

Expert Answers to your Tech Questions

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Is It Worth Attempting?

I am looking for some advice. My dad is the original owner of a 1986 928 S which now has approximately 170k miles on it. About three years ago the radiator went, and the car was parked and not used since. Dad has had the car looked at, but the bill to fix it was north of \$12k. Engine mounts, front assembly, radiator, etc., all need to be replaced. Here's the tricky part: This is the car I took my wife (now) to Prom in 1987.

I would love to restore and get it running again and am willing to do the work (or as much as possible) myself. So now for the big question: Is this even worth attempting?

You might be surprised to know that this type of question comes up quite often. Many a Porsche owner today has looked at their older Porsche, which has been in storage or sitting unused in the garage for many years, and wondered if it's worth the time and money to make the needed repairs and restore it back to operating condition or better. We believe that before taking on a project of this magnitude, you need to really consider the complexity of the project, the time involved, your mechanical abilities, the cost, and ultimately how important the car is to you.

This car obviously has a great deal of sentimental value. The fact that your father is the original owner, plus you used this car to drive your wife to a very special occasion in your relationship, makes it unique to you and your family. These types of emotional connections are very powerful and typically as the years go by these connections become even stronger and often far outweigh the monetary value involved. For some people, this alone makes the effort of repairing

the car worth attempting.

There, of course, is another side to this question, which is what it's really going to cost now to bring the car to operating condition and keep it running properly in the future. By no means is \$12k-plus a small amount of money, and based on what you said, it sounds like you are considering the bigger picture beyond just the issue with the radiator that took it off the street originally. This is one area where many people make the mistake of not considering everything the car needs in order to make it a viable running vehicle again.

Automobiles like Porsche were not meant to just sit; even when they are not being used, wear and tear is taking a toll on the condition of the car. Components like seals, camshaft belts (928, 944 and 968 models), tires, plastic, fabrics and paint all degrade just from their exposure to the atmosphere. If you feel the estimate you previously received does not cover all potential issues with the car, then we suggest that the car be further

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looked at so that a total dollar amount can be estimated. Often, when someone stops driving their car, they do so without preparing things important for longer term storage. The gasoline may have gone bad and varnished components in the fuel-injection system; the gas tank could be rusted and if so further levels of complexity could be added to your project. Additionally, care must be given when restarting an engine that has been dormant for a long period of time. Mechanical components like piston rings, camshafts and crankshaft need to be lubricated before startup.

You need to understand the cost beyond the initial repairs, and though you may not need to fix everything immediately, you need to know the ultimate costs involved.

You mentioned that you were willing to work on the car yourself. This can be a very good thing, especially from the standpoint of saving money, but you have to be honest about what you can and cannot do. If you are not familiar with the 928, there are service and repair manuals available that can help you significantly in your ability to understand and perform the work on the car. If you have a good mechanical aptitude but little or no experience working on the 928, you may want to purchase a repair manual before making a decision about starting the project. Doing so will give you the opportunity to better understand what you don't know and determine if you feel comfortable proceeding with the work.

The factory manuals for the 928 are great but are no longer available new from Porsche; however, they can sometimes be found used in places like eBay, so keep that in mind.

You did not mention that the value of the car is of great concern to you, but for many people in similar situations this is often the overriding factor. The National Automotive Dealer Association (NADA) has pricing valuations for older cars. NADA identifies the value range of a 1986 Porsche 928 in operating condition to range from \$9,800 on the low side to \$16,100 on the high side. These values are an average with some cars

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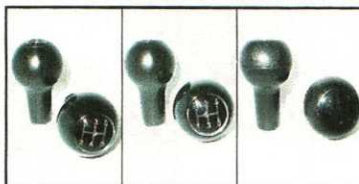
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being worth less or more based on overall condition. Unfortunately, cars that are not in running condition are of lesser value typically due to the fact that repairs are needed and the cost to repair is based on someone's opinion. In these cases, having a comprehensive written estimate from a well-known professional Porsche repair facility can be important.

