

# Technical Article: Air Conditioning System Maintenance and Repair

**Posted By: Joe on 8-21-2001 - 6:11PM**

**Subject: HC's,R-12 systems, etc.**

OK. Here we go My name is Joe and I have over 20yrs experience in the field of automotive repair. Over the past 1½ years one of the shops I own has charged over 132 passenger cars and trucks with hydrocarbon refrigerants, mainly using Envirosafe ES12a. I have been watching this forum for quite some time, and thought it was about time I posted something.

We have had nothing but the best of experiences with hydrocarbon refrigerants. Here in the south it is HOT! Over 100 on a regular basis. The ONLY time we have found insurmountable difficulties is when trying to service vehicles with dual A/C units. This problem SEEMS to have been resolved with the new industrial version of ES12a. We have found that the hydrocarbon refrigerants do not cool as well as the Freons at idle speeds; although, usually acceptably well. The worst offenders are older R12 systems. This is due to the expansion valve/orifice not being truly calibrated for these chemicals; and (theoretically) the heat produced in the condenser when using these types of refrigerants. We DO NOT add any additional propane to any of our installs. (No problems with that, just stated for reference.)

First, the facts:

**FACT:** If your compressor has locked up or worn out, you now have metal particles inside your A/C system. In these cases you MUST disassemble the system so that all tubes can be flushed. This means that you must remove the expansion valve/orifice tube to allow the flush to flow through the system. While it is out it would be silly not to replace it!! You also need to replace the accumulator since it probably has the largest deposit of crap inside its

UNFLUSHABLE walls.

FACT: If your system oil smells burned or is discolored in any way the above flush and clean also applies.

FACT: ANYTHING inside the system that can either PARTIALLY or completely clog the exp valve/orifice needs to be removed BEFORE you complain that your system is not cooling properly.

FACT: Unless you are using the OEM recommended refrigerant for a system there is no way to know in advance the exact amount of hydrocarbon blend refrigerant that will correctly charge your system. This fact is born out of experience. Even if you do know the exact amount of refrigerant that your system will need, it is difficult to measure it out without an electronic scale and a 30 lb bottle. It is really difficult to get ALL the refrigerant out of the small cans! The BEST charging method is using temperatures and pressures.

FACT: The GREAT majority of A/C systems I have seen have no trouble hitting vent temps in the low 40s while the vehicle is moving in 90-92 deg ambient air. Of course, only when serviced then charged correctly.

FACT: If your system is not cooling properly because it is low on refrigerant, you have a leak!!

FACT: 80% of the time the leak in the system is one of the charge valves! For \$1, replace them both while you have the system open!! Replacing the caps with new ones is also recommended since they will also have new seals in them.

If, as an individual, you are charging an A/C system that has a known slow leak and plan on using a hydrocarbon refrigerant you may run into several problems. 1. During the periods when the A/C system is NOT in use, it is POSSIBLE for only ONE PART of the refrigerant mix to leak out of your system and leave you with an improper mix ratio of propane to isobutane; this can cause reduced cooling and the inability to get the system back to full efficiency without a full suck and recharge. 2. If the slow leak is anywhere on the high-pressure side of the system, there is a GOOD chance that during previous or current use that part of your oil supply leaked out with the refrigerant. Oil level in an A/C system is CRITICAL to BOTH the preservation of your compressor AND the proper cooling balance between

low and high rpm use! The oil in an A/C system actually mixes with the refrigerant and is carried through the system continuously when in use. This means that it is pushed through you!

r expansion valve/orifice tube continuously as well. Too much oil can restrict flow at high rpm causing a low low side and a high high side. Too little oil can cause pressures at idle speed to be too high on the low side and too low on the high side. You can fool any system into cooling somewhat at a SPECIFIC rpm when the oil level is wrong, BUT, all other rpms will produce really poor cooling. Compressors and systems are designed for a specific oil volume. SOME systems are designed for as little as 4 oz of oil. If one of these systems loses just 1 ounce of oil the system is 25% low on oil! Imagine how your body would perform if it was 25% low on blood! The margin for a correct oil level is small. What I am saying here is that a CORRECT oil charge is CRITICAL to getting those 40 deg vent temps in 95 deg weather! AFTER FLUSHING THE ENTIRE SYSYEM make sure that when consulting a manual or a dealer that you ask for the TOTAL system oil capacity. Otherwise I have found that 90% !

