



# **Evaluation of the Potential Impact of Emissions of HFC-134a From Non Professional Servicing of Motor Vehicle Air Conditioning Systems**

Provisional Final report

**ANNEXES**






June 2008








Annex A (cf. Section 2)

Interdynamics (<http://www.id-usa.com/>)

S&P and top off cans

Photo	Designation	Fitting type	Capacity / Contents
	AF-3	S&P	13 oz. R-134a 1 oz. of oil, QwikBoost performance booster, leak sealer and O ring conditioners
	AF-6	S&P	19 oz. R-134a
	RFT-134a	S&P	14 oz 11 oz. of R-134a 2 oz. polyol Ester Oil, o-ring conditioner, Concentrate of "Maxi Cool" Performance Booster with AC Cleaner
	RLS-134X	S&P	13 oz. R-134a Leak Sealer
	RLS-134a	S&P	12 oz. R-134a Leak Sealer

	HMR-134a	S&P	<p>13 oz.</p> <p>R-134a Leak Sealer</p>
	HMT-1DC		<p>7 oz.</p> <p>6 oz. of R-134a refrigerant 1 oz oil pack of Ester Lubricant and High Mileage anti-wear additives Leak Sealer</p>
	NUV-134a	S&P	<p>13 oz.</p> <p>R-134a AC Fluorescent Dye</p>
	COL-134a	S&P	<p>14 oz.</p> <p>A C Cleaner Leak Sealer O'Ring Conditioner</p>
	ORD-134DC		<p>7 oz.</p> <p>6 oz. of Refrigerant 1 oz. of Lubricant</p>

## Recharging Kits

Photo	Designation	Fitting type	Capacity / Contents
	AF-1	S&P	18 oz. R-134a Oil Leak sealer
	AF-2	S&P	14 oz. 11.5 oz. of R-134a 2.5 oz of oil, QwikBoost performance booster, leak sealer and O ring conditioners
	AFK-11CS	S&P	
	GL-1	Valve equipped	16 oz. R-134a Oil Leak Sealer
	GL-2	Valve equipped	12 oz. R-134a Oil Leak Sealer

	GL-3	Valve equipped	10.25 oz.  R-134a Oil Leak Sealer
	GL-11CS	Valve equipped	2 x 12 oz.  R-134a Oil Leak Sealer
	BC-1	S&P	22 oz.
	QCK-2CS	S&P	14 oz.  11 oz. of R-134a 2 oz. oil with O-Ring Conditioner and Leak Sealer 1 oz. Xycleen™ auto additives to promote a cleaner system
	MAC-134a	Valve equipped	19 oz.  16 oz. of Refrigerant 3 oz. of Lubricant including Cleaner, Leak Sealer & O-Ring Conditioner

	MAC-134aRFL	Valve equipped	19 oz.
	SD-134a	Valve equipped	14 oz. 12 oz. of R-134a 2 oz. of oil, leak sealer, o-ring conditioner
	RGM-2CS	S&P In Line Gauge	14 oz. 11 oz. of R-134a 2 oz. of Ester Lubricant with O-Ring Conditioner 1 oz. AC Cleaner and Leak Sealer

## Combination Retrofit & Recharging Kits

Photo	Designation	Capacity / Contents
	AFK-10	3 cans of Artic Freeze Refrigerant
	RKR-8	3 cans of High Mileage R-134a and Oil Built-in Gauge, adapters and fittings
	RKR-7	Charging hose with pressure gauge in line 3 can of 15 oz. 12 oz. of R-134a 3 oz of oil per can with High Mileage Anit-Wear Additives and "System Safe" Leak Sealer for all rubber leaks
	RKR-5	3 Cans of 15 oz. 12 oz. of Refrigerant 3 oz of Oil
	RKC-3CS	2 Charging Cans of Ester Lubricant 9 oz. of Ester Lubricant O'ring Conditioner 3 oz. of R-134a
	RK-9	•2 oz. R-134a Oil Charge
	BRK-4	PLUS 8-1½ oz. of Ester Oil Charge with O-Ring Conditioner for complete system fill. Net Wt. 11 oz.





## Charging Kits



Photo	Designation	Fitting type
 <p>The image shows the packaging for the EZChill Recharge Kit. The packaging is blue and white, featuring a picture of the kit's components, including a blue hose and a yellow nozzle. The text on the packaging includes 'EZChill Recharge Kit' and '134a &amp; Oil'.</p>	MB-134a	S&P
 <p>The image shows the packaging for the EZChill 24' Extension Hose. The packaging is blue and white, featuring a picture of the blue extension hose and a yellow nozzle. The text on the packaging includes 'EZChill 24' Extension Hose'.</p>	MB-24EXT	S&P
 <p>The image shows the packaging for the EZChill R-134a Recharge &amp; Measuring Kit. The packaging is white and blue, featuring a picture of the kit's components, including a gauge, a hose, and a nozzle. The text on the packaging includes 'EZChill R-134a Recharge &amp; Measuring Kit'.</p>	HGT-134aCS	S&P
 <p>The image shows the packaging for the EZChill R-134a Recharge &amp; Measuring Kit. The packaging is blue and white, featuring a picture of the kit's components, including a gauge, a hose, and a nozzle. The text on the packaging includes 'EZChill R-134a Recharge &amp; Measuring Kit'.</p>	GBM-2CS	S&P
 <p>The image shows the packaging for the EZChill R-134a Recharge &amp; Measuring Kit. The packaging is blue and white, featuring a picture of the kit's components, including a gauge, a hose, and a nozzle. The text on the packaging includes 'EZChill R-134a Recharge &amp; Measuring Kit'.</p>	GBM-3CS	S&P
 <p>The image shows the packaging for the EZChill Quick Charge. The packaging is blue and white, featuring a picture of the kit's components, including a hose and a nozzle. The text on the packaging includes 'EZChill Quick Charge'.</p>	QC-1CS	S&P

**JOHNSEN'S**

**Refrigerant cans**



Photo	Designation	Fitting type	Capacity
	R-134a	S&P	12 oz.
	R-134a + UV Glow charge	S&P	12 oz.

