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WHEN THE HEAT DROPS OFF

It's a good thing that most people live in parts of the country where they want heat in winter as much as cold air in summer, and also need defrost/defog much of the year, or the climate control business would be deadly slow in winter. One of the less common complaints is that "I get okay heat when I first start out, but then there isn't much." Which of course is the opposite of what you expect – that the car is slow to warm up and by the time there's a decent amount of heat, the motorist is at his destination and shutting the engine down.

The exact nature of this problem can vary, of course, so a really clear understanding of what's happening is important. Is the car idled to warm up before the driver leaves? In that case, the technician may be looking at an off-idle issue. Or does the heater work in slow traffic, but drops off as road speed picks up? Or is it the opposite, where the heat is fine at road speed, but drops off as traffic increases near the motorist's destination?

Let's begin with the heater that drops off when the vehicle (in our specific example a 1997 F-150), is driven off. But then, when the truck is parked and idling, the heat continues to drop to nothing. The technician first discovers that heater inlet hose is hot, but the outlet hose is cold, so he concludes the heater core is plugged.

Cooling System Flushing

The core is plugged, but flushing it doesn't seem to help. There is enough evidence that with a plugged core, a single flush, even backflushing, often isn't enough. Many shops report that it may take repeated backflushing and forward flushing. Interestingly enough, sometimes you see a lot of garbage come out, but other times you don't see a lot of visible debris. However, appearance of the flushing water aside, after about 3-4 tries, the heater performance may get much better. But that's with a machine (Figure 1), not just some water hose or shop air gun at the heater core neck (Figure 2).

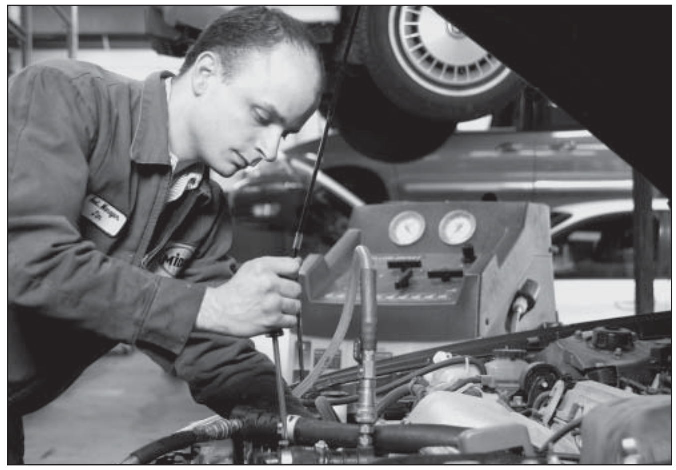

Figure 1: *Drain-flush-fill machine is still the best overall way to service a system, but it may take several flush operations to get a plugged heater clear enough.*

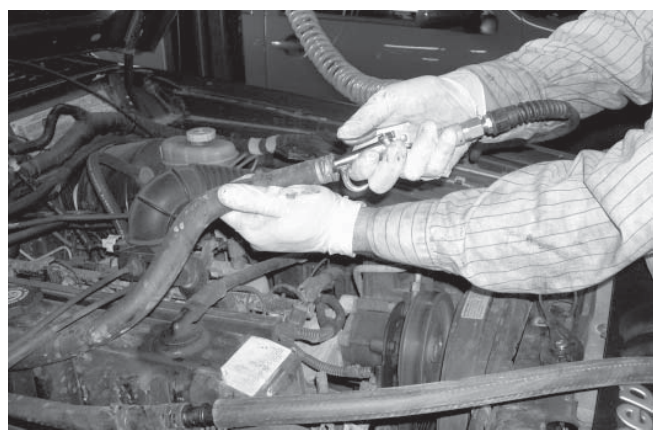

Figure 2: *Too many shops without machines try clearing heater cores with shop air, and when it doesn't work, just conclude the core has to be replaced.*

ALSO INSIDE THIS ISSUE:

Figure 3: A premium flush device is a better alternative, such as this Hecat pulsating flusher.

Figure 4: *Hecat pulsating flusher, like the company's A/C equipment, can do forward and back flush, imparting a hammering effect to the coolant flow to clear out debris.*

One alternative is the Hecat Coolant Pulsator (Figures 3, 4), which like the company's A/C flushing machine, creates an air/water hammer-like pulsing action (about five times per second), which can break loose deposits of debris and sealer.

Flushing the entire cooling system doesn't hurt, and prior to coolant replacement, it's certainly a good idea. And if you use a flush/drain and fill machine, you can get a pretty good fill and minimize the possibility of air locks.

But when you have a significant restriction, a system flush may not help much either. The most effective flushing is of the individual component – heater core, radiator, engine block, maybe even hoses.