All versions and year models of Porsche's 928 are unique. They have become very rare, and it is not often that one really sees them on the road. Having a car like this will be of great interest and no doubt get a lot of attention in the future. We suspect that the value of these cars in very good condition or better will in time go up significantly.

We also recommend talking directly to outfits that specialize in the 928 (such as 928 Classics in Virginia and 928 International in California) who have been through the process you are considering numerous times

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and know all the pitfalls and costs. You might also want to join the 928 Owners Club, Austin, Texas.

So, when you ask if it worth attempting to put it back on the road, there are a number of things that you must consider. Do your homework and make sure you understand what you are getting into both short and long-term. Consider the importance of the car to you and your family members. Put the plan together and be honest about what you can and cannot do or afford. We believe if approached in this way, the answer will be obvious, and if the decision is made to proceed with the project, then you will likely have a lot of fun because you will know what and why you're doing it. Best of luck.

Anxious Pump Watcher

I have an '05 997 Carrera with 38k and want to know what maintenance I should focus on to keep it trouble-free. I have recently read about issues with the plastic water pump impellers; can you elaborate on that concern? What can I watch/listen for? How prevalent? What is the cause? Ramifications of failure?

I recently went through the anxiety and expense of having the RMS/IMSB retrofit and subsequent new clutch installed when I noticed a handful of small metal particles in my oil and some signs of weeping seals under the car. Is the water-pump issue another thing that is going to keep me from enjoying the car I waited so long to own?

There is no question that both the M96 and M97 engines Porsche produced from 1997-2008 and installed in the Carrera, Boxster and Cayman models have had issues. However, today there is a lot of history to look back on and knowledge gained about why problems take place with these engines and how to prevent them. Those owners who choose to be informed and proactive in the maintenance of their cars will be far less likely to experience problems. Those owners who treat these Porsches like an appliance and don't pay attention to the spe-

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cial needs of the engines are at greater risk of problems that can escalate into more complex issues like serious collateral damage or even an engine failure.

These engines respond very positively to an aggressive maintenance program that includes the preventative replacement of certain components prior to failure. The water pump is one of these components, and it deserves your attention because it carries the potential risk of causing serious collateral damage to the engine even before the pump actually fails.

The basic issue is how the pump degrades towards failure and how that affects the M96 and M97 engines. It is important to know that water pump-caused damage can take place in multiple scenarios, and know that early engines (five-chain design) react differently than the later engines (three-chain design). More on this later.

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Most of the time there are no obvious warning signs as the water pump-caused damage takes place; the collateral damage to the engine could happen before you ever knew the water pump had become compromised. Now for the real twist: The water pump could suffer the same exact failure, and it is possible that no engine damage would take place for weeks, months, possibly ever. But then, by keeping the pump in service, it could degrade further and still cause this serious damage. Confusing, of course, and as such some owners have unwisely chosen to ignore the warnings.

That plastic parts in the cooling system degrade and water pumps normally wear out provide the bases for this problem. Understanding this problem and its potential random nature is important, and we promise there is a solution that will allow you to enjoy your car and even sleep at night.

Automobile manufacturers have been using plastics in cooling systems to save weight but primarily cost. It's simply cheaper to make parts out of plastic than out of metal. Plastics tend to work very well in the cooling system, but only to a point. Over years of usage, physical changes to the plastic can take place because it is exposed to antifreeze (coolant) 24/7 whether the engine is running or not. At the same time, the coolant is exposed to the aluminum in the engine and radiator(s), which causes the PH ratio of the coolant to become more acidic, which accelerates the degradation of plastics and rubber. This continuous exposure to the coolant, along with the repeated hot/cold temperature and pressure cycles of the cooling system, can cause the plastic to become brittle, because the chemical additives known as plasticizers that provide plastic with its strength and flexibility will leach out of the plastic.

