



CERTIFIED • OEM QUALITY • RELIABILITY

SUCCESS IN COOLING

ENGINE WATER PUMPS



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FOREWORD

The purpose of this booklet is to provide a basic overview of a water pump and information on how to avoid common reasons for water pump or cooling system problems, and best practices for water pump replacement and cooling system restoration.

Information in this booklet can also help determine the possible cause and validity of a warranty claims on an automotive and heavy-duty engine water pump.

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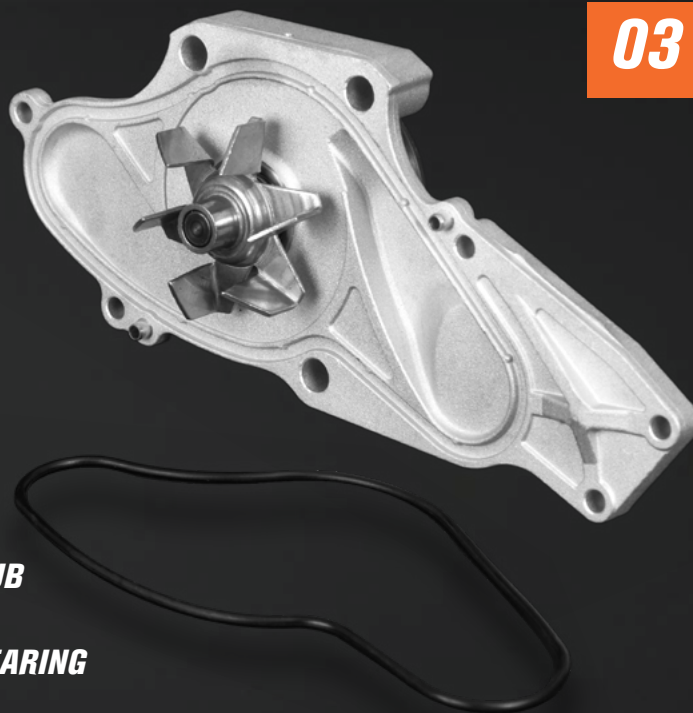
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WATER PUMP

The water pump is responsible for pressuring and propelling anti-freeze mixture (coolant) through the cooling system. Five main components make up an engine water pump: the hub, bearing, housing with a weep-hole or chamber, seal, and impeller. Of these five, the water pump seal and the bearing are found to have the highest instances of failure.



HUB

BEARING

**HOUSING WITH
WEEP HOLE/CHAMBER**

SEAL

IMPELLER

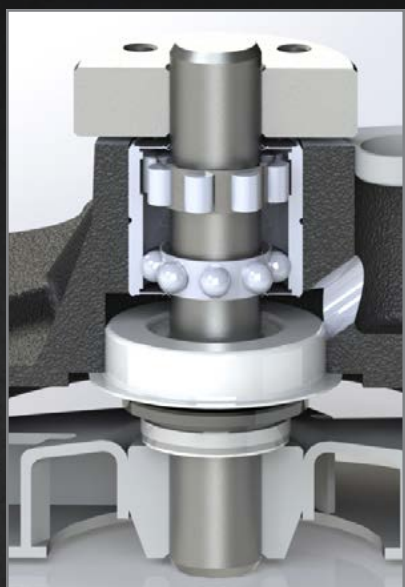
THE COMPONENTS OF A WATER PUMP: WATER PUMP BEARING

The water pump bearing allows for the water pump to rotate. The ball bearings and/or roller bearings (also known as an integral shaft bearing), are contained in a case packed with bearing grease. The two ends of the case are sealed, securing the bearing case. On one end is the press-fit water pump hub or pulley, and on the other end is the press-fit water pump impeller. A shaft rotates in the center of the bearing case. The bearing case is press-fit into the water pump housing along with the seal.

The seals on the water pump bearing case are not only designed to keep the bearing grease in, but to keep harmful engine residue and particulates out. It is important to note that the bearing seals will not withstand coolant. If coolant passes the water pump seal, it will enter the bearing case and washout the grease. If this occurs, the water pump has completely failed. It will begin to make loud noises, causing the water pump to consequently seize and break apart.