In the case of the '97 F-150, the shop ended up going for heater core replacement, which didn't seem to cure the problem. Nor did removing the restrictor from the heater inlet hose. The technician checked for a combustion leak (there was none) and carefully topped up the system to prevent the possibility of an air pocket.

Vehicle History

The vehicle history at other shops of good repute warned against some possibilities: the F-150 already had a new radiator, water pump, and thermostat, and the system had been flushed several times. Coolant temperature was over 185 degrees F.

But even with a brand new heater core and heater hoses, as soon as the thermostat opened, the technician found that although the heater inlet hose was hot, the outlet was cool. The answer is a restriction, in this case in the heater return hose connection at the water pump. Cleaning it with a drill bit was the cure. One lesson: even repeated flushing may not clear a restriction. Other restrictions can be a kinked hose or of course, plugging of the radiator or heater – or a bit of both.

Why It's Rarely One Thing

But don't stop there, for as noted, the gradual loss of heat has other causes—particularly a weak water pump and defective thermostat, and they might be contributing. Anything that affects coolant flow can be responsible, for as soon as the thermostat opens, the coolant circuit extends through the radiator.

In fact, whenever a car comes in with any no-heat complaint, typically the technician goes through all the diagnostic possibilities, and when something is found to be wrong, he tends to think "that's it." However, like some A/C cooling problems, there's almost always more than one thing wrong when the issue is heat.

Why is this? Well, in many cases the problem is system neglect. With today's extended coolant service intervals, motorists often figure, "The coolant interval is 100,000 (or even 150,000) miles, so I don't have to do anything for a long time." They don't realize there's a time limit of perhaps five years. Or even worse, there are some manufacturers that don't even specify coolant service intervals – Volvo and Volkswagen/Audi come to mind. They typically will say something like "Inspect the coolant; replace if dirty."

These companies' lack of specific service intervals, long established, are apparently based on older models, and their typical 4-5 year intervals for replacement of such parts as hoses (add in the theory that if a hose must be replaced, the cooling system will be flushed and refilled). At least that's something we've heard from some of their people. "Oh really?" was a typical reply when we noted that when most shops replace a radiator hose, they just drain the radiator, nothing more. And if a heater hose or hose quick connect is leaking, a shop may just use pinch-off pliers (Figure 5) and end up just topping up the system after the service.

Figure 5: *Clamping off hoses instead of draining the system enables a shop to do parts replacements without a coolant drain-and-fill. But it means you can't assume coolant change simply because of prior system service.*

Mercedes has a 15-year/150,000-mile coolant service interval, and although dealer shops may do the job at much shorter intervals, many buyers of the less expensive Mercedes models avoid the dealer after the warranty period, just like other motorists. The Mercedes 15-year interval is based on long experience with G-05 antifreeze (Zerex brand in U.S. or Havoline Custom Made) and a silica gel packet in the coolant reservoir that dribbles out tiny particles of silicate to "refresh" the silicate inhibitor in the factory fill (Figure 6). Of course, it includes the rather shaky assumption that the system will always be topped up with a 50-50 mix of G-05 and that the hoses and other system components last to that interval. That's not much different from the approach of Volvo and Volkswagen, in the real world.

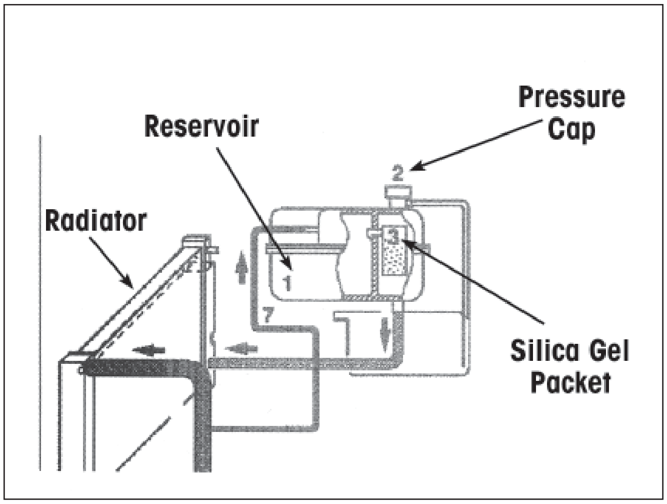

Figure 6: *Mercedes-Benz has 15-year/150,000-mile service interval, derived from experience with a silica gel packet in the coolant reservoir. Particles are released from packet to refresh the silicate additive content of the antifreeze.*

But in truth, no systems seal perfectly for very long, and when they get topped up, it could be with anything, often just tap water. Or in fact, they run low on coolant for a while. In time, neglect affects all makes, and if a system has just been topped up over the years, neglect should hardly be a surprise. Then, parts deteriorate in ways that relate to the "bell-shaped" curve. You remember learning about that in high school, right? Some parts fail at low mileage, others at some middle mileage, and a few last nearly forever. And a number of parts that look fine at some normal mileage go into a sharp death spiral in a short period thereafter. Belts and hoses are the most common – belts, because the nearly invisible cracks and glaze sudden accelerate; hoses, because they crack internally, out of sight. Radiators and heaters may leak at low mileage, but seem to have to reach a significant level of plugging before they affect heat transfer enough for the motorist to notice the engine is running hot in summer, or not producing much heat in winter.

