KEEPING IT

Coolant incompatibility and the usual assortment of great service

The coolant inside each of the reservoirs—from a Toyota, a '98 Dodge Intrepid and a VW Passat—looks about the same color. It's red…well, maybe pink…or is it orange? Yup, must be that new orange OAT (organic acid technology) coolant, with the special inhibitor package that provides a promise of longer coolant life.

In reality, only one of the three is a "pure" OAT antifreeze—in the VW. And as such, Volkswagen carries no replacement recommendation. Then again, VW never has had a replacement interval, even with its conventional coolants, something no one at VW has ever explained to our satisfaction. The antifreeze in the Dodge Intrepid may be orange and contain some OAT, but it's really what we call a "hybrid," and it may be going away after a brief trial. The Toyota? It uses a traditional Japanese coolant—a high-phosphate, nonsilicate formulation.

If you want to take this whole thing a step further, look at a Dodge truck. You'll see green coolant in its reservoir. Looks about the same color as the green stuff in a Mazda, but the coolant in each is totally different. Well, at least all coolants are compatible. Or are they? As we're finding out, there's a fair amount of incompatibility among coolants, both with the new extended-life antifreezes and when mixing the new OAT coolants with what we now call "conventional" formulas.

Questions & Answers

The National Automotive Radiator Service Association (NARSA) has been wrestling with this issue, trying to sort out the confusion and see where the real-world problems exist. It has been getting coolants analyzed and talking to scientists and chemists, plus engineers at the vehicle manufacturers.

NARSA admits that it doesn't have all the answers, but it may be able to help you avoid the major pitfalls. Here are NARSA answers to some frequently asked questions. First, though, a few caveats: Many changes are occurring in coolant chemistry, and NARSA believes Daimler/Chrysler U.S. will be going to a new coolant formulation very shortly. Ford, meanwhile, has said it's considering a hybrid for its U.S. cars, but for the present is continuing with conventional American coolant.

Those caveats aside, here's a service-oriented summary of what you need to know to help minimize the chances of doing something wrong with your customers' cooling systems.

First of all, forget coolant color; it's just a dye and means nothing. GM and Texaco, which codeveloped the Dex-

COOL

By Paul Weissler

tips highlight the coverage from this year's NARSA convention.

Cool brand of OAT antifreeze for late-model GM vehicles, picked orange to distinguish this type of antifreeze from conventional American coolant, which is green or gold. Volkswagen, which also uses an OAT formulation as mentioned earlier, has a similar dye that most of us think is pink. Toyota's traditional red dye is a totally different product. Although the orange coolant in Chrysler L/H models contains OAT, it's a custom hybrid, with Chrysler specifically forbidding the use of Dex-Cool in these cars. It would have been better if Chrysler had used some other dye color.

What kinds of coolants are out there? Aside from the limited sale of propylene glycol to environmentalists, it's ethylene glycol... about 93% ethylene glycol, that is, plus water and specific rust and corrosion inhibitors. Here's a rundown:

Conventional American coolant (green or gold) contains silicates (a long-used aluminum corrosion inhibitor) and other inhibitors. Silicates work quickly to protect aluminum, but also are depleted relatively quickly in service. They're also somewhat abrasive (being based on silicon-sand), so they've been implicated in water pump seal wear. Advocates say tests show silicates last longer than was commonly believed. And with the latest seal materials, they actually do a better job of protecting the water pump, because they both resist cavitation erosion-corrosion and "repair" any that occurs.

OAT coolant (orange or pink) contains no silicates and no phosphates. It's a blend of two or more organic acids, a specific class of inhibitors with slow-acting, long-life properties. Texaco's Havoline Dex-Cool (also sold under the Goodwrench label by GM) was the first example. Prestone and Peak also have introduced OAT coolants that are chemically compatible with Dex-Cool.

