



Clore Automotive Cooling System Service College of Product Knowledge



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What is Cooling System Service?

Cooling system service includes all aspects of repairing and maintaining vehicle cooling systems. For the purposes of this informational piece, the discussion will focus on the maintenance application of replacing old coolant with new. This effort can take many forms, but is usually limited to the following four methodologies – a basic drain and fill service, a vacuum exchange service, a forward flush service or to a complete system back-flush.

A basic drain and fill service changes only the coolant stored in the radiator. It requires no equipment but replaces the least amount of coolant of the four options. A coolant exchange service entails removing the old coolant and replacing with new, usually done with slight pressure or vacuum extraction. This methodology provides a better level of efficiency than the traditional method, but still replaces only about 60% of the vehicle's coolant. A coolant flushing service uses low pressure push new coolant into the vehicle, which displaces the old coolant, driving it out of the system. This methodology provides an even higher level of exchange efficiency, replacing virtually all of the old coolant. Finally, a complete system back-flush uses low pressure to push new coolant into the system against the normal coolant flow, providing enhanced enhanced cleaning action, breaking loose contaminants and scales. A complete system back-flush is the most efficient (greatest level of fluid replacement) and effective (best cleaning/renewing action) methodology.

Why is it Important?

- New coolant (whether standard or long-life) consists of approximately 95% ethylene glycol and 5% additives. The ethylene glycol will never wear out, but the additives will. The additives contain corrosion inhibitors, dyes, anti-foaming agents and lubricants. Additives wear out creates the need to change the coolant periodically.
- New vehicle manufacturers recommend coolant replacement at specified intervals. The intervals can be more often if a car is driven in "severe" driving conditions which include; stop and go driving, trailer towing, operation in extreme heat or cold, as well as other conditions.
- Today's engines run hotter than ever before, with temps at 195° or higher under load. Coolant needs to dissipate more heat and do it with less coolant and smaller components. Any issues with components or fluid quality can severely impact the performance of the vehicle, including the overall performance, fuel economy and emissions.
- Changes in vehicle components require new service inspections that should be included in any vehicle service. The aluminum radiators favored today for their lighter weight have smaller tubes and fluid passageways and are more easily plugged, affecting cooling performance. Engine management systems require more stable operating temperatures to maximize engine performance and fuel economy. Engine temperature issues can result in computers changing fuel and ignition settings, impacting drivability, increasing fuel consumption and causing other vehicle problems.
- Long-life (organic) coolants are more susceptible to pre-mature oxidation (build-up of contaminants) than standard coolants. This is because long-life coolants create a lining on the inside of the cooling system to prevent electrolysis and corrosion. This is important because of the many differing materials inside an engine cooling system.
- Higher cooling system temperatures can also shorten the life of automatic transmission fluid (ATF). Heat degrades ATF and most vehicles route ATF through cooler lines and into the cooler, which is incorporated into the radiator. Higher cooling system temperatures prevent ATF from cooling properly, shortening service life and possibly causing premature transmission failure.

How is the Service Performed?