**Charging Kits**

Photo	Designation	Fitting type
	R-134a check & charge hose	S&P
	R-134a Recharge Kit	S&P

## QUEST


### Refrigerant cans and charging kit

Photo	Designation	Fitting type	Capacity / Contents	Price
	QUEST R-134a with Sub-Zero	S&P	19 oz. 17 oz. of R-134a 2 oz. of Sub-Zero Synthetic A/C Booster, Patented Reusable	\$ 91
	QUEST R-134a	S&P	12 oz. R-134a	
	QUEST Quick cool R-134a	S&P	14 oz. 12 oz. of R-134a 2 oz. of PAG Oil to Lubricate and Quiet Noisy Compressors, Stop Leak and O-Ring Conditioner	\$ 14.68
	QUEST Stop leak	S&P	12 oz.	
	QUEST R-134a High Mileage	S&P	13 oz. 12 oz. of R-134a 1 oz. of High Mileage Lubricant	\$ 10.97



	QUEST R-134a Sub-Zero	S&P	15 oz.  13 oz. of R-134a 2 oz. of Sub-Zero Synthetic A/C Booster	\$ 16.78
	QUEST Sub Zero synthetic A/C booster	S&P	4 oz.	\$ 4.79
	QUEST R-134a HIGH MILEAGE	S&P	4 oz.	\$ 4
	QUEST R12/R22 Super Seal	S&P	R12-R22	\$ 19.99
	QUEST R-134a Cool Down	S&P	Contains PAG oil, R- 134a refrigerant, conditioners and sealers	\$ 2.66
	QUEST R-134a quick cool			\$ 9.70

	QUEST R-134a Oil Charge	S&P	11.5 oz. 8.5 oz. of PAG oil 3 oz. of R-134a plus conditioners	\$ 5.32
	QUEST R-134a plus	S&P		\$ 8.35
	QUEST R-134a refrigerant with Stop Leak	S&P	12.3 oz.	\$ 6.74
	QUEST R-134a Super Seal	S&P		\$19.99
	QUEST R-134a Total Treatment	S&P	5 oz. 2 oz. of R-134a, 2 oz. of PAG oil and quite noisy compressors, 1 oz. of Cool Down	\$ 3.67

## Combination Retrofit & Recharging Kits

Photo	Designation	Fitting type	Capacity / Contents
	QUEST ReChill Kit	S&P	2 x18 oz. of R-134a 4 Oz of Sub-Zero Synthetic A/C Booster

## Charging hoses

Photo	Designation	Price
	R-134a recharge hose with gauge handle	\$ 14.68
	Manifold gauge & hose set	\$ 52.48

## Annex B (cf. Section 2)

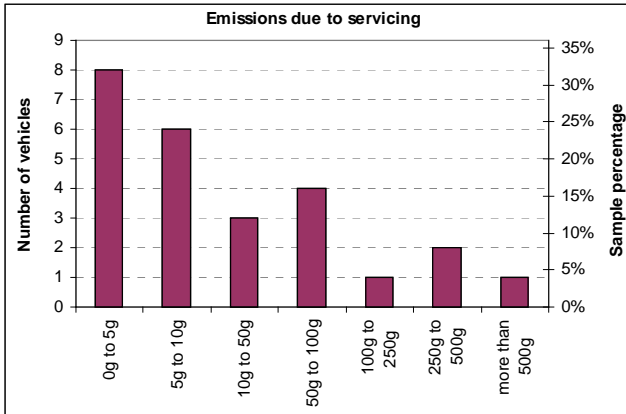


Figure A.1: Number of vehicles as a function of emission range due to servicing (sample 1).

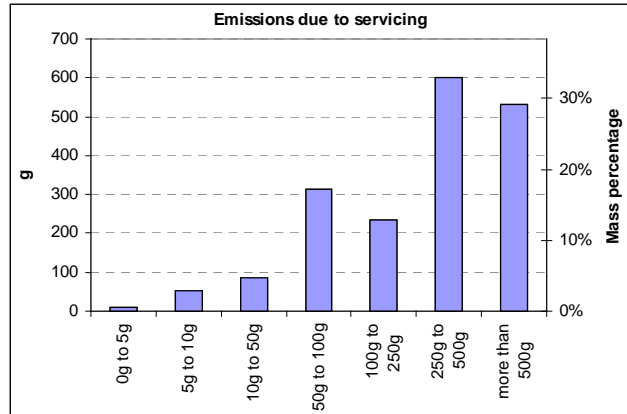


Figure A.2: Mass emission as a function of emission range due to servicing (sample 1).

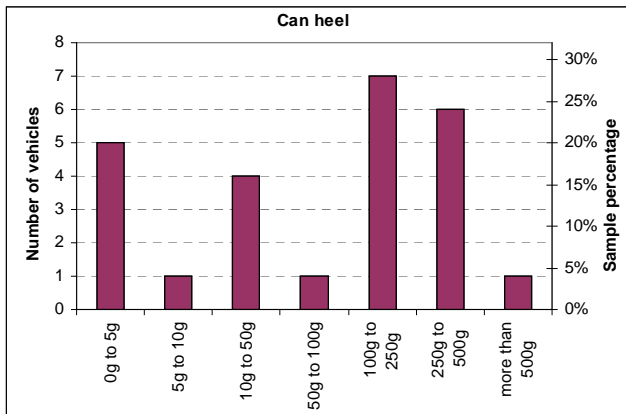


Figure A.3: Number of vehicles as a function of can heel range (sample 1).

