WHAT'S NEXT IN AUTO A/C

By Paul Weissler

Things are heating up in the world of mobile a/c service. While discussions on the next possible refrigerant continue, service equipment designed to work with the current refrigerant and meet the newest SAE standards is now available.

Photoillustration: Harold A. Perry; photos: Wieck Media, Robinair & Jupiter Images

The world of auto air conditioning service is in the middle of a sea change, and the 2008 Mobile Air Conditioning Society (MACS) convention and trade show held in January of this year was dotted with examples.

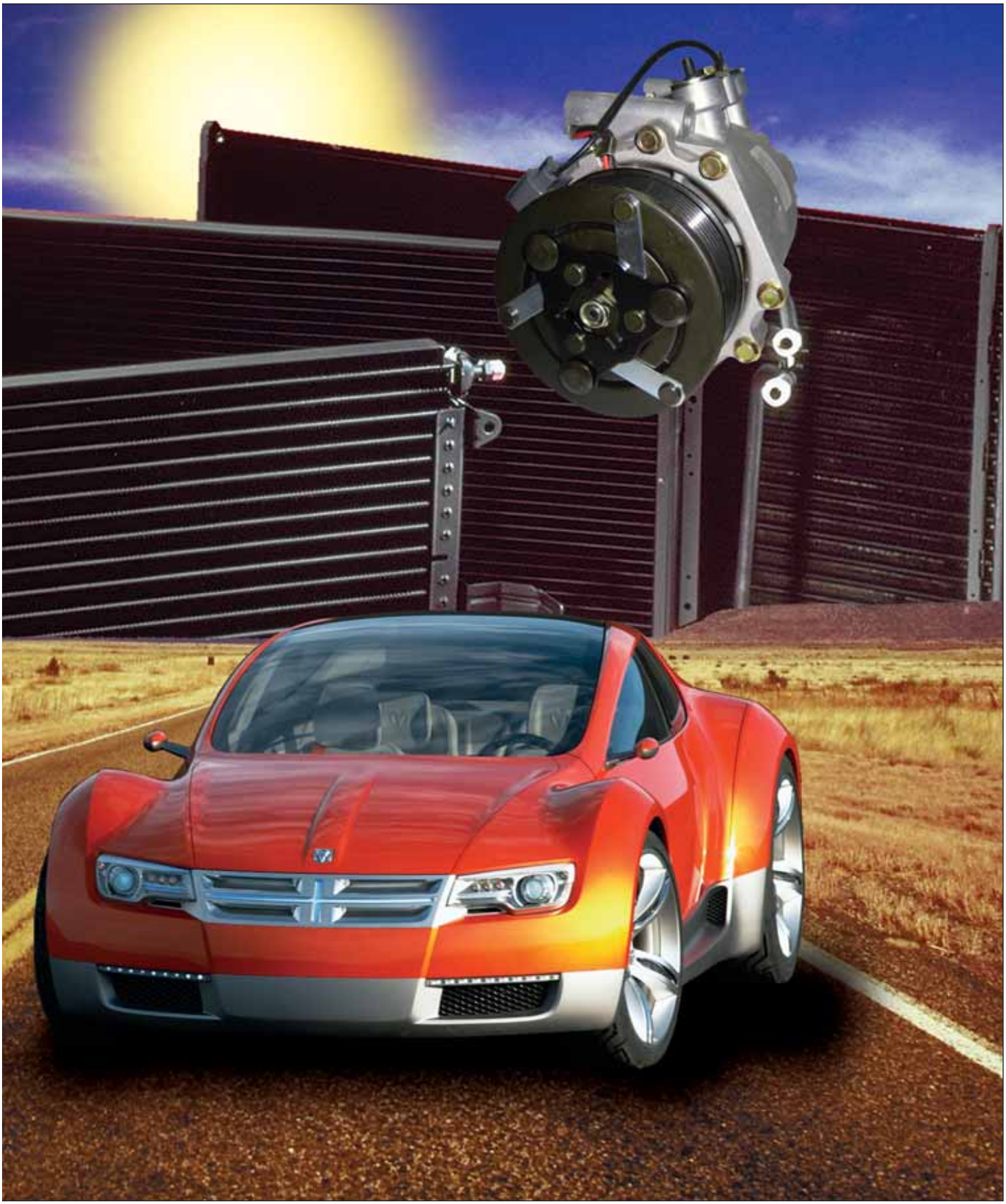
There's a lot to talk about, of course. In this report we'll tell you about a couple of new refrigerant blends that show some promise for success, new R-134a equipment that has found its way to the marketplace, a new generation of leak detectors and a bevy of new tools and kits designed to make a/c service easier and faster. Let's get right to it.