- Coolant exchange used to be performed by removing the lower radiator hose or opening a petcock in bottom of the radiator and allowing the coolant to drain. This methodology had a very low efficiency in that only the coolant in the radiator itself was replaced.
- Newer service methods use a variety of mechanical means to remove old coolant and add new coolant, increasing the efficiency and effectiveness of the service versus the traditional method.
- One service style uses vacuum to remove the old coolant. Vacuum-style machines connect to the vehicle through the radiator cap and pull out the coolant using up vacuum. This process is fast and simple, but only removes approximately 60% of the old coolant. It also requires the vehicle to be running and the thermostat opened. During the extraction, portions of the engine can be running without any coolant for a short period. OEMs do not endorse this process, as undue stress can be placed on radiator and heater core and because no coolant is being circulated (even if it is just for a short period of time). This methodology is referred to as coolant exchange.
- Another service style uses the new coolant, under pressure, to displace the old coolant, forcing the old coolant out of the system. This is referred to as a flush, due to the machine's ability to force new coolant in under pressure and help clean out the cooling system. This methodology replaces a far greater percentage of the old coolant, approaching 100%, for improved efficiency and effectiveness.
- The most effective service option is back-flushing. This technique follows the flushing procedure, but forces the new coolant through the system in the opposite direction of the normal flow, which cleans the cooling system better than any other service technique.
- **VIPER** offers only flushing style machines, which are connected to the vehicle either through the upper radiator hose (using supplied adapters) or a heater hose (using supplied tees). **VIPER** Cooling System Service Equipment can be used to forward flush or back-flush vehicle systems.
- The **VIPER** service procedure initially connects to the vehicle using supplied radiator cap adapters to perform a vacuum test on the vehicle to ensure system integrity before commencing with the actual flushing service.
- After successfully completing this test, the flushing hook-up is made. Most flushes are performed via an upper radiator hose connection, using supplied adapters. This connection allows the machine to force new fluid into the vehicle, going against the system flow and forcing the thermostat open. The used coolant is then captured as it comes out of the top of the radiator. The entire service is performed vehicle while the vehicle is off avoid the need for the tech to deal with a running (and hot) engine.
- The **VIPER** machines use a shop air-operated pump to control flow of coolant to and from the vehicle.
- **VIPER** always recommends performing a radiator cap pressure test. This simple test will help confirm proper cooling system operation. According to the experts at Stant, 20% of all radiator caps are defective. This test will help ensure that the cooling system service is done right and will help the operator sell related products.
- Just like ATF service, most any vehicle is a candidate for coolant replacement. A system with leaks will need additional service and a system with built-up contaminants will usually see some performance improvements. The only caution needs to be in cases of older vehicles and the amount of pressure placed on the system. Weak seams or solder joints can be damaged if too much pressure is forced into the cooling system.
- Unlike ATF service, OEMs do recommend the use of chemical additives and cleaners for cooling system service. Cleaners will break down accumulated build-up of crud in a system, facilitating removal during the flushing process. Since coolant systems are not designed for high pressure, this is the best method to flush out system heavy build ups. The cooling system additives recommended by the OEM's are primarily for diesel applications where additives need to be replenished on a regular basis.

Coolant Basics

- Cooling systems operate under pressure. Most systems operate at approximately 15 psi. The radiator cap will generally be marked with the system rating. The cap is an integral part of the cooling system. The cap manages the pressure in the cooling system to ensure adequate boil-over protection (when coupled with proper coolant). It is also a safety mechanism. In the case of boil-over, the cap will vent the excess pressure.
- Coolant has a flow direction. Most vehicles have a coolant flow that has hot coolant coming out of the engine through the upper radiator hose and into the radiator. The thermostat is a good indicator of where the flow is coming from. The thermostat will remain closed until the engine reaches peak operating temperature and then open to allow the flow of coolant. Some vehicles have a reverse flow system (GM trucks w/ 5.3L, Jeep 4.7L) and have a slightly different system connection.
- Never use tap water to dilute coolant. "Safe" drinking water can contain unacceptable levels of minerals, sulfates and chlorine, which may not harm you but which can become corrosive in a cooling system, even in small quantities. Minerals may leave deposits in the cooling system, which can reduce the effectiveness of the cooling system.

- There are more than 14 different coolants in new vehicles and most are not interchangeable. Almost all have an ethylene glycol base but differ in the inhibitor packages. Care must be taken to avoid problems when coolants are mixed. If mixed, gelling, loss of corrosion protection or even coolant failure may occur. Many OEMs use different additives to deal with certain concerns or issues such as corrosion, scale or component life.