of the time they will quote you the capacity for the compressor by itself!!! Pouring the oil out of your old compressor and measuring it ONLY works if the entire system is/was completely and correctly full of oil!!! It is our experience that about 18 of 20 vehicles we disassemble are either low on oil from leakage, or over filled by a previous technician. Once again, the correct oil level in an A/C system is critical to proper cooling. You cannot be sure your oil level is correct without flushing the system and refilling it PROPERLY. YES IT REALLY DOES MATTER! (regardless of refrigerant type)

Hydrocarbon refrigerants and the vacuum. Do you need to pull a vacuum to charge a system? You decide. You need some way of getting all of the old refrigerant out of the system, especially if it was a Freon. Freon do NOT like air in ANY quantity. Any air/Freon in the system together will cause corrosion and future issues. A hard vacuum is one way of insuring that your newly charged A/C system is free of the possibility of any air mixing with any left over Freon. Charging with a hydrocarbon refrigerant into either a 10 vacuum

or a zero vacuum does not affect the cooling dramatically (2-5 degs), BUT it DOES affect your high side pressure greatly. If you charge with air in the system you can see high side pressures equal to or exceeding straight R12. Higher pressures mean more work for your compressor. In our experiments with a fleet of three cylinder Geo Metros, the drivers, (all R134 to ES12a conversions!) FAR preferred to drive the cars with A/Cs that had been charged under a !

hard vacuum because they had more pep than the ones charged at zero vacuum. The difference in the amount of horsepower needed to run the compressors was enough that anyone could feel the benefits! Getting a correct charge with a hard vacuum can be more difficult than when air is in the system for a technician who is used to reading pressures with R12 or R134. You simply have to pay closer attention to your temperatures since the high side pressure may not be where your experience tells you it should be. We charge all our vehicles under a hard vacuum.

If you do not have a good vacuum pump, you can use the following method. To protect my own butt I must mention that it is against the law to vent any refrigerant into the atmosphere intentionally Ok, yeah and uh huh You can chase the old refrigerant and air out of the system by simply charging one can worth on either the high or low side and venting (ahem, reclaiming) on the other side. Years ago this was done all the time with R12. It does not work as well as a hard vacuum for the Freons, but for the hydrocarbons it works quite well. A hard vac is still better for total evacuation.

We DO NOT charge our vehicles using the refrigerant weight formula for hydrocarbon refrigerants. It simply has never worked well for us. We charge all systems using temps and pressures. We charge the system to 50-70psi static pressure then start the engine/compressor and finish the charge with the system running at 1500-2000 rpm over the NEXT 30+ MINUTES! Hydrocarbon refrigerants are a mixture and need to be allowed equalize for a few minutes after every squirt into the system. In fact, after you have achieved your CORRECT pressures, you can actually see a 2-6 degree temperature drop in the overall system after the refrigerant has mixed in the system for a

24-36 hour period! We have seen this time and time again. Other than systems with dual A/C, the hardest systems to properly charge are R12 (some R134) systems on rear wheel drive vehicles that have a mechanical fan on the front of the engine.

Here is a quick note on those mechanical fans with a temperature-controlled clutch. You NEED these fans to work PERFECTLY if you want anything close to proper cooling from one of these cars. ESPECIALLY at idle and low speeds!! The temperature-controlled clutch is designed to engage the fan when the air passing over it (from the radiator!) reaches a certain temperature. If the thermostat in the cooling system of your car is even 5 degs lower in opening temperature than what the car was designed for the air passing through your radiator could take up to 10-20 minutes (or likely never) to get up to a high enough temperature to engage the fan clutch (which will then disengage after the temp has dropped again)! This is LONG past the time where your A/C vent temps have climbed above 70 degs and can take up to 6 miles of driving at 50+ mph to get the condenser to cool off again! You need a fully operational fan clutch assy and the correct thermostat in your cooling system for the A!