The Next Refrigerant

Although R-134a is still the U.S. refrigerant for the foreseeable future, the Europeans are close to a legally mandated phaseout, which is less than three years away. Will cars they produce for export to the U.S. come with a new refrigerant, or might the Europeans do a crash engineering job to design their vehicles to accommodate two totally different systems able to come down the same vehicle final assembly lines? We don't know because they don't know. Reports say there still are no firm contracts signed for components and chemicals for any alternative to R-134a.

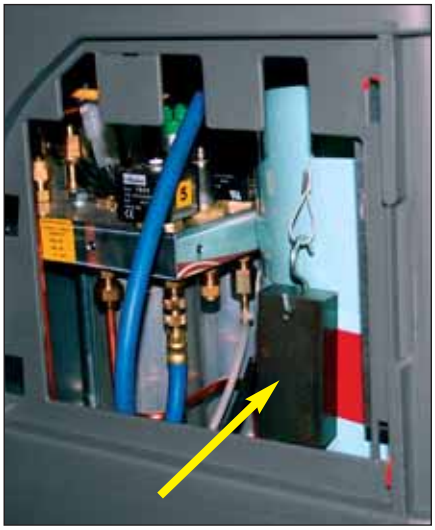
All the blend refrigerants that were considered alternatives have fallen victim to toxicity and other issues. There are still the likely very expensive high-pressure carbon dioxide refrigerant systems. And there's R-152a, a mildly flammable refrigerant, which would require an underhood-only system (with a separate, liquid coolant heat exchange to the underdash system). And use of this refrigerant raises some packaging issues.

Recently emerging as a new choice is HFO-1234yf, the primary ingredient in a previous blend, Fluid H, by Honeywell. Taking out the second ingredient, a fire retardant but also a cardiac sensitizer among its issues, means that HFO-1234yf alone raises flammability questions. But tests show its flammability is far less significant than that of R-152a, and so it could be circulated through an underdash evaporator,



same as an R-134a system. HFO-1234yf takes so much ignition energy to set aflame, it cannot be ignited with a butane lighter or even an arc welder, according to DuPont and Honeywell, who are in a joint venture to commercialize this refrigerant. Toxicity testing to date has produced good results, they said, and performance testing shows it's slightly more efficient than R-134a. Direct circulation to an underdash evaporator saves one level of heat exchange, which has cost, packaging and efficiency advantages.

HFO-1234yf has a pressure-temperature curve almost identical to that of R-134a, and any system leaks reportedly could be found with current R-134a electronic detectors. The new refrigerant's appeal? Its global warming number is just 4, well below the European regulatory limit of 150, and far below that of R-134a, which is 1200. Although HFO-1234yf is not quite a drop-in replacement for R-134a, it's close enough so that major system changes would not be necessary. However, the flammability issue, although minor, might mean that a safety venting system for HFO-1234yf would be needed, such as sensors to detect any leakage from the evaporator, and electronics to instantly open valves to vent the refrigerant charge to the atmosphere.



Photos: Paul Weissler

SAE J2788-compliant a/c service machines must have a way to check scale accuracy in the shop. A typical approach is by using a calibration weight (arrow), with a calibration sequence in the machine's computer illustrated on its digital display.

The German manufacturers have verbally committed to producing carbon dioxide (CO_2) refrigerant systems, and continue to develop them. In meetings with equipment makers prior to the MACS show, they worked to ensure that, if CO_2 is chosen for production, electronic leak detectors and recovery/recharge equipment would be available for service. Because it has a global warming number of just 1, CO_2 would not have to be recycled (a similar decision for HFO-1234yf, if it's used, would be premature at this point). Because we inhale air and exhale CO_2, technicians apparently would have to wear a mask while using a leak detector.

