

Technical options for reducing R-134a emissions along Mobile A C lifetime

Session 3

D. Clodic, Ecole des Mines de Paris
J. Harnisch, ECOFYS

Refrigerant emission reduction at production and capacities handling

- **During the refrigerant manufacturing process**
From 0.5% down to 0.1%
- **Recovery of liquid and vapor heels by end users or refrigerant distributors**
From 5% down to 0.5%
- **Proper design of all types of hoses and connections**
From 0.5% down to 0.1%
- **Impacts are high because the total annual refrigerant market is concerned.**

Better servicing and repair (1)

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

- High emissions due to poor servicing, one example:

Schrader without cap



Better servicing and repair (1)

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

- Recommendation : elimination of undue openings
of the refrigerant circuit

Caps with an without O-Ring



Better servicing and repair (2)

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

- Recommendation : conditional rather than preventive maintenance
- Conditional maintenance =

DO NOT TOUCH SYSTEMATICALLY

Better servicing and repair (3)

Automated diagnosis of failures

Valeo Clim-Online



- Technical data base
- 10 000 vehicles diagnosis
- Symptoms identification
- Diagnosis methods
- Diagnosis
- Intervention methods
- Standard wiring diagrams
- Catalogue function
- Components Part Numbers
- Fitting time
- Forum

Better servicing and repair (3)

Automated diagnosis of failures

Global objective : Reduction From About 400g emissions along Life Time to 30g or less

Valeo Climtest system



Permits to diagnose:

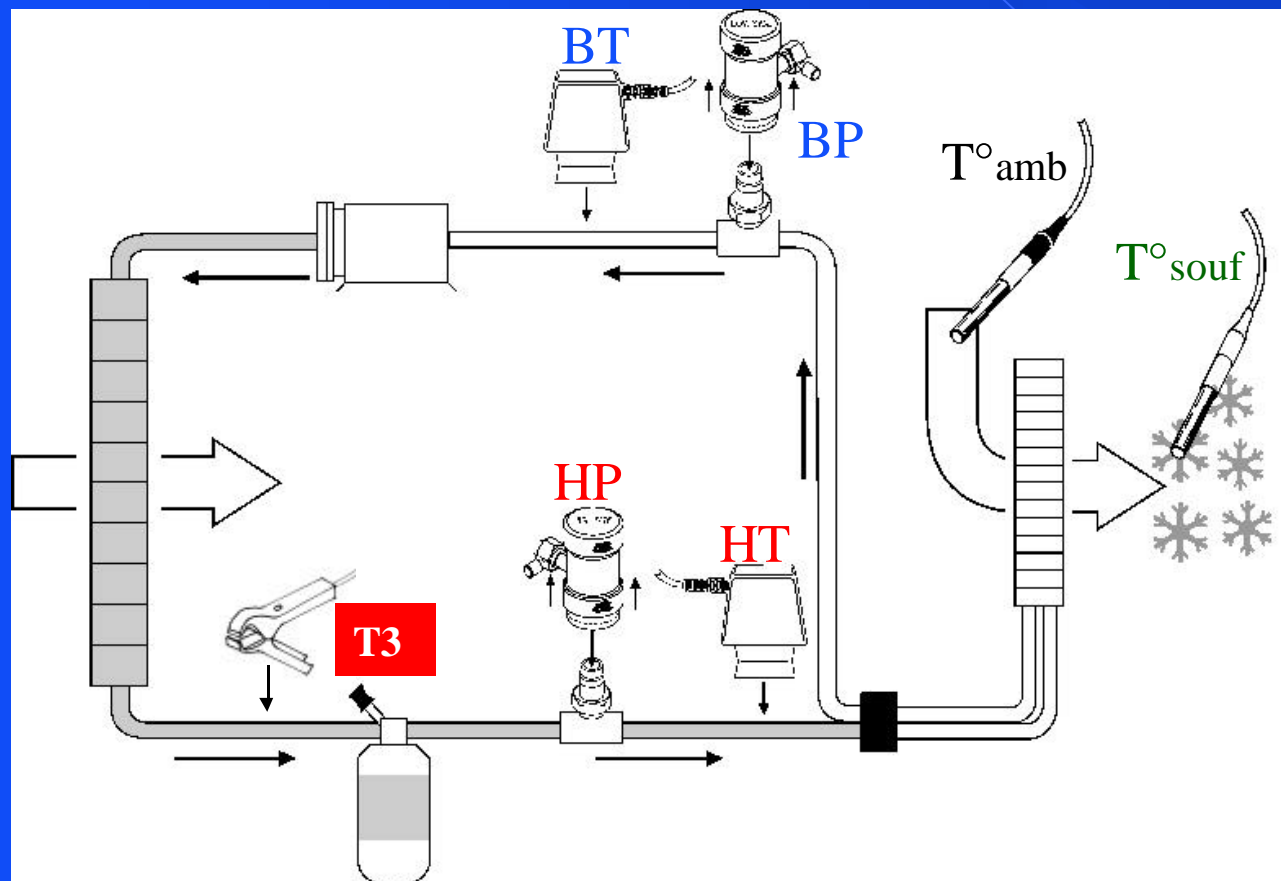
- the way the system operates,
- an excess or a shortage of refrigerant,
- a blocked orifice or receiver,
- another problem that needs an extensive diagnosis.

