THE MOBILE AIR CONDITIONING SOCIETY WORLDWIDE©

MACS SERVICE REPORTS

Total Vehicle Climate and Thermal Management™

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HEATING AND DEFROST-- ARE YOU GETTING THE TICKETS?

We've issued warnings about the incompatibility of browsers (specifically Mozilla Firefox and Google Chrome) with many of the tech info websites. But there's also a new issue about which you should be aware: Windows 8/8.1 Professional, the current Microsoft business operating system, at this time is not compatible with the key General Motors "Techline" diagnostic systems, particularly Tech2Win, SPS (reprogramming) and the current (GDSII) Global Diagnostic System. They are, we understand, compatible with the Windows 7 Professional system, and if that's what you have, don't "upgrade." We would suspect that this level of incompatibility also is true for other OE diagnostic and reprogramming systems, so if you are thinking of changing your computer or its operating system, be sure to check with your equipment supplier for a browser issue as well. Do not rely on what you see at a factory website, as it may be out of date in these regards. We hope to see these GM systems made compatible soon, and will advise when we hear it's been done.

Unless you have a second shop in the southern hemisphere, there's not going to be a robust A/C business in January and February. However, lack of heat in the dead of winter is every bit as unacceptable to motorists as no cooling is on a hot summer day. Every time this year we talk about heater service, but the shops that feature A/C service in warm weather seem almost invisible in winter. Billboards and advertisements for A/C service in spring and summer? There are lots of those. However, we don't see very many, if in fact any, for heater and defroster service in winter.

Maybe it's a geographic issue; many of the shops best known for their A/C volume are in the relatively mild winter parts of the country. Actually, we know a number of shops with first-rate skills for all aspects of climate control. In the days when a seasonal antifreeze coolant change was common, some shops would mention better heater performance as part of a pre-winter service. But with extended-life coolants, that doesn't happen so much anymore. Unless you're getting enough business from solving hard-starting complaints, the seasonal companion for A/C in spring and summer is heater and defroster service in winter.

A leaking heater core is an exception, of course. It's year-round business that comes right into the shop. And sometimes during warm weather, people will object to being unable to modulate the A/C cooling, which is of course primarily a function of the heating system.

But there's no question; when it's cold outside, people want the heater to work, and if you promote your expertise with the same kind of marketing you do for A/C, it can fill voids in your service volume. ■

ALSO INSIDE THIS ISSUE:

IF IT ISN'T A PLUGGED CORE, WHAT IS IT?

Everything we've seen says that a plugged heater core is a primary cause of poor heater performance, but it's hardly the only cause. In fact, it may not even be a majority of the causes, and doesn't always mean the system needs a new core.

Sure, when the core is badly plugged, there's often no choice; you have to replace it, and the job may be expensive. But often there is a choice. We're talking about back-flushing the core. But first of all, you have to prove that the core really is plugged. If you get a 15-40°F temperature drop from the inlet hose neck to the outlet along with poor heating, that's a pretty sure sign (Figures 1, 2). You can disconnect the outlet hose on the engine side, then run the engine and see if there's a solid column of coolant flowing. If not, that's a confirming event.

But before you replace a heater core, most customers will opt for a back flush. It won't be nearly as big a ticket as installing a new core, but if you work with an effective piece of equipment, the results are almost surely likely to be worthwhile. With the labor time involved, chemicals, maybe a couple of hoses, etc., it's not pocket change either. And it's sure to boost your shop's reputation for saving the customer money. If you measure the heater duct outlet temperature when you start and after your best efforts, you're almost sure to be able to show an