Other European makers, including Fiat, Renault and Peugeot-Citroen, have cited major issues with CO_2. General Motors is hedging bets, with a mild commitment to CO_2 but an indicated readiness to use HFO-1234yf, if it's deemed feasible.

A choice of a new refrigerant for European cars should already have been made, to ensure enough time with production-level components to integrate a new a/c system into new models and perform field tests. Carbon dioxide is furthest along in development, but because a CO_2 system poses cost and remaining reliability issues, HFO-1234yf still could make it. Or, as seems very possible, European carmakers could split, some going for CO_2, the others for HFO-1234yf. A decision by this summer seems certain, but we also thought we'd know a year ago.

We can reasonably say this: If CO_2 is used as a refrigerant by *any* makers, they surely would prefer to install it only in models for the legally mandated European market for at least a year or two. Recognizing the CO_2 reliability questions, the last thing the makers want to do is have to perform factory fixes for such new technology on export models. The European law requires an alternative to R-134a only in new models, not in what largely are carryovers.

Bottom line: If a CO_2 system comes to the U.S., the quantities will be very small and the warranty coverage very generous, and an independent shop wouldn't have to think hard about it until probably 2015. HFO-1234yf is another matter. It's more likely to be seen here much sooner if it's selected. We believe that if HFO-1234yf seems likely

The CPS Products AR2788 a/c service machine has an all-metal body with three drawers in front and one at the bottom, for storing spare filters.

The Flo-Dynamics/Norco Clima/CS CCST Nos. 388 (shown) and 288 a/c service machines are both automatic, but only the 388 can be equipped with an optional printer, refrigerant flush mode and vehicle diagnostic module.

Removing the front cover from the Ritchie/Yellow Jacket No. 37880 a/c service machine affords full service access to all the electronics and electrical modules, plus both compressors.

to pass longer-term toxicity tests, the CO_2 systems will be shelved. And if Europe settles on one refrigerant to replace R-134a, with good toxicity results, HFO-1234yf would surely be the choice, if Honeywell and DuPont offer it at a reasonable price. HFO-1234yf is the one possibility that might even become a global refrigerant at some point in the future.

We'll keep you posted. But your main market now and for many years to come is still R-134a, so we recommend budgeting for new equipment ASAP.

New R-134a Equipment

It's not just the U.S. Most of the world—including Asia—is sticking with R-134a because there's no overall better substitute on the horizon. The European ban on R-134a, made without a valid alternative ready to go, was unwise, as there is still no firm decision on a replacement. The R-134a global warming number of 1200 is a concern to environmentalists, but only if the systems leak. Fact is, today's systems have been made far tighter.

In addition, energy consumption of R-134a systems has been reduced. This also improves their global warming performance, because energy to run the system is about two-thirds of auto a/c's global warming effect (leakage produces the rest). Automotive a/c accounts for 5% of total U.S. gasoline consumption.

Energy is saved by improved computer controls of reengineered compressors, more efficient condensers and evaporators and reduced charges of oil and refrigerant (means less fluid to pump around the circuit). R-134a charges are as low as 10 to 14 oz., oil charges as low as 3.5 oz.

Last year we talked about the effect of smaller charges, what poor performers the old machines are and how inaccurate their scales are (if they have them). We added that the new SAE J2788 machines would give us the needed level of precision both in recovering refrigerant and weighing it, and then recharging very accurately—to within .5 oz. We don't have to repeat that any more than we already have, but you now can see we're making slow but steady progress on the problems.

A year ago we had just one machine that met the new SAE J2788 standard. Now we have seven, all lab-tested to remove at least 95% of the refrigerant

RTI Tech's No. 980 a/c service machine features a swiveling head for easy viewing while working and, as shown, a removable front cover for access to the tank and replaceable modules, including a two-section solenoids bank for in-shop service of the machine.