Better servicing and repair (3)

Automated diagnosis of failures

Global objective : Reduction From About 400g emissions along Life Time to 30g or less

Climtest connected to the AC loop

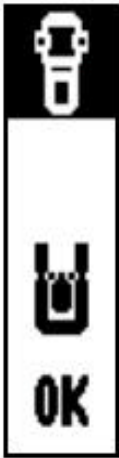
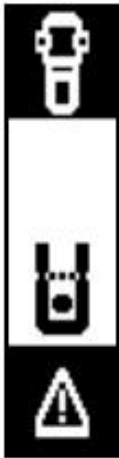
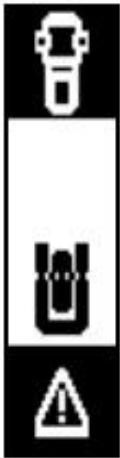





Better servicing and repair (3)

Automated diagnosis of failures

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

Climtest diagnosis

					
All is OK	Refrigerant shortage	Refrigerant excess	Orifice blocked	Orifice or receiver blocked	Other problem

Better servicing and repair (4)

Automated diagnosis of failures

**Global objective : Reduction From About 400g emissions
along Life Time to 30g or less**



- **Recommendations :**
- **Systematic FMA : Failure Mode Analysis permits to classify occurrences and severity of failures.**
- **Data base implementation based on descriptions of failures from the AC service network under a predefined format in order to identify critical components.**

Better servicing and repair (5)

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

- Method of test for leak detectors permitting to define minimum sensitivity threshold (1 g/yr)

Performance of some leak detectors

Trademark	CPS	ITE	KANE – MAY	LEYBOLD Inficon	LEYBOLD Inficon
					
Type of detected gas	CFC,HFC,HCFC	CFC,HFC,HCFC	CFC,HFC,HCFC	CFC,HFC,HCFC	CFC,HFC,HCFC
Sensitivity threshold in fixed position	3 g/yr.	1 g/yr/	1 g/yr.	1 to 2 g/yr.	1 to 2 g/yr
Sensitivity threshold in motion	4 g/yr.	1 g/yr.	1 g/yr.	1 to 2 g/yr.	1 to 2 g/yr.
Sensitivity threshold in polluted ambiance	3 to 5 g/yr.	Impossible at 500 ppm	1 g/yr.	Impossible at 500 ppm	Impossible at 500 ppm

Better servicing and repair (6)

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

Leak detection on an A/C loop



Better servicing and repair (6)

**Global objective : Reduction From About 400g emissions
along Life Time to 30g or less**

Recommendations :

- **Method of leak detection and adequate training**
- **Leak detection and leak fixing before recharge**