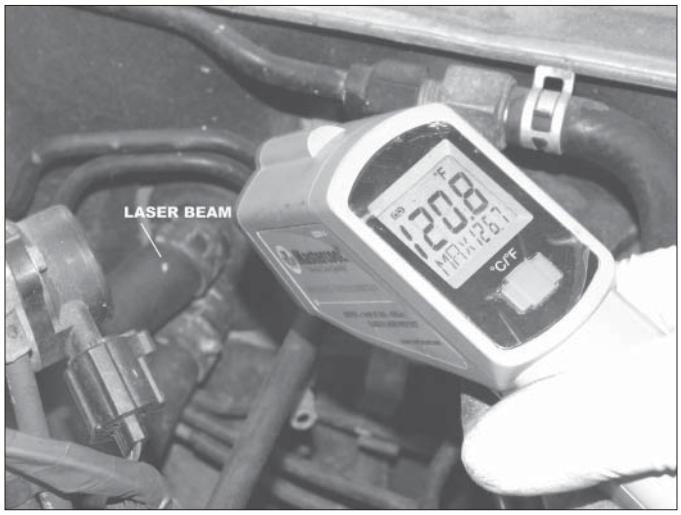

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Figure 1: *Checking the temperature drop across the heater hoses at the core necks should show a very small drop. If you see a drop of 15 to 40°F and heating is poor, a restricted core is a likely problem. Here we're using an infra-red thermometer with laser sighting so we're sure we're aimed at the right hose. Look for a temperature drop from inlet to outlet of about 3 to under 10 degrees and a high-enough coolant temperature. In this case, the coolant is still warming up, but the temperature drop across the hoses is running just under seven degrees. (120.8 versus 126.7). However, measuring coolant temperature on the hoses is not really accurate and will read somewhat lower than the coolant flowing through it, so also check with a scan tool reading the coolant temperature sensor to get the temperature of the coolant itself.*

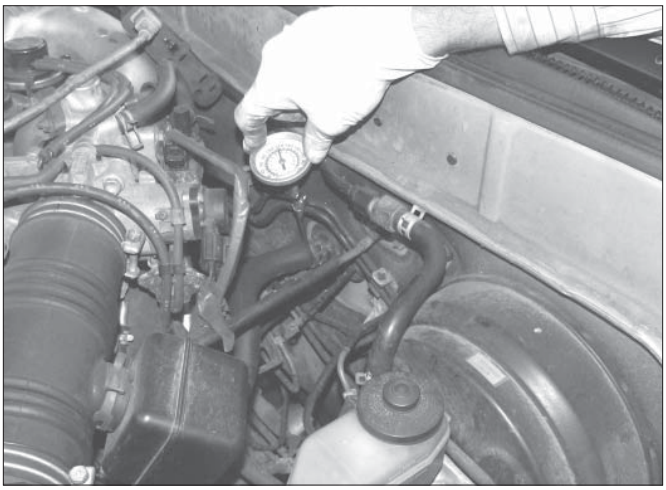

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Figure 2: *Checking temperature drop across the heater hoses with a probe-type thermometer as shown will produce more accurate results (assuming the thermometer itself is accurate). But it may take a few minutes for the thermometer to reach the temperature of the heater hose.*

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Figure 3: *After one back flush, heater outlet air temperature is up from about 94°F to 102°F, which is an improvement, but maybe the shop can do better.*

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Figure 4: *Use of a chemical flush got the outlet temperature up some more, to 117°F.*

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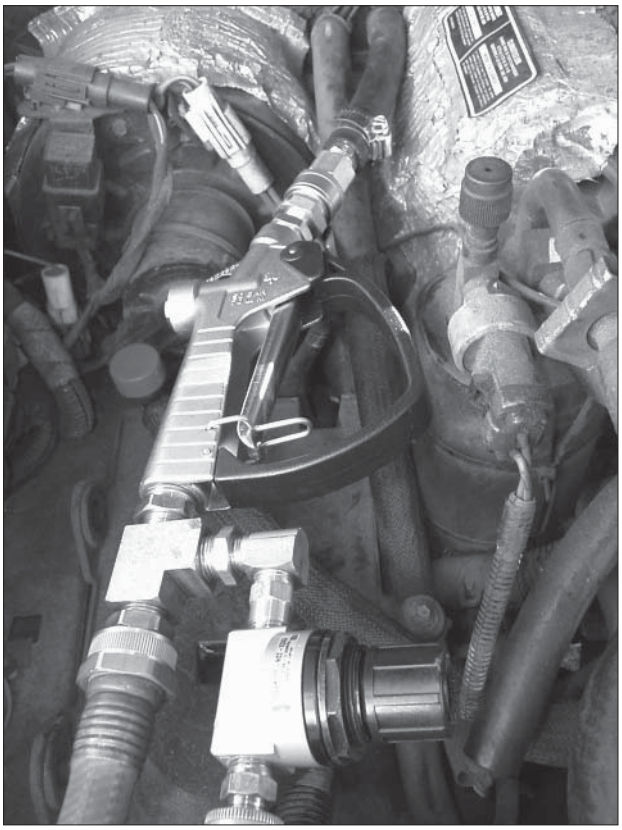
Figure 5: *After several more attempts at back flushing, the probe in the floor air duct shows the temperature is now very good, hitting 155°F.*



Hecat Inc

Figure 6: *Back flushing with a flush and fill machine or a pulsating flusher as shown, is likely to yield the best results.*

improvement. See Figures 3, 4, & 5.

