball bearings are the most commonly used bearings in water pumps. In some cases, a combination of ball and roller bearings is used. This combination makes the water pump stronger and therefore more suitable for heavy-duty applications.
TYPES OF IMPELLERS

Impellers are made from two different types of material:
- Plastic
- Metal

Plastic impellers put less load on the bearing and are less sensitive to cavitation than metal impellers. The downside is that plastic impellers become brittle over time.

CAVITATION:

Occurs when the local pressure in a turbulent moving liquid drops below the vapour pressure of the liquid. This results in vapour bubbles forming.

Because of the movement, the pressure on the vapour bubbles increases, making the bubbles implode. Imploding vapour bubbles damage the pump, especially the impeller.
HOW TO MAINTAIN A WATER PUMP?

The correct installation of a water pump will help extend its lifespan. Most water pumps come with an installation manual. Following the installation process in the manual is strongly advised.

Once installed, use the following tips to ensure the water pump lasts for as long as possible:

- Make sure the other parts of the cooling system, such as the radiator and thermostat, are installed and working properly.
- Use the coolant prescribed by the manufacturer and check the coolant level from time to time.
- Perform regular checks of the condition and performance of the belt and its drive.
- When conducting checks, it’s also important to check for any leaks or worn-out parts.

WHEN SHOULD A WATER PUMP BE REPLACED?

A damaged water pump might not circulate coolant through the engine effectively. This puts the engine at risk of overheating and serious damage. Therefore, if a water pump is malfunctioning, it’s very important to immediately stop the engine and look into a replacement or repair.
HOW TO REPLACE A WATER PUMP?

1. DRAIN THE RADIATOR
Firstly, avoid burns by ensuring the engine has cooled off before you begin. Place a bucket under the radiator to catch the coolant so it can be disposed of safely. Then, open the petcock valve at the bottom of the radiator. If there is no drain valve, loosen the lower radiator hose. Coolant is toxic and must be disposed of safely to avoid harming people, animals and the environment. Do not dump it into the sewer or on the ground. For advice on how to dispose of it correctly, contact your local waste facility or environmental protection agency.

2. REMOVE THE FAN BELT
Take note of how the belt is routed before you remove it, so you can reinstall it correctly. Tip: take a photo. For engines with a belt drive, remove the fan belt by loosening the tension on the automatic tensioner.

3. REMOVE ANYTHING ELSE THAT’S IN THE WAY
This could include the fan and fan shroud, or if the pump is driven by the timing belt on an OHC (Overhead Camshaft) engine, the timing belt cover. Also remove any brackets or other engine-mounted accessories that are blocking access to the pump.

4. UNBOLT THE WATER PUMP FROM THE ENGINE

5. CLEAN THE PUMP’S MOUNTING SURFACE TO REMOVE ALL TRACES OF OLD GASKETS
The mounting surface must be clean and dry before you install the new pump.

6. POSITION THE GASKET ON THE NEW PUMP
Use gasket sealer or adhesive as required, then bolt the new water pump to the engine. Always use thread sealer on any threads that screw all the way through into open water jackets. This is not required for blind bolt holes.

7. REFILL THE COOLING SYSTEM CAREFULLY
It may take some time for all the air to vent out. Many cooling systems have vent valves that can be opened during a refill to allow air to escape.
COMMON WATER-PUMP FAILURES AND HOW TO FIX THEM

HOW TO RECOGNISE THAT THE WATER PUMP HAS MALFUNCTIONED?

In most cases, a malfunctioning water pump will leak coolant. This leakage could cause coolant to enter the bearing. The bearing will then run less smoothly, leading to a jammed pump and disaster.

Always be sure to check the water pump when you refill the coolant, and during periodical check-ups.

The following signs could also indicate that the water pump has malfunctioned:

1. LEAKAGE FROM THE MOUNTING PLATE

   ▶ How to detect this issue?
   ▪ Leakage from the mounting plate is very easy to spot. You will see coolant dripping or notice large leaks on and around the mounting surface or on the housing.

   ▶ What causes this problem?
   ▪ Improper installation of the water pump or improper use of seals, gaskets or sealant.

   ▶ How to solve it?
   ▪ Dismount the water pump and check the condition of the gaskets and seals. It’s important that these are properly installed and in good condition.
   ▪ Scrape away old gasket remnants and clean the edges of the mounting part if necessary.
   ▪ Install a new gasket around the edges of the mounting part.
   ▪ If the gaskets and seals are in good condition and installed correctly, the problem is in the water pump itself. Replace the water pump immediately.

2. RUST AND CORROSION

   ▶ How to detect this issue?
   ▪ Rust and corrosion on the surfaces of the water pump, such as corrosion on the impeller, will prevent the water pump from circulating coolant properly. There is also a possibility that rust and corrosion particles will get sucked into the cooling system and cause damage.

   ▶ What causes this problem?
   ▪ The coolant is dirty, incompatible, or a mixture of coolants with different chemical properties.
   ▪ There is too much pressure. This creates air bubbles that accelerate the corrosion process (cavitation).

   ▶ How to solve it?
   ▪ The only real solution for rust and corrosion is to replace the water pump. Before installing the new pump, it is critical to thoroughly flush and clean the entire cooling system. Once it’s completely clean, fill the system with the recommended coolant.
3. DAMAGED BEARING

▶ How to detect this issue?

▪ A rattling or grinding noise coming from the water pump indicates a worn bearing. Another way to detect a damaged bearing is to turn off the engine and look for lateral play on the shaft. When applying pressure by hand, there should be no play. If any lateral play is noticed, it’s time to replace the damaged bearing.

▶ What causes this problem?

▪ A misaligned belt that has caused damage over time.
▪ A belt that is too tight and has overloaded the bearing, causing it to wear out quickly.
▪ A damaged mechanical seal that has allowed the coolant to leak through the bearings and wash away the lubricant. Without lubricant, the bearings run less smoothly and wear out quickly.

▶ How to solve it?

▪ The water pump must be replaced. While replacing the water pump, also check each part of the belt drive system:
  · belt
  · tensioner pulley
  · belt tension and alignment