/C to operate properly. These cars also need to have the engine up to full operating temperature before you can properly charge the A/C using temps and pressures.

If you are (slowly) charging a system (at 1500-2000rpm) and have reached what you think are the correct pressures on the high and low sides, but your vent temp is still at 65+ degs, you are probably under charged. (this commonly occurs on HOT days 95+ degs) In this case, wet down both the condenser and accumulator with a garden hose and watch the pressures drop. Add another ounce of refrigerant and WAIT for the pressures to climb again. Wait until the water is all gone and the pressures have stabilized; about 6-10 mins. Repeat until the vent temp drops and the pressures are where they need to be. DO NOT OVER CHARGE! The difference between a correct charge and over/under charging seems to be about plus or minus 1.5 ounces!! (Especially as the ambient air temp rises above 95degs) This method assumes that you are

being careful and SLOW and waiting for system stabilization between charges! You do not want to over charge in ANY case. The main reason is that you really cannot purge!

Remove excess refrigerant from the system. Once again, most hydrocarbon refrigerants are mixtures and you have no way of knowing which part of the mixture you are removing from the system. If you must bleed excess from the system I would ONLY do it after the system has been running for at least 30 minutes at 2000 rpm to fully mix the parts of the refrigerant. Even so, I do not recommend it.

As for the correct pressures that TOTALLY depends on the ambient air!!!! Typically, what you would like to see is about a continuous 21-24 psi on the low side / 95+ ambient air / 1500-3000 rpm / while the car is moving over 30 mph. The high side should likely be slightly over 190 psi in these conditions. Worry more about the low side and your vent temps. I say it this way because it is near impossible to create driving air conditions for the condenser while it is sitting in your driveway. Driving the car with a low charge will cool the condenser to the point (just like spraying water) where the pressures will drop and the compressor will cycle (reducing cooling) or the evaporator will freeze up. This can most commonly be observed during a road test where the vent temps are lower at 20-30 mph than at 50 mph!! A low pressure switch set too high will also cause this condition even when refrigerant charge is correct!!! Practice makes perfect in this situation. You simply need to! go slow and use your gauges, thermometer and road tests.

The road test:

The drop dead best way to get a TRULY full and correct charge with ANY refrigerant is to read the gauges WHILE the car is in motion. The readings you will get will be TOTALLY different than the ones you got without the car moving. TOTALLY. Route the hoses AWAY from the throttle linkage and exhaust and then under the rear most portion of the hood where the hood gasket will not crush them, usually. Then trap the hoses and gauges under a wiper blade so that you can see them through the windshield while driving. If you are brave, route the charge hose through the drivers window and charge as

needed. With this method you will actually start to understand and be able to use the data in a temp/pressure chart!! Especially the high side pressures portion.

These are typical results for us in 90-92 deg ambient air: (all recirc air at max blower after 6-10 mins)

R134 system convert to ES12a with electric condenser fans>> 36-40 degs driving; 43-47 @ idle

R12 system convert to ES12a with electric condenser fans>> 38-43 degs driving; 45-50 @ idle

R12 system convert to ES12a with mechanical fan>> 40-45 degs driving; 48-58 @ idle

Someone will probably ask about dual A/C now. Well, the theory is that because of the increased thermal efficiency of the hydrocarbon refrigerant, most condensers simply get too hot, too quick when asked to handle two A/C units using a hydrocarbon refrigerant. The increased propane in the new "industrial blend" seems to have fixed this issue, but we have only tried it once so far. (worked acceptably) Note that the above method of cooling the condenser with water is **HIGHLY** recommended when trying to get the correct charge on ANY dual A/C system with any refrigerant.

Bottom line:

All components, lubricants, and capacities must be correct for any A/C system or refrigerant to produce low temps in 90+ deg ambient air all all rpms. This is why reputable A/C shops must fix all leaks, flush the entire system, fill with fresh and correct amount of oil, and replace any questionable parts (orifice, exp valve, accumulator) before they can expect the A/C system to work like the day it rolled off the assembly line. Otherwise, they would be burning up all their time guessing and dealing with comebacks. (not that this doesn't happen!)

There are no short cuts.

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