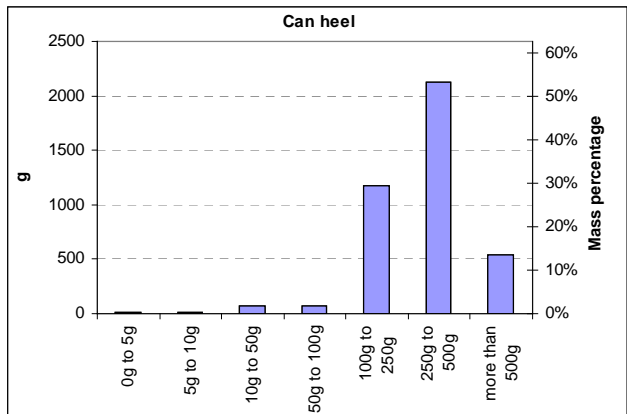


Figure A.4: Mass emission as a function of can heel range (sample 1).

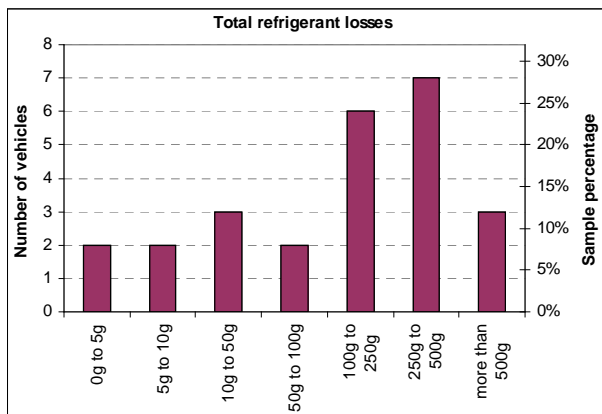


Figure A.5: Number of vehicles as a function of total refrigerant emissions (sample 1).

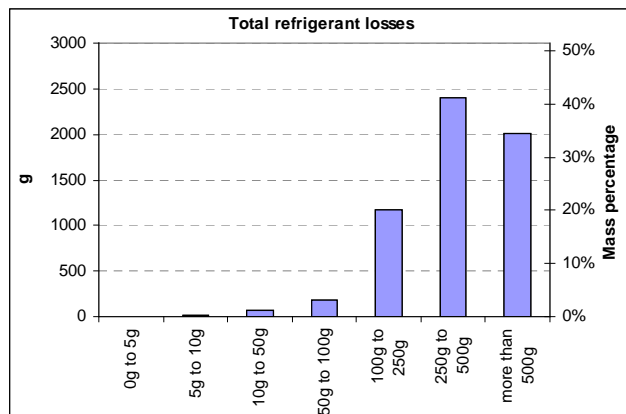


Figure A.6: Mass emission as a function of total refrigerant emissions (sample 1).

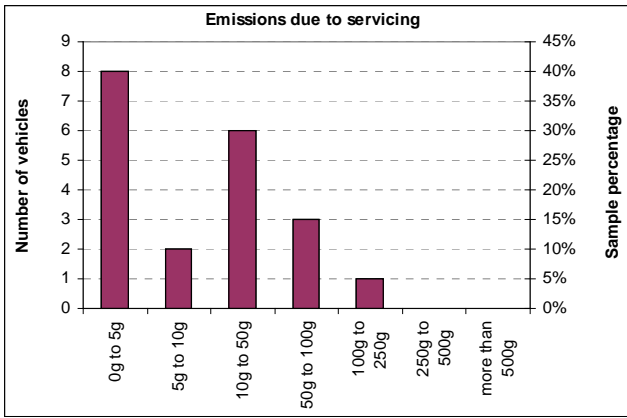


Figure A.7: Number of vehicles as a function of emission range due to servicing (sample 2).

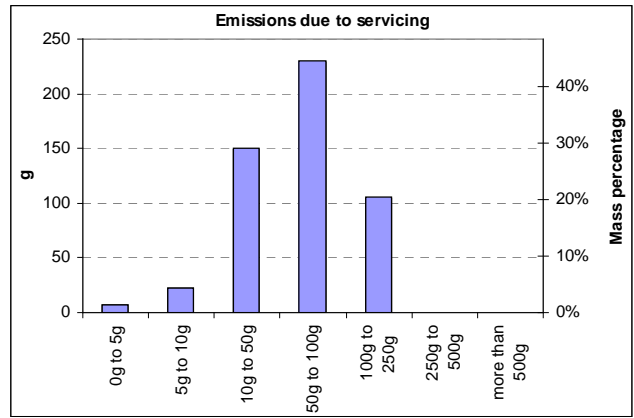


Figure A.8: Mass emission as a function of emission range due to servicing (sample 2).

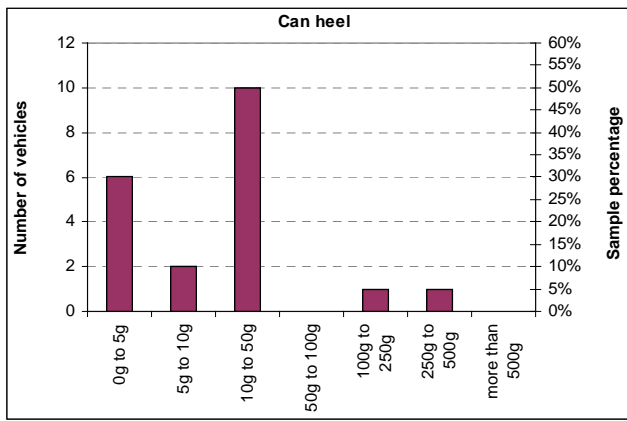


Figure A.9: Number of vehicles as a function of can heel range (sample 2).