Typical emissions at connecting



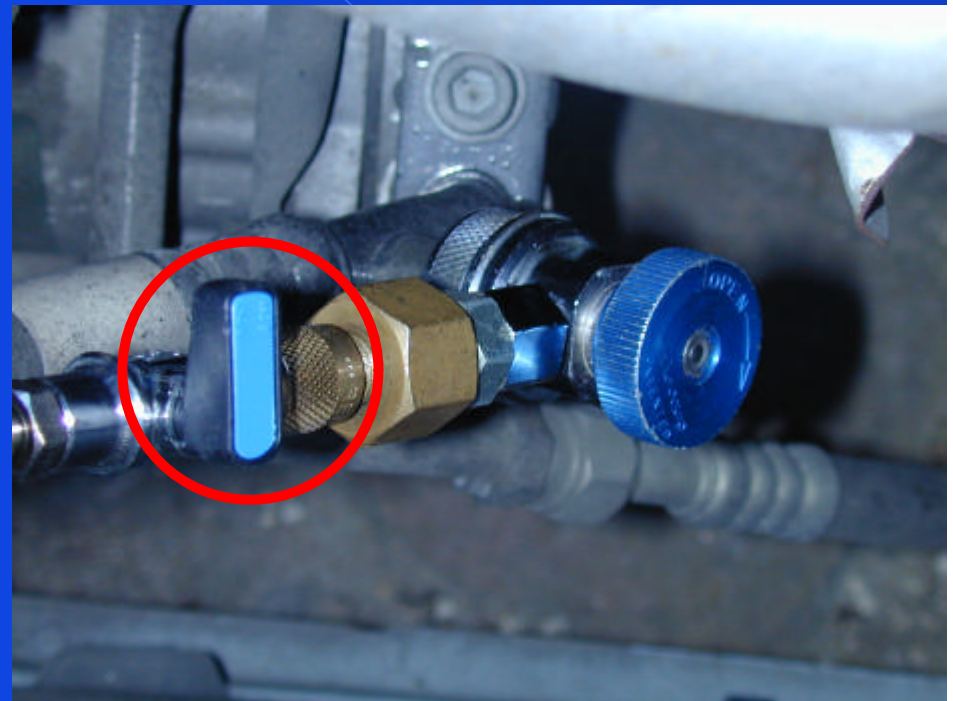
Leaks.avi

Better servicing and repair (8)

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

Recommendation :