As the plastic impeller becomes brittle, the outermost pieces of the impeller's coolant circulating blades can fracture from the force needed to generate coolant flow. These

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pieces of fractured blades then literally break away and circulate throughout the cooling system. Once this plastic debris enters the cooling system, the pieces of impeller blade can flow back to the water pump and make contact with the remaining impeller blades and cause them to break off, thus adding to the debris already in the cooling system. Initially there is no warning of any kind, but as more impeller blades break away, coolant flow volume is reduced, which in turn leads to higher engine coolant temperatures. This scenario is more typical of lower mileage cars that mostly sit unused and do not get their coolant flushed on a regular basis.

Physical damage can also take place to the water pump impeller through mechanical wear as the water pump ages. Classic water pump failure is generally related to the wear of an internal bearing that

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holds the impeller shaft and internal seal in position within the water pump housing. The water pump's drive pulley is permanently attached on the impeller shaft (external to the housing), and the pump impeller is installed (internally) at the opposite end of the impeller shaft. When the water pump is installed in its operating position, the pump impeller will be located into a machined recess that is part of the engine crankcase. This must be a close fit so as to build sufficient water pressure as the impeller spins within this recess to push coolant out of the pump with enough force to create adequate flow regardless of engine speed.

The drive pulley is rotated by movement of a highly tensioned serpentine drive belt, powered from the engine's crankshaft. The tension applied by the drive belt to the water pump pulley places a constant and significant force against the water pump's internal impeller shaft bearing. The coolant antifreeze does provide some lubrication to the impeller shaft seal; however, belt tension and years of operation will cause the bearing to wear, which causes movement or play to develop between the impeller shaft, bearing and housing. This means that both ends of the shaft will experience increasing run-out or movement as the wear becomes worse.

This can create enough movement of the impeller that it will make physical contact with the internal machined surface on the engine crankcase and cause the impeller blades to break off. When this happens, they can travel uncontrolled throughout the cooling system. Sometimes these pieces can become lodged in places within the cooling system and remain there indefinitely. Unfortunately, the plastic debris can also find its way into the cylinder head(s), where it can become lodged at the entrance to one of the small coolant capillary passages where the debris can then restrict or block coolant flow from reaching these critical areas

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within the head. When this happens, the area just downstream of this debris-caused blockage point can develop a localized hot spot because it is no longer receiving adequate coolant flow. In a short time frame this localized hot spot can severely overheat and crack the cylinder head at that point.

Typically, there will be no warning of an overheating engine displayed; the temperature gauge would read normal. This is because the problem is specific to a localized area within the cylinder head; the restriction will not affect coolant flow to the rest of the engine. The collateral damage done from a cracked head will depend on which version of the engine you have.

The five-chain engine was used in the Boxster models from 1997-2002 (six model years) and the Carrera from 1999-2001 (three model years). In these engines when the cylinder head's internal

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structure is compromised, it usually affects the separation between oil and coolant flow passages, allowing coolant and engine oil to become intermixed. The engine oiling system operating pressure is considerably higher than the cooling system, so in the early stages of a cracked head, oil would be forced into the cooling system. As oil enters the cooling system, sludge will form and begin to hinder coolant flow. This is also known as a coolant/oil milkshake due to the resulting chocolate-looking mixture. In the later stages of this intermix, coolant will then enter the oiling system and contaminate the engine oil. As this happens, the lubricating qualities of the engine oil are quickly lost.

The presence of even a small amount of antifreeze and water in the oiling system can compromise all of the oil-lubricated friction surfaces within the engine. This includes bearings, piston rings, cylinders, all valvetrain components including cams, lifters and especially the IMS bearing. If this problem is not found and corrected in a timely manner, the resulting internal engine damage can be significant, likely ending in the complete loss of the engine.