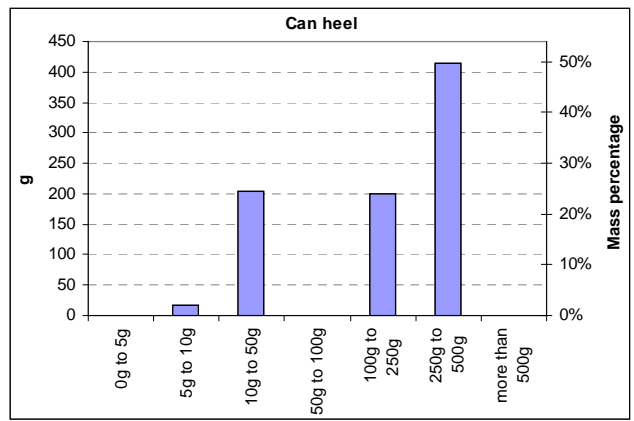


Figure A.10: Mass emission as a function of can heel range (sample 2).

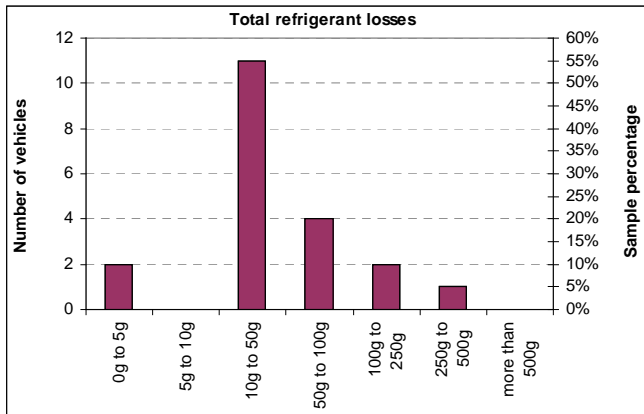


Figure A.11: Number of vehicles as a function of total refrigerant emissions (sample 2).

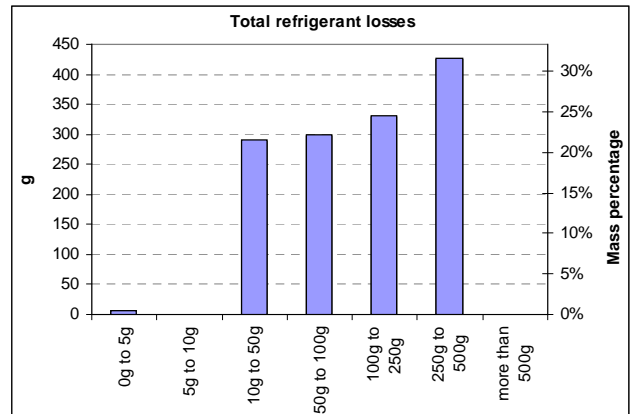


Figure A.12: Mass emission as a function of total refrigerant emissions (sample 2).



## Annex C (cf. Section 3)

### Details of garage visits and operations

**Garage number:** 1    **Date:** 09/13/07    **Vehicle:** CADILLAC Deville, retrofitted to R-134a

---

Two refrigerant leaks have been detected by ARMINES on the MAC circuit (using an electronic leak detector): one on the suction fitting of the compressor and one on the low-pressure service valve (LPSV).

#### **Operation description**

First, the technician requests general information such as:

- What refrigerant?
- When has the MAC system been retrofitted?
- Does the system blow cold air?
- What is the car vintage?

Then the same technician looks at the vehicle to check the retrofitting sticker, the mileage of the vehicle. He checks the ventilation, the temperature of the air blown, and the compressor clutch. The manager advises to perform a diagnosis based on a leak search. The quotation for the diagnosis is 19.99\$.

Having agreed on the proposed service, a technician is in charge of the vehicle. A gas analyzer is connected to the LPSV of the circuit to verify the refrigerant type. The analyzer indicates 100% R-134a, 0% air.

A rapid tour of the MAC circuit is done with a current lamp to check the various fittings and the condenser.

Then, he turns ON the starter of the vehicle to check the compressor clutch engagement.

An automated Refrigerant recovery and recycling (RRR) group is connected to the high and low-pressure service valves (PSVs). He starts the car, turns on the air conditioning system (maximum ventilation) and the HP and LP pressure levels.

The engine and the air-conditioning being turned off, the automated RRR group is started. The refrigerant is recovered, recycled, and the system evacuated. The refrigerant circuit is maintained evacuated during 15 to 20 minutes in order to verify if the pressure in the circuit goes up. I have not been able to see the pressure value, and thus to know if it increased.

Then oil and DYE have been added, and the MAC circuit has been recharged.

Once the system has been recharged, the system is maintained under pressure during about 30 minutes (engine and air conditioning on for about 15 minutes). After that a leak search is performed, all along the circuit, using an UV lamp and glasses. A leak is found on the LP fitting of the compressor. A second leak search is performed with an electronic leak detector, which confirms the leak on the same site.

The advice is to change the compressor, the suction line, and the liquid receiver. The quotation is of 1,360 \$.

We request if only the O-ring at the compressor suction port could be changed. From his point of view, the answer is no, the three components have to be changed.

We argue that the repair cost is too high and ask if the circuit can be recharged without the leaks being repaired. He refuses and we take the car back as is.

The MAC system has been recharged with about 900 g of refrigerant. After the leak search the technician has not recovered the refrigerant.