Long-Life Coolant

- The use of long-life coolant in vehicles has raised questions about the need for regular cooling system service. With advertised service life of 100,000 to 150,000 miles, many motorists simply forget about the cooling system.
- The fact is that while long-life engine coolant offers an extended service interval over traditional coolants, a properly operating cooling system is more critical today due to higher engine temperatures, computer controlled engine monitoring and smaller cooling systems.
- An important note is that long-life coolant carries a recommended service life of 5 years / 150,000 miles. The “5 year” term is typically forgotten. Cooling system components are generally covered only under the standard warranty (typical 3 years - 36,000 miles). The useful life of belts, hoses, water pumps and radiators is largely unchanged from years past.
- The most prevalent cooling system concern is low fluid levels. Not only does the low level impact the cooling system’s effectiveness, but in certain applications, the air trapped in the cooling system helps turn the long-life coolant into a sludge-like substance requiring major service to restore performance levels.
- Electrolysis has become a much more common problem. If left unchecked, corrosion and hose degradation can occur. Electrolysis occurs primarily from the coolant mixture picking up electrical current through components from a poor ground. This energized mixture flowing through the cooling system attacking soft metal components such as copper and aluminum. The energized coolant will erode the waterpump, hoses, heater core and radiator. Recently, there have been technical alerts on inspecting and dealing with poor or improper grounding with a number of late-model vehicles. Electrolysis can erode components in a very short period of time.
- When servicing long-life equipped vehicles, develop a comprehensive plan on what the cooling system service will encompass and what coolants will be used. There are over 14 different coolants used in new vehicles. When performing a service, care must be taken to replace the original fill coolant with the best replacement choice. Not all coolants are recommended for every vehicle. Know what options are best for you and your customers.
- Remind customers that a preventive cooling system inspection will cost less than a roadside emergency call. Cooling system problems rarely occur in a parking lot or driveway!

Suggested Long-life Service Check List

- Coolant Level – Check level and system integrity. If low, use the proper tools and determine where coolant is escaping (internally, externally or evaporation). Repair before proceeding with additional service.
- Coolant Color – Inspect the coolant to determine if the coolant is virgin or if it has been mixed with another coolant. If the coolant mixture is unknown, recommend a flush to ensure proper protection. Most long-life coolants cannot be mixed for any reason other than an emergency.
- Coolant Condition – Inspect overflow container, inside of radiator cap and inside of radiator. If contamination or build-up is evident, recommend a system flush/cleaning as part of service. Use a high quality solvent based flush. Never use acid based cleaners as they can damage components.
- Coolant Protection – Measure the coolant/water mixture and determine boil-over/freeze point. Use only a high quality refractometer for accuracy.
- Electrolysis Levels – Perform test while vehicle is running and accessories off. Using a DVOM (digital volt ohmmeter), attach one end to the negative battery post and set the positive probe into the coolant and measure the voltage reading. If a reading over 400 millivolts is found, recommend a fluid exchange and determine the grounding issues.
- Inspect Hoses – The useful life of hoses is about 4 years. Visually inspect the hoses for wear points, deforming or abrasions. Use the pinch test to inspect for both hard hoses and for extremely soft hoses. Hoses are prone to fatigue from heat and wear (the hardness test) and also prone to internal degradation from electrolysis especially near the connection points (the soft test). Oil soaked hoses may test as being soft and require replacement. Recommend hose and clamp replacement as necessary.
- Pressure Test - Perform a system pressure check and test the radiator cap also. Replace any needed components before further service. Issues such as a defective radiator cap will not allow the cooling system to operate properly. Small leaks in hoses and pumps will lead to failure.
- Put a small amount of pressure against the thermostat to see if it holds pressure. A failing thermostat will usually stick open and not hold pressure. This open thermostat will cause abnormal engine temperatures and affect the overall vehicle performance, fuel economy and emissions. Replace with a new stat before further service work is performed.

Note: Customers need to understand that a component replacement now is less expensive than a roadside breakdown and a tow charge later.

