FOR THE AUTOMOTIVE AIR CONDITIONING AND COOLING SYSTEM PROFESSIONAL

# ACTION

September/October 2007

## Ultimate Cooling

## Has flushing become a bad word?



ACTION™
P.O. Box 88
Lansdale, PA 19446

Printed in USA

# Has flushing become a bad word?

***Cleaning heat exchangers requires more than just changing the fluid.***

*by Karl Matis, Vice President HECAT, Inc.*

The engine cooling system is the heart of all heat exchange processes in an automobile today. Poor engine cooling will not only affect engine life, but will also affect the efficiency of the heater core, A/C condenser, transmission oil cooler, and even the electronic device cooling in hybrid vehicles.

Many customers believe that cooling system flushing is no longer necessary since their car has that "lifetime" antifreeze in it. Because we are such creatures of comfort, many cooling system related problems will first appear in a shop with the complaint of "no heat" or "poor A/C cooling."

There have been many complaints for some time that a corrosive, sludge-like substance is clogging cooling systems in vehicles equipped with long-life antifreeze. We have all read the many technical articles about the theories and facts behind the different products and the problems associated with lack of service, improper use, and the mixing of incompatible products. Proper cooling system flushing is still the answer.

Flushing is a term that has been improperly applied to fluid exchangers. Many of today's coolant "flushers" are not real flushing tools, but only fluid exchangers. They indeed do a great job at completely evacuating the old fluid to replace it with new, and during this process they will obviously provide some internal cleaning.

But when facing a hard blockage, such as sludge, scale, debris, or corrosion buildup fluid exchange equipment just cannot get the job done. Regardless of whether the vehicle has the traditional green, organic acid technology (OAT), or the phosphated or silicated hybrid organic acid technology (HOAT) antifreeze, the flushing need and process is the same.

Although we are primarily discussing internal cleaning, the first step on any cooling system is always inspection. Look for signs of weakened hoses, poor connections, corrosion, and other telltale signs of trouble. Pressure test the cap, pressure test the system for external leaks, do an internal leak test to check for combustion gas leakage, and don't forget to check the condition of the fan. Be sure to check and straighten the external fins, and verify that the condenser and radiator are free from external debris and bugs, cleaning them if necessary. After inspecting the cooling system's integrity, a coolant-compatible chemical cleaner may be added (if you wish) and allowed to circulate according to the manufacturer's directions before recovering the coolant.

Regardless of the preliminaries, always recover the antifreeze and never allow it to drain into sewers or waterways. Once properly drained, the system can be opened to provide the necessary outlets for debris removal. The block, radiator, and heater core should be isolated and disconnected from hoses and other components, and the thermostat should be removed. Use an effective, high-volume flushing and cleaning process (we manufacture the HECAT Coolant Pulsator) to flush the radiator, block, and heater core in both directions.

Although many technicians believe that openly flushing a previously drained system is now illegal due to regulations regarding antifreeze disposal, it can be done, even in California. A water pollution control administrator for the City of Hayward, Calif., said, "The city allows automotive service facilities to discharge the flushing of automotive cooling systems into the sanitary sewer system provided that all coolant which can practically be drained from the system is first captured for recycling or off-site disposal. The City recognizes that cooling system flushing is a necessary service that the public needs and requires."

Coolant system flushing, transmission oil cooler flushing, and A/C component flushing are necessary and required services that cannot be ignored. Many coolant system problems today are directly related to the lack of this service. Automatic transmission manufacturers, A/C compressor manufacturers, and the many component rebuilders often require proper flushing of the associated heat exchangers or their warranty will be voided.

When it comes to heat exchanger flushing, we often hear comments such as "it causes more problems than it solves," "it is too difficult," "it takes too much time," or "it's too messy." Our research indicates that most of these opinions are directly related to either the poor performance of the cleaning process chosen, the use of improper chemicals, or the technician simply not understanding the inherent nature of the system, its components, and how to properly clean them.

An additional problem is buying into the marketing of products that do not perform as advertised. These issues become most evident when looking at the problems associated with A/C evaporator and condenser flushing. It is our opinion that some of the methods and chemicals are so ineffective that they only promote and perpetuate continued unsatisfactory results.