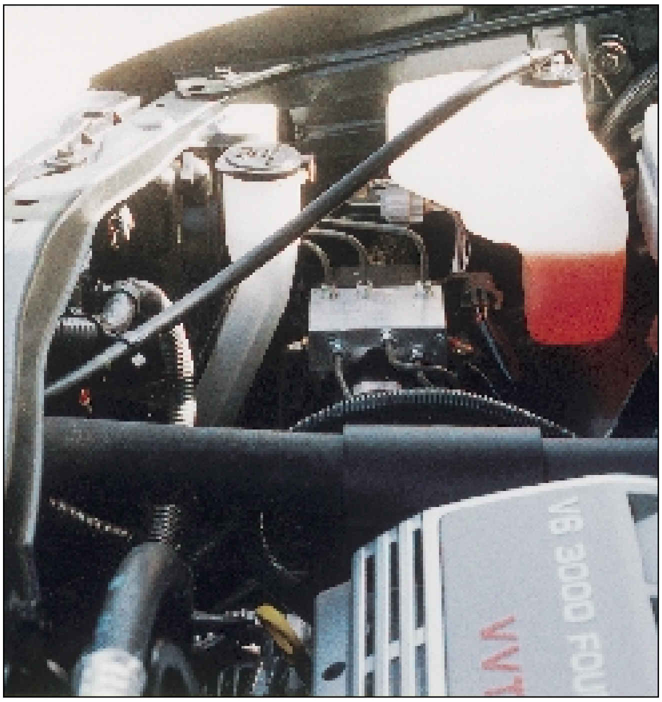
Conventional Japanese coolant (green or red) contains no silicates, but has a heavy dose of phosphates and other inhibitors, including a modest amount of one or two organic acids.

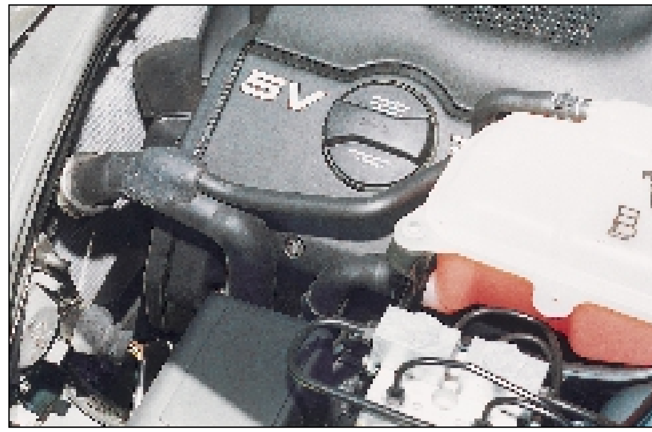
Conventional European coolant (blue or yellow) contains a low dose of silicates and no phosphates, but does include other inhibitors, including one organic acid.

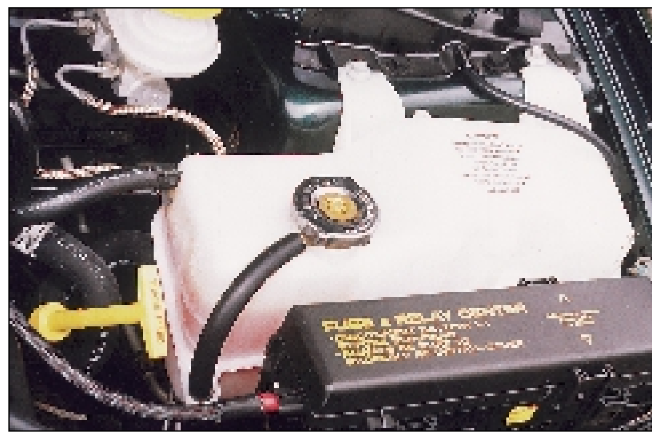
Hybrid European coolant (blue or green) is similar to conventional European, but with a much greater dose of organic acids. It's a balanced formula designed to have the silicates provide the primary protection for the aluminum, then allow the organic acids to provide long-term protection.

Hybrid American coolant (green or orange) contains a moderate dose of silicates, plus a blend of organic acids.

So with all these coolants around,







Photos: Paul Weissler

Three overflow reservoirs and all the coolants look the same. Actually, they're all different. At top right is a VW Passat, which has an OAT coolant that's different from GM's Dex-Cool. At right is a Dodge Intrepid, which uses a silicate/OAT hybrid. Above is a Lexus ES300 with Toyota coolant, basically a high-phosphate, nonsilicate formula.

who uses what?