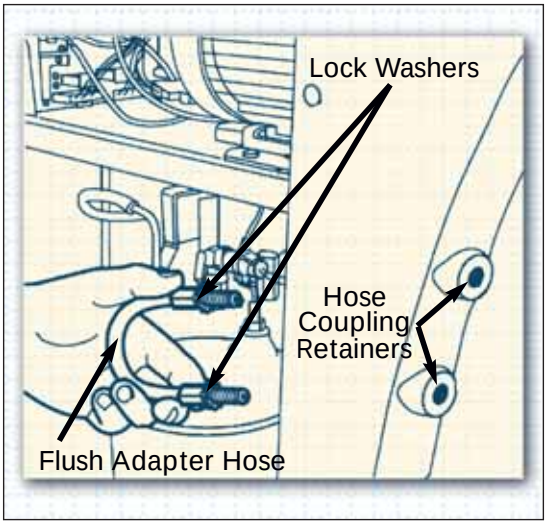
Photo & Illustration: Robinair

The Robinair No. 34788, the first machine to be certified, has a flash card slot at the side (arrow) for installing software upgrades and updates.

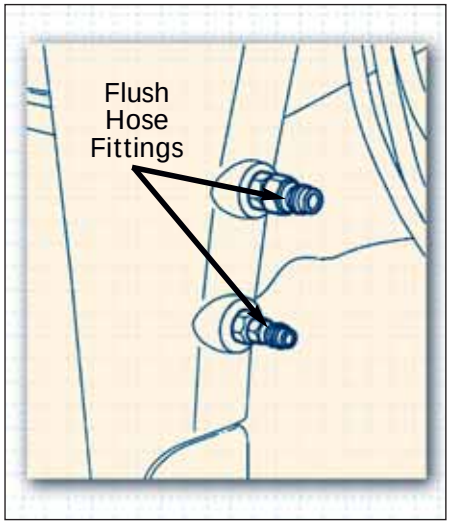
with accuracy within 1.0 oz., and to recharge refrigerant with accuracy within .5 oz. And every machine *must* come with a way for a technician to check scale accuracy (no option), so you'll get a small check weight and a machine computer calibration check in the software.

The old machines, which met the SAE J2210 standard, went out of production on Dec. 31, 2007 per amendments to the Clean Air Act of 1990. But they still can legally be used and are being sold by marketers at what seem to be very low prices. However, even at a fraction of the price of a J2788 machine, they're no bargain. The new recover/recharge/recycle machines, in addition to scale accuracy, are designed with a host of features, such as vacuum leak check, automatic air purge, plugged filter indicator, along with on-board self-diagnosis, modular components and easy-to-remove exterior panels, for in-shop serviceability. So you can call a company's tech support line to confirm what you need, and with overnight delivery get a module you can install right away to put your machine back in service.

Six of the seven machines have automatic R/R/R sequences, so a technician doesn't have to stand around and watch. The excellent performance and speed of these new machines enables them to be used as diagnostic tools.



A Robinair modification for use of GM dealer machines (the ACR2000 and new 48800) is the installation of a flush hose with fittings (left) in place of the retainers for the service hoses couplings. With the hose couplings attached to the flush hose fittings (right), the machine can flush any oil in the service hoses and the machine's internal plumbing prior to servicing a hybrid with a high-voltage electric compressor. This setup, factory-installed on the new Model 48800, would meet the proposed "H" amendment to SAE J2788, for use on systems with these compressors.



Illustrations courtesy General Motors

How often is refrigerant charge (over- or undercharging) a possible cause of, or contributor to, a poor cooling/no cooling problem? A wrong charge almost always is a possibility, so a new machine gives you the chance to find out, without investing a lot of diagnostic labor time. Here's a quick overview of them all:

•CPS Products' AR2788 (*www.cpsproducts.com*) is a fully automatic a/c service machine with an all-metal cabinet with three storage drawers down the front. It uses motorized valves instead of solenoids for greater reliability. It also features a special cycle to improve recovery (though not necessarily to 95%) if ambient temperatures are lower than the normal 70° to 75°F. The unit's vacuum pump rating is 6 cfm and its compressor is a fully rebuildable type. A service kit is available.