BENEFITS OF CASE HARDENED BEARINGS

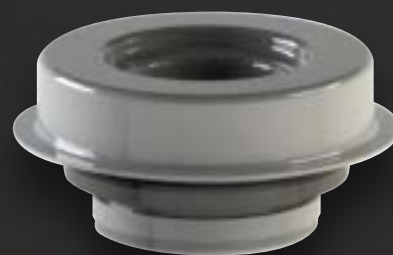
- Long life
- High load capacity
- Tough on the outside, flexible on the inside
- Can better withstand an imbalance or vibration in the cooling system



THE COMPONENTS OF A WATER PUMP: **WATER PUMP SEAL**

The water pump seal is critical for water pump operation. The bearing rotates within the center of the seal, which turns the impeller, moving the coolant through the cooling system. The seal contains coolant within the housing or designed block cavity, and its critical function is to keep the coolant from contacting the water pump bearing.

A water pump leak will indicate an initial seal failure. A small amount of coolant will escape the water pump through the weep-hole or chamber. This is yet another design feature to keep coolant away from the water pump bearing. The water pump should be replaced if a leak is found from the weep-chamber after operation of the vehicle.



DID YOU KNOW?

The seal on the water pump has a break in period of about ten minutes of operation. Small seepage is completely normal and very common in a water pump replacement.

THE COMPONENTS OF A WATER PUMP: **WEEP-HOLE / CHAMBER**

Mechanical water pumps are purposefully designed with a weep-hole. The purpose of the weep-hole is to keep coolant away from the water pump bearing during seal failure and allows for coolant to escape during initial water pump break in. Many new OEM water pump designs now include a chamber surrounding the weep-hole. This weep-chamber allows the normal break in seepage to be collected and evaporate rather than a drip or two falling into the engine compartment or to the ground, alarming the customer and polluting the environment.



THE COMPONENTS OF A WATER PUMP: **METAL IMPELLERS**



BENEFITS OF METAL IMPELLERS

- Highly durable
- Will not crack during press fit
- Will not shatter or deform
- Performs at high RPMs
- Withstands high torque forces
- Withstands high temperatures
- Withstands chemicals



WATER PUMP SEAL FAILURE

Like any other mechanical part, the water pump seal will eventually wear out. Even with the best maintenance schedule, parts have a limited service life. A common failure will begin with the appearance of a small amount of coolant from the weep-hole. This may go unnoticed until the fluid appears on the ground or the smell of burning fluid becomes apparent.

Poorly maintained or contaminated cooling systems is the other major contributor to seal failure. Rust and loose particles will eat away at the water pump seal.

The water pump seal can also be subject to conditions that reduce its service life or damage the component rather quickly. Imbalance in the system is the number-one contributor to rapid seal failure. Reinstalling the old fan clutch onto a new water pump can stress the seal and bearing as can a damaged fan blade or belt tensioners. Adding cold water to a hot radiator or over-heated cooling system can fracture different components including the water pump seal because of thermal expansion. Always wait for a cooling system to cool down before attempting any work or opening the radiator.

BEARING FAILURE

The same imbalance that causes seal failure will eventually or immediately cause bearing failure. If the seal fails and coolant makes it to the bearing, the fluid will wash away the bearing grease and cause total bearing failure. This will seize the bearing and could lead to a snap of the bearing shaft. Over tensioned belts or faulty tensioners, along with a faulty fan clutch or broken fan will produce the necessary stress to damage or destroy the water pump bearing.

Notice in photo 03, the pulley is tilted at a slight angle, a sign that indicates bearing failure.



DID YOU KNOW?

A commonly overlooked cooling component is the fan clutch. The fan clutch usually is found mounted to the water pump. A worn-out water pump will have the same miles as the fan clutch. Reinstalling the original fan clutch onto a new water pump is a poor decision that will lead to premature failure of the water pump. Replace both at the same time.