Before You Sell The Job

When the diagnosis is made, the next step is to sell the job. In the case of a 2006 Honda Pilot, a no-heat problem was traced to a plugged heater core. The OE core isn't bargain basement – about $400, and it's a dog to replace. The MOTOR/AllData flat rate is almost nine hours, and that doesn't include replacing the heater hoses and flushing the cooling system, nor recovering and recharging the air conditioning. Figure perhaps eleven-plus hours, and with materials and an OE core, that's probably pushing $1500, maybe more if the labor rates and sales tax in your state are high.

The answer the technician chose in this case was to run a chemical flush through the heater core, then backflush the core with water, letting the flush machine run for an hour. The end result wasn't equal to a brand-new core, but the heat was decent and the motorist was happy.

What About Thermostats?

You may have noticed that we didn't mention thermostats when we talked about neglect. You can't "neglect" a thermostat, but it can operate improperly, and perhaps a major problem is that any time there's poor heat, a lot of shop seem to consider a new thermostat an "automatic" installation as an opening move.

But although a 'stat can fail, if an engine reaches normal operating temperature in some reasonable time, and can hold that temperature, the 'stat is probably good. And that's something you can check, either with an infrared thermometer (ray gun) on the thermostat housing, or with a scan tool (or even both at the same time, Figure 7).

Figure 7: *Coolant temperature checks with a scan tool and infrared gun won't be quite the same, but they do tell when the thermostat opens, and also provide enough of a comparison to pick up restrictions and sensor errors.*

However, if the vehicle history includes a thermostat replacement, the only question is "what thermostat?" And you may want to take a look at it.

But you should know what the OE 'stat looks like. If it has a jiggle valve to balance pressures and bleed air, and an O-ring seal or something similar, a low-priced aftermarket replacement with just a notch (if even that) and/or a weak spring may not be an adequate match in cold climates (Figure 8). So although the stat may hold normal operating temperature in the shop, it may lose the necessary control as the

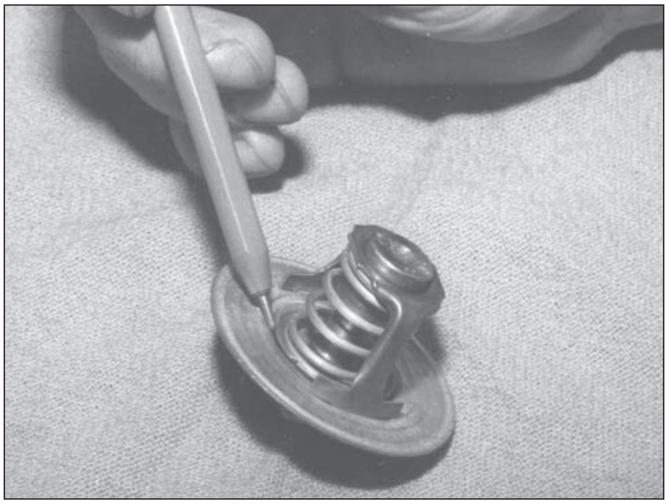

Figure 8: Cheap universal thermostat designs may have weaker springs, lack a jiggle pin vs. the OE design, or may lack an elastomeric seal.

car is driven. How can you determine this?

Well, you can connect a scan tool and drive the car, watching the coolant temperature sensor reading. This isn't a perfect way, because a number of things could affect coolant temperature. The thermostat is a primary suspect, but cooling fan operation can be another, not necessarily on high speed, but even on low speed if ambient and coolant temperatures are low. Ram air can also be a contributing factor.

Today's smaller engines have a lot of surface area exposed to airflow, and maintaining coolant temperatures is difficult but important. In fact, coolant temperatures will soon be on the rise, we have been told by OE engineers, because the warm engine enables a reduction in friction, improving fuel economy. So you can expect to see normal coolant temperatures starting to creep up to 225 degrees F. in the next several years. That should help with heating on small engines, although it will require upgrades in cooling system performance in hot weather (there's always a tradeoff).

In the meantime, a 180-195 degrees F thermostat is what the engine probably has, and if it is providing that temperature range in road testing on a cold day, changing it won't do anything for a heating problem. Save yourself the installation time and your customer a few dollars.

