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COOLANT/ ANTI FREEZE

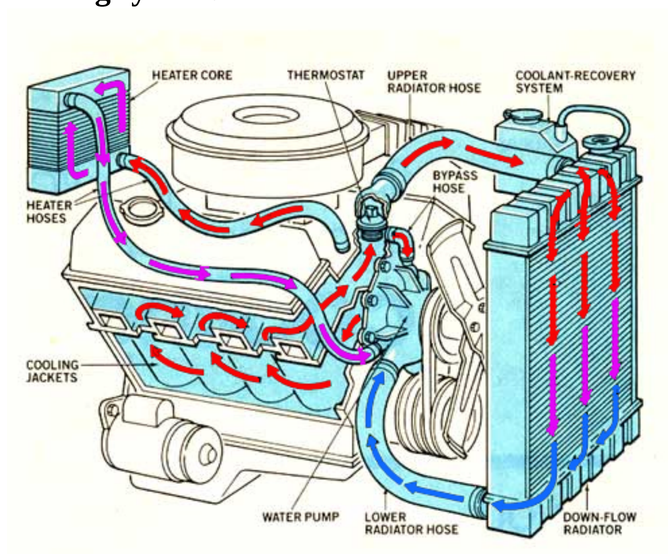
WHAT IS COOLANT? WHAT IS ANTIFREEZE?

A coolant is a fluid which flows through or around a device to prevent its overheating, transferring the heat produced by the device to other devices that use or dissipate it.

In other words coolant absorbs heat from the engine and then dissipates it through the radiator. It is also dissipated through the heat exchanger in the passenger compartment when you crank your heat in the winter.

Coolant, which is commonly called antifreeze, is a mixture of ethylene or propylene glycol and water, usually in a 50/50 ratio.

An ideal coolant has high thermal capacity, low viscosity, is low-cost, non-toxic, and chemically inert, neither causing nor promoting corrosion of the cooling system.
Discover below the car coolant function:



The purpose of coolants is to control the temperatures of fluids and various engine parts in all weather conditions.
Coolant fluid is a special fluid with additives, because it needs to remain liquid at very low temperatures (below 0°C), but must not evaporate at very high-temperatures (above 100°C). Coolant for cars also needs to have anti-corrosive properties in order to protect the metallic surfaces of the engine's various parts.
Another of its less well-known purposes is to keep your vehicle's passenger compartment warm.
Is coolant the same as antifreeze? Anti-freeze has the same purpose as coolant, but it is even more resistant to the cold. Also antifreeze is a concentrated product, normally based on glycol and containing inhibitors. It has to be diluted at a suitable concentration for use. The diluted liquid is usually called coolant .These higher performance levels should be sought in places with extreme weather conditions. Coolant (or antifreeze) protects your engine from freezing while defending components against corrosion, as well as plays a critical role in sustaining overall engine heat balance by removing heat. The coolant capacity of modern systems is smaller and the operating temperatures and pressures higher, while greater use of lightweight materials such as aluminum increases the risk of corrosion.

As a rule of thumb, only about 28% of the thermal energy released by burning fuel in the engine is available for driving the car.

- **About 7% is used to overcome friction in the engine, drive train, tires etc.**
- **Another 35% disappears out of the exhaust, and**

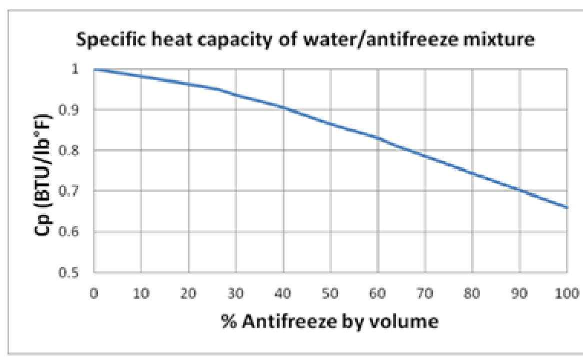
- **The remaining 30% has to be removed by the coolant or the engine block would go into melt down.**

This heat removed by the coolant provides a balance in the overall removal of engine heat that is critical in ensuring that the engine operates properly. Overheating could result in accelerated deterioration of the oil and subsequently the engine itself.