•GM cars and light trucks built since the 1996 model year use Dex-Cool OAT. VW/Audis since 1998 use an OAT, but it's a different formula. The '99 Mercury Cougar uses an OAT-type coolant that's reportedly similar to Dex-Cool.

•Except for the '99 Cougar, Ford U.S. vehicles use conventional American antifreeze. And except for the hybrid coolant in '98-on L/H cars (Intrepid, Concorde, 300M), so do Daimler/Chrysler U.S. vehicles.

•Mercedes uses a conventional European antifreeze that has been upgraded, and may outlast the conventional stuff.

•GM Opel products sold here (namely the Cadillac Catera) use Dex-Cool.

•Volvos and BMWs use a hybrid European.

•Japanese cars use a conventional Japanese coolant.

•Korean cars use either a conventional Japanese or conventional European antifreeze. (It depends on who did the in-depth engineering for the Korean company.)

•Medium-duty and heavy-duty diesel vehicles should use specific formulas, with additives that meet recommended practices of the American Trucking Association's Maintenance Council. Some OEMs use specific OAT formulations. Cummins, on the other hand, forbids pure OATs, and recommends a specific silicate-containing hybrid with heavy-duty additives as part of a "lifetime" fill maintenance program.

Some problems exist when you mix OAT coolants with the conventional stuff, or when you do an OAT retrofit. Much evidence points to the fact that if you mix conventional American antifreeze (silicated) with an OAT type in a system with virgin aluminum (that's not protected by either type), severe corrosion will result. The producers of OAT coolants approve their use in any system, provided it's been thoroughly flushed out first.

NARSA's position is more conservative (factoring in the issues raised by the vehicle makers), and is based on the assumption that all you can obtain for service is conventional American green/gold or an American orange OAT. NARSA still recommends conventional American green/gold antifreeze. Specifically, NARSA recommends the following:

•Use Dex-Cool or an aftermarket OAT only in GM cars that were factory-filled with Dex-Cool. Although you can top up with any of the three OATs available, the best practice is to flush out the system first, to remove at least 90% of the old coolant.

•Do not use an OAT antifreeze in any Ford product aside from the '99 Cougar. It may attack certain gasket materials (particularly in Ford modular V8s). It also can be responsible for water pump cavitation erosion-corrosion, reports Ford.

•Do not use an OAT coolant in any

Chrysler product. OAT has been shown to increase damage from water pump cavitation erosion-corrosion, particularly in some truck V8s. If you can't get the specific Chrysler orange hybrid, flush out the system and install a conventional American antifreeze.

•In European cars equipped with a hybrid or conventional European antifreeze, use a conventional American silicated antifreeze.

•In Japanese cars equipped with silicate-free coolant, rely on this bit of history: These coolants never were sold in any quantity in the U.S. Japanese cars seem to survive nicely on conventional American products, so the safe approach is to stick with them. Both Japanese silicate-free and conventional American coolants contain phosphates, so they share that key inhibitor.

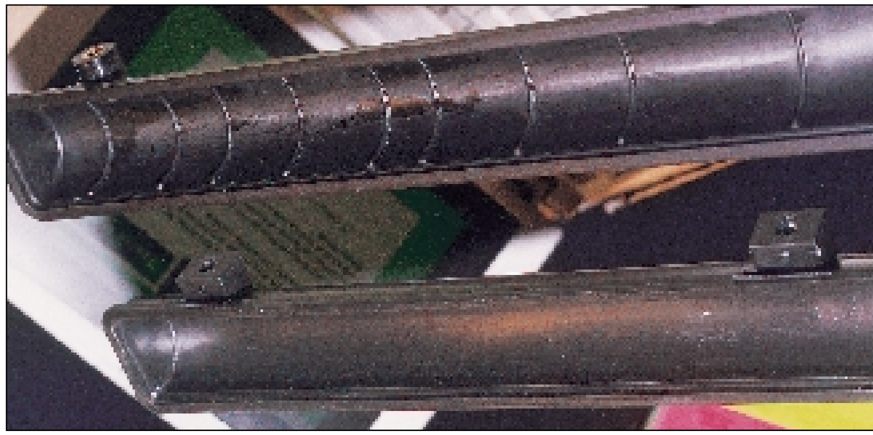
•On heavy-duty vehicles, stick with the OE recommendations.