Prior giving the car back to us, he handed us a complete document on the "recommended service not authorized by customer", and we will notice later that the technician had added a sticker showing the refrigerant type, the refrigerant charge, the name of the garage and OF the operator.

**Operation cost:** 19.99 \$

**Garage number:** 2    **Date:** 09/13/07    **Vehicle:** CADILLAC Deville, retrofitted to R-134a

---

ARMINES has detected two refrigerant leaks on the MAC system circuit using an electronic leak detector: one on the suction fitting of the compressor and one on the LPSV.

**Operation description**

This garage includes about 4 technicians.

The operator starts the vehicle and the air conditioning system.

The ventilation is set on the maximum to check the blowing and the temperature of the blowing air. He also checks that the compressor clutch engages properly. He notices the retrofitting labeling we had previously posted.

The operator connects a manifold on the HP and LP service valves (SVs) in order to check the service pressure of the system. He notices that the compressor cycles and the LP oscillates.

He diagnoses that the refrigerant level in the circuit is low and that a leak possibly exists. Then he explains to us how to perform a leak search using UV, but for him the leak is too small and that it will be difficult to identify the site.

He indicates the price for the refrigerant recharge only, and he repeats several times that he does not guarantee that the air conditioning will run over the time. He will also mention that the compressor seems "weak" and proposes to change it. The quotation for that is of 850 \$.

We accept the refrigerant recharge. He verifies the manufacturer charge indicated on the label on the under hood and takes two 12-oz small cans (S&P type) with a charging kit.

The operator connects the flexible to the charging kit. He connects the whole to the LP port of the circuit. The first can is screw and perforated (S&P type). He turns on the engine and the air conditioning, and starts the charge with liquid refrigerant (can upside down).

He has the feeling that the can is empty. He opens the clamp to deliver the can and S&P the second one. Doing the same, he charges the refrigerant, cylinder upside down. When he thinks that the can is empty, he opens the clamp to disconnect the can.

The small cans contain neither oil nor DYE.

The operator verifies the air temperature at the exit of the blowing outlets and touches several times the suction hose of the compressor.

No leak search is performed.

**Operation cost:** 80.00 \$

**Operation description**

About 10 technicians work in this garage.

The operator recommends me a refrigerant recharge of the air conditioning system and to perform a leak search.

Prior to start the work, he explains to me how he is going to proceed, in particular that he will recharge the system with DYE to locate the leak.

He connects the automated RRR group to the HP and LP SVs, checks the pressures with the A/C off, and then with the A/C on.

He inspects the circuit with a classical lamp. No specific default is found.

The engine being off, he starts the RRR group. He recovers and recycles the refrigerant. He evacuates the system and recharges the nominal charge of refrigerant with an addition of DYE (the operator has verified the charge on the label existing on the under hood). The duration of the operation is of about 45 minutes.

Once the recharge is done, he disconnects the valves from the HP and LP ports and checks the circuit with an UV lamp.

He tightens the Schrader of the HP port. Incidentally, he pushes twice the Schrader and some gas is released to the atmosphere.

Then he checks the circuit with an electronic leak detector. No leak is found.

The operation ends by a test on the operation of the MAC system. The vehicle is started and the A/C is also started at high speed (maximum ventilation with recycled air). He checks the temperature of blown air.

**Operation cost:** 104.24 \$

**Operation description**

There are about 7 technicians in the garage.

The operator recommends a complete diagnosis (19.99 \$).

The operator checks the blowing temperature and the ventilation inside the cabin. He checks visually the compressor clutch.

He connects the automated RRR equipment to the HP and LP SVs and checks the pressure levels.

After those first verifications, he recovers the refrigerant, evacuates the system, adds some DYE, and recharges the circuit. I do not know whether the circuit is recharged to the nominal charge or only with partial charge.

Then, he performs a leak search with an UV lamp and specific eyeglasses. All the circuit is checked and the evaporator is thoroughly checked. The diagnosis of the operator is as follows:  
Low refrigerant pressure, overfilled with oil (probably can refill). The system needs to be evacuated and recharged with 1.5 lb R-134a. No UV leak detected.

The operator recommends repairing the system by recovering the refrigerant and recharging the circuit. He gives me a list of recommendations to repair the system. The quotation for this operation is 177.42 \$. I refused the repairs.

The technician has lost the cap of the LP SV. He replaced it by another one that does not fit.

Based on the remarks of the operator, I dismount the complete suction line of the compressor and the fitting of the liquid line to check the oil in the circuit. Hoses are not filled up with oil. Nothing is abnormal.

Using the vacuum pump, I evacuate the circuit. I add some R-134a, and again I evacuate the circuit using the transfer group down to 30 kPa. Then I charge about 150 g of refrigerant. I perform a leak search with an electronic detector on the fittings I have just disassembled. The fitting of the compressor suction is OK. There is a small leak on the fitting of the evaporator outlet on the expansion valve.

**Operation cost:** 19.99 \$

**Garage number:** 5    **Date:** 12/14/07    **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is small, only one operator.

The operator starts the vehicle and the A/C system. He checks that the AC system blows cold air. Then he looks at the compressor clutch to verify the engagement. He connects a manifold and checks the HP and LP SVs of the circuit.

His diagnosis is that there is not enough refrigerant. He says that there may be a leak somewhere. I ask if the leak can be fixed or if the system can be recharged. He answers that the leak is too small to be located and recommends going ahead with the recharge. He insisted on the fact that he will not guarantee the service.

The operator checks the charge indicated on the label. Then he goes at the back of the garage to pick up two small cans (12 oz) and one connecting kit. The kit is already connected to one small can. He unscrews it and the can leaks significantly (liquid and gas). He connects the kit to one of the two new small cans and connects the whole to the LP SV. He turns on the car and the A/C system. He fills up the refrigerant in liquid phase. He does the same with the second small can.