Engines are constructed from several different metals and it's important to prevent corrosion and scale build up in the cooling system at normal operating temperatures. Around 60% of engine failures can be attributed to cooling system problems.

Antifreeze is multi-functional and vital to the correct operation of the engine. A modern coolant/antifreeze needs the following features:

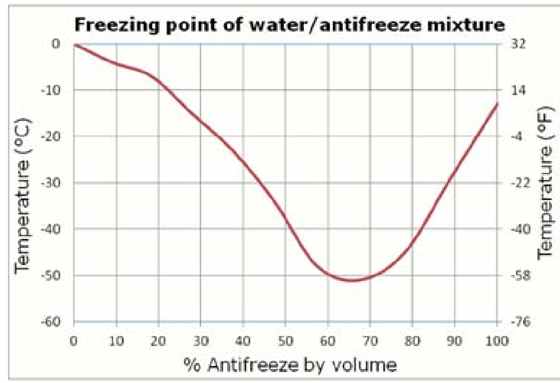
- **Corrosion prevention**
- **Excellent heat transfer**
- **Protection from freezing**
- **Prevention of scale build up**
- **Compatibility with hard water**
- **Stability at high temperature**
- **Compatibility with plastics and elastomers used in the engine**
- **Low foaming**



The most common coolant is water. Its high heat capacity and low cost makes it a suitable heat-transfer medium. It is usually used with additives, like corrosion inhibitors and antifreeze. Since around 1930 the necessary freeze protection and heat transfer has been provided by mixtures of water and ethylene glycol. This is available in large quantities from the petrochemical industry and has the added advantage of raising the boiling point of the mixture. While water provides the best heat transfer, glycol is also used in coolants to provide freeze protection.
The addition of glycol slightly reduces the heat transfer of the water, but in most climates and applications, freeze protection is critical.

More recently propylene glycol has been introduced as a less hazardous alternative to ethylene glycol although this is much more expensive and some manufacturers have been reluctant to use it.

The important recent technical advances have been in the field of corrosion prevention, hard water compatibility and control of scale build up. Engine design has changed to improve fuel efficiency and lower emissions as well as reducing weight and costs. These demands have made engine operating conditions even more severe, so that much more is required from the cooling system.



The coolant/antifreeze used at first fill is chosen by the vehicle manufacturer as the most suitable. Subsequent service top ups or renewals should use a product meeting the original specification so the vehicle warranty is not affected.

Beyond the warranty period, it is still best to follow the vehicle manufacturer's recommendation, however the coolant/antifreeze used should at least meet minimum specifications such as BS6580:2010 or ASTM D 3306. These are general and important standards that provide a basic level of performance for cars and light vans.

The concentrate is diluted with water prior to use and to ensure adequate cooling system protection a concentration of between 40% and 50% (by volume) is recommended. It's important to remember that vehicle cooling systems are sealed and, under normal circumstances, should not need topping up. If the coolant level in the radiator expansion tank drops, the cooling system should be checked fully.

Nearly all engines use coolants with similar base fluids: a 50/50 mix of ethylene glycol and water. In some circumstances, industrial engines may utilize other base fluids, such as additives water or a mixture of propylene glycol and water.

In addition to the base fluid, there are a small amount of other ingredients including corrosion inhibitors, antifoams, dyes and other additives. While these other ingredients make up only a small fraction of the overall coolant, they are what differentiate one coolant from another.

Historically, conventional coolants have been green in color. Currently, these green coolants typically use a phosphate/ silicate mix as the main components in their inhibitor system. Conventional inhibitors like silicates and phosphates work by forming a protective blanket that actually insulates the metals from the coolant. These inhibitors can be characterized chemically as inorganic oxides (silicates, phosphates, borates, etc.). Because these inhibitor systems are depleted

by forming a protective layer, conventional green coolants need to be changed at regular biennial intervals, typically every two years.