That means perhaps circulating a flushing chemical through the system, then using a flush and fill machine (not just a drain and fill machine) or at least a back flush gun like the Hecat/Gates pulsating flusher (Figure 6). We have seen enough cases where it took circulating flushing solvent to start the process, then 3 to 5 operations with back flushing equipment to provide decent heater operation. Particularly on an older car, perfection isn't necessary, just results that are good enough to satisfy a customer for whom a heater core replacement might cost more than he'd be willing to spend. Unlike A/C, plugged heaters are rarely seen on cars seven years or younger. It happens, but most are on older models.

Here's an example worth noting: a 2006 Honda Pilot with the complaint that the air coming out of the vents is warm, but not hot enough to produce a comfortable cabin. The technician checks the heater in and out temperatures at the hose necks, and they're 180°F and 154°F. So the problem obviously is not related to coolant temperature itself. But that 26 degree temperature drop is huge. Often we see as little as 3 to 5 degrees, and certainly less than 10 degrees when there's good flow. The technician began by using a full strength chemical flush through the core only multiple times, and then switched to power back flushing for an hour with water only, and finally with power back flushing through the entire cooling system.

The results were decent for the investment. With good equipment, a lot of the flushing time doesn't require continuous attention, and the motorist was very satisfied. Of course the Pilot heater core replacement is a labor-intensive operation, flat rated at about nine to ten hours (including heater hose replacements, cooling system flush and fill, as well as air conditioning recovery and recharge). Yes, the job also requires removal of the dashboard, the HVAC units (including the heater case) and of course the evaporator (Figure 7). That makes it one tough job, and for a first-timer on this vehicle, add a few hours to that labor time. Including the cost of the OE heater core (you wouldn't take a chance with anything else for this big a job) can bring the total up to a number that might floor a customer.

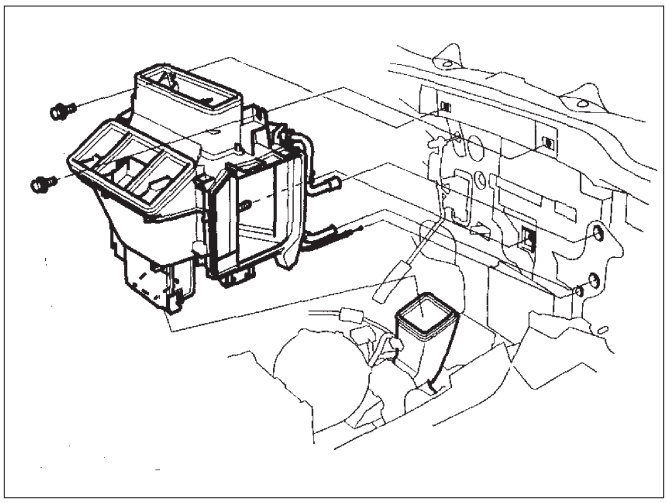


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Figure 7: *Replacement of a Honda Pilot heater core is a last choice job, because it requires a lot of time, including taking out the dashboard to be able to remove the HVAC case as shown.*

That doesn't mean you should only go for the intensive flush if the job is this expensive or very close. However, as we've noted, very few heater core replacements are pocket change, and a specialist should be able to offer this kind of lower-cost alternative. It's still a worthwhile amount of la-

bor, and unless the customer is really willing to go for the full-price alternative, it's likely that any improvement you get from the effort will be perceived by most customers as worth the lower investment.

Just as an aside: this vehicle has a heater coolant valve, so make sure it isn't the problem; a subject we'll talk about later in this report.

THE AIR POCKET

The high mounting of the heater core on many cars means that they can be prone to trapping a lot of air. Probably the most notorious are Nissan products, and there are more complaints about trying to jack up the front end of a Nissan vehicle so that the air pocket works its way up to the front and out. "I had it up so high the rear bumper was touching the shop floor, and the air bubbles still wouldn't come out" is a line we've heard more than once. Some Japanese cars have installed air bleeds on hoses at the top of the firewall on a few cars we've seen, but the complaints persist. The company has issued a variety of service recommendations over the years.

Nissan hardly is the only one with air entrapment issues, but it has used coolant flow patterns that are among the most complex in the industry.

