

AUTOMOTIVE



SOLUTIONS LLC

TELEPHONE: +1 (817) 293-3232

FAX: +1 (817) 887-0847

EMAIL: JVIVAR@AUTOMOTIVESOLUTIONSLLC.COM

2120 RIDGMAR BLVD., SUITE 206

FORT WORTH, TEXAS 76116 USA

WWW.AUTOMOTIVESOLUTIONSLLC.COM

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(This article was written by Vanessa Attwell. Motor Age Magazine March 2013)

Here are some tips on finding really difficult air conditioning system leaks

One of the smartest techs I know always checks customers' air conditioning systems during the winter months, long before the first hot day arrives. By quickly checking a system to make sure it operates, he figures he'll find any problems in a system long before the customer does, which keeps customers happy and keeps any possible repairs in his service bay.

It's a great idea, but the thing about checking an A/C system months before anyone will use it is that he has to be absolutely sure he's found any refrigerant leaks on the vehicle. Otherwise the refrigerant he puts into the system will gradually leak out over the cold months, and he would then have to fix the vehicle again when he would likely be busy doing other things. So he has to be absolutely sure he's found even the smallest leak and that he's fixed the problem properly. That can be tough, because some refrigerant leaks are really difficult to find.

No doubt, locating really tough refrigerant leaks can be a nightmare, and unfortunately fixing-by-guessing just isn't an option, because (among other reasons) refrigerants are so strictly regulated. But it really is possible to find even the smallest, slowest leaks if you use a systematic approach of forming suspicions and then proving or disproving them and some real-world testing techniques. If you're sure an A/C problem indeed is due to low refrigerant level because of a leak (and not because of an electrical problem, belt problem, or some other problem) and you can't find that leak using the typical testing methods in your diagnostic arsenal, here are a few ways you might not have thought of to find even the toughest leaks, keep your customers happy, your wallet full and keep vehicles from coming back with their air conditioning systems empty after you've repaired them.

Always Start With Fundamentals

As with pretty much every other diagnostic strategy, visually inspecting the system for anything obvious at the beginning of a diagnosis can save quite a bit of time. In this case, you're looking for signs of trouble such as stone chips on the front paint, recent body work, new components near air conditioning parts, oil stains or even signs of corrosion on or under components. Check the front of the vehicle particularly carefully - a rock through the condenser is common. If the front has a lot of stone chips or dead bugs, then it's quite possible that something hit the condenser causing a leak that let the refrigerant out.

Also check for components that might have rubbed or vibrated against something else and caused a leak, or signs that something has punctured or contacted one of the delicate A/C pipes or components. Note though that this isn't the stage where you identify the cause of leak and order replacement parts. This is the stage where you try to develop a suspicion about the cause of the problem-you'll prove or disapprove those suspicions in the next few steps.

Next (unless you found an obvious leak during the preliminary step that needs to be repaired before further testing), completely fill the A/C system, allowing for lines and rear components if applicable. Check the service information to find out how much refrigerant is supposed to go in the system if you're not sure or have any doubts (and don't forget the compressor oil if required-you don't want to cause more problems during the diagnosis). When the system is full, let the refrigerant circulate through the system for at least a few minutes before you start looking for the leak (this gives you the best chance of finding the leak).

If you identified anything suspicious during the preliminary inspection, this next step is when you confirm or disapprove those suspicions by testing the suspicious area and finding out for sure.

Start by making sure the leak detection tool is working correctly. Assuming you're using the "sniffer" tool, follow the manufacturer's recommendations on calibrating the tool, make sure its batteries are OK, and check to make sure its tip is not contaminated (or covered in dirt) - and that it's set to detect the correct refrigerant.

Then, using the sniffer, check for leaks systematically, inspecting one component at a time, moving along the system and paying particularly close attention to the bottom of components, connections or fittings because refrigerant is heavier than air and will tend to sink. The reason for checking the components systematically, in order, is so that you don't accidentally overlook anything and you can be absolutely sure you've tested everything involved in the system. If you're checking the system while it's operating make sure that the condenser fan isn't blowing away the evidence of a leak.

There are two things to be mindful of at this stage if you're looking for a tough-to-find leak in addition to confirming or disproving your suspicions. First, just as with electrical systems, connections can be weak spots in A/C systems so checking areas such as O-rings, hoses that flex, welds, clamps and connections very carefully really can pay off. The other thing is that the components you can't easily see, such as those under the dash, rear A/C components, valve cores, under clamps and the like can be challenging to test. But if you're trying to find an elusive refrigerant leak, you need to expose and check those hidden components carefully. Odds are good that if you can't find the leak after carefully checking the exposed components, then it's probably in something that's hidden from view. Additionally, even if you've found a leak in the previous step you still need to make sure that it's the only leak in the system.

An Alternative to Sniffing

If, after testing all the components in the fully charged system with a functioning sniffer tool, you still can't find the leak-or if you don't use a sniffer tool-a good way to find an elusive leak is to use A/C tracer dye. Be sure to use the correct amount of dye for the system you are testing and stay away from using oil with a dye added. That might be OK when you are doing a component replacement, but not as the means to getting dye in the system. Be sure to run the A/C and allow enough time for the dye to circulate through the system and leak out. Then inspect the system carefully for leaks.

If you still can't find the leak-or if you can't use dye or a sniffer-charge the system to its maximum capacity, taking into account what the A/C systems lines hold, and then (borrowing a method commonly used to check for tire punctures) spray all connections with soapy water and look for tell-tale bubbles or sputters that indicate leaks while the system operates and also when it's shut off. It might take a while for the leak to show up using this method so you might want to park the vehicle somewhere and move on to another task for a while, then come back to it. The reason for doing the soapy water test after doing the sniffer and dye tests is because the soapy water will wash away any dye or oil stains that could have helped you out with those other two tests.

Repair Made?

After you do finally locate and repair the leak, you're not done. There are two important steps to make sure that the vehicle is fixed properly and doesn't return in a few weeks with the A/C inoperative again. The first step in verifying your repair occurs during the recharge of the system. Pull the system into a full vacuum and let it sit for at least five minutes. If vacuum is lost, odds are there still is a leak somewhere.

The second step in verifying the repair was successful is to go back over the leak area you found originally and retest it. In most cases, there is still enough dye in the system to indicate any problems if you didn't get it corrected or you can use the sniffer to recheck. Be sure to check over the entire system. Sometimes you can fix one leak, only to have another appear that you didn't, or couldn't, detect the first time around. The other thing

seems obvious, but it's well worth mentioning to make sure that there's enough compressor oil-and the correct oil for the system-in the A/C system after the repair. One parts representative told me very recently that close to 100 per cent of compressors that fail after an A/C repair do so because there wasn't enough oil in the system, and the resulting debris is almost impossible to remove from the tiny orifices inside the air conditioning system. Be sure to follow the OEM service guidelines on adding oil after a repair or component replacement.

No doubt, finding elusive leaks can be a real diagnostic challenge. Sometimes conventional testing methods don't work, and guessing and hoping are just not acceptable repair methods. But with a systematic plan of attack, some diagnostic tricks and sometimes a whole lot of patience you can find any leak and confidently repair A/C systems at any time of year, keeping your customers happy-and keeping you busy making money rather than fixing previous mistakes.

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