How About Water Pumps?

As we've noted earlier, unless there's good coolant flow, heater performance will be poor. We've heard this: "Why would you need a lot of coolant flow in cold weather? Won't slowing the flow through the radiator keep the coolant hotter?" Yes, but there's a difference between temperature and BTU (heat as measured in British Thermal Units). So yes, you need a lot of coolant flow, and that's why so many engines with complex heater circuits have auxiliary electric water pumps. And here's a heads up: electric water pumps instead of engine-driven pumps are coming on conventional gasoline engines (Figure 9), because they can be demand-driven very precisely. All that means is that they may do more pumping when it's needed, such as for heater operation in winter at low vehicle speed, or in heavy traffic in warm weather to prevent overheating. We just saw one on the new 2.0-liter turbocharged four-cylinder that will be starting to replace the in-line six on BMWs (began with the Z4 this past Fall, and more models to come in 2012).

Like variable displacement air conditioning compressors that will change displacement according to cooling load, an electric cooling pump will change diagnosis, for no longer can you check pump output by revving the engine to increase pump speed, squeezing the upper radiator hose or checking for increased coolant flow from a heater hose into a jug (Figure 10). A computer will be deciding how much

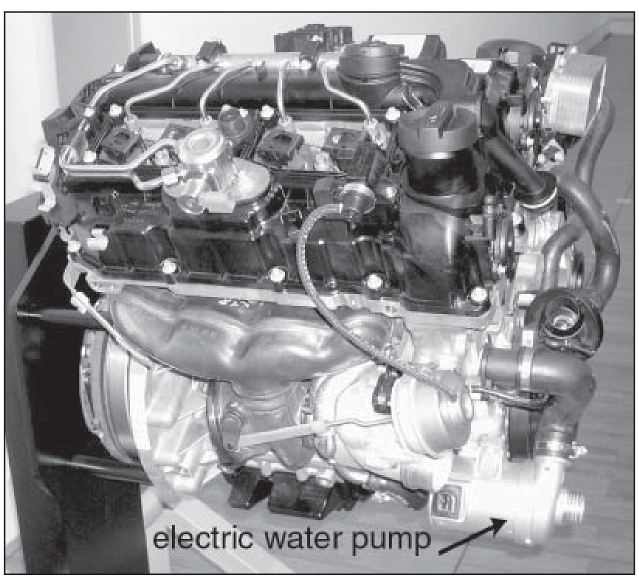

Figure 9: BMW's new turbocharged 2.0-liter four-cylinder has an electric water pump mounted at the lower right front. The 2.0-turbo replaces the in-line six-cylinder for fuel economy improvement, first in the Z4 and likely most other BMWs in the 1-series and 3-series size classes.

Figure 10: Looking for a heavy coolant flow (such as from the heater outlet hose into a container with the engine running) is one way to check flow from a conventional water pump. But with an electric pump, the pump flow rate is determined by the powertrain computer.

coolant should be pumped, and inadequate pumping could well be caused by a bad temperature sensor.

Classic "Pattern" Problem

This next case history sounds somewhat like the first, but it's really not: there's okay heat at cruising rpm, but it drops to nothing at idle on a 2002 Nissan Altima. The first reaction would be coolant circulation, perhaps caused by a restriction somewhere outside the heater core itself, as the heater was backflushed and flow through it seemed to be good. You may be thinking "It's a Nissan, so it must be air in the system." You're right, and jacking up the front of the car until the rear end is almost touching the garage floor, then running the engine and system with a Lisle Spill Free Funnel of coolant in the radiator fill neck was the cure. If you don't have this funnel kit, you can turn an old radiator cap into an air bleed valve by removing the sealing gasket and blocking the pressure valve open with a piece of wire (Figure 11).

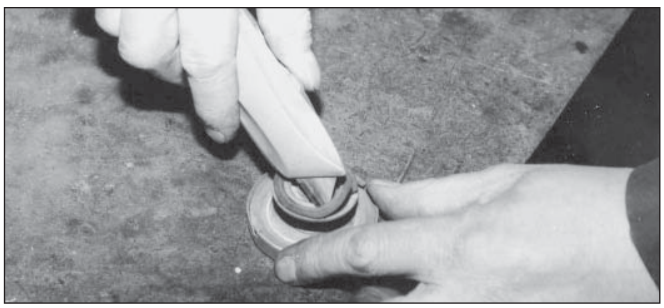

Figure 11: *An old pressure cap with the seal cut and removed, and a piece of wire to keep the pressure valve partly open, can help bleed air from the system.*

But Nissan is hardly the only make that seems to trap a lot of air. The worst case is any vehicle with rear HVAC, because if you jack up the front of the vehicle, the rear heater sits low, and any air pocket just sits there. What's the answer? Fill the rear heater core by disconnecting at the heater itself, and hopefully any minor bubbles will work their way out of the system during system thermocycling.