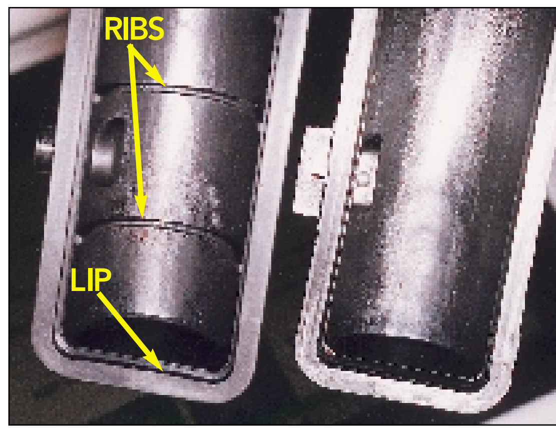
•For temporary use, as in a roadside emergency, mixing different coolants is better than using just plain water. But the system should be flushed out and refilled with the correct coolant as soon as possible.

What if a customer insists on a retrofit to get long coolant life? Widely reported tests by Valvoline-Zerex and Prestone indicate that cooling system protection with conventional American silicated antifreeze can last for 5 years/100,000 miles if the system has been maintained well from the start. That means being continuously topped up and the antifreeze concentration maintained at 50% to 60%. That same treatment, by the way, is needed to enable an OAT antifreeze to safely go 150,000 miles in the five-year period. In any case, the quality of the water, which is half the fill, may be as big an issue as concentration.

There are reports that NARSA is pushing distilled water. Who wants to bother with that, you ask? The answer: If you're in an area where the water is very hard and the shop doesn't have a water softener, why not? A gallon of distilled water is cheap insurance.

How important is coolant concentration to system longevity? When the specified 50/50 mix gets too low—maybe 20% antifreeze—that's an area





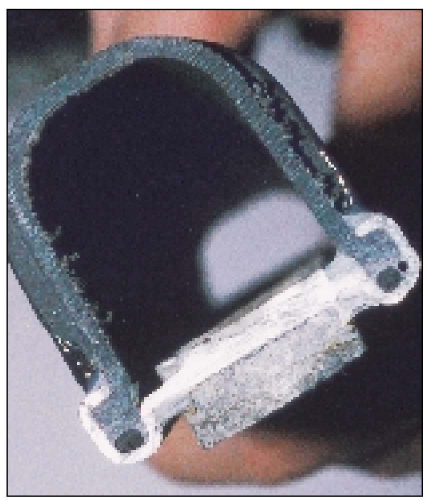
Above: These radiator tanks fit the same core, but the one at the top is an OE-grade design, the one at the bottom a lower-priced aftermarket tank. The OE tank is much shinier, indicating a higher nylon content for greater strength. **Right:** Close-up of the two tanks shows the OE-grade tank has strengthening ribs inside and a wider support lip around the gasket surface.

where any antifreeze (silicated or OAT) can face a problem. Other radiator and heater corrosion problems occur when a poor job is done on removing old coolant, which may be so bad that a fresh fill of either type also turns bad very quickly. This problem has surfaced on systems using conventional American silicated antifreeze.

Some problems have been reported with systems using Dex-Cool. Although aluminum is considered the most sensitive material for coolant performance, GM also has been dealing with cast-iron rusting problems on Chevy/GMC S-10s with the 4.3-liter V6. The problem, first reported by NARSA member shops, seems to be in still another but related category—low coolant level. No one is sure why the 4.3-liter V6 is so sensitive to a low coolant level, but it's causing rusty sludge buildup in the radiator and heater. GM will release a choice of flushing procedures shortly. You can top this one up, but make darn sure it's with a 50/50 mix.

There are some special precautions to take when performing mechanical repairs on a vehicle's cooling system. The first, obviously, is to never mix coolants. Another is that if the system contains an OAT and the customer wants to maintain the long-term service interval, stick with an aluminum radiator. Remember, OAT coolants contain a copper-brass corrosion inhibitor but may not protect adequately against lead solder, particularly high-lead solder. That concern originally was recognized by GM, which prohibited retrofitting its Dex-Cool OAT to older models with copper-brass radiators. Now, GM's tech service people say they can't approve any retrofit of Dex-Cool into any system that was factory-filled with a conventional American silicated antifreeze.