LEAKING WATER PUMP

A water pump leak can originate from other areas besides the weep-hole. Incorrect tightening of mounting bolts, use of gasket sealant, or pinching of mounting gaskets and seals all can contribute to a leak. If addressed quickly, water pump failure can be avoided. If left unattended, a cooling system failure can result in overheating and engine damage.

A quality water pump will include the proper sealing devices required for the water pump replacement. Reputable water pump manufacturers do not recommend the use of further sealant items.



DID YOU KNOW?

The use of gasket sealant is not required on most water pump replacements and should only be used where the OEM design calls for it. Unless used in extremely limited amounts and precisely, any excess, exposed material will harden, become loose, and enter the cooling system causing blockage. This hardening can also cause voids in the sealing area and coolant will find its way out and appear as a faulty water pump.

BREAKAGE

Water pumps are in most cases metal; either aluminum, cast iron, or steel. A water pump is a strong, rugged engine component built to last many years and miles. A break in a water pump is usually associated with major imbalance in the rotation dynamics of the water pump. Fractures are caused by over tensioning of, or faulty belt tensioners, over tightening of the mounting bolts, reuse of the original fan clutch, or incorrect tension of a new fan clutch, and misalignment of the mounting or belt systems. Incorrect tools used to install the water pump such as pry bars and hammers have led to this condition. Bearing seizure can also contribute to destructive failure.





ELECTROLYSIS

Electrolysis is the result of electricity flowing through the cooling system and causing an electrochemical charge on certain metals. This charge can cause damage throughout the cooling system and cause discoloration, corrosion and flaking of metals, and pinholes. The cause of electrolysis is a loose or damaged ground on any electrical source or poor coolant pH balance.

HELPFUL TIP

If the water pump that is to be replaced has these features, check the electrical system and review other accessible cooling system components for material discoloration or pitting. Never use the radiator as a ground. Poor cooling system maintenance can cause a coolant PH imbalance producing chemical electrolysis.



FAILURE FROM CAVITATION

Cavitation is voids in the coolant filled with super-heated vapor that can erode both plastic and metal. Incorrect coolant and water mix is a major cause of cavitation. Restrictions in the coolant flow can cause the voids as well because of vapor pressure and suction generated by the pump.

A pressure test of the cooling system will reveal any leaks in the system and proper coolant mix or properly formulated coolant will help avoid cavitation.

HELPFUL TIP

If the water pump that is to be replaced has these features, check the entire cooling for restrictions and inspect the entire cooling system including a pressure check, checking the radiator and radiator cap for leaks, and replacing all hoses and the thermostat.



CONTAMINATED SYSTEM FLUID

A coolant change at water pump replacement is an important, and often overlooked step in a water pump replacement.

Contaminated coolant can appear rusty if contaminated from oxidation or the consistency can become thick possibly from mixing different types of coolant. Leaks in the cooling system can introduce air into the coolant and cause degradation of the coolant and cavitation. Not using enough or using too much water mix can damage engine components and regular tap water can leave deposits of minerals that can clog the system and erode materials. The water used in a cooling system should be distilled. The type of coolant used is also an important factor in today's vehicles as different OEM's are using specific formulas as part of the engine design.

DID YOU KNOW?

Today, multiple coolant types exist for different vehicles. Using the correct blend recommended by the OEM is critical for the health of the cooling system. These blends should not be mixed, such as OAT based formulas with IAT formulas. This practice can turn the coolant into sludge because of chemical reactions, reduce the boiling point, or raise the freezing point temperatures.



WARRANTY EXCLUSIONS

USMW Professional Series a brand of US Motor Works, LLC warrants products to be free from defects in material and manufacturing, under normal use and service. The following images are indications of damage caused by improperly maintained systems and modifications.