Diverse technologies have been developed to protect engines from corrosion.

In Europe, problems with hard water minerals forced coolant technologies to be phosphate-free. Calcium and magnesium, minerals found in hard water, react with phosphate inhibitors to form calcium or magnesium phosphate, which typically leads to scale formation on hot engine surfaces. This could lead to loss of heat transfer or corrosion under the scale.

To replace phosphates, conventional European coolants contain a mix of inorganic oxides like silicates and inhibitors called carboxylates. Carboxylates provide corrosion protection by chemically interacting at the metallic corrosion sites, rather than by forming a layer of inhibitors that cover the total surface. The mix of carboxylates and silicates is also called a hybrid technology because it is a mix of conventional inorganic technology and fully carboxylate or organic technology. European coolants exist in various colors; typically each manufacturer requires a different color.

In Asia, problems with water pump seals and poor heat transfer have led to the ban of coolants containing silicate. To provide protection, most coolants contain a mix of carboxylates and inorganic inhibitors like phosphates. These coolants can also be considered hybrids, but they are distinct from the European hybrids due to the lack of silicates. Coolants from Asian OEMs can be a variety of colors including red, orange and green.

Extended-life carboxylate-based coolants (ELC) were developed to be globally acceptable and provide superior performance over existing technologies. This technology is also known as organic additive technology (OATs). Because full carboxylate coolants have no silicates, they meet the stringent requirements of the Asian specifications. They also meet the European coolant requirements because they have no phosphates. These coolants have developed international popularity due to having an unsurpassed corrosion protection for extended time intervals.

It is worth noting that some people refer to these as "organic additive technology" (OAT) because the inhibitors which provide the corrosion protection are derived from carboxylic acids. In actuality, the protection is provided by neutralized carboxylic acids called carboxylate. This distinction is important because all coolants operate in the neutral or basic pH range (pH equal to or greater than 7). In fact, most coolants are made beginning with an acidic precursor; for example, conventional coolants based on phosphate start their lives as phosphoric acid.

Carboxylate inhibitors provide corrosion protection by chemically interacting with the metal surfaces where needed, not by universally laying down layers, which is the case with conventional and hybrid coolants. The implications of this functional difference are enormous: extended life cycles, unsurpassed high temperature aluminum protection, as well as heat transfer advantages on both hot engine surfaces and heat-rejecting radiator tubes where heat transfer is critical to optimal performance. High quality carboxylate-based coolants have demonstrated performance of more than 32,000 hours in stationary engine applications without being changed. One measure of true extended life performance is that at the end of a fleet test, the used coolant can be removed from the engine and still successfully pass tests designed for fresh coolants!

TYPES OF ANTIFREEZE

There are only 3 main anti-freeze types/coolant types, at most 4 so far less than the types of car engines!

GREEN ANTI-FREEZE/GREEN COOLANT

These are the traditional type of anti-freeze most commonly used in North America. Their silicate and phosphate composition provides protection for aluminum and bare iron surfaces. They need to be changed every 30,000 miles or once every two to three years.

OAT ANTI-FREEZE/OAT COOLANT

OAT stands for Organic Acid Technology.OAT anti-freeze contain ingredients such as 2-EHA, sebacate and other various organic acids. Unlike green anti-freeze, they generally do not contain silicates or phosphates. Usually, OAT-based coolants will be dyed a different color to green anti-freeze. They must be changed once every five years or 150,000 miles.

HOAT ANTI-FREEZE/HOAT COOLANT

HOAT stands for Hybrid OAT. This antifreeze use organic acids but not 2-EHA and usually include silicates to provide protection for aluminum surfaces. HOAT anti-freezes are used by many European car manufacturers, although they are also used by American companies such as Chrysler and Ford. A HOAT coolant will need to be changed every five years or 150,000 miles.