What replacement intervals you follow depends on which type of coolant is used and the type of service the vehicle will see. With conventional American green/gold, if the system is kept full with a 50% to 60% mixture of



Late-model Ford radiators (above) are said to be nonrepairable, because the header tabs supposedly won't take recrimping. Cutaway of Ford radiator (below) shows how epoxy fills the gasket trough to produce an inside-out bond.

a quality coolant, a replacement interval of 2 years/30,000 miles is incredibly conservative. Chrysler and Ford long have approved about 3 years/50,000 miles, and there's evidence that even these intervals are conservative for a well-maintained system. If the mix is diluted further, all bets are off.

With a quality OAT coolant, if the system is kept full with a 50% to 60% mixture, the 5-year/150,000-mile interval is fine. If the coolant is diluted, corrosion problems could crop up.

The real world says that medium/heavy-duty diesels don't get a coolant change, that the factory fill is run until it's time for an engine overhaul. Both Cummins with its hybrid coolant and Texaco with its heavy-duty OAT have supplementary additive packages to extend the life of the factory fill. Cummins recommends installing an additive package (or a new coolant filter, which also contains the additives, depending on application) at 150,000-mile intervals (about once a year). Texaco recommends using its additive package at 300,000-mile intervals (about every two years).

Cavitation Problems

As coolant flows through the water pump, it may boil at the inlet. As it flows to the pressure side of the pump, the bubbles collapse with explosive force. This is called cavitation, and the mini-explosions of the bubbles can pockmark the pump chamber and impeller, knocking off the protective layer of corrosion inhibitor (erosion) and exposing the metal surfaces to corrosion. Because silicates act faster than OAT inhibitors, they recoat the exposed surfaces, for a so-called fast repair. In addition, there are claims that OAT coolants are more prone to cavitation than conventional coolants. GM designed its cooling systems to minimize pump cavitation, prior to the changeover to the Dex-Cool OAT.

Service Tips

As you'd expect, no organization sorts through more information on servicing cooling systems than NARSA. Besides coolants, here are some of the latest things its members learned about keeping cars and light trucks from overheating.

Radiator Repair vs. Replacement. If you've always believed that complete replacement is the only choice when there's a problem with an aluminum/plastic tank radiator, NARSA is offering 2:1 odds on a successful repair. The basis for the confidence: a recent national survey showing that its members are successfully repairing two out of three such radiators. Those odds are almost as good as for conventional copper/brass radiators, with which radiator shops have long experience (but against which cheap replacements are a competitive force).

The only market where replacement is dominant is the copper/brass/plastic tank radiator, but it's a small piece of the pie, and may be related to parts availability. In Canada, for example, the copper/brass/plastic radiator is being recored, and the percentage of replacements is low.

The reasons why repair beats replacement are simple:

•The OE aluminum/plastic radiator typically is a high-tech design, and a quality replacement is not cheap, including the premium aftermarket models. A high percentage of repairs involve the plastic tank or its sealing gasket. Plastic tanks are readily available for virtually all applications, and the prices of OE-quality tanks have been coming down. The price difference between OE-quality and the low-priced tanks is as little as $2 to $3, so a radiator shop can give you better quality and still beat the price of a new radiator. The repair typically comes in at $50 to $100, a fraction of the price of an OE-grade new radiator. Specify an OE-equivalent tank to get the most durable job.

•Even if the radiator needs a new core, and the shop installs a premium-quality recore, the job ends up at $50 to $75 less than new—not mashed potatoes when the radiator is just one part of an overall service job on which you have to be competitive. A recored or repaired OE unit is sure to outperform a cheap import. That's important if you're looking for good cooling performance following an overheat-related repair. Ford tests of off-brand imports showed

New pressure tester gauges go up to 30 psi, and that's what you'll need if you have to test a system that's specified for 25 psi.

they didn't come close to its OE specs for heat rejection (or durability). And with today's small grilles or no-grille underbody breathing, there isn't much margin for underperformance.

