


Coolant pump replacement





by Jacques Gordon

When replacing the water pump involves timing chain adjustment, such as on GM's 2.4L Ecotech engine, or requires removing the engine altogether, as on a Mazda CX9, you'll do everything you can think of to ensure a perfect job. But even on the simplest V-belt-driven water pump job, the goal is the same: give that new water pump its best chance of living a long and trouble-free life. Here are some things to remember that can help you reach that goal.

First of all, it helps to remember that an engine's cooling system has two functions. One is to reject heat generated by combustion. The other is to keep the engine operating in a relatively narrow temperature range so the fuel trim strategy works properly.

But engine load changes frequently, so the amount of heat absorbed by the coolant can change dramatically. The thermostat controls the amount of heat carried to the radiator, the site of all heat rejection, and vehicle speed or variable speed fan(s) control the amount of heat extracted from the coolant once it reaches the radiator. In some newer models, shutters are also used to control airflow through the radiator, and in other models the Powertrain Control Module (PCM) will increase idle speed (in neutral) to increase coolant flow rate if needed. So the engine's cooling system is a dynamic and highly-engineered collection of components and strategies that's constantly adjusting to conditions.

What goes wrong?

While water pump designs vary significantly, they all share some basic features: a shaft rides in a sealed bearing, and an impeller is mounted on one end of the shaft and a drive hub is on the other end. The bearing is mounted in a cast housing, and a shaft seal behind the bearing keeps the coolant where it belongs. The casting may be just a holder for the bearing/shaft assembly or it may be the complete water pump with multiple inlet/outlet passages.

The shaft seal is where the vast majority of water pump failures occur, almost always caused by contamination in the cooling system.

In most seal designs, the parts of the seal that move against each other are plastic and they're lubricated by coolant, so a little bit of seepage is normal. These seals wear so slowly that it's unusual for them to wear out. According to engineers at Gates Corporation, seal failure is typically caused by a gritty solid material in the coolant that abrades the sealing surfaces. The grit is a result of cooling system contamination caused by improper service or lack of service. Improper service consists of two things: adding antifreeze to a system that's different from the antifreeze already in the system, or adding tap water that contains minerals instead of using distilled or de-ionized water.

There are several different types of antifreeze on the market, and magazine articles that describe the chemistry of each type have appeared here and in other publica-

How to avoid comebacks

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tions. For now, it's enough to know that corrosion inhibitors in the coolant form a thin coating on the metal to prevent corrosion, and that these corrosion inhibitors don't last forever.

There are three basic types of corrosion inhibitor and variations on each type, and they are not compatible with each other. Mixing a significant amount of two different types of coolant will degrade the corrosion inhibitors in both of them, and corrosion protection will be depleted sooner than planned. When this happens, the grit mentioned earlier will begin to form and travel throughout the system, abrading the water

pump seal and possibly clogging tiny cooling system passages. Adding antifreeze that's different from what's already in the system or adding tap water that contains minerals are the main causes of this kind of cooling system contamination.

Coolant contamination is also caused by lack of maintenance. In order for corrosion inhibitors to protect the metal, the coolant must actually contact the metal. That's why it's important to make sure the cooling system, and not just the recovery reservoir, is always completely full. When the engine is not running, corrosion that forms on frequently un-

wetted metal will eventually be washed into the cooling system when the engine is running. This is a bigger problem on cast-iron engines, but on any engine it contributes to the sludge often found in radiators and heater cores.

All corrosion inhibitors break down with time and repeated heat cycles, and eventually the glycol (the main ingredient in antifreeze) becomes slightly acidic. When this happens the coolant begins to act like an electrolyte, an ionized liquid that will conduct electricity. This causes galvanic corrosion of the dissimilar metals in the system, and aluminum is extremely reactive in this environment. When the corrosion inhibitors wear out, the thin aluminum in radiators and heater cores suffers the most.

Cavitation damage is another source of cooling system contamination. Cavitation occurs in liquid that is subjected

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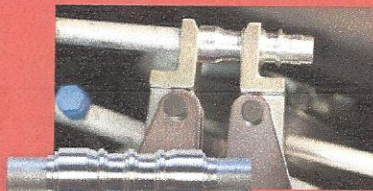
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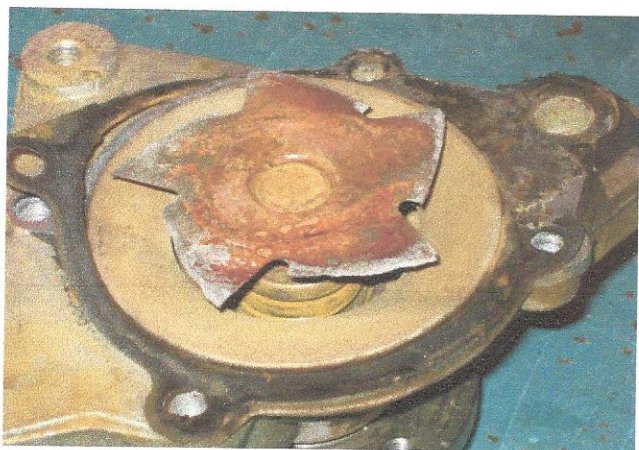


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Cavitation occurs where turbulence is high.

to a rapid reduction in pressure, forming tiny low-pressure bubbles. It happens anywhere there is turbulence in the cooling system, especially around the water pump impeller. The bubbles rapidly collapse, creating a violent shock wave that blasts tiny bits of metal from the cast-

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Corrosion inhibitor for steel was depleted a long time ago.



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Calcium from tap water can be deposited throughout the system.

ing. Those gritty bits attack the seal and contribute to sludge. Corrosion inhibitors quickly form a protective layer on the now-exposed metal, and even though cavitation will damage this layer too, the corrosion inhibitors continually rebuild the layer as long as the coolant and inhibitors are in good shape.