During the charge, he puts a hand on the suction line of the compressor and checks several times the air temperature at the blowing outlets.

**Cost operation:** 70.00 \$

**Garage number:** 6    **Date:** 12/15/07    **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is small and includes one main technician and one operator.

The operator opens the under hood and press several times (at least 5) the Schrader of the LP SV. Each time refrigerant is released.

The technician joins us and asks me to start the car and the A/C system with the maximum ventilation speed. He checks visually the compressor clutch engagement. He takes the screw driver and presses again 3 or 4 times on the Schrader of the LP SV.

He turns off the car engine. Again he presses several times the Schrader of the LP SV.

Then he offers to recharge the system, but insists that he does not guarantee the operation. I agree to his offer.

He picks up a 12 oz small can and a charging kit equipped with a pressure gauge.

He charges liquid refrigerant. No refrigerant release occurs during the charge.

He does not make any recommendations and does not perform any leak search.

**Cost operation:** 60.00 \$

**Garage number. 7**    **Date:** 12/16/07    **Vehicle:** Mitsubishi Montero

---

**Operation description**

This garage is part of a chain of garages offering quick servicing (engine oil, filter, ...). He also offer A/C system servicing. I notice that he is also equipped with an automatic refrigerant recovery group.

The garage includes 4 to 5 employees.

The operator enquires about the problem (no cooling). He checks neither the temperature of the blowing air nor the engagement of the compressor clutch.

He only recommends refrigerant recharge. The price for the refrigerant recharge is a lump sum of 130 \$. I ask if that price includes a leak search. He answers that they never do that. He says that the price covers a simple refrigerant recharge (recovery + recycling + evacuation, and recharge).

I indicate to the operator that the price is high compared to the service (only recharge). He recommends me to go to Krage and buy small cans.

**Operation cost:** NONE

**Garage number. 8**    **Date:** 12/16/07    **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is a medium-size shop including about 4 technicians.

One of them enquires about the problem. He recommends directly refrigerant recharge and leak search using DYE.

The price list offers diagnosis (blowing air, compressor clutch) and leak search for 89 \$. Once the diagnosis is done, if nothing is detected, they propose refrigerant recharge for 145 \$.

I notice that the garage is equipped with an automated RRR group.

**Operation cost:** NONE

**Garage number:** 9    **Date:** 12/16/07    **Vehicle:** Mitsubishi Montero

---

**Operation description**

There are only two technicians in this garage.

The operator checks the temperature and the air blowing in the cabin. He presses twice on the valve of the LP SV. He also checks visually the compressor clutch engagement.

His diagnosis is that the refrigerant level is low. He recommends a leak search and refrigerant recharge.

When doing the leak search, he leaves the circuit under pressure and connects a hose of compressed air to the LP SV. He starts to fill with air and realizes that the Schrader of the LP SV leaks. He recommends replacing it. He does not have a new part and cannot order it. He suggests that I go to a store to buy one and to come back for the refrigerant recharge.

No fee is charged for this diagnosis. I have obtained air in the circuit for free !

I do not come back to the garage because I did not find the part in a specialized store or in another garage.

**Operation cost:** NONE

**Garage number:** 10    **Date:** 12/16/07    **Vehicle:** Mitsubishi Montero

---

**Operation description**

I come back in a garage of the chain I have already visited in order to check if all garages offer the same operation mode.

The person in charge tells me the price of a refrigerant recharge: 130 \$ without any other information.

I agree.

The operator checks the air blowing and the air temperature at the blowing outlets. He looks at the compressor clutch engagement.

He connects an automated RRR group and looks at HP and LP pressures, with the system ON and OFF.

He recovers and recycles the refrigerant, then evacuates the system, and recharge the circuit with the manufacturer nominal charge that he has read on the label in the under hood.

No DYE is added. I have not been able to see whether or not oil has been added.

No leak search is performed.

He checks that the system provided cooling by measuring the temperature of the air blown in the cabin, prior to give me the car back.

No comment is made on the leak tightness of the system.

**Operation cost:** 132.91 \$

**Garage number:** 11 **Date:** 03/03/08 **Vehicle:** Mitsubishi Montero

---

The vehicle has not been used for three months. A leak search is performed on the A/C system with an electronic detector. No leak is found.

**Operation description**

The garage is a small one with only one technician. The garage is located in a gas station equipped with two hydraulic car lifts.

I tell him that the A/C system does not cool the cabin. He recommends refrigerant charge. He does not say a word about leak search.

I react as someone who does not understand. He gives me some more details: he uses small cans, 12-oz type with charging kit without pressure gauge. The service cost is 70 \$.

I do not make the operation in this garage because he has no time to do it.

**Operation cost:** NONE

**Garage number:** 12 **Date:** 03/03/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is a medium size one (4 technicians) specialized in radiators and A/C systems.

The technician checks the temperature of the blown air and the engagement of the compressor clutch.

He connects an automated RRR group to the HP and LP SVs, and check service pressures.

After this diagnosis, he recommends leak search before charging refrigerant.

He recovers and recycles the refrigerant, evacuates the system, and recharges it according to the manufacturer nominal charge indicated on the label available on the under hood. The RRR group adds automatically DYE when the circuit is evacuated.

Once the charge is completed, a leak search is performed first with an UV lamp, then with an electronic detector. The leak search duration is about 15 minutes. No leak is found. He recommends me to stop by in about a week to check UV traces.

**Operation cost:** 138.18 \$



**Garage number:** 13 **Date:** 03/03/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

This is a small garage with two technicians.

One technician checks the compressor clutch and the temperature of the blown air. Then he connects a manifold and checks the service pressures. He recommends a leak search.