Velocity and agitation are the keys to overcoming the "path of least resistance" within the parallel paths of today's heat exchangers. Although they are very popular, marketed well, and at times very inexpensive, simple circulating systems, spray can cleaners, and fluid exchangers do not produce the velocity or agitation required to remove all the contaminants from the component.

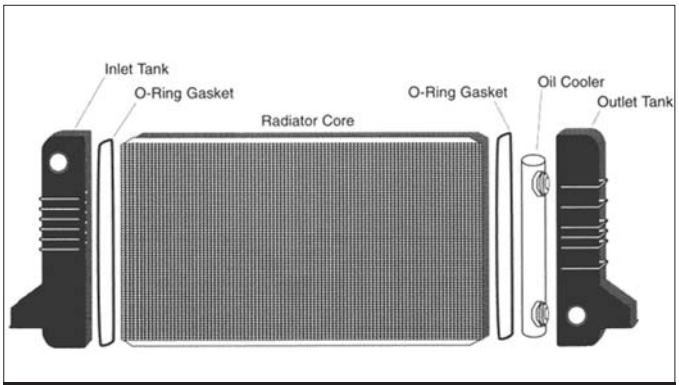


**Figure 1: Many radiators use a simple crossflow design.**

Since the ultimate goal is to be sure the job is done right the first time in the most economical, professional, and EPA-compliant manner so that the repaired system will operate properly for many seasons, the technician must understand the specifics of each individual system failure and how it has affected the heat exchangers.

## Designs

Heat exchanger designs vary widely, as do engine blocks and heads, and debris can anchor itself in the twisting paths, header chambers, corners and crevices of any system. The only effective method for removing these contaminants is one that has the volume, velocity and agitation necessary to dislodge and carry them away.

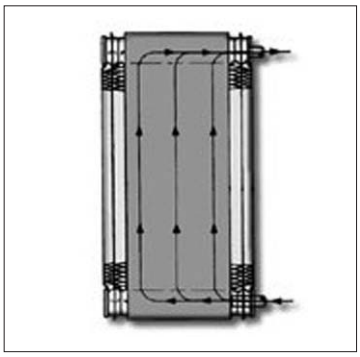

**Figure 2: Single-pass evaporator**

Complete or partially assembled systems cannot be flushed, and you cannot flush through fill, drain, or A/C charging ports. Always isolate the heat exchangers and flush through the most direct and unrestricted path to obtain the most satisfactory results.

Open chamber, single pass heat exchangers transfer the fluid from one tank to another via multiple cross tubes. This is the most common design for radiators (Figure 1), heater cores, air-oil coolers, and charge air coolers. It is also found as an older design of A/C evaporators with the tanks on top and bottom (Figure 2). These heat exchangers require flushing in both directions with provision for adequate debris outflow at both tanks. The bottom tank or "well" of the open chamber evaporator is notorious for pooling solvents, and an evaporative product must be used followed by generous high-volume dry air to evaporate and remove all the solvent. Failure to properly remove an A/C flushing chemical will be the sure cause of a rapid repeat system failure.

Most in-radiator transmission oil coolers are of an open web or mesh design. This design makes the cooler an excellent filter and it will trap clutch materials and other metallic debris that will clog and impede proper oil flow. These units must be backflushed to remove the debris that cannot be pushed through.

Tube-and-fin and serpentine heat exchangers have one tube, or a small group of common tubes, that just weave back and forth from the inlet to the outlet (Figure 3). With the exception of some serpentine layouts, these designs are not used so heavily in automobiles today, but the tube and fin design is still used in many industrial and stationary heat exchanger applications. This design has proven to be fairly easy to flush, and backflushing (in opposite direction of normal

flow) is recommended.

