November 2009
Technical Newsletter

Automotive Electronic Control Systems

AECS
Training, Equipment and Data for Automotive Diagnostic Specialists

# Air-conditioning Equipment Technology from AECS Ltd

***AECS*** as a training and equipment provider, we come across many misconceptions about air conditioning. In this article I would like you to take a fresh look at some of the aspects of air-con service.

In my view the role and profitability of regular automotive air-con maintenance is totally under-estimated by most automotive technicians. I believe that as a tutor I have to try to change this.

**Air-con systems leak.**

As a result of inevitable leaks on any automotive air conditioning system of any brand, the air-con system can cause high fuel consumption and is in danger of expensive damage after having been intensively used for about three years without service.

Why do we get our customers to come in with their cars for regular services? To change oil and filters, and to check a number of items on the vehicle. Hardly any garage seems to ever service an air-con system as part of a regular service. Therefore all systems wait for expensive terminal failure, which ends up not being repaired on most vehicles as a result of the very high costs.

Yet air-con service is so simple and so profitable! As long as you have the right equipment and knowledge. Some garages (and even air-con specialists) are dabbling around with a gauge set and a separate compressor and feel that they are totally ready for air-con service.

Please let me layout what you need for proper air-con service and motivate the components technically:

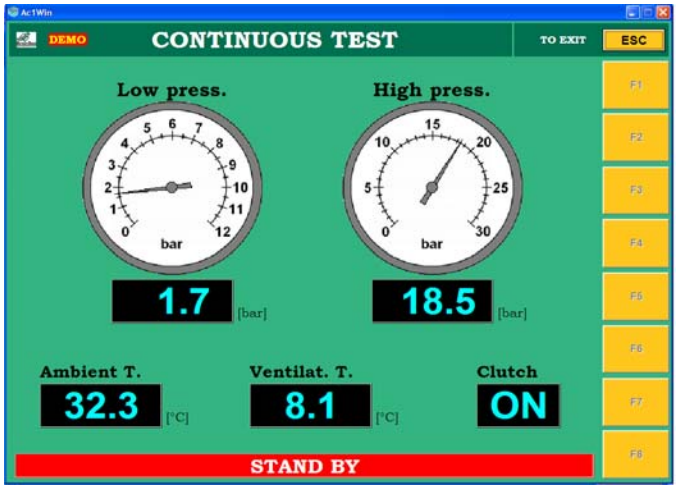
**Connect to the vehicle**

You need hoses, couplers and a gauge set with manifold to connect to the air-con system's quick couplings.


*Picture Ecotechnics gauge set*

Often these gauges are used for diagnostics without the operator realising that by simply connecting them they are altering the system's charge. Alternative for quick diagnostics are tools with pressure sensors which cannot alter the system's charge.


*Electronic pressure sensors from diagnostic kit.*



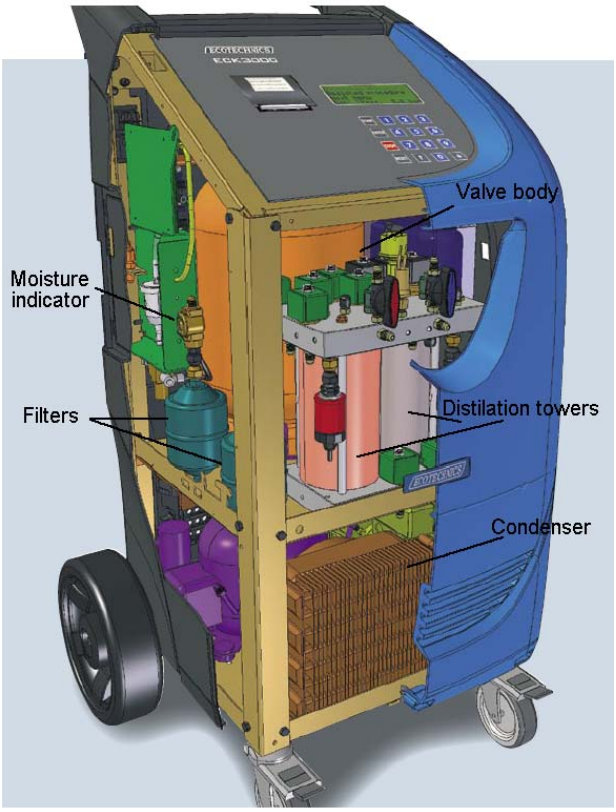

**Evacuate (remove) the refrigerant**

You need to be able to evacuate the refrigerant from the vehicle into a storage bottle

*Evacuation pump and waste bottle*

Often the used refrigerant (with the PAG oil) gets pumped straight into a waste bottle for it to be destroyed by a company like BOC gas, yet the refrigerant does not lose it chemical composition unless it is mixed with blend gases.

The best practice by far is to recycle the refrigerant, by filtering, distilling and de-acidising it.




*Ecotechnics ECK recycle and recovery (R&R) machine with distillation towers and filters.*

The distillation columns besides separating some gases, separates the oil which inevitably escapes together with the refrigerant. The oil volume needs to be measured and visually inspected for discolouration. The quantity needs to be measured as the system does not have a dip stick.