The A/C circuit is under pressure and performs a leak search with an UV lamp during about 2 minutes without even knowing if there is refrigerant in the A/C system. He says that no leak exists.

He says that it is normal; one recharge is necessary every 5 years.

I agree for the refrigerant recharge.

The refrigerant is not recovered and the circuit is not evacuated. He reads the manufacturer charge. He adds liquid refrigerant using the manifold from one cylinder of virgin refrigerant. He uses also a scale to measure the quantity of refrigerant he is charging.

**Operation cost:** 70.00 \$

**Garage number:** 14 **Date:** 03/04/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

This medium-size garage includes 2 to 3 technicians.

The garage is specialized in AC systems, short repair, and electric systems.

The operator checks the ventilation and temperature of blown air. Then he checks the compressor clutch and connects a manifold in order to check the service pressures.

He recommends recharge of refrigerant with some DYE. According to him, the leak cannot be located immediately. He also recommends coming back in a few days to check the circuit tightness with an UV lamp.

The operator has processed as follows:

The circuit is under pressure; the initial refrigerant charge is of 102 g.

First, he charges DYE using a pump.

Then he connects a manifold to the HP and LP SVs. The valves of the manifold are opened (gas is released to the atmosphere for about 1 minute).

He puts the refrigerant cylinder upside down and starts the charge in liquid phase.

The A/C system is ON, the manifold valves are wide opened for several minutes.

I have recovered 494 g.

**Operation cost:** 95.00 \$

**Garage number:** 15 **Date:** 03/04/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

Two technicians work in the garage. The garage is specialized in the repair of A/C systems and engine cooling radiators.

The operator checks the ventilation and the temperature of the blown air. Then he checks the engagement of the compressor clutch. The diagnosis is a need of refrigerant. The operator recommends refrigerant charge with DYE to check the leak tightness of the system.

The operator uses an automated RRR group and operates in a usual way: recovery and recycling of the refrigerant, evacuation of the system, and recharge.

Once the system is recharged, the leak check is performed using an electronic leak detector. The operator also opens the small door inside the cabin, on the passenger side, allowing the access to the evaporator. No leak is found. Thus he recommends me coming back after a few days to check if there are DYE traces.

**Operation cost:** 93.97 \$

**Garage number:** 16 **Date:** 03/04/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

The garage is large including more than 8 technicians and the same number of hydraulic car lifts. I am the only one customer in the afternoon.

The garage is specialized in diagnosis and repair of A/C systems.

The first offer is to check the A/C system for a diagnosis (29.99 \$). I agree on that.

I am not allowed to enter the working area. I observe the operation from a certain distance.

In a first step, the operator checks rapidly the temperature and the air blowing in the cabin. Then he connects the A/C system to an automated RRR group. I do not know if he adds refrigerant or if the circuit is maintained under pressure. Anyway he performs a leak search using an electronic leak detector (with adjustable sensitivity).

After about 40 minutes of leak search, the operator comes back to me. He explains that no leak has been found. He recommends recovery and recycling of the refrigerant, system evacuation and refrigerant recharge. The quotation is in the range of 100 \$, including diagnosis.

I agree.

The operator starts the automated RRR group and program the recovery, evacuation, and refrigerant recharge based on the manufacturer nominal charge that he has read on the system label.

**Operation cost:** 98.26 \$

**Garage number:** 17 **Date:** 03/05/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

The garage is specialized in cooling radiators and A/C systems. There are about 5 to 7 technicians.

The operator recommends at once performing a leak search (60 \$). He checks the compressor clutch. He connects the automated RRR group (HP and LP SVs) and starts the A/C system.

The LP decreases and the compressor cycles. He stops the car engine. HP and LP are balanced. He takes a usual lamp and has a first look at the system. Then he takes an electronic leak detector and goes all over the system. After several minutes of examination, no leak is found.

He says to me that it might be the condenser or hoses and estimates to 550 \$ the repair costs.

I do not agree to the repair. He offers to recharge the system with « stop leak », one small can QUEST (R-134a + oil + stop leak additive). He connects the can to the LP SV. He starts the car engine and the A/C system. He continues the refrigerant charge with the can upside down (in liquid phase) and with a stirring movement.

**Operation cost:** 119.54 \$

**Garage number:** 18 **Date:** 03/05/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

The garage is very small, a single operator. He offers a first diagnosis.

He connects a manifold to the HP and LP SVs. He notices that the system is under pressure.

He asks me to start the engine and to turn on the A/C system. The LP drops. He explains that there is not enough refrigerant in the A/C system.

He offers refrigerant recharge for 70 \$.

He also says that there may be a leak, and that he does not guarantee that it will work for long.

Thus I request that he performs a leak search in order to locate the leak and repair it. But he tells me that the leak is too small.

He recharges the system, in liquid phase, via the LP SV, the engine and the A/C system both running.

He does not mention DYE.

**Operation cost:** 70.00 \$

**Garage number:** 19 **Date:** 03/05/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is small with only one technician.

As usual, I tell him that the A/C system does not work well, no cooling and efficiency has decreased with time.

He says that there may be a leak on the circuit and offers refrigerant recharge with DYE. He recommends to use the A/C system as usual and to come back when the efficiency will be low in order to check the leaks with DYE.

The garage is equipped with an RRR automated group. He recovers and recycles the refrigerant, evacuates the system, and recharges the refrigerant with DYE.

I recovered 699 g.

**Operation cost:** 94.12 \$.

**Garage number:** 20 **Date:** 03/05/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is small with two technicians.

He advertises his services for A/C system checking.