•The fully automatic Clima/CS CCST No. 388 from Flo-Dynamics/Norco (*www.flodynamics.com*) has a printer, oil injection, refrigerant flush mode and vehicle diagnostic module as options. The No. 288 also is automatic but has a smaller display and simpler controls that do not allow adding the options just mentioned. The unit's vacuum pump rating is 5 cfm.

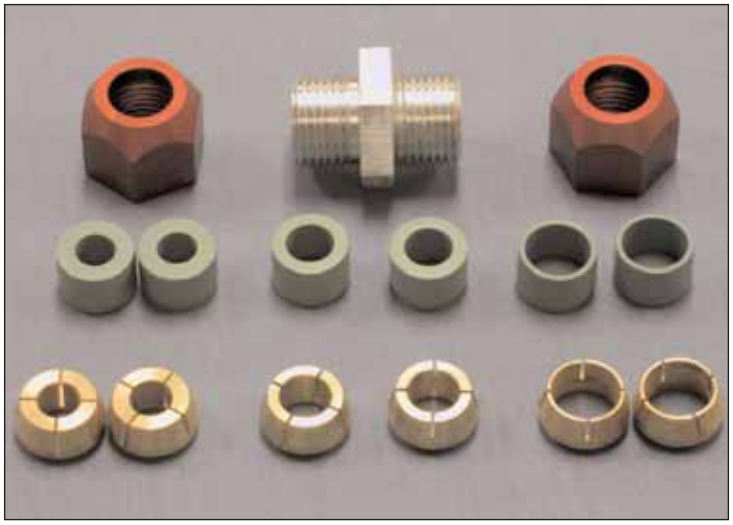
•The Ritchie/Yellow Jacket No. 37880 (*www.yellowjacket.com*) fully automatic refrigerant machine has two compressors; the second one takes the load off the first and pulls the system into deep vacuum when necessary. A sophisticated control system allows the refrigerant to be heated without a heat band; the compressors can be run to produce hot discharge gases when necessary. The unit also has a simplified "quick cycle" if system pressures at the start of recovery indicate low refrigerant.

•The 34788 refrigerant machine from Robinair (*www.robinair.com*) is fully automatic and the first machine to be certified. Software upgrades and updates are downloaded onto a flash card that goes into the side of the machine. Robinair's No. 34288 requires manual selection of each operation. Both machines use the 1.5-cfm vacuum pump in a special sequence with the compressor, to enhance performance. And both use an internal refrigerant vessel to help the scale maintain its calibration.

•The ArcticPRO No. 980 from RTI Technologies (*www.rtitech.com*) is a fully automatic machine whose control head swivels 180° for convenient operator viewing. Its vacuum pump rating is 7 cfm, the highest among the seven machines. A "Tech Alert" transmitter/receiver system permits technicians anywhere in the shop to monitor machine operation and know when it's finished, or if a vehicle system problem has caused it to stop. The unit uses an internal refrigerant tank to protect scale calibration and noninflatable tires to maintain machine orientation.

A forthcoming amendment to SAE

New leak detectors that will meet the SAE J2791 standard are expected to be coming on the market shortly. The SAE standards committee has been experimenting with a number of prototypes, one of which is shown here.



AirSept's new tubing connector kit (left photo) is for repairing rub-throughs, corroded lines and kinks. It uses sealing sleeves instead of O-rings, and is designed for hardware and sleeves for the three popular sizes (⅜, ½ and ⅝ in.). The company demonstrated the sealing capability of the kit with this setup of three connectors (right) connected to a hydraulic pump with pressure gauge. It held to well over 2000 psi.

J2788 will cover cross-contamination of oils between conventional systems and those in hybrids with high-voltage compressors. These include 2005-07 Honda Accords and 2006-08 Civics, plus Toyota Priuses since 2004, 2006-08 Lexus RX 400h models, 2007-08 Toyota Highlanders and Camrys, Lexus GS 450h models and LS 600s, and Nissan Altimas. Add in the new GM "two-mode hybrids" (Chevy Tahoe and GMC Yukon), plus many more that are on the way.