•Don't assume a repair is impossible. NARSA shops have learned effective techniques for common situations. For example, with a later-model Ford radiator, the header tabs that hold the tank are not rated for long life if they're opened and recrimped (such as for replacement of a tank or tank gasket). As a result, Ford considers these radiators "throwaways," and doesn't supply replacement tanks. However, shops have learned how to use epoxy at the header to hold the tank and help seal the joint. And premium aftermarket tanks have been introduced for some popular Ford applications.

If the radiator has a copper/brass core and the leak is from a stress crack in the header (a common Chrysler problem, for example), recrimping obviously won't do anything. However, the plastic tank can be discarded in favor of soldering on a brass tank. One supplier is offering brass tanks to radiator shops specifically for this repair.

Time for a New Pressure Tester? You've probably had your cooling system pressure tester for a long time, and so long as it worked and you kept acquiring adapters for the new fill necks, it was fine. However, the old ones were designed for testing systems by pumping them up to about 16 to 18 psi at most (and most were in the 13-to-15-psi range). Now the pressures are creeping up, as engineers tweak cooling systems to meet specific engineering standards against overheating.

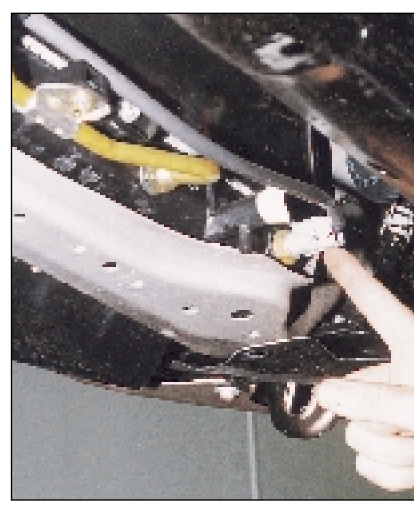
Some Camaros/Firebirds have caps rated at 25 psi, and you can expect to see similarly high pressure readings on many vehicles, as "aero" front ends and underbody breathing kick up coolant temperatures. The new coolant testers have gauges recalibrated to read up to 30 psi, so maybe this is the time to spring for a new pressure tester.

This broken thermostat bridge allowed the valve to cock and jam in the partly open position, a condition that may simulate a plugged radiator or weak water pump.

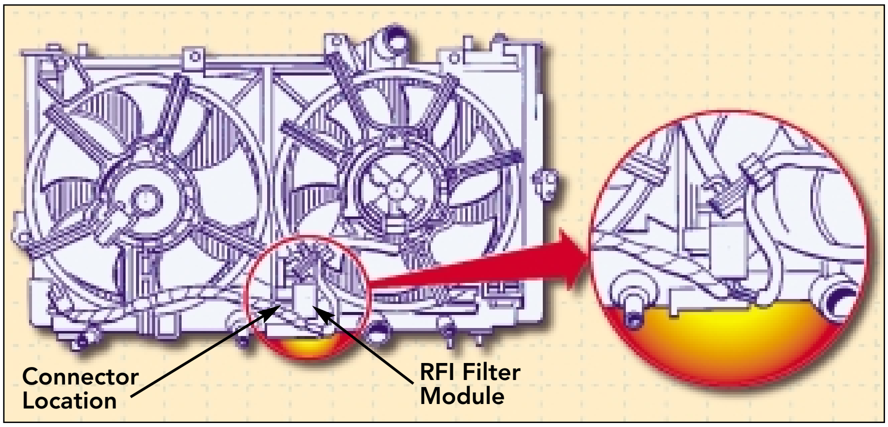
Plugged Radiator, Weak Pump or... When an engine cools normally at idle but overheats on the road, the primary suspects are a plugged radiator or weak water pump. NARSA members have been reporting many cases of cooling systems plugged with leak-stopping additives, however, often because motorists were trying to avoid the expense of replacing a leaking heater core. With these additives, the core gets sealed (plugged, actually), while the restrictions in coolant flow that result cause overheating during operation that calls for higher flow rates. If you check coolant temperatures with an infrared thermometer, you'll notice that the readings in several parts of the cooling system are all over the map, varying in some cases by 70° or more (on each side of a restricted area). It will take a lot of work to backflush and push out enough sealer to restore cooling system performance. And that leaking heater core will finally have to be replaced.