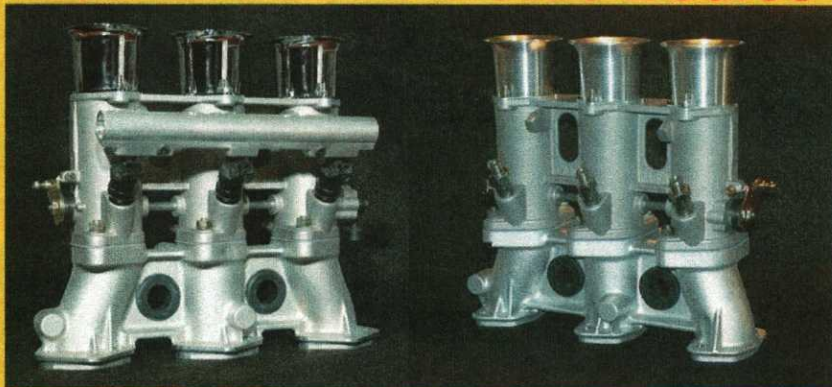
The three-chain engine was utilized in the Boxster from 2003-2008 (six model years), the Cayman from 2006-2008 (three model years) and the Carrera models from 2002-2008 (seven model years). When the plastic debris blocks the capillary coolant passages in the heads of a three-chain engine, it will typically crack the heads on the back side of the combustion chamber and can allow coolant to enter the secondary air injection (SAI) passage(s). The coolant will flow through the SAI passage(s), enter the exhaust port(s) in the head(s) and then out into the exhaust system. The external symptom that is seen will be coolant coming out the exhaust pipe.

Obviously, regardless of which engine you have, this is serious damage requiring significant expense and downtime for repairs.

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Those keeping a close watch on their car should pick up on some changes, but as described, this collateral damage can take place without any prior warning or symptom being seen.

A few other points: As impeller blade material becomes damaged or removed, there will be a marked decrease in the ability of the water pump to produce enough coolant pressure and flow to meet the cooling needs of the engine. Under these circumstances, the driver should notice that the engine is running hotter than normal all the time.

Keep in mind that other issues than a water pump problem could present the symptoms of a hot running issue. Any significant rise in engine operating temperature or a low coolant level warning should be diagnosed immediately to avoid the possibility of engine damage. Watch your gauges and take action when something does not look right

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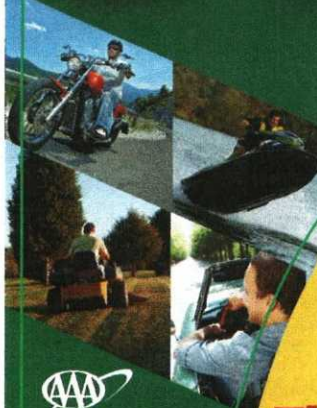


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and include constant monitoring the coolant level. Also, there are other potential issues that can cause a coolant and oil intermix problem to develop, and these are completely unrelated to cracks in the cylinder head(s). The M96 and M97 engines are equipped with a coolant-to-oil engine heat exchanger located on top of the engine. If the internal passages within the heat exchanger fail, coolant and oil can mix.

Also, all 996 Carrera models (not the 986s) are equipped with an Air Oil Separator (AOS) that has coolant running through the control head. If for some reason the AOS control head becomes faulty in a way that compromises the integrity of the internal coolant containment, the resulting leak could allow coolant to flow directly into the engine's crankcase.

Additionally, Carrera and Boxster models equipped with a Tiptronic transmission also have a heat exchanger for cooling the transmission oil. Like that of the engine heat exchanger, failed internal passages can cause a coolant and transmission oil intermix.

Some people have asked for and sought out aftermarket water pumps that have metal impeller blades. It sounds like a great idea, but, unfortunately, it has not worked out that way. Some M97 engines (late 997s) did come with a water pump fitted with a metal impeller. The impeller fits into the tight machined recess in the engine's crankcase just like the plastic version.

As described earlier, when wear takes place in the impeller shaft bearing, play in the shaft will develop, thus allowing movement of the impeller. As the bearing nears failure, enough movement of the impeller blades is possible for them to make contact with the crankcase, and the high-speed spinning blades gouge into the crankcase material. The resulting damage and loss of material in this critical area quickly destroys the crankcase and its ability to generate adequate coolant flow for the

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engine. Although one problem is solved with a metal impeller, it creates a worse situation, because the crankcase cannot be repaired.