*"The quantity which comes out needs to go back in!"*

Inspecting the colour of the oil is important as it is an indicator of what kind of mechanical strain the compressor has had, and if it makes sense to recharge the system.

We don't need come backs in our workshops!

*Contaminated PAG oil from a system with a worn compressor.*

The oil reintroduced into the system needs to be of suitable viscosity (three different types) and from a closed airtight container.

The quantity of recovered oil varies greatly from service to service even on the same vehicle.

Best practice is to measure the quantity recovered by for example weight. Store the recovered oil in a clear bottle and automatically reintroduce the same quantity of new oil in to the vehicle.


*Three different viscosities PAG oil bottles. These oils are chemically single capped (non Daphne).*

**Vacuums and leak check the air-con system**

The next thing you need to connect is a vacuum pump, the vacuum pump needs to draw any remaining gases out of the system, including possible water vapour. The vacuum pump needs to be serviced regularly, of which a service record needs to be kept. The vacuum pump needs to be connected to the vehicle through a gauge set, just like the evacuation compressor.


*Ecotechnics vacuum pump with gauge set*

The vacuum stability needs to be checked, to ensure that no vacuum leak is present wasting the refrigerant which is to be charged into the system. After a period of vacuum time you need to switch the pump off and monitor the gauges for some time to see if the system has a leak.

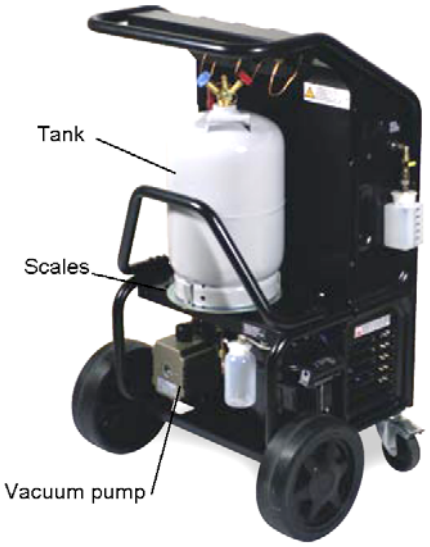
Best practice is that the vacuum leak check on the vehicle gets performed automatically and that vacuum pump unit automatically indicates that it is in need of maintenance.

After the vacuum leak check a Nitrogen pressure leak check can be performed.

## Did you Know?

We are constructing 2 **Hybrid** training seminars ready for launch in **Feb 2010**.

- First level covers: How does it work, how to stay safe and how to maintain the car properly.
- The second level is diagnostics.




*Ecotechnics ECK R&R unit's vacuum pump*

**Charge (refill) the system**

After the system has passed the (vacuum) leak check the system needs to be recharged, for this purpose the vacuum pump (and gauge set) needs to be removed and a bottle with clean pure refrigerant needs to be connected. The operator needs to check in a data base how much "gas" the system needs and has to precisely meter this out….

For this purpose the operator needs a set of electronic scales, one which records the weight before and after the charging process. When the desired weight of refrigerant has been introduced into the system the bottle need to be closed, manually or automatically by a set of extra solenoids which can be purchased with the scales.

There is no way that on modern systems with only 500 grams (+/-10 grams) of R 134a the charge quantity can be guessed by 'feeling the tubes'. This almost certainly will end up in expensive air-con failure.

*Picture of electronic scales*

Best practise is that the machine has a data base which contains a charge quantity table, of which you only have to select the vehicle model and age. After which the machine automatically meters out the correct amount of refrigerant.

*Ecotechnics ECK 3900 (2010 model) fully automatic recovery/ recycle system*

Charging can be done with liquid or gaseous refrigerant. An operator with loose components needs to think about this.

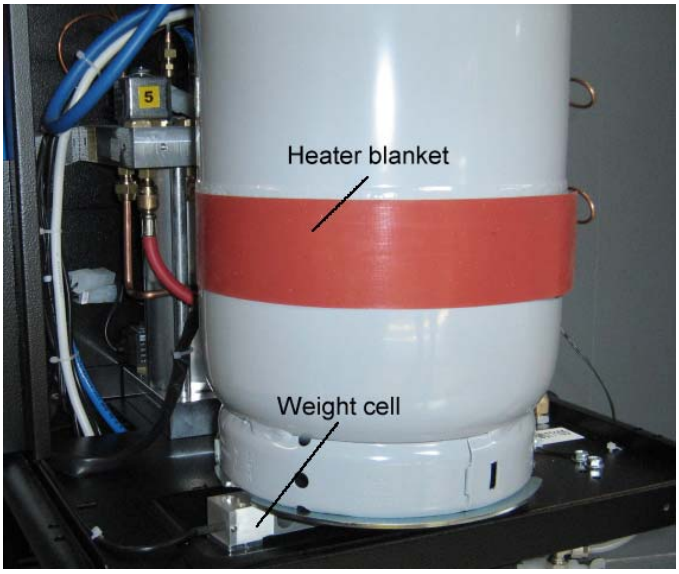
Best practise is a machine with solenoid valves which will automatically select liquid on the high side and gas on the low side. On such a machine the pressure difference during charging is created by a heater blanket around the on board refrigerant bottle, which turns on and off automatically. A heater blanket speeds up the charging process dramatically.