Nissan is also not the only one with air bleeding issues. The "worst ever" probably was the 2002-2005 MR-2, Toyota's mid-engine small sporty car with an extremely complex front-to-rear cooling system layout, worse in some respects than any Nissans. In fact, many shops would just make sure there were no leaks, drain and fill the reservoir and radiator, thermocycle the system (warm-up, let air bubble out of fill neck, then top up and let system cool down and top up again -- repeat twice). Not the greatest practice, but it beat the alternative. If you had a leak and had to repair and then refill, you could follow any of the on-line recommendations of enthusiasts, or use the factory procedure, which you'll find in your aftermarket service information system. But there aren't many MR2s on the road, so we'll continue to focus on the more conventional cars, as few are problem free. The main issue is that all cooling systems have become more complex, "catching up with Nissan," with a couple of dozen hose connections. The complexity gets worse with hybrids and plug-ins, which often require coolant flow loops for power electronics, battery chargers (for plug-in hybrids) and in some cases for the battery packs (see Figure 8, Chevy Volt). And for specialty vehicles with high-output electrical systems, coolant-cooled alternators also are part of the picture.

The best defense, therefore, is to be pro-active when the car is in for any other service. You should be checking for seeping connections, looking for any indication that a

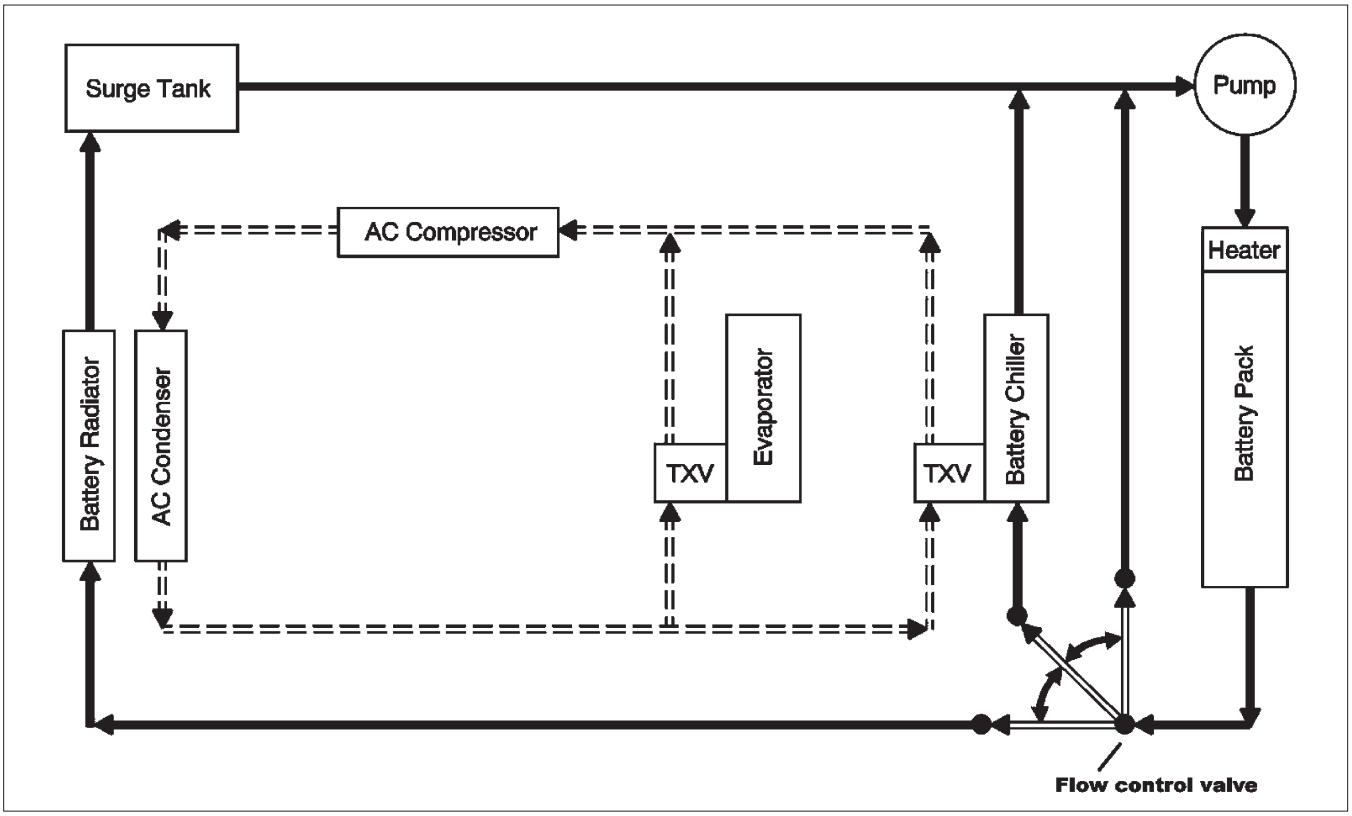

Figure 8: *Chevy Volt is one of the hybrids with several coolant flow circuits. Shown is the one that is combined with the A/C circuit to heat the battery pack in extreme cold or cool it in hot summer weather. Flow control valve has one inlet port (from battery pack) to three outlets (one to battery radiator, surge tank and electric pump; a second to the battery chiller in the circuit that includes the A/C heat exchanger; a third that bypasses both of the others). For heating the battery pack, the valve goes straight up, and coolant flows from battery pack into pump, through heater (electric, turned on) and then into battery pack. For cooling, valve is flat down (horizontal position), so coolant flows from battery pack to and through battery radiator and surge tank and into pump, through electric heater (turned off) and into battery pack. For extra cooling, valve is in mid-position (45 degrees), so coolant flows from battery pack through chiller (where it's cooled by A/C) and then into pump (electric heater is turned off).*

pressure cap is not sealing properly (results in low coolant level, admits air to system).

GETTING RID OF THE AIR POCKET

Every cooling system traps some air, and purging it is usually a pretty straightforward procedure. Raise the front end and thermocycle the system (warm-up, let air bubble out of the fill neck, then top up, let the system cool down, and repeat as often as necessary (typically 3 or 4 times). This can be time consuming, but it works for all but the most difficult systems. Using a top up funnel, such as the Lisle type with the adapters for different size fill necks, is as good a tool as any (Figure 9).