But we also find that some air entrapment results from failure to open all the air bleeds. Yes, you'll open the one in plain sight on the thermostat housing, but look around and you may find others (Figure 12).

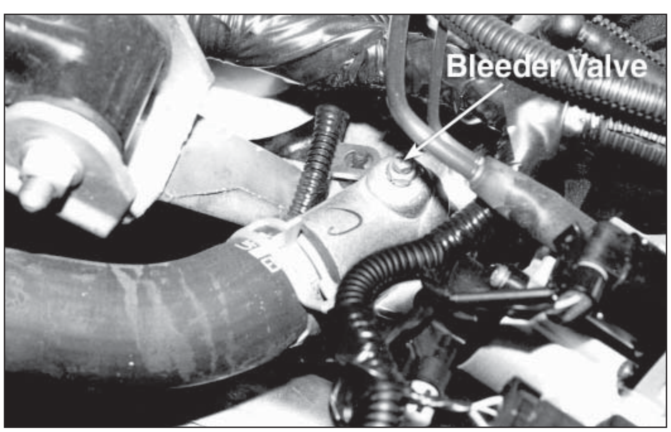

Figure 12: *Air bleed on top of thermostat housing. This one is obvious, but others may not be so easy to find.*

Heater Installation – OE vs. Aftermarket

Another problem that is often missed—or misdiagnosed—is poor heat after an aftermarket heater core is installed, particularly when the next step is installing a new OE heater core and then complaining about aftermarket parts.

Good example: a 2001 Pontiac Montana-- on which the heater core was replaced with an aftermarket part-- has poor heat, and its thermostat is found to be sticking open, so it's replaced, and there's a small improvement, but not enough. The system is flushed, and there's another small improvement, but at this point, the almost-new heater core obviously is not producing much heat.

This could have been prevented. The Montana minivan that was serviced for a no-heat problem indeed had a plugged heater core. The cause was found, and that original heater core was replaced. Heater output seemed to be okay to the floor registers. However, the heat dropped dramatically to the windshield when defrost was selected, which seems to indicate a hot air supply issue. The technician disconnected the A/C compressor and got an increase in defrost outlet temperature, but that was not a fix, of course. He took apart the dash, and determined that the problem was the aftermarket heater core, which was almost a half-inch shorter than the OE core, allowing much of the air that had gone through the evaporator to bypass the heater core.

He was very unhappy with the aftermarket core, which he felt was a bad engineering job, but is this a fair assessment? We'd say no.

Aftermarket heat exchangers are often a "compromise" size and design to cover multiple applications, which helps the aftermarket suppliers with inventory and pricing. The catalog recommendations mean they'll be a reasonable fit, and if there's an air gap, the technician ignores it at his peril. Unless he wants to ship back the part and buy an OE core, it's his responsibility to make up and attach a filler strip to permanently seal it. It's nice if the aftermarket replacement comes with a filler strip kit you can install, but if not, you have to do it. Some OE replacement parts have the same issue, although they are more likely to include the filler strip, perhaps even attached to the heater core.

Aftermarket heat exchangers also may have fewer tubes. This is hardly a "given," as we've seen many aftermarket ones that contained as many of those itty-bitty tubes as the OE. But for a particular supplier filling out his product catalog, it can happen here and there. Are you in an area where the climate hits extremes –very hot in summer and/or very cold in winter—and you get one of these "well, it physically fits" aftermarket heat exchangers with an obviously minimal design? Then we'd say OE might be the better way to go—no arguments.

A Related Problem

The temperatures are in the teens, and the coolant temperature on the 1998 Dodge pickup V-8 is holding in the 180-190 degree F range (scan tool reading) while the truck is idling or cruising in town. Turn on the heater and the air temperature from the floor registers is about 100 degrees F, despite the fact that the heater inlet hose reads about 175 degrees F, and the outlet hose in the low/mid-150's F. That may be a slightly bigger drop than you'd like, but it's okay, we'd say. The water pump had been replaced by another, reputable shop, which also installed a new 195-degree thermostat. The system is a conventional blend-air door type and the controls are working normally, so the technician is betting on a plugged core, and replacing it becomes his first-thought repair of choice.

Close call, because he thinks it through and decides the core is okay. Indeed it is. But the A/C compressor is running, and even in defrost it wouldn't be running with ambient temperatures in the teens. Checking the wiring, he finds a defective ambient-low pressure switch. And that's all folks.

What About This One?

Another Dodge Ram V-8 pickup, a 2003 model with single zone HVAC. Air on the driver's side is cold, but it's warm on the passenger side. Heater hose neck temperatures are in the normal range.