Cavitation is controlled by increasing the pressure in the cooling system, making it harder for the bubbles to form in the first place. A bad radiator cap and/or a system that's low on coolant will decrease cooling system pressure, increasing cavitation even when the engine isn't working hard and depleting the corrosion inhibitors faster.

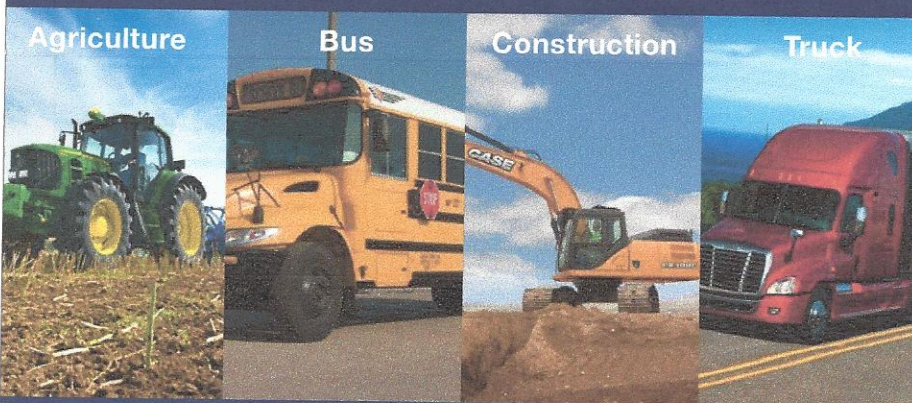
Which coolant should be used?

By now it should be easy to understand the importance of replacing all of the coolant when replacing a water pump. There is still some confusion in the industry about what coolant to use in a given vehicle, but the OEMs all say there is no such thing as a universal coolant. In addition to the difference in corrosion inhibitor technologies mentioned earlier, there are other additives that can affect specific materials in O-rings, gaskets and plastic radiator tanks. That's why there is not always an aftermarket equivalent to some OEM coolants. Even when there is a good aftermarket alternative, it's not always easy to know if it's the correct type because not all service information systems list the OEM coolant type for all models. However, many parts catalogs list the factory-spec antifreeze right there along with the water pump part number, so your parts man may be able to tell you

what belongs in the system.

Coolants come in many different colors, but that's not a reliable way to identify them. Antifreeze is mostly glycol, which is naturally clear, and the makers can add any color their customer desires. So while Ford and Toyota both use HOAT coolants in some models, they are different colors. No matter which coolant you use, read and carefully follow the

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directions on the package. Even on OEM coolants, the corrosion protection may not match the original coolant's service life, and the instructions may call for special flushing procedures or replacing certain non-metal parts.

Flushing

According to ACDelco, flushing the cooling system is critical to avoiding repeated water pump failures. Not only will it help remove rust, scale and other solids that may quickly damage the pump's seal, many water pump warranties actually require a system flush before installing the new pump. That's because it's the only way to make sure all the old coolant has been removed from the system. ACDelco recommends using a fluid exchange machine or power flush equipment. There are flush tools on the market that back-flush the system and/or use "pulsating wave action" that increases the chance of getting solid residues out of the heater core and radiator.

There are several effective chemical flushing agents on the market, although many techs have successfully used simple dishwashing detergents. At one point, GM even recommended a specific brand of automatic dishwasher detergent. However it's important to avoid creating actual suds in the system, which is why real flushing agents may be a better choice. Again, carefully read and follow the directions on the package.

Making the seals last

As noted earlier, the water pump seal is lubricated by coolant. Most pump makers caution against turning the pump even by hand before the seal is surrounded with coolant, and some recommend soaking the new pump in coolant before installation. Any way that works for you is OK; just make sure the seal is wet before the pump turns even a few rotations.

Any tech who has suffered a leaking gasket after replacing a water pump will make sure it never happens again. In addition to removing all of the old gasket material, it's important to make sure the sealing surfaces are totally clean and dry, especially when the gasket is a rubber O-ring. Water and antifreeze do not compress, and clamping an O-ring into a wet groove will cause the rubber to split. If the pump is sealed with a paper gasket, only use



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Rust in the coolant abrades the water pump seal.

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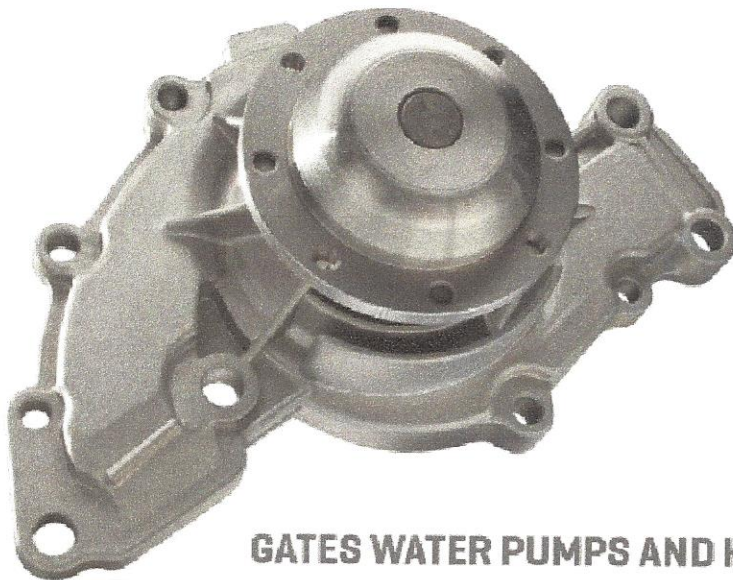
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