TECH FEATURE:

Cooling System Colors

By Larry Carley

There is a true rainbow of coolant colors in the aftermarket. Which one is right for your customers?

Have you ever seen the inside of an aluminum water pump that was not adequately protected by the corrosion inhibitors in the coolant? Or a radiator or heater core that failed from the inside out because of internal corrosion? These kinds of parts failures are all too common. Yet they can be easily prevented by using the "right" coolant and changing the coolant before trouble starts to heat up.

All types of antifreeze contain corrosion inhibiting chemicals to protect bare metal surfaces from electrolytic attack. Though auto makers disagree on which chemical additives work best in their vehicles, essentially any kind of antifreeze will work in any vehicle. But how well will it protect the cooling system? And for how long? And will it void the OEM warranty? These are important questions that need to be answered before choosing an antifreeze for a particular vehicle application.

There are essentially three basic types of antifreeze corrosion additives for passenger cars and light trucks:

- "IAT" (Inorganic Acid Technology) is the traditional "green" formula antifreeze. This is the stuff General Motors used until 1996, Chrysler used until 2001 and Ford used until 2002 in its trucks, and 2003 in its passenger cars. The green additive package contains phosphate and silicates, and provides good protection for cast iron and aluminum engine parts, as well as copper/brass radiators in older vehicles and aluminum radiators in newer vehicles. The corrosion-fighting chemicals are fast-acting but wear out after two to three years or 36,000 miles of average use, so green coolant needs to be changed periodically to minimize the risk of corrosion damage.

- "OAT" (Organic Acid Technology) is usually dyed orange to distinguish it from other types of antifreeze. In 1996, GM began using a new extended-life antifreeze, called "Dex-Cool." The coolant contains a totally different kind of additive package called Organic Acid Technology (OAT). The OAT corrosion inhibitors are slower acting and provide protection over a longer period of time. OAT coolants typically have a service life of up to five years or 150,000 miles, making coolant changes less frequent - but still necessary (a fact that many motorists seem to forget).

  Other applications that currently use OAT antifreeze as the factory-fill coolant include 1996-and-newer Audi, Jaguar, Porsche, Volkswagen and Land Rover, 2001-and-newer Saab, and 1996-and-newer Toyota, Nissan, Honda, Mazda and other Asian makes.

  Though OAT provides good protection for aluminum, it may not be the best choice for older vehicles with copper/brass radiators because of the lead-based solder used in the radiator. Some say OAT-based coolants may also provide little protection against cavitation erosion in water pumps with aluminum housings (unless the pump impeller is carefully designed to minimize cavitation).

- "HOAT" (Hybrid Organic Acid Technology) antifreeze is usually dyed yellow but may also be dyed orange or green. HOAT coolants are currently used by Ford, Chrysler, Mercedes, BMW and Volvo. The additive package in a HOAT formula coolant also contains silicates for added aluminum protection. Most of the antifreezes in this category also meet the European "G-O5" specification for hybrid extended life coolant. The service life for HOAT is also five years or 150,000 miles.

UNIVERSAL COOLANTS?

Why not just have one "universal" coolant for all makes and models? Some antifreeze suppliers do sell a universal product. They claim it is fully compatible with all types of coolants and is safe to use in virtually any American, Asian or European vehicle application. Universal coolants are typically OAT or HOAT formulas that can go up to five years or 150,000 miles between changes when the coolant is used to replace another coolant or is added to a cooling system that already contains an OAT or HOAT coolant. But if used to top off a cooling system that already contains an IAT green formula coolant, the service life is the same as the original IAT green coolant (two to three years or 36,000 miles).

The issue with universal coolants is that a single formula cannot meet the conflicting OEM specifications for IAT, OAT and HOAT coolants. If a universal coolant contains silicates, it does not meet the OEM OAT specification. If it contains no silicates, it can't meet the OEM HOAT specification. And if it contains phosphates or inorganic acid technology ingredients, it can't meet the OEM OAT or HOAT specifications. Consequently, some antifreeze suppliers argue there is no such thing as a universal coolant because one formula cannot meet all the conflicting OEM specifications. This means distributors must offer three different coolants to meet the IAT, OAT and HOAT specifications - otherwise the coolant may not satisfy the OEM warranty requirements. That's why the safest recommendation is to use the type of coolant specified by the vehicle manufacturer.

Of course, once a vehicle is out of warranty, motorists can use any type of coolant they want - and many do. Many people still prefer the traditional green formula coolant because it's the least expensive, even if it requires a little more maintenance. Others may want to switch from a green coolant to a longer-life OAT or HOAT coolant to reduce the need for maintenance. The aftermarket gives motorists a choice so they can choose a product that best suits their needs.

COOLANT MARKET

According to market research, there are approximately 224 million registered cars and light trucks on the road today. Of these, 56 percent or 125 million were originally equipped with IAT (green formula) antifreeze, 34 percent or 76 million were factory filled with OAT (orange) antifreeze and 10 percent or 23 million were factory filled with HOAT (yellow or G-05) antifreeze.

If a customer chooses a different type of coolant than that which was originally in the vehicle's cooling system, the cooling system should be flushed to remove all of the old coolant. This will avoid any potential incompatibility issues between IAT, OAT and HOAT coolants. We have not heard of any horror stories of bad things happening inside a cooling system when different types of coolants are intermixed. But antifreeze suppliers caution against mixing different types. Their advice is to use "same with same."