In recent years, anti-freeze manufacturers have been creating universal antifreeze that can be used with all vehicle types. These extended-life coolants only differ in colour. Some may be orange while others may be dyed blue or purple.

COOLANT DEGRADATION

Generally, coolant degradation is accounted for in manufacturers' "recommended use" intervals. Conventional coolants containing silicates degrade primarily due to rapid inhibitor depletion. This is because silicates lay down protective layers over the system components as part of their protection mechanism. Therefore, coolant inhibitors must be replenished or changed regularly to ensure the surfaces will remain protected if the silicate layer is disturbed.

In general, coolants degrade over time as the ethylene glycol breaks down into primarily glycolic and formic acids. Degradation occurs more quickly in engines operating at higher temperatures or those that allow more air into cooling systems. The coolant should be tested on an annual basis if it is intended to operate the system for several years between coolant changes, and particularly where the coolant is used in severe applications.

One test ensures the pH is still above 7.0. Some coolant technologies can protect as low as pH 6.5, however, it is typically not good practice to allow a coolant to operate below a pH of 7.0. Glycol

breakdown products are acidic and contribute to a drop in pH. Once a coolant has degraded, due to glycol breakdown and pH drop, engine metals are at risk for corrosion. Coolant degradation can be slowed by using coolants with extended life inhibitors and by ensuring that the equipment is operating correctly and within designated design limits.

Testing for corrosion inhibitors is another method of checking the coolant condition. While extended life inhibitors do not typically need to be tested as long as proper usage recommendations and correct fluids are used for top-off, conventional inhibitors deplete and need to be tested. Other than tests for nitrites and molybdate, most conventional coolants require either continual supplemental coolant additions (SCAs) or lab analysis to ensure proper performance.

Various inhibitors, such as nitrites and molybdates, are easily monitored using test strips. Because nitrites deplete rapidly compared to other inhibitors, testing for nitrite allows one to learn the coolant's nitrite level, but nothing else. Some engines require inhibitors such as nitrites to be maintained at certain levels to offer protection against cavitation corrosion, which can occur in engines with removable cylinder liners. Nitrites tend to deplete rapidly in conventional coolants and must be replenished at regular intervals. Carboxylate-based ELC coolants typically have lower nitrite depletion levels because the carboxylate provide the required cavitations protection and therefore much longer preventive maintenance intervals.

Automotive original equipment manufacturers (OEMs) now recommend the use of either a hybrid coolant or a full carboxylate ELC. Conventional, standard green coolants are absent from this picture. Heavy-duty diesel OEM recommendations have a wide array of possibilities. In the industrial sector, some OEMs require the use of silicate coolant, while others require silicate-free for heat transfer concerns. Similarly, some require phosphate-free avoiding hard water scale deposits. This scale tends to form deposits on the hottest part of the engine, which reduces heat transfer and can potentially induce corrosion. Finally, some OEMs require the use of nitrites to protect against cavitations, while others have no such requirement. Because the phenomenon of cylinder liner cavitations is design specific, all engines are not affected in the same way. It is important to understand the needs of specific equipment.

Coolants play a vital role in preserving the overall engine heat balance and protecting engine components against corrosion. An estimated 60 percent of engine downtime in the commercial trucking sector is coolant related. Regardless of the market in which the coolant is used, it is safe to assume that coolant education relating to product chemistry, use and ongoing maintenance plays a vital role in creating a productive and profitable environment.

MAINTENANCE & SERVICING

Servicing the coolant involves draining and/or flushing your car's cooling system and then replacing the old coolant with fresh coolant. Draining out the coolant and refilling the system removes dirt and dust particles that can clog up the cooling system and cause problems in winter and summer.

The best maintenance practice is to know the exact coolant required for and placed into an engine, and to control any fluid used to top-off the equipment. Although many techniques are available, a

refract meter should be used to measure the glycol water ratio because it offers the most reliable method to identify the precise glycol content of the coolant.