Long-Life Cooling System Service Tips

- When diluting long-life coolant with water, only use de-mineralized or distilled water. Typical tap water contains minerals that can build up as scale on the inside of the cooling system.
- When choosing a long-life coolant for use in your shop, read more than the advertisements. Many replacement coolants are not compatible with each other and there can be a difference between “OEM Approved” and “Meets OEM Specifications”. Ask your dealer for more information.
- Recommended Diagnostic Service Tools for Cooling System Service
 - Coolant Flush Machine** – Offers ability to perform pressure test, vacuum test and flushing for maximum versatility.
 - Flushing Solution** – Depending on the condition of the vehicle, it may require a chemical flush/cleaning to remove build-up inside the cooling system. Purchase a high quality flush/cleaner with a water soluble base. Never use an acid based flush in any vehicle with aluminum radiators or heater cores. See **VIPER** Part No. 5090.
 - Refractometer** – Provides accurate assessment of coolant/water concentration. See **VIPER** Part No. 5026.
 - Coolant Leak Detection Dye Kit** – Use a dye compatible with long-life coolant. Some dyes can stain or discolor long-life coolant, causing diagnostic concerns during subsequent services. See **VIPER** Part No. 483926.
 - Non-Contact Infrared Thermometer** – Useful for diagnosing cooling system service problems and avoids having the techs handling hot hoses and components.
 - DVOM Meter** – Measures voltage in the coolant (electrolysis) as it circulates through the cooling system.

Note: Cooling system-related issues continue to be the #1 cause of roadside breakdowns according to the US Department of Transportation. Proper service can keep your customer's vehicles running better and off the side of the road!

What Type of Service Is Best?

- The question for many shops performing cooling system service is, What will best serve the customer's needs? Cooling system service options can include a simple drain and fill, a coolant exchange or a cooling system flush. The service needs are changing with the advent of long-life coolants, changing technology in today's vehicles and the growing amount of under-performed maintenance in North America.
- Long-life coolants have unique service issues and, with smaller cooling systems, the margin for system problems is decreasing. Consumers without proper education are often “putting off” much needed vehicle maintenance and paying for it later with more problems and higher repair costs. The recommended service interval is thought of as 150,000 miles with the more important 5 year interval often forgotten.
- The traditional “drain and fill” service has declined in popularity primarily because it does not allow exchanging a high enough percentage of coolant to properly service the cooling system. Many current vehicles are utilizing smaller radiators with smaller capacities. Draining and refilling only the radiator offers little benefit to the consumer or their vehicle. Most of the newer radiators no longer have a drain plug, requiring the tech to remove the lower radiator hose. This type of service is a messy, low efficient option.
- Shops looking at coolant exchange equipment have several options, including vacuum-style machines. This type of machine incorporates one sealed container for the used coolant and another for the new coolant. These machines require the engine to be running with the thermostat open, removing up to 60% of the old coolant via vacuum.
 - Features that appeal to shops and techs alike are the single point system accessibility (via the radiator cap opening) and relatively short service times.
 - The primary downside to this type of exchange is that the vehicle is required to run without any coolant in the system for a short time during the exchange. As the system warms up and the thermostat opens, used coolant is pulled from the vehicle via vacuum and, when coolant is no longer flowing from vehicle, a valve is turned and the new coolant is pulled back into the vehicle (from the vacuum on the cooling system). Another downside to this methodology is that it does not offer the ability to pressure test vehicle components and cannot perform back-flushes, which are critical for cleaning contaminated long-life systems.
 - Most OEMs do not approve of this type of service because it requires the vehicle to be run for a short period of time with limited amounts of coolant in the engine. It also does not exchange all of the coolant. In addition, any shop using cleaning chemicals needs to remove a much higher percentage of the used coolant/cleaner mixture than this type of machine affords, or risks leaving a quantity of the cleaner in the vehicle's system.
- Another type of cooling system service machine is the flush-style machine. This type of machine requires two access points (usually through a disconnected upper radiator hose) and utilizes a pump to force new fluid through the cooling system, which displaces and forces the removal of the old dirty coolant.
 - While this style of service requires more complex vehicle connections, this type of service offers necessary system and component testing as well as a higher percentage of coolant exchanged (very important when using cleaning solutions).