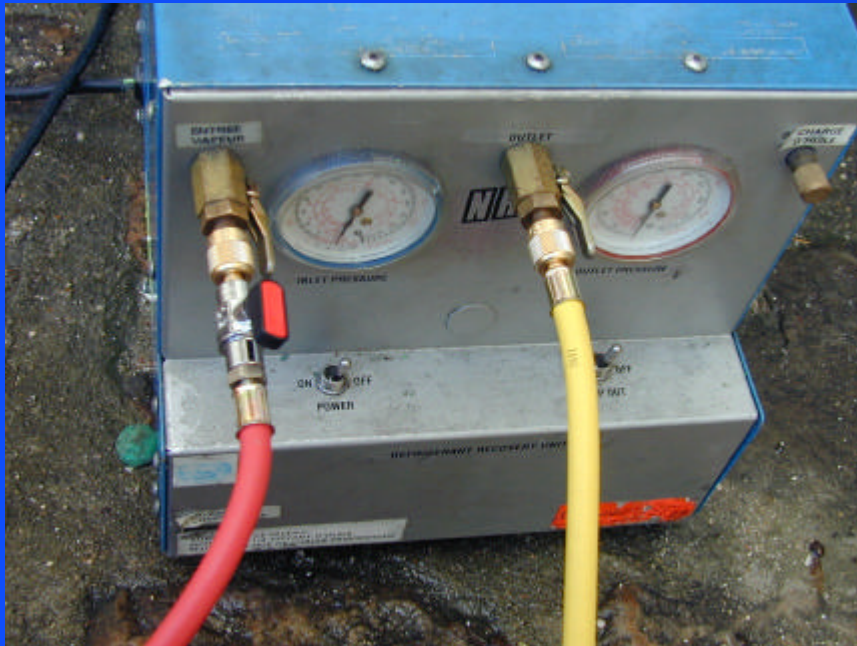
Hoses with valves



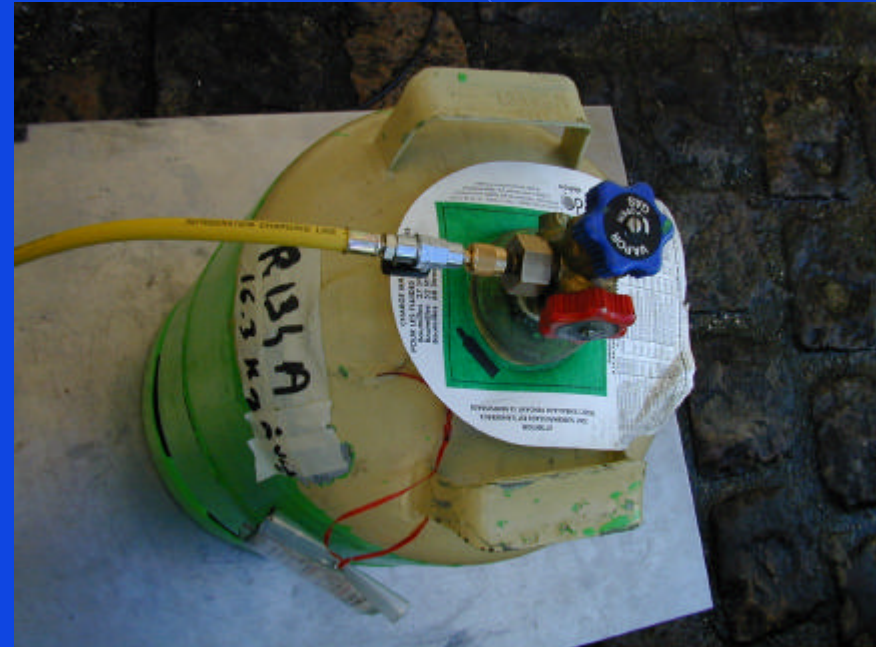
Better servicing and repair (9)

- Measured quantities of refrigerant trapped in the 2 hoses (2m long and 6.25mm internal diameter) is of 30g.
- Recovery equipment shall be designed in order to recover the trapped refrigerant inside the hoses.

Recovery equipment



Recovery capacity



Better servicing and repair (9 & 10)

Global objective : Reduction From About 400g emissions
along Life Time to 30g or less

- Recommendations:
- Better design of recovery equipment : recovering residual refrigerant in hoses and in the equipment itself.
- Systematic approval of recovery efficiency of recovery equipment

Better servicing and repair Summary of recommendations (1)

- **Critical analysis of actual guidelines : e.g. systematic filter drier change leading to circuit opening. Feed-back : 1 filter for ever.**
- **On-line guidance for method of diagnosis for operators**
- **Annual lessons learnt to determine leak prone components**
- **Training of operators with a control by 3rd party**

Better servicing and repair Summary of recommendations (2)

- **Indication of refrigerant recharge in the vehicle maintenance log book**
- **Annual summary of refrigerant invoices by garage and by After Market Make**
- **Annual follow-up of refrigerant sales for servicing**

Emission Reduction at End Of Life

Global objective : Reduction From About 300g emissions
along Life Time to 50g or less

- How to respect End OF Life Vehicle Directive leading to an 85% recovery efficiency of the refrigerant charge ?
- Note : 95% recovery efficiency and more is affordable
- Enforcement only ?
- Deposit leading to a pay-back on each recovered kg of refrigerant ?
- Training of specialized operators in scraping companies

Possible emission reductions

	Optimistic actual scenario (g of R-134a)	Best possible scenario (g of R-134a)
Capacity heels	8	8
Filling of the system	2	0
Fugitive emissions and accidental ruptures	900	300
Emissions during servicing	198	15
Emissions at End Of Life	68	15
TOTAL (g of R-134a)	1 178	338
TOTAL (kg eq. CO2)	1 531	439

Emission Reduction along the lifetime

Summary

- Global cooperation is needed : chemical industry, car manufacturers, after sales service and scraping industry
- Adequate monitoring and follow up of annual refrigerant emissions
- Enforcement