The technician first suspects the blend air door, because they have been a pattern failure on the truck. But he decides that this is unlikely for the symptom, with a single-zone system, and besides, the control seems to be working okay. It's a warm day, so he decides to see what happens if he turns on the air conditioning.

The driver's side gets even colder, and the passenger's side stays warm. Now the technician figures he can justify pulling the HVAC case, and he sees that the airflow through the heater core is split vertically (lower half to driver's side, upper half to passenger's side). That indicates that if the bottom half of the core is internally restricted, airflow to the driver's side can be cold, whereas the upper airflow can be heated as normal. Cutting apart the heater core indeed showed the bottom half to be plugged with debris, and a new core restored proper temperature control (Figure 13).

This example shows that how debris accumulates in a heater core depends on its design and flow pattern, and the orientation of the core in the HVAC case. Cut-apart cores we've seen tell us that a uniform deposit of foreign matter is not necessarily the norm. If the hose neck temperature seems normal but the heat distribution from the registers is not, keep this in mind. If you can reach the core with a temperature probe, you may find a very uneven temperature distribution across it, which confirms the restriction diagnosis.

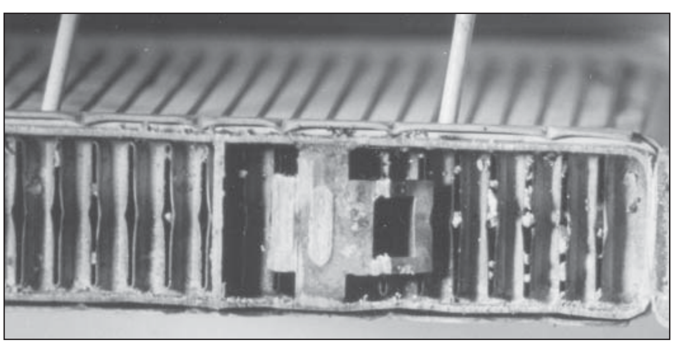

Figure 13: *Cut-open heater core shows plugging in one-half, so flow through the core may look good, but heating can be poor or uneven side to side.*

Those Auxiliary Coolant Pumps

Auxiliary coolant pumps provide circulation for improved heating at idle on many conventional gasoline engines with marginal heating performance until engine rpm is past part throttle. They are also are used on hybrids, to provide the continuation of heat during an idle stop, and they operate on many conventional gasoline engine vehicles (such as Mercedes) in the luxury car class when the engine is turned off. The luxury makers apparently discovered that their passengers often sit in the car for 5-10 minutes after a shutdown, listening to music or just engaging in conversation. Have to keep them comfortable. So if the vehicle is factory-equipped, you can check the pump to make sure it's working if there's a poor heat complaint.

How about a vehicle that doesn't have an auxiliary electric pump as a factory installation? Well, installing one in a vehicle with marginal heating at idle, perhaps because it's used in a very cold climate, is an appealing idea, but with today's computer controls not so simple.

Sure, you can buy an electric coolant pump, perhaps from the companies that supply them for racing applications, or even one of those Bosch pumps sold as a spare part to replace an OE installation. But all you'd get is a 12-volt pump and maybe a mounting bracket. You could wire it into the blower circuit, but without vehicle speed and temperature signals to turn it off, it would run all the time. And even jury-rigging it with a microswitch on the temperature selector is likely to be a problem.

About the only practical time you can add an electric pump is when there's a factory kit to deal with a field heating problem. An example is the 2003-06 Chevy Trailblazer EXT and GMC Envoy XL and Denali XL—the long-wheelbase models with three seat rows. These vehicles had marginal heat distribution to the rear, and GM installed an electric pump to improve coolant circulation to the rear heater core during the middle of the 2006 model year (actually starting in January 2005). So check the door sticker for the build date, and if it's January 2005 or later, the vehicle probably has a coolant pump. You can check by looking for it under the coolant reservoir, near the solenoid-activated heater coolant control valve.

If it's an earlier model, there is a kit, and it's really a very specific set of parts for the 4.2 in-line six (Kit No. 89024885) or the 5.3-liter V-8 (Kit No. 89024886), including hoses shaped to fit for a good installation. The job is factory flat-rated at 2-1/4 hours, including A/C refrigerant recovery and recharge, as the A/C accumulator has to be removed for the installation.

As the wiring diagram shows (Figure 14), the kit includes a pair of relays, a special wiring harness to go with the hoses and pump, and wiring into the HVAC control module. So without the complete kit, trying to install an electric water pump is not likely to result in a robust, successful job. We're not going to provide any real detail, because it's covered in a 13-page factory service bulletin (No. 05-01-37-002A, also listed as Document ID 1720850) from your electronic information system. Of course, it's also available (along with the wiring diagram, Document ID 1633128) from the official GM service information website – www.acdelcotechconnect.com. Note: one of the reasons we're running the wiring diagram is that although we found it in the factory tech info website, we couldn't find it in our aftermarket electronic service information system. But remember, you can always call the aftermarket info provider and ask for it by the number above.