He recommends refrigerant recharge. After I have explained the problem, he connects directly an automated RRR group (only to the LP SV of the system). He does not check the compressor clutch. He notices that the LP pressure cycles, but that the system is under pressure. He reads the manufacturer charge.

He does not recover the refrigerant remaining in the system; he only tops up the charge.

I have recovered 946 g instead of 680 g.

**Operation cost:** 60.00 \$.

**Garage number:** 21 **Date:** 03/05/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is small with two technicians. As most of garages, he advertises A/C servicing.

The operator neither checks the blowing air temperature inside the cabin nor the compressor clutch. He connects directly an automated RRR group (SPX Robinair Cooltech 700) to the HP and LP SVs.

He starts the refrigerant recovery, evacuates the system, and recharges. He has read the manufacturer charge before charging the system. He adds oil and DYE in the system using the RRR group.

Although I insisted, he did not perform leak search. He just tells me to come back later for an overall check of the system.

**Operation cost:** 89.90 \$

**Garage number. 22    Date: 03/06/08    Vehicle: Mitsubishi Montero**

---

**Operation description**

The garage is small with two technicians.

First the operator pushes the Schrader of the LP SV. Result: Pschittt !!!! He feels better: there is still some refrigerant. He also checks the air temperature at the blowing outlets and the engagement of the compressor clutch.

Then he connects an automated RRR group to the HP and LP SVs. He starts the car engine. The LP drops, the HP is low, the compressor cycles...

Diagnosis: compressor or expansion valve problem. The two parts have to be replaced. Estimate of the two parts: 550.00 \$.

Estimate of the repair duration: 24 hours.

**Diagnosis: FREE**

**Garage number. 23    Date: 03/06/08    Vehicle: Mitsubishi Montero**

---

**Operation description**

In this small garage only one technician. He is rather meticulous and performs a thorough operation.

He checks the compressor clutch, the air temperature at the blowing outlets, HP and LP pressures (system ON and OFF), and he analyses the gas type in the circuit (3.5% air).

Then he starts the automated RRR group with: refrigerant recovery, system evacuation, and refrigerant recharge.

After the system evacuation, he performs the test of pressure raise in the circuit during 20 minutes (this is an option on the automated group). Result: no pressure raise.

After the refrigerant recharge, he checks the circuit with an electronic leak detector. He inspects all the circuit. He also checks the evaporator leaks through the blowing outlets. Result: no leaks.

When charging the refrigerant with the automated group, he has also added DYE. He recommends me to stop in a garage to locate the leak.

I recovered 591 g of refrigerant.

**Operation cost: 120 \$ for the full process.**

**Garage number. 24    Date: 03/06/08    Vehicle: Mitsubishi Montero**

---

**Operation description**

The garage includes three technicians.

The first thing the operator does is to push the Schrader of the LP SV to make sure that there is gas in the system. Then he checks the air temperature in the cabin, HP and LP pressures, and the compressor clutch. He leaves the system under pressure. Although I insist, he does not perform leak search.

He only tops up the refrigerant charge, engine OFF, using an automated RRR group connected to the HP SV of the system.

**Operation cost: 80.00 \$**

**Garage number.** 25    **Date:** 03/07/08    **Vehicle:** Mitsubishi Montero

---

**Operation description**

This one is a gas station including a garage. There are two technicians.

First the operator checks the engagement of the compressor clutch. He checks the air temperature of the blown air with a thermometer, and touches the hose exiting the evaporator.

He unscrews the HP and LP covers and notices DYE traces. With assurance, he says that the leak comes from that point.

He offers to recover the refrigerant remaining in the system in order to change the Schrader. I question him to know if some other leaks may exist. He answers that the sole source of leaks is the Schrader.

He connects the automated RRR group (Cornwell Tools RAC341342K) to the HP and LP SVs. He recovers the refrigerant in the system. He disconnects the automated group, and replaces the HP Schrader. Then he evacuates the system and recharge refrigerant.

**Operation cost:** 150.00 \$

**Garage number.** 26    **Date:** 03/07/08    **Vehicle:** Mitsubishi Montero

---

**Operation description**

This medium-size garage includes 5 technicians.

The operator offers to perform leak search for 35 \$.

The operator starts the car engine and checks the temperature of air blown.

He connects the automated RRR group to HP and LP SVs and checks if the circuit is under pressure.

He starts the A/C system and notices that the pressure drops.

He turns off the A/C system and adds DYE. Then he searches leaks with an UV lamp. After 10 minutes, no leak is found.

The operator offers to recharge the system and to come back when the system does not provide cooling in order that he can locate the leak.

**Operation cost:** 102.50 \$

**Garage number.** 27 **Date:** 03/07/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

This garage includes two technicians.

The operator pushes the Schrader twice. Then he checks the air temperature and the compressor clutch.

He connects the RRR group (Robinair Smartcart) to the HP and LP SVs via a manifold. He emptied the circuit by releasing all the gas to the atmosphere.

Once the circuit is evacuated, he prepares the DYE can installed on the LP of the RRR group, then he reads the manufacturer charge and charges the system with 1.5 lb of R-134a.

He does not perform leak search and do not recommend me to stop by a few days later to check refrigerant leaks.

**Operation cost:** 124.60 \$

**Garage number.** 28 **Date:** 03/08/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

Three operators work in the garage.

The operator in charge of the Montero checks the compressor clutch, and then the temperature of the blown air.

He connects the automated RRR group (SPX ROBINAIR Cool tech 3400Z) to the HP and LP SVs in order to check the pressures (with the A/C on and the A/C off). Then he puts the circuit under pressure using CO<sub>2</sub>.

A first leak search is performed with water and soap. No leak is found.

He empties the system by releasing its content (CO<sub>2</sub> + R-134a) to the atmosphere.

He connects another automated