Another cause of similar overheating symptoms is a defective thermostat. If the stat fails to open completely, the coolant flow just won't be adequate for high-load cooling. One NARSA shop even provided an extreme example—a stat with a broken bridge and a valve cocked partly open. Weak stats are an even more common problem with some motor home and truck V8s (the stat bounces closed when hit with the high-pressure pulsations of the flowing coolant). In these cases, install a heavy-duty stat, which has a more muscular power capsule.

Some Japanese cars overheat due to still another cause—a radiator fan coolant switch located in the bottom tank of the radiator. Here's the deal: If the radiator is even slightly restricted, the coolant in the bottom tank is cooler. So the engine has to run significantly hotter before the coolant in the lower tank is hot enough to close the switch. And typically, the engine overheats before that happens. You may see that the fan is coming on late, and



If the coolant fan thermoswitch is in the radiator's bottom tank, as on this late-model Toyota Camry, a partly plugged radiator, weak water pump or any major coolant flow restriction can result in late turn-on of the fan.



The RFI choke on Chrysler Neons and L/H models is at the bottom center between the two fans as shown. In this location, it was susceptible to stone damage. In 1998, a phase-in began of fan motors with built-in suppression.

a shop in a hurry may be tempted to just thread in a replacement coolant switch. However, if you bench-test the switch in a pot of coolant, you'll see that it's operating at spec.

It's also possible for a weak water pump to produce the same effect, and no one wants to pull a recessed Japanese engine water pump for inspection without reasonable assurance that it needs replacement. But if the radiator is good, there's no evidence of plugging with leak-stop additives and the coolant flow from the upper hose obviously is weak, how much choice is there? Coolant flow testers are available and relatively inexpensive, and it's worthwhile to have one.

The Part That Doesn't Exist. A part that doesn't exist shouldn't cause trouble, but it does, on 1995-97 Neons (and potentially on some Chrysler L/H models). The truth, however, is that it's a part that really is there, but Daimler/Chrysler's tech service people didn't know about it, and what NARSA found is that this generic issue is a potentially significant one.

The problem you'll encounter is that the fans don't work. In addition, a/c performance drops, and unless the vehicle is cruising, the engine soon overheats. The hitherto-unknown part is a radio suppression choke, and even if it isn't in the wiring diagrams for the Neon or some L/H models, it definitely does exist.

The problem is that it's a "Part In Assembly," which means that it's part of the front cooling module that comes complete from a supplier. As far as Daimler/Chrysler was concerned, it received a cooling module with an electric fan assembly engineered to meet its performance specs (including any needed radio suppression), and with a wiring connector that would plug into the vehicle harness. The shop manual wiring schematic, therefore, just shows an electric fan assembly. The choke was the supplier's add-on to meet the radio antistatic requirements for the fans. Starting late in the '97 model year, some fan motors were modified to incorporate the radio suppression choke.

The overall problem of detail parts is nothing new. Many times car companies won't release them unless there's a heavy demand for an expensive assembly. But at least you know the part is there, and the factory understands the diagnosis and replacement issues.

Look closely at the Neon/LH fan issue just discussed. The problem surfaced when rocks damaged the low-mounted suppression choke module on vehicles still under warranty. When dealer techs found the fans themselves actually were working, they spoke to the factory tech service people and the existence of the suppression choke was identified. To save the enormous cost of a dual electric fan module, a supply of the previously unknown chokes was obtained and released, along with a new wiring connector (Part Nos. 04897717AA for the module, 04897674AA for the connector). And if you check your MOTOR/Alldata information system, you'll be able to find a service bulletin that tells how to install it.

What happened with this Part In Assembly is that it created a problem you can expect to see more often—parts that are included in modules by suppliers but not called out separately, not identified by the vehicle manufacturer and, most important, therefore parts you can't get. NARSA was advised of a cooling module part on another Daimler/Chrysler make—a commonly serviced item that was about $1 wholesale. However, it wasn't called out by the supplier. And if someone in D/C tech service hadn't noticed and had it made available, the one way to get it would have been with a very expensive component ($300 or even more).

Last year Toyota's chief engineer said he was reluctant to purchase electronic modules from the outside, for fear that "all parts will be 'black box' parts, beyond the technical understanding of the carmakers. That's not good." He's right, but unless the suppliers and vehicle makers do a better job of exchanging details, the problem is only going to get worse. M

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