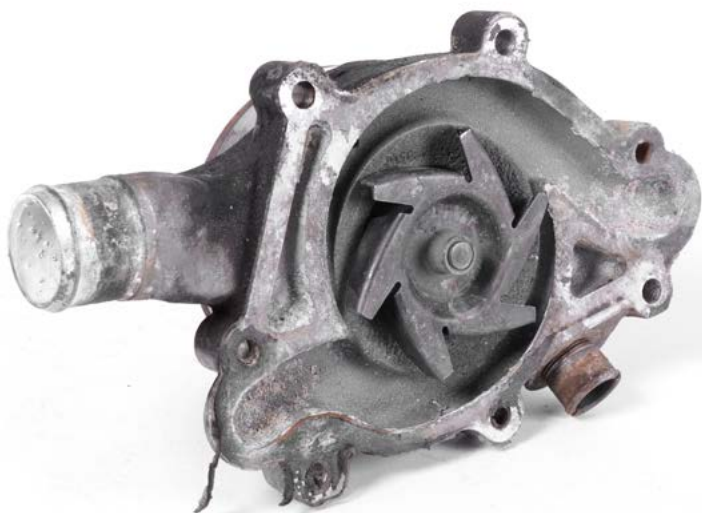
**New water pump with
old related parts**



● Poor AC/ F+W maintenance



Contaminated coolant or cooling system



Poor cooling system condition (Cavitation)



Poor cooling system condition
(Electrolysis)



COOLING SYSTEM OVERVIEW

COOLANT CONTAINMENT SYSTEM

RADIATOR & CAP Radiator Caps have seals that help the radiator build up pressure for the circulation of the coolant. The Cap also acts as a release valve that opens when the pressure or temperature of the coolant exceeds a certain point to prevent damage to the radiator or hoses.

COOLANT collects the heat from the engine and transfers it out of the engine through a heat exchange at the radiator. Coolant also prevents freezing and protects engine components from corrosion.

THERMOSTATS restrict or allow coolant motion as needed through specified temperature regulation.

COOLANT CONVEYANCE SYSTEM

WATER PUMPS push the coolant through the engine.

HOSES are the plumbing used to carry coolant between the engine and radiator.

BELTS provide the rotation required for many engine components.

TIMING BELTS synchronize valves and rotate water pumps in many applications.

TENSIONERS maintain the correct amount of belt force throughout operation and help protect other engine components such as the power steering pump from stress and fatigue.

AIR COOLED TRANSFER SYSTEM

FAN BLADES, FAN CLUTCHES, & ELECTRIC FANS assists in moving the air that allows the heat exchange to happen between the radiator and the coolant. A fan clutch should be replaced when installing a new water pump.

BEST PRACTICES CHECKLIST

Safety & Personal Protection

- Engine is off & cooled
- Eye protection
- Gloves
- Fluid containment

Coolant Containment System

Check Radiator. (Flush or Replace If)

- Obstructions (external)
- Obstructions (internal)
- Bent or broken fins
- Check Coolant. (Replace If)
- Improper type or mixed
- Rust or discoloration
- Low coolant level, at or beyond recommended service time

Check Radiator Cap. (Replace If)

- Does not hold pressure
- Rust or discoloration
- Incorrect model or type

Check Thermostat. (Replace If)

- Stuck open or closed
- Rust or discoloration
- Installed incorrectly

Pressure & Stability

- Check pressure
- Bleed system of air

Coolant Conveyance System

Hoses (Replace If)

- Cracked, burst, or has abrasions
- Pinching (hose clamps)
- Discoloration (oxidation)
- Collapsed or soft

Air & Coolant Power System

Fan Assembly & Fan Blades (Replace If)

- Damaged, cracked, missing fin(s)
- Wobble
- Corrosion
- Interference
- Imbalance
- Not operating properly

Fan Clutch (Replace If)

- Leaking
- Stuck on or off
- Free spins (spin by hand)
- Replacing the water pump

Water Pump Installation

- Clean mounting surface
- Torque mounting and fan/pulley bolts properly
- Check for interference (spin by hand)
- Check for leaks (after operation)

Belts - Serpentine, V, Timing (Replace If)

- Cracking
- Discoloration (oxidation)
- Edge wear
- Splitting
- Missing ribs
- Loose fit

- At or beyond recommended service time

Tensioners & Pulleys (Replace If)

- Rust & seal cracks
- Bearing wear
- Pulley wear
- Misalignment
- Noises (squeaks & grinding)
- Loss of spring force
- At or beyond recommended service time



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