If a system is likely to trap air, there will be bleed valves that should be opened. With problematic heaters, the one in the hose against the firewall on Nissan and other cars, not only have to be opened, but make sure a valve isn't plugged with debris, as they often are. Clean out that valve before you begin thermocycling.

If a lot of coolant has escaped and you can't seem to get rid of the air pocket while filling the system, the most practical approach may be to drain and refill. It actually can give you a better shot at the problem.

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Figure 9: *Lisle funnel comes with adapters for tight fit into engine coolant fill. Pour 50-50 mix of coolant into funnel, then jack up front of car and remove the stopper. Run engine and air will bleed from system and system will take coolant from funnel to maintain full system. Several efforts at thermocycling (engine warm-up and cool down) may be necessary to get virtually all the air out of the system.*

REAR HEATERS

When the system has been drained and it's time to refill, the rear heater can pose a special issue. If you jack up the front of the car, you've lowered the rear heater, so any air in the rear will stay there. Hopefully you know the routine: fill that rear heater with coolant before you go for the front system, and turn the heater control to full heat, so any small amount of air in the lines to the rear will not be a source of complaint and will eventually bleed out.

COMBUSTION GASSES

Of course, what appears to be an air pocket may actually be combustion gas getting into the cooling system. In fact, when an "air pocket" keeps reappearing despite your best air bleeding efforts, it's likely you're fighting a combustion gas leak, usually from a leak at the head gasket joint, but possibly from a mini-crack or other engine issue.

There are several possible ways to detect a combustion gas leak. With the engine warmed up, rev the engine to about 4000 rpm and if there's a leak, you could see bubbling in the radiator fill neck or reservoir. But if it's nothing that obvious, the alternatives are pretty well established, such as using a gas ana-

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Figure 10: *Combustion gas analyzer probe can identify leakage from engine, particularly head gasket, into coolant jackets. Lower coolant level from fill neck, wrap plastic sheet over fill neck and push gas analyzer probe through plastic sheet and see if it detects combustion gas emanating from coolant.*

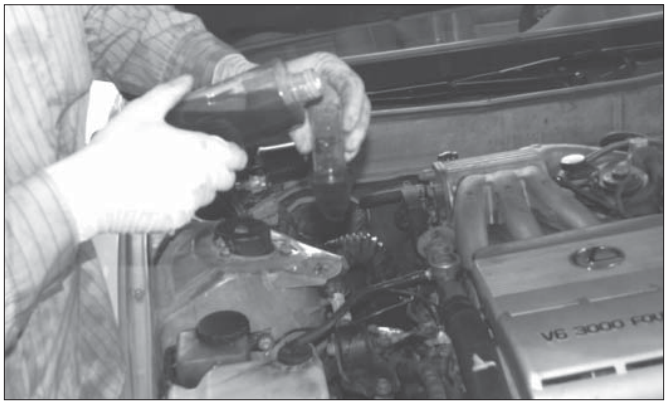

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Figure 11: *Combustion leak detector that indicates combustion gas in coolant is another method. Fill tube (in this case each of two tubes) to specified level with blue test fluid.*