Regardless of which type of coolant is used, there are several points worth noting. If the cooling system contains visible sediment or has had a part fail due to corrosion, it needs to be thoroughly cleaned and flushed before the system is refilled. This can be done with a coolant flushing-cleaning machine, or by adding a can of cooling system cleaner to the radiator, driving the vehicle for several days (follow the directions on the product) and then draining and flushing the cooling system. Accumulated rust and scale can reduce heat transfer and may make the engine run hot or overheat. Any crud inside the cooling system will also react with the corrosion inhibitors in the fresh antifreeze, reducing the potential service life of the coolant.

ADDING ANTIFREEZE

Unless a customer is buying premixed antifreeze that requires no water (because it already contains water), antifreeze should always be mixed in equal parts with clean, distilled or deionized water when the cooling system is refilled. Avoid using ordinary tap water or even bottled drinking water because it usually contains dissolved minerals and salts that can shorten the life of the corrosion inhibitors in the antifreeze.

A 50/50 mixture of water and ethylene glycol antifreeze (any type) will protect against freezing down to -34 degrees F and boilover up to 263 degrees F with a 14 psi radiator cap. Never use straight water or straight antifreeze in the cooling system! Straight water provides no corrosion protection whatsoever. It will also freeze at 32 degrees F and boil at 212 degrees F (unpressurized). Straight antifreeze is also a poor choice because it freezes at 10 degrees F and does not conduct heat as efficiently as water (which may cause the engine to run hot and overheat). The best way to change the coolant is with a coolant exchange machine that replaces all of the cold coolant with new coolant. Just draining the radiator may leave up to a gallon of old coolant inside the engine block.

WATER PUMPS

The water pump is the heart of the cooling system because it circulates the coolant between the engine and radiator. The radiator is a heat exchanger and allows air flow to carry heat away from the coolant so the engine doesn't run too hot. A pump failure or a plugged radiator will usually make the engine overheat.

Water pumps work hard, typically pumping several hundred gallons of coolant per hour at highway speeds. Because of the continuous load, pump failures are not uncommon. The first symptom is usually leakage at the pump weep hole. Other symptoms include bearing noise (rumbling, chirping or growling), loss of coolant (through the leaky shaft seal), overheating (from coolant loss or separation of the impeller from its shaft) and fan wobble.

One way to spot a water pump with bad shaft bearings is to check pulley or fan play with the engine off. The pulley or fan should not wobble or show any visible play when it is tugged by hand. Suspected seal leaks can also be diagnosed by pressure testing the cooling system.

If a water pump needs to be replaced, the choices are a new pump or remanufactured pump. Reman pumps reuse the housing, impeller and shaft, and typically include a new bearing and seal assembly. Because of the variety in OEM pump configurations, make sure the replacement pump has the same mounting configuration, bolt locations and hose connections as the original. Also compare pump heights as these may also vary depending on the dimensions of the timing cover or other belt-driven engine accessories.

When a water pump is replaced, the cooling system should always be drained, flushed and refilled with a fresh mixture of antifreeze and water to restore proper cooling performance and corrosion protection. Belts and hoses should also be carefully inspected, and replaced if any are found to be in less-than-perfect condition. Hoses that are brittle, aged cracked, bulging or chaffed must be replaced. New clamps should also be recommended. Belts that are frayed, cracked or glazed also need to be replaced.

On overhead cam (OHC) engines that use the timing belt to drive the water pump, check the mileage on the original timing belt. If the belt has been in service more than the OEM recommended replacement interval (60,000 miles on older vehicles, and up to 100,000 miles on newer ones), the timing belt should also be replaced. This will save the labor of having to do the job twice because the timing belt usually has to be removed to install the pump.

If the engine has overheated because of a pump failure or loss of coolant, the thermostat should be replaced, too.

Another item that may also need replacing is the fan clutch (if the vehicle has one). The lifespan of the fan clutch and water pump are about the same. Because of this, many experts recommend replacing both components at the same time to reduce the risk of future cooling problems.

RADIATORS

A radiator may have to be replaced if it is leaking or is clogged internally and cannot be cleaned. Leaks can be caused by external or internal corrosion, vibration damage (hairline fatigue cracks) or by punctures (rocks or collision damage). A radiator can also be damaged if the coolant freezes during cold weather (not enough antifreeze in the coolant), or if the engine overheats or runs hot creating steam erosion inside plastic end tanks.

A can of cooling system sealer can often provide a temporary fix for a leaky radiator, and there are special epoxy glues available for patching small leaks in aluminum radiators. But the only permanent fix for leak is to repair or replace the radiator. A new radiator costs about the same as having an old radiator repaired, and it usually comes with a better warranty. Plus, there's no waiting for the radiator shop to fix the old radiator - which may take several days depending on the work load.

Radiators on most late-model vehicles are aluminum with either aluminum or plastic end tanks. Most radiators on older vehicles have a copper/brass core with metal end tanks. Aluminum is lighter weight and lasts longer because it has no lead soldered joints. Either type of radiator can be used in a vehicle, but the best advice is to replace same with same. For high-performance applications or hard-working vehicles, a stock copper-brass radiator or aluminum radiator can be replaced with a larger, thicker or more efficient aluminum radiator to improve cooling performance.

To consolidate applications, many replacement radiators are designed to fit as many vehicles as possible. The radiator may have extra fittings (which can be plugged if they are not needed). But as long as the radiator fits the engine compartment and has the necessary hose connections, it should work as long as it has a cooling capacity that is equal to or greater than the original radiator.

Before installing a new radiator, the cooling system should be cleaned and flushed. Other items that should also be replaced include the radiator cap (make sure the pressure rating is the same as the original), radiator hoses (upper and lower), heater hoses and hose clamps. The cooling system should then be refilled with fresh antifreeze and clean distilled or deionized water (not tap water).