Multi-pass, parallel flow heat exchangers are very common in today's cars. Primarily used as A/C evaporators (Figure 4) and condensers (Figure 5), they are favored for their compact and lightweight design and heat exchange efficiency. The problems and challenges

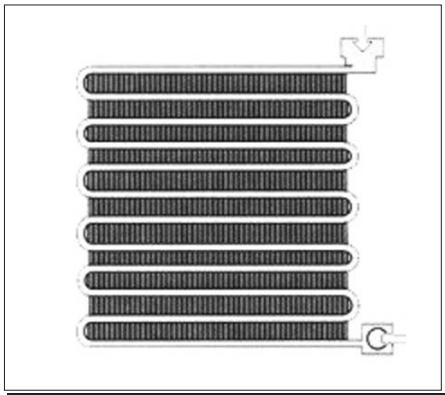

**Figure 3: Serpentine condenser**

associated with cleaning this type of heat exchanger has convinced many technicians that condenser flushing cannot be done successfully.

If a compressor failure is not an issue, a parallel flow condenser (PFC) can easily be flushed of the waste oils and reused. Backflush first (bottom to top) to loosen any debris that cannot be driven through the small passageways. Flushing the component "in car" will require some solvent volume and velocity, and it may even be necessary to remove the PFC and reposition it to prevent larger debris pieces from just churning around in the inlet chamber. Successful flushing can done when you understand the internal flow.

The initial solvent volume is best removed by a second flush in the opposite direction – top to bottom – followed by a generous blow of high-volume dry air to be sure all the solvent is removed.

### Looking forward

"Back in the day," many OEMs approved heat exchanger flushing and often recommended it, but today's systems are designed better and lasting longer. Most OEMs do not need to support component flushing as a published

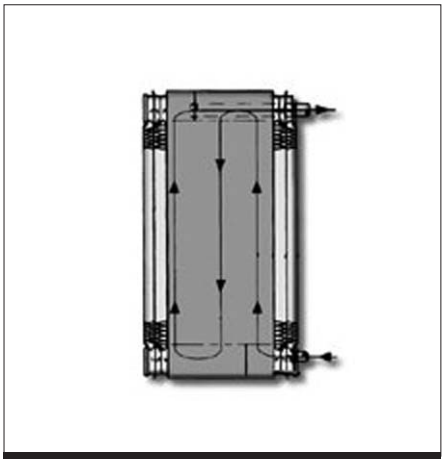

**Figure 4: Multi-pass heat exchanger**

service procedure, and many have moved away from it. However, in the aftermarket flushing has proven effective at reducing time and materials during repairs or major service on older vehicles.

Many manufacturers are now using

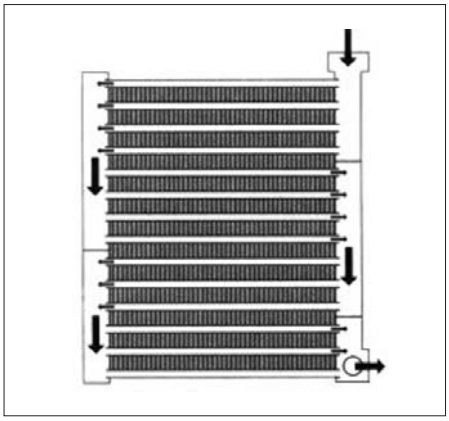

**Figure 5: Parallel flow condenser**

modular cooling units that incorporate the radiator, transmission oil cooler, condenser, and electronics cooling as one very expensive single component. This will become more common and flushing the individual heat exchangers properly will be necessary to avoid the huge cost of replacement.

Because so many variables exist than can affect cleaning success, always test the component and confirm your satisfaction with the cleaning process before you return the vehicle to service. In the case of A/C components, when blowing out a solvent with air, use a fine mesh strainer on the outlet or even something as simple as a clean rag. Observing what comes out can tell you a lot about internal conditions. In severe cases, it may be necessary to repeat both the chemical flush or the pressure flush to achieve satisfactory results.

Regardless of what equipment, method, and chemical(s) you choose, it is ultimately the technician's responsibility to be sure this process has a positive effect on the system. Flushing a heat exchanger properly is a proven way to reduce the expense of comebacks and warranty repairs. Keeping your customers repair costs to a minimum and providing repairs that give long, trouble-free service will only strengthen your reputation and profitability. ❄