So, what's a refract meter? And when do we use one instead of a hydrometer? A refract meter is a device used to measure the refractive index of liquids. As there is a good correlation between the concentration of antifreeze in a coolant solution and the refractive index, a refract meter is used to determine the concentration of antifreeze. A refract meter is easier to read and more accurate than a hydrometer. As they are more expensive they are more usually used in workshops rather than by private motorists. This determines the level of freeze protection and ensures the proper concentrations of corrosion inhibitors.

Because it is operating in a hot, hostile environment, coolant will break down over time. Most importantly, the coolant's rust inhibitors get used up, leaving the small cooling passages in your engine and radiator vulnerable to corrosion. Even with these rust inhibitors, some corrosion will inevitably take place, contaminating the coolant with debris.

If the rust inhibitors stop working, the cooling system will rust from the inside out. The biggest source of rust in a car's cooling system is the engine block.

In time, these bits of rust will also clog the tiny passages within the radiator and heater, causing your engine to overheat. When an engine overheats, the result is a bonus yacht payment to your mechanic that someone else should be making.

Another preventive maintenance measure includes checking the cooling system itself to confirm that it is full and operating properly. Operating with low coolant can lead to numerous problems because a coolant cannot protect surfaces that it does not contact, and glycol water vapors can be extremely corrosive. Just checking an overflow tank that is not part of the flow system can be misleading if the system is not working properly. Also, the radiator cap itself can be an integral part of the system if it is designed to hold a specific pressure. These caps may be tested to determine whether they are holding the proper pressure, which is key to the smooth operation of the system. If system pressure is operating lower than designed, the coolant will boil at a lower temperature. Rapid boiling (known as film boiling) can lead to severe corrosion due to hot spots and improper coolant contact.

CHECK YOUR COOLANT REGULARLY

You might spot a leak before it causes a breakdown. Disappearance of coolant could be caused by either an external or internal leak, the latter being more expensive. Either one should be addressed quickly, since running low or out of coolant can lead to catastrophic engine failure and many boat payments to your mechanic.

So it's important to check engine coolant level regularly – weekly if possible – it's not hard to do.

The level shouldn't change unless there's a leak somewhere, and if there is a leak, it's much better

discovered early and at home, rather than in the outside lane of a motorway when the engine overheats. Also consider following items:

• Coolant is usually red, green, blue, or yellow. If it looks colorless, looks rusty, or has things floating around in it, flush your cooling system and add new coolant.

• If the coolant has a sludgy, oily surface, immediately take the vehicle to your mechanic to check for internal head gasket leakage. The service facility has special equipment for performing this check.

• While you're messing around with your cooling system, feel the radiator hoses, too. They're the big hoses that go into the top and come out of the bottom of the radiator. If they're leaking, cracked, bulgy, or squishy, they should be replaced.

CHECKING THE EXPANSION TANK

The car's radiator is fitted with an 'expansion tank' that allows the coolant to expand under rising pressure and temperature. This is usually clear plastic so you can see the level inside, and marked with maximum and minimum marks.

If you're topping up the coolant level it's essential that you identify the expansion tank correctly - adding antifreeze to the screen wash, brake fluid or power steering reservoir would be a very bad idea.

Check the vehicle handbook for the location of the coolant filler cap, and follow any vehicle-specific advice given. Also consider following bellow matters:

- **Only check the coolant level when the engine is cold - it should be between the maximum and minimum marks. If you check your coolant level when the engine is hot, the coolant should be at or just below the "max" line.**
- **Check regularly and look out for wet or white staining on coolant hoses too .Check your coolant level periodically, your owner's manual will have a recommended interval in which to check the coolant level.**
- **Refer to the handbook to make sure you use the correct type of antifreeze and follow the correct procedure**
- **Some coolant recovery systems are pressurized and have a radiator pressure cap instead of a normal cap. Some older vehicles have no coolant reservoir, so to check and add coolant; you have to open the cap on the radiator.**
- **Never add coolant to a hot engine! If you need to add more liquid, wait until the engine has cooled down to avoid the possibility of being burned or cracking your engine block. Don't open the caps on either of these systems when the engine is hot; if you do, hot coolant may be ejected (the system is pressurized).**
- **If the level drops in a modern car's sealed cooling system the coolant must be escaping from somewhere - get a garage to investigate.**