If you have a water pump removed for replacement and it is found to have missing pieces of the impeller blade(s); we strongly suggest the cooling system be flushed until *all* of the impeller pieces are recovered. The risk of collateral damage to the engine is too high to gamble.

We suggest the best way to protect the long-term health of your M96 or M97 engine from this type of damage is to consider the water pump as a service item. We believe if the water pump is replaced every four years or 50,000 miles, whichever comes first, the chance of experiencing a water pump failure with consequences like those described above diminish significantly.

We also recommend installing

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DISCOVER

tech notes

the genuine factory water pump from Porsche. If the water pump is replaced on this or an even more conservative schedule, there should not be an issue.

We also recommend a complete drain, flush and refill of the cooling system, using only Porsche factory coolant in a 50/50 mix with distilled water every two years and then again when the water pump is replaced. Porsche does not recommend changing the coolant, ever, unless it must be replaced for some coolant system-related repair, like when it is necessary to install a replacement engine due to an un-repairable failure. The ethylene glycol itself will last indefinitely, however the important additives in the coolant will deteriorate within a few years.

Other maintenance you can do to help maintain your engine over the longer term: First, change the engine oil often, every 3-5k miles. Use a 5W-40 weight engine oil from a boutique or specialty manufacturer like Joe Gibbs Racing, Motul or Red Line or others that have the high-pressure additive of zinc dialkyldithiophosphate that equals or exceeds 1,250 parts per million to protect the valvetrain. Cut the oil filter open and inspect for metal, plastic and rubber debris at every oil change. Finding these materials in the oil indicates that something is beginning to fail, like an intermediate shaft bearing (IMS), timing chains, chain rails, lifters, etc.

We recommend changing to the LN Engineering Spin-On Oil Filter Housing, which filters all the oil, all the time. If you decide to stay with the factory oil filter housing with the internal oil bypass, just replace it every 20k miles; at about \$40 it's cheap insurance. Like you did, changing the IMS bearing on your engine when the bearing is accessible is recommended.

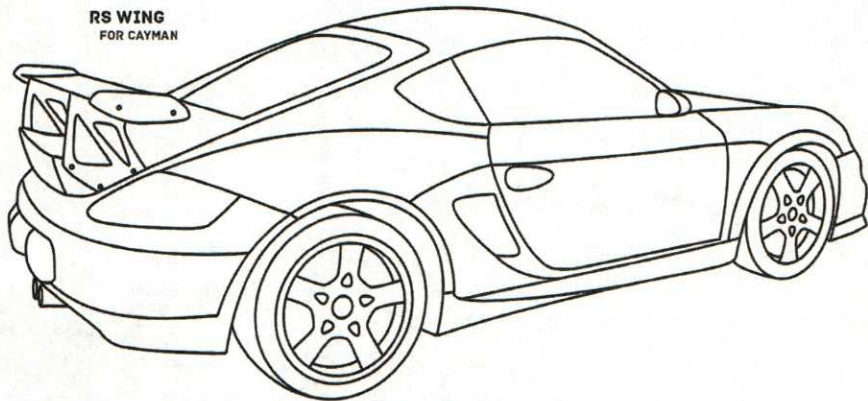
If you have an M97 engine (or a remanufactured engine installed after 2006) where the IMS bearing cannot be removed without engine disassembly, have the outer IMS bearing seal removed so the bearing can get adequate lubrication.

continued on page 58

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tech notes

Also, listen to your engine and watch your gauges, if something doesn't sound or look right, get it checked out immediately.

Those owners who take the time to understand and engage in the proper preventative maintenance needs for these engines should enjoy the benefits in the long run. Likewise, seeking out and working with the professionals who are providing the component upgrades and services that have taken so much of the guesswork out of the M96 & M97 engine will also be to your advantage.

Hopefully in the coming years we can all look back and say that there is no reason why owning a 98X Boxster, 987 Cayman or 99X Carrera would be anything less than a great experience. Although there is no such thing as the perfect car, Porsches generally are way above average in reliability and, of course, in fun. Enjoy!

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