By the way, if a customer doesn't want to pay for installation of a kit, you can offer this tip: always adjust for heat from the FLOOR register, not the VENT, which would duct the hot air through a longer path. And that tip, along with regular cooling system service, also could be enough to keep the rear seat passengers adequately comfortable in winter. ■

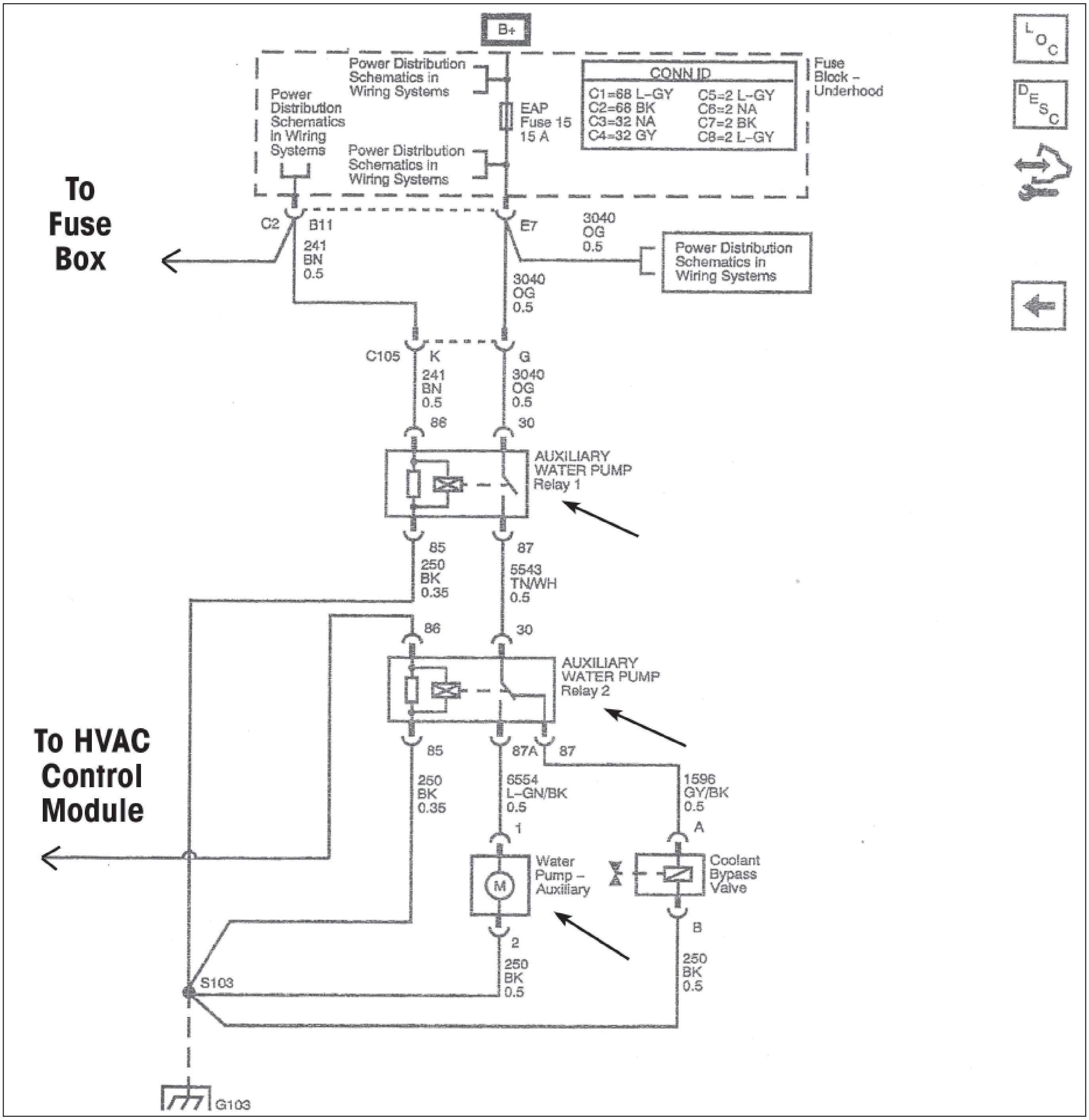

Figure 14: This is the wiring diagram for the auxiliary electric water pump rear heater modification for certain GM SUVs. Notice the two relays (which come with brackets, special harnesses, etc. in addition to the electric pump), necessary to provide a well-integrated system. This is not something a shop could readily replicate with a universal-type electric water pump.