Problem: Conventional a/c systems use PAG oil, and the high-voltage compressors in those hybrids must use POE (polyol ester) oils. POEs may not equal PAGs for lubrication but protect the compressor's motor windings. And if there's any high-voltage leakage, POEs help insulate the motors, so high voltage doesn't jump to the compressor body and possibly electrocute a technician. SAE J2788 set a 1% limit for cross-contamination of POE with PAG. But the amendment will reduce that to .1%, to maintain resistance of the refrigerant/oil mixture in the compressor at a specified 10 megohms under all conditions. Machines that meet this requirement will carry a special "H" designation.

We expect that all the new machines will either pass a new test and meet the .1% or be able to do it with some simple modification. Robinair, which makes the GM dealer machines (the existing ACR2000 and the new SAE J2788 unit, the 48800), had to address the issue immediately per a GM request. Robinair released a simple retrofit kit for the ACR2000, which also is being factory-installed on the 48800 and is likely to go on the 34788 and 34288 aftermarket machines previously mentioned. The kit provides a hose connection that enables the machine to run refrigerant through the service hoses and machine plumbing to clear out any PAG oil prior to servicing a high-voltage compressor system with POE oil.

Other makers may do something

similar, or perhaps just specify a different set of service hoses for high-voltage compressor systems. Tests are being run at this time, and we expect decisions very shortly.

The issue does make it clear that if you have any intention of servicing high-voltage compressor systems, don't order a machine with oil injection (or if factory-equipped, just disabled), as the SAE J2788 amendment will not allow it, according to current indications. Oil injection is not a great idea even for PAG oil systems, because there are three popular viscosities in use (46-53, 100, 125-150 Centistoke), and failure to change the oil bottle in the machine would lead to an incorrect oil charge.

Soon to arrive will be SAE J2810 machines, which will conform to a new standard for recovery-only equipment. They also must recover 95% of the refrigerant, but need not have a scale and won't recycle. They're intended for mobile service, wrecking yards, etc.

We also noted last year that it doesn't take more than a few ounces of leakage to create a performance problem the customer will notice in hot weather. If a small system leaks just a few ounces in a year, the performance loss is going to be a complaint before a year is up. You also have to find much smaller leaks than today's detectors can identify.

New Electronic Leak Detectors

We soon will also be seeing the first of the new generation of electronic leak detectors that sense down to ½ oz./yr. (4 grams/yr.), vs. the old ones, which were rated for ½-oz./yr. (14g/yr.) leaks. An auto a/c system has about 10 refrigerant line connections, plus a compressor shaft seal that alone typically loses close to that half-ounce. So all the refrigerant line connections had better be a lot tighter than ½ oz./yr. For if a system has 10 connections leaking at a rate of ½ oz./yr., that's a total of 5 oz. in a year. And with seepage from the compressor shaft seal and perhaps the service valves, the system likely would need a recharge more than once a year, unless leaks are found and fixed. The 50- to 60-oz. systems with that level of leakage would go years before needing refrigerant, but those days are gone.

The HECAT H-1000 flushing machine uses Genesolv SF, a refrigerant/solvent that can be pumped through a/c components as a liquid, then vaporized under vacuum for removal. The system filters the solvent for reuse, storing it in the tank in the back of the unit.

Although the new leak detection standard, SAE J2791, was completed last year, the first detectors to meet it are just now being certified and readied for production. Through my work with the SAE standards committee, I've worked with prototypes, and they should be a quantum leap ahead of what has been available. Here are some of the required features:

Much greater sensitivity. There are switch positions for 4, 7 and 14 g/yr. (⅛, ¼ and ½ oz./yr.), leak rates measured with a probe moving at 3 in./second and passing a calibrated leak from a distance of ⅜ in. The previous 14g/yr. (½-oz./yr.) leak rate was measured with the probe moving at just 2 in./second and passing a calibrated leak from a distance of only ¼ in. This is a far tougher set of tasks.

More precision in the detection. At the 4g/yr. (⅛-oz./yr.) setting, the detector probe also must sweep past a 2g/yr. leak and not indicate a leak, so you wouldn't be misled into trying to fix an unfixably small leak. The same applies at the 7g/yr. setting with a 4g/yr. calibrated leak, and at the 14g/yr. setting with the probe passing a 7g/yr. calibrated leak.