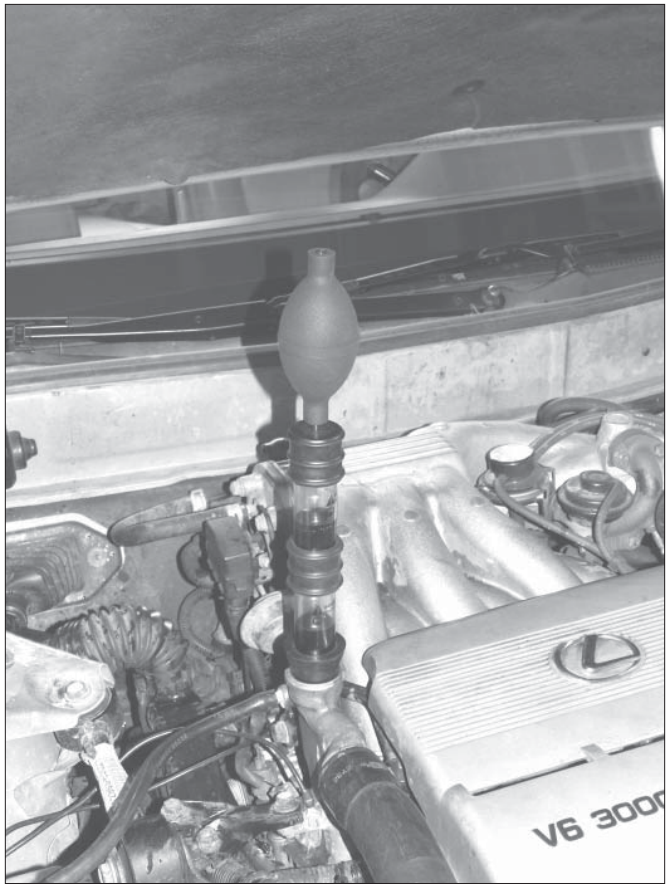

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Figure 12: *Top up coolant fill neck, then draw out enough coolant so detector can be inserted and will not touch coolant. Assemble detector in coolant fill neck as shown.*

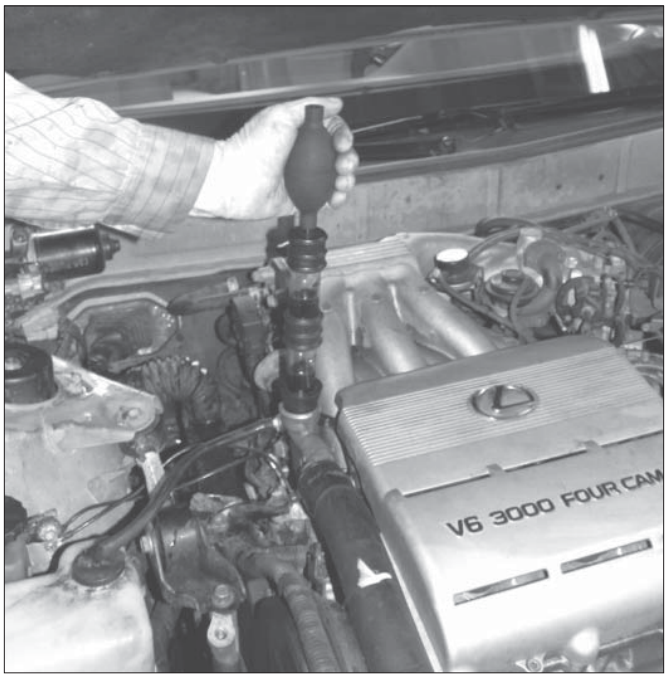

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Figure 13: *Hold leak tester in place as shown (do not squeeze bulb at this time) and have helper start engine and hit gas pedal, then allow return to idle for several seconds. Repeat this 12-15 times, squeezing the bulb each time as engine returns to idle. If fluid changes color from blue to yellow (green for diesel engine), there is a combustion gas leak.*

lyzer probe in the radiator fill neck, not touching the coolant, pushing through a plastic wrap over the neck (Figure 10). But probably the most widely used is the color-change (blue to yellow) fluid system; the one we've had good luck with is the UView double-tube type, which seems to deliver accurate results (no false positives). See Figures 11, 12, & 13.

DRAINING THE SYSTEM

Normally when there's a bad leak that you fix, there's no choice: you have to drain and then refill the system. We've said this many times over the years: even with the best equipment, you may get only a moderate percentage of the used coolant out of the system on any vehicle. Ford makes it very clear with the statement that you can't get any more than 80% of the coolant out of the engine while the engine is in the vehicle. So unless you plan to remove the engine and turn it upside down (yes, we're being facetious), you're going to leave a lot of coolant in the system. But don't make the situation worse. Opening the radiator drain cock might get out 30% of the coolant, and if you empty the reservoir, you might get the percentage up to nearly 50%. If there's an engine block drain plug, locate it and open it (Figure 14), or at least disconnect the lower radiator hose. Many block drains, when opened, will kick the percentages into the 60-70% range. We have seen them on some engines, such as the Nissan 2.5L, and some Chrysler engines such as the 3.7L V6, which makes at least a check for one worthwhile. Overall, however, there are preciously few block drain plugs on late models but every engine has a lower radiator hose.