- The optimum cooling system service on newer vehicles utilizes “back-flushing” methodology. Reversing the regular coolant flow (back-flushing) removes far more build-up than a forward flow process.
- Most machines do not require the vehicle to be running, resulting in cooler under-hood temperatures and avoids the tech having to work with a hot system.
- Long-life coolants are more susceptible to break-down when exposed to air in a system. Neither the “drain and fill” or “coolant exchange” styles of machines will remove the contaminants and system sludge and restore the cooling system to proper condition.

What to Look for in a Cooling System Service Machine

- When in the market for a cooling system service machine, shop around and make sure the machine purchased will meet your specific service needs. As more long-life vehicles are finding their way into the service centers, be prepared to meet the service need. Flushing solutions/cleaners, coolant replacement options and trained technicians are all essential to providing the best service possible. Always ask about on-site training with the purchase of your next coolant machine.
- Visit the following website www.cloreatomotive.com and double click on **VIPER Coolant** icon and then on the **VIPER AF3250**. Watch the video and see how **VIPER** can give you the necessary tools to service your customer and their vehicles.
- Look for simple operation, so that every member of the shop team can operate it successfully. **VIPER** uses an easy, 2-valve design with simple control selections, for quick, easy service.
- Look for easy conversion between different styles of coolant. **VIPER** offers quick-change tanks, enabling a single coolant machine to service all vehicles.
- Look for variable exchange speed control, which allows precise adjustment and control of the cooling system service process.
- Look for ease of connection: are the fittings and adapters complete enough to service a wide variety of vehicles and are they well designed for easy interfacing with the vehicle? For each machine under consideration, ask: “Where do I hook up and do I have the proper fitting for the vehicle?” **VIPER** offers a variety of different sized tees and radiator hose adapters to fit most vehicles. With **VIPER**, you will not have to turn away a customer.
- For each machine under consideration, consider the power required to operate that machine. **VIPER** uses shop air to power the equipment. Shop air is the most plentiful power source and provides excellent power for vacuum and pressure testing as well as the flushing operation.
- Beware of machines that power the exchange/flush utilizing a 12V hook-up to the battery of the vehicle being serviced. With the advent of more sophisticated on-board computer systems, the use of 12V-powered devices may trigger a fault code. If this happens, some vehicles can reset their own computer with removal of the device. In certain cases, though, the vehicle may require a scan tool to reset the on-board diagnostics back to OEM settings.
- Consider the level of customer acceptance of the service type that coincides with each machine under consideration, both in terms of pricing and level of service offered. Is there a way to show the difference between old and new fluid? The **VIPER** return hose incorporates a built-in sight glass for visual confirmation of the service.
- Consider the level of after-sale support offered by the manufacturers of each of the machines under consideration. Confirm the availability of a tech line for after-sale assistance and help in identifying fittings and procedures for newer applications. **VIPER** offers a 800 tech line available to all users, plus supports an extensive selection of replacement parts, provides a comprehensive user’s guide with each unit and provides service tips via the web. **VIPER** also provides in-field training and offers leave behind videos to aid in the training of your service team.
- Consider the level of responsiveness available from each manufacturer if the machine were to need service or repair. **VIPER** uses a nationwide repair and service network for any in field repairs and provides factory direct support for any needed replacement parts and fittings.
- Consider the warranty provided with each machine. Determine what the warranty covers and the length of time offered. **VIPER** products offer a limited 1-year warranty. See users manual for details

Due to the year round usage and high demand for service offered by this type of product, do not make your decision based on the selling price only. Think ahead and make sure the decision is based on ease of service, amount of training needed, assurance that you can service all of your customers’ vehicles and finally that all employees will be able to operate this equipment.