Reduced false triggering, including a series of tests in a chamber with a contaminated atmosphere. In these tests, the contamination isn't from the fumes of other chemicals; it's R-134a itself in the air.

Although great improvements have been made, some chemicals are in the same detection spectrum as R-134a, so there's no way even these new electronic detectors will be totally immune to false triggers. Methanol (washer flu-

Dorman's No. 800-600 tubing connector kit for repairing damaged aluminum a/c lines uses an in-line swaging tool to install the connectors.

American Lokring's new pliers (right) for its aluminum or brass tubing connectors requires a significantly smaller handle opening angle, compared with the older tool at left, so it can be used in tighter quarters.

The Ritchie/Yellow Jacket anemometer, introduced as a tool for balancing airflows in buildings' climate control systems, also has several functions that make it well suited for use in automotive a/c systems.

id and some brake cleaners) is an example, so wipe up any washer fluid spill before you use an electronic detector. A list of common chemicals must be tested per SAE J2791; those that will cause a detector to false-trigger must be listed in the instructions. Some of the chemicals are pretty potent, and if the detector inhales a big dose, it may take up to 20 to 30 seconds to clear. Using an electronic leak detector effectively starts with a learning experience, which means much more than simply a quick read of the instruction manual.

Electronic leak detectors are used with the a/c system off, for obvious safety reasons. However, their greater sensitivity also may give you a better shot at finding an active leak (one that occurs only with the system running). That small leak you find, which you might not repair on an older system and which you'd never have found with an older leak detector, might be one that really opens up with the system operating. If a system has lost a large amount of refrigerant and you can find only a couple of small leaks, you at least have a couple of places to carefully retest with the system operating (and the detector on a higher leak setting).

Useful New Tools & Kits

The MACS trade show always introduces some useful tools aimed at a/c specialists, many brand-new to the market. At this year's show, among the ones that drew considerable interest were:

•The AirSept connector kit. It fits all three popular tubing sizes and enables quick repairs of rub-throughs and sections of corroded refrigerant lines without the need for special tools. Instead of O-ring seals, this compression-fitting-type repair has sleeve seals of specific thicknesses for the tubing diameters. An individual kit is more than a single repair connector on the Lokring and Dorman systems described below, and it doesn't have their special-purpose connectors. But it also does not require purchasing a kit with tools and connector assortments (*www.airsept.com*).

•The HECAT H-1000 flushing machine. Although most flushing machines have fallen out of favor, this one is gaining converts. It uses Honeywell's Genesolv SF refrigerant/solvent, which stays in liquid form under light pressure as the machine causes it to pulsate through heat exchangers, hoses and, reportedly, even expansion valves. When the flush cycle is done, the H-1000 uses light vacuum to boil the solvent out of the system—no residue. The machine filters the solvent for reuse, over and over—no disposal (*www.hecatinc.com*).

•A pair of Mastercool infrared thermometers with ambient temperature sensing using a thermocouple. No. 52224-B has a 15:1 field of view and the thermocouple is an option; No. 52225-A has a 30:1 field of view and the thermocouple is standard (*www.mastercool.com*).

•Dorman Products' No. 800-600 tubing connector kit. It's for aluminum a/c lines that are kinked, crushed or leaking. The connectors, which are swaged using an in-line tool, are very similar to those long sold by American Lokring, which exhibited a line that includes more specialty connectors (such as repair fittings for GM pickup condensers) and brass connectors for other-than-aluminum lines, such as steel (*www.dormanproducts.com*). American Lokring uses a pliers-like tool, which recently was redesigned, so the handle doesn't have to open as far, enabling the tool to be used in tighter quarters (*www.lokringusa.com*).

•Ritchie/Yellow Jacket's airflow meter (anemometer). Out-of-position ductwork and weak blower motors can reduce airflow, but more likely today are plugged cabin air filters. This tool, which is used widely to balance airflow in buildings, not only is good for auto a/c airflow diagnosis, including dual-zone flap-door systems, but enables you to indicate the filter problem to a customer without going under the dash and pulling out the old element. M

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