The difficulty of draining the typical system is one reason (yes, there are several others) why long-life coolants are in universal use. Specifying distilled or otherwise purified water is done for the same reasons. The increased packaging of 50-50 mixtures is done for two reasons:

1) ensures the quality of the water is good;

2) improves the solubility of high doses of many of the widely used corrosion inhibitors. They dissolve in water, but not so well in the ethylene glycol antifreeze.

That's why our preference is for using a premium flush-and-fill machine with back flush capability, to get the maximum amount of used coolant out of the system (still not 100% by any means) and minimize the possibility of air pockets during filling of the system. But the equipment is not pocket change, so we recognize it's a hard sell. The low-cost alternative is a vacuum-fill device, which incorporates a venturi to pull the system into a vacuum, and then lets the system draw coolant in to fill it.

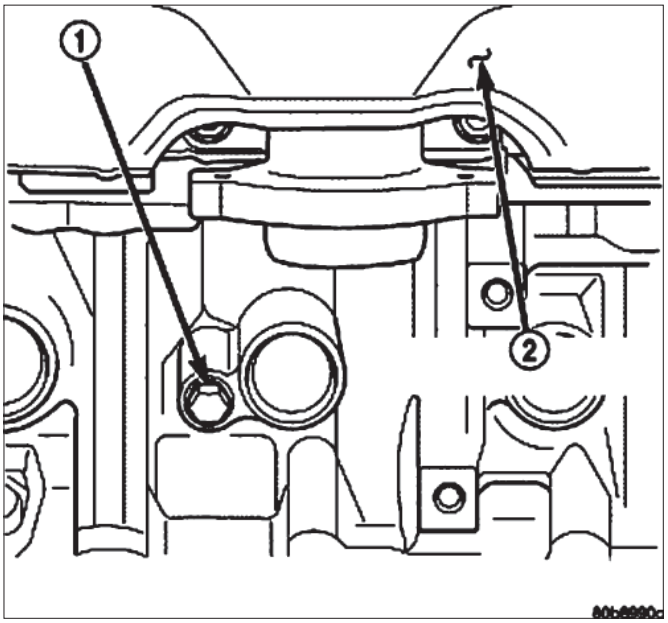

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Figure 14: *Some engines still use block drain plugs, so check for one and remove it to improve the percentage of coolant drained. Shown as (1) is the 3.7L-V6 drain plug on a Jeep Liberty; it is just below the exhaust manifold (2).*

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Figure 15: *Use of air lift tool is an effective way to remove air from cooling system. Attach air hose as shown to venturi vacuum pump and look for gauge reading to build up to at least 24 in. of vacuum or higher. Then close ball valve (shown closed) and disconnect venturi pump from the radiator neck adapter. Vacuum reading should hold for at least 20 seconds or there's a leak that has to be fixed.*

It works well with an empty system that has no vacuum leaks, and vacuum does have a sealing effect versus pressure leaks. The big problem is emptying the system. As noted earlier, opening the radiator drain gets some 30% or so of the coolant out. If there's an engine block drain, opening it improves the percentage, and on some engines disconnecting the lower radiator hose from the engine is an alternative. From there on, it's onto filling the system. You could also flush the heater core separately, which would remove dirty coolant from that heat exchanger.

Once the system is as empty as possible, connect the vacuum lift kit, pushing the tapered neck into the coolant fill. Virtually all manufacturers approve this device today, even Nissan, which has tried just about everything in the way of system filling techniques. The venturi vacuum device may not pull as deep a vacuum as the vacuum pump in a premium flush and fill machine, but assuming you have a good air compressor producing normal shop air (over 90 psi), it will be enough to develop 24 inches of vacuum or more. If it holds for about 20 seconds

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Figure 16: *Connect fill hose in container of 50-50 mixture of coolant as shown, then lift and place coolant jug on top of radiator, open ball valve and coolant will be drawn by vacuum into radiator. If coolant jug is running low on coolant, close ball valve and refill jug as necessary.*