COOLANT LEAKS THAT RARELY MAKE THE CHECKLIST

When you're looking for a coolant leak, particularly in the middle of winter, the reservoir rarely makes the checklist. But it should, certainly when nothing else is obvious. Leaking seams, particularly the side of the reservoir that is mounted so it's up against the body, are tough, because the coolant dribbles out of sight. Equally difficult are those with the reservoir that's part of the fan shroud (Figure 15), a common location on a lot of Ford products, particularly SUVs and pickups. These leaks outwardly may resemble a problem with the radiator top tank seal.

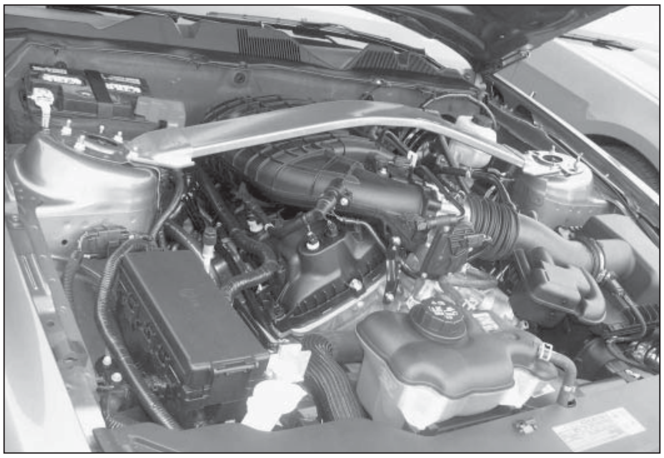

Figure 15: *When reservoir is mounted on the fan shroud as shown, a leak from a reservoir may appear to be from the radiator top tank.*

The reservoir was a known problem on 2006—09 six-cylinder Explorers (and Mountaineers), but it can happen on any vehicle with a similar shroud location. So lifting the reservoir for inspection is worthwhile.

The reservoir hose was improperly positioned on a small number of new rear-drive Chrysler products (Charger, Challenger, Chrysler 300) with the new 3.6-liter V-6, and it resulted in significant leakage. That doesn't mean that it's strictly a factory assembly line issue, for this sort of thing can happen from routine underhood service too. Chrysler specified checking the fit of the hose on the neck, to make sure it's within about a quarter-inch of the reservoir end of the neck. ■

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2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
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7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	A	B	C	D

1. Technician A says some individuals are born with a natural talent for things mechanical. Technician B says most individuals have probably had to work to acquire the skills they have. Who is right?
   a. Technician A
   b. Technician B
   c. Both
   d. Neither

2. Technician A says great technicians understand that they cannot rely on what they learned in their early years, or even what they learned last year. Technician B says great technicians take the time to learn from their mistakes, and apply those lessons to avoid repeating them in the future. Who is right?
   a. Technician A
   b. Technician B
   c. Both
   d. Neither

3. A technician's most important tool is:
   a. Internet resources and trade magazines
   b. Their scope
   c. Their digital multimeter
   d. Their mind

4. Technician A says you can't repair a problem unless you know for sure what that problem is. Technician B says communication between the customer and the technician is critical. Who is right?
   a. Technician A
   b. Technician B
   c. Both
   d. Neither

5. Technician A says gathering information is the most important step in a diagnostic process. Technician B says information gathering is primarily achieved through observation and research. Who is right?
   a. Technician A
   b. Technician B
   c. Both
   d. Neither

6. Technician A says, depending on who you talk to, easily half of the problems occurring in any system of cars these days are related to software programming and/or updated components. Technician B says enthusiast forums can be resources that could very well hold the key to solving your customer's complaint. Who is right?
   a. Technician A
   b. Technician B
   c. Both
   d. Neither

7. To verify a repair, you can:
   a. Repeat the tests you used to find the problem in the first place
   b. Operate the affected system to see if it now works as it should
   c. Perform a test drive in order to allow the system to test itself
   d. All of the above may be appropriate

8. Electrical circuit testing and multimeter usage are being discussed. Technician A says that there is no better method for finding electrical faults than voltage drop testing. Technician B says resistance tests using an ohmmeter are just as effective as voltage drop testing. Who is right?
   a. Technician A
   b. Technician B
   c. Both
   d. Neither

9. Technician A says pin #16 is the power terminal of the Diagnostic Link Connector (DLC). Technician B says pins #4 and #5 are the ground terminals of the DLC. Who is right?
   a. Technician A
   b. Technician B
   c. Both
   d. Neither

10. Technician A says a fuse is a resistor. Technician B says parasitic drain over 300 milliamps is a typical specification for unacceptable draw. Who is right?
    a. Technician A
    b. Technician B
    c. Both
    d. Neither