## Notice:

Recently it came to AECS' attention that according to our competitors

1. we are involved in selling equipment we can not service or back up?
2. we are broke?
3. that our suppliers are broke?

I am not sure why this slander is out there but I am happy to say that we (AECS) and our suppliers are in a very solid and healthy condition! And YES we can back up what we sell!




*Heater blanket inside the ECK.*

Nitrogen pressure leak tests or diagnostics through logic can also be performed by such machines, something which is very time consuming with manual equipment.

For high volume air-con installations like buses the refrigerant needs to be positively charged in to the vehicle, for this purpose a separate high volume charge compressor is build into a truck designated unit, this is needed for systems where more than approx. 1.5 Kg's of refrigerant is needed.

*ECK truck with high volume components and positive pressure R134a charging pump.*



**Equipment knowledge**

On all air-con recovery systems high pressure condensable gases (incorrectly called non condensable gases) get introduced into the recovery tank, increasing the pressure of the tank.

On a manual system (loose components) the pressure of the tank and its temperature needs to be measured, to work out with a chart if the high pressure condensable gases are slowing the recovery process down. Sometimes bringing it to a halt, damaging the recovery compressor. Best practise is to have the logic (electronics) in the machine decide if these gases are present and then have the machine automatically purge these gases out of the on board tank. This automatic process eliminates the chance of refrigerant entering into the atmosphere.

**Environment**

The Ecotechnics equipment from AECS Ltd are as one of the few suppliers homologated in the USA market under the strict new no loss SAE standard SAE J-2788. This Jan 2008 standard specifies the machine's precision with regards to the loss of refrigerant during the recovery/ recycle procedure and the precision in charging volume. This is in line with the IRHACE's voluntary NZ guide lines.

**Summary**

To set up for air conditioning service there are several items which are essential. The purchase figures I have used are indicative and vary from equipment brand to brand.

**Manual (loose components)**

- *Compressor/condenser unit*, to evacuate the refrigerant from the air-con system into a (waste) bottle. (+/- $2,000)
- A *vacuum pump*, to extract air moisture and refrigerant from the air-con system, plus to create vacuum so the new refrigerant is being drawn into the system after evacuation has taken place (+/- $400).
- A *waste refrigerant bottle* (exchange) (+/- $300).
- A *gauge set* with connectors and hoses (+/- $300).
- A bottle with *new refrigerant* to connect to the gauge set (+/- $300).
- An electronic weight *scale* set (with solenoid valves) (+/- $600 (+/- $1,600)).
- *Dye injection* equipment and leak search light/ goggles (+/- $300).
- *Oil injection* equipment (+/- $250).
- And maybe a refrigerant *identifier*, but this is not essential (+/- $5,000).

Adds up to between $5,000 and $6,500 in equipment (without the identifier) to set up for servicing air conditioning systems manually.

Each step of the process has to be set up and started manually and needs to be supervised by a trained operator. A simple extraction and recharge (regular service) will take about 30 to 45 minutes of labour (+/- $65) and a full amount of new refrigerant (on average about 700 grams per vehicle charge +/-$15) as with this manual process the recovered refrigerant is not reusable. Creating a lot of environmental waste each service.

**Automatic (with R&R station)**

An alternative is to set up with a recovery/ recycle machine, which includes:

- Compressor/ condenser
- Vacuum pump
- Automatic leak detection (some with Nitrogen)
- Recycle bottle and refrigerant purifying equipment
- Gauges with hoses and connectors
- Electronic weight scales with solenoid valves
- Dye injection switch gear (weight cell and solenoid valves)
- Automatic oil injection mechanism (weight cell on waste oil bottle, weight cell on new oil bottle, solenoid valves and controller)
- And in some cases a built in refrigerant identifier (+/- $1,800).

A recovery/ recycle machine adds up to between $6,500 and $14,500.

To perform a regular automatic service will take no longer than 5 minutes of attention of a low skilled operator. The whole process is automatic and will take about 30 minutes. A print out will show how much of oil, dye and time has been used, for the invoicing of the customer.

**Business case**

For a standard service (recovery, leak test, cleaning/drying, recharge cycle) most workshops charge between $95 and $195.

Please consider all the facts, also the technical back up and training from AECS before investing into the highly profitable air-con service and repair partition of our automotive industry.

*AECS* Ltd
Training and Equipment suppliers.
06 8749 077 or check www.aecs.net

***AECS* Training coming up:**

**DMS1-1 17th & 18th November**

**AIRCON 19th & 20th November !!**
**in Auckland**

See our website for more details
www.aecs.net


***Hybrid Courses***

Note: The AECS **Hybrid** diagnostic courses are due to be launched early next year!