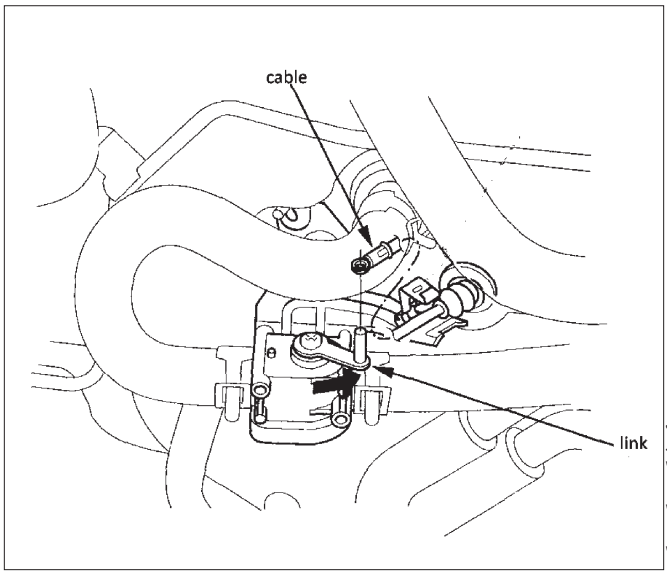

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Figure 17: *Most heater coolant valves can be externally checked to see if linkage moves and hoses can be felt to determine if valve is opening or closing.*

or longer, it should keep the system air-free as coolant is drawn in (Figures 16, 17). Is the vacuum lift a "perfect" answer? Nothing is perfect, and if the system flow configuration is complex, well, you never know. If that's a possibility, a thermocycle or two should finish off the job.

PARTIAL PLUGGING

There's a perception that debris plugs all the tubes of a heater core gradually, but that's just not the way it often happens. Sometimes larger particles fill one section first. While the flow through the rest of the core continues reasonably well. So the first symptoms (depending on how the core is mounted relative to the floor ductwork on the driver versus passenger side), may be poor heating on only one side. That symptom leads many technicians to look for a ducting problem, or in the case of a split system, to a problem with the mode control and/or temperature control (actuator and/or the flap door) on the misbehaving side.

Okay, but before you tear apart a dashboard, keep the partial plugging in mind. Unfortunately, if there are tubes that are reasonably clear, a simple flow test may be deceptive, because you'll see what is apparently good flow from inlet to outlet. But unless there's a trouble code for a split system temperature sensor or actuator, a pulsating back flush is the higher-percentage service and generally a lot less labor-intensive (with a higher rate of success) than tearing apart the dashboard. ■

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

1. The following are major functions of engine coolant except:
   a. inhibiting corrosion
   b. providing boil over suspension
   c. preventing freeze up
   d. lubricating the water pump

2. Conventional coolants checked for alkalinity with a pH strip will measure around:
   a. 1.0 to 3.5
   b. 3.5 to 6.0
   c. 8.5 to 11.0
   d. 11.0 to 13.5

3. When testing for the presence of stray voltage, the rule of thumb has always been around 300 mV or less measured in the coolant. True or False?
   a. True
   b. False

4. Technician A says that IAT, OAT, HOAT and P-HOAT are acronyms for different types of coolants. Technician B says that specific colors are used to indicate a specific type of coolant. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both technicians A and B
   d. Neither technicians A nor B

5. Most shops will use a combustion leak detector to finalize a head or head gasket diagnosis. An emissions gas analyzer can detect _____ in the filler neck just above the liquid level when the engine is running to supplement your diagnosis.
   a. CO
   b. CO_2
   c. O_2
   d. NO_x

6. As moving air hits a restriction, drops in air pressure occur. An Airlift system is a simple application of this, known as:
   a. the burping principle.
   b. the Bernoulli effect.
   c. air pocket flushing.
   d. thermostat cycling.

7. Technician A says the second generation Prius is known for water pump bearing failures around 120k miles. Technician B says the third generation Prius ditched the mechanical pump for a 12 volt unit to reduce engine drag and increase fuel economy. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both technicians A and B
   d. Neither technicians A nor B

8. If a heater core inlet hose is 30° warmer than the outlet hose, coolant is flowing well. True or False?
   a. True
   b. False

9. Technician A says that temperature problems have nothing to do with the HVAC module or actuators. Technician B says actuators can get hung up and break because of a broken air door. Which technician is correct?
   a. Technician A only
   b. Technician B only
   c. Both technicians A and B
   d. Neither technicians A nor B

10. A recent study revealed that over _____ % of late model vehicles on the road have at least _____ service issue(s) which can ONLY be addressed by updating the software on an electronic control module.
   a. 80%, 5
   b. 60%, 3
   c. 40%, 1
   d. 20%, 2