- **Only in an emergency should you add only water to the coolant system!**

CHECKING THE COOLING FAN

In normal driving, airflow through the radiator keeps the engine temperature stable but when ambient temperatures are high and the vehicle is stationary for some time, the temperature will start to rise. Thermostatically controlled cooling fan(s) mounted on the radiator help to maintain the correct engine temperature in these conditions but it's important to check that they operate correctly.
Follow this simple procedure to check the operation of the cooling fan(s):
• Set the car heater to cold
• Run the car to normal temperature
• Allow the engine to idle for around five minutes
• Watch the temperature gauge - don't allow the car to overheat
The fan should cut in automatically - if it doesn’t there may be a fault with the fan temperature sensor, the wiring or the fan itself.

WATER QUALITY

Although tremendous progress has been made in improving the performance of modern day antifreeze/coolants there is still one factor that can reduce their effectiveness – the quality of the water used for dilution! High levels of calcium and magnesium in tap water, that cause furring of kettle heater elements, can also lead to deposits and scale build up in the engine cooling system. If you are in hard water area it is advisable to use distilled or deionized water in the cooling system rather than tap water.

HOW TO CHANGE COOLANT/ HOW TO CHANGE ANTIFREEZE?

If you want your car to last longer, learn how to change the anti-freeze coolant. Car owners should change their car antifreeze at least once a year. Changing antifreeze is not difficult.
Coolant change equipment:
• Service Repair Manual
• 2-3 Gallon Drain Pan
• 50-50 Antifreeze Coolant
• Pliers

When to change coolant?

Over time, this liquid will gradually get used up, and so it should be checked on a frequent basis – every 3 to 6 months.

How to change coolant in car?

Step 1: Antifreeze car Safety Precautions

Make sure you follow all the necessary safety precautions to prevent an accident. Avoid spilling the coolant and keep pets and children away from the work area. Make sure the engine is not running and wait until it is cool.

Step 2: - How to drain antifreeze/ How to drain coolant

Place the drain pan under the radiator petcock drain valve. Remove the petcock drain valve by hand or use a pair of pliers. Observe the anti-freeze leaving the recovery tank and the cooling system as it enters the drain pan

Step 3: How to Change engine coolant - Remove Engine Plugs

Remove the radiator pressure cap to allow the rest of the coolant to leave the radiator. Use a wrench to remove the engine block drain plugs. Let the anti-freeze flow from the engine block into the drain pan. Make sure all the coolant has been drained from the radiator and the coolant recovery tank.

Step 4: How to add antifreeze to car - Refilling Cooling System

Reinstall the engine block drain plugs and the petcock. Find out how much anti-freeze your car is supposed to have by reading the service repair manual. For example, if the manual says four quarts of anti-freeze, add two quarts of coolant and two quarts of water. Pour the 50-50 mixture of anti-freeze and water slowly into the radiator's filler neck with a funnel.

Step 5: Changing coolant - Start the Engine

Turn the engine on and let it idle for a few minutes. Let the engine heat up without the radiator cap on. Turn on the car's heater to the high or hot position. Look into the radiator to see if the coolant is circulating. This means that the thermostat is open. Install the radiator cap and make sure the coolant sure the coolant recovery tank is full. Test the protection level of the coolant and you are done.

HOW TO FLUSH A RADIATOR?

What is a coolant flush?

It consists in changing the coolant in your cooling system; it is something that you can do yourself if you have a little technical expertise in automotive mechanics. We would recommend, however, that you have this done by your garage mechanic, but if you want to do it yourself, the flushing coolant procedure is as follows.

When to flush coolant?

Over time, radiator coolant loses its properties. As a general rule, it should be changed every 60,000 km or every 2 to 4 years (refer to your service manual for the manufacturer's recommendations). Please note: radiator fluid is toxic.

Useful to know before adding coolant:

Before carrying out any operations, make sure that you have an appropriate receptacle for recycling these liquids and a pair of gloves.

How to flush radiator/ How to flush coolant?

• The coolant should only be changed when the engine is cool – i.e., when it has been switched off for several hours.

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• Refer to your service manual to find out where the cooling circuit and filling cap are located. Also find out where the radiator's drainage tap is. The radiator is usually near the front of the car next to the engine. Clean the metal slats on the front and back of the radiator that allow air to move throughout with soapy water and a nylon brush (brush in the direction of the radiator fins to remove dirt and grime)
• Open the filling cap over a container in order to optimally drain the circuit.
• Position a receptacle under the drainage tap at the bottom of the radiator, then open the valve so that all of the oil in radiator coolant can drain out.
• We recommend that you wait 30 minutes for the circuit to drain completely.

How to do a coolant flush?

Warning: used coolant should not be disposed of down the drain or in the wastewater system: it should be taken to an appropriate place, such as a garage or a waste collection area

HOW TO ADD COOLANT?

It's important to make sure you use the right antifreeze at the right concentration.

• Put the radiator drain cap back on and then start to pour coolant into the cooling circuit via the filling cap. You should use 5 L of fluid or more, depending on the vehicle.
• There will be air in the circuit, so you will need to add the coolant gradually.
• Carry on adding coolant until the level of fluid is just between the minimum and maximum markers.

• Start the engine, leaving the vehicle in neutral. If you wish, you can turn the heating up to its maximum setting in order to get the new fluid to circulate around the whole circuit.
• Switch off the engine and recheck the level of fluid. Add more if necessary and then repeat the previous operation until the level has stabilized.
• A few days after you have filled it up, check the coolant level again.

OTHER COMMENTS

- **Lots of misinformation about the compatibility of the different types of coolant technologies exists in literature and the marketplace. While it is not good maintenance practice to mix two different coolants, it will not result in compatibility issues as long as coolants from high-quality, reputable suppliers are used. Coolants are generally considered to be compatible, however, mixing coolants of two different qualities results in a mixture of intermediate quality. While not a disaster, mixing a great coolant with a mediocre coolant will result in a coolant with something of less than great performance.**
- **If you live where the temperature dips below freezing, we suggest that you ask your mechanic to check the concentration of the coolant. Coolant that's diluted or weak can freeze when the temperature drops below 32 degrees Fahrenheit.**

- **Over dilution with water would have a negative effect, because the corrosion inhibitors would be present in the engine at quantities lower than originally designed. Coolants are designed to work over a range of dilutions. The optimum for most coolant systems is 50 percent coolant and 50 percent good-quality water, and in general coolants are designed to tolerate dilution down to about 40 percent concentrate and 60 percent water.**
- **How do I find out what type of coolant is in my car? If the type of coolant in a vehicle is unknown it is not easy to identify it without the use of sophisticated analytical procedures. The color of the coolant does not prove type or quality of the product. The best course of action is to drain and flush the system and refill it with the recommended type of coolant at the correct dilution level.**
- **Who uses propylene glycol? Propylene glycol (PG) based antifreeze/coolant is offered by a number of suppliers as a less toxic alternative to ethylene glycol based products. Good quality PG products have a very similar performance to ethylene glycol based products and they are used by people who are worried about the toxicity of ethylene glycol based products. No major vehicle manufacturers currently use PG based products for original fill, but PG based products are more widely used in Austria and Switzerland where there is legislation that restricts retail sales of hazardous products.**
- **Antifreeze has a sweet aroma and taste, which pets find particularly appealing. As little as a half teaspoon of the stuff can kill an average-size cat, and eight ounces will do in a 75-pound dog. There's no substance that you can add to antifreeze to make it less appealing to animals, but antifreeze made with propylene glycol instead of the usual ethylene glycol is about a third as toxic.**

It's important to make sure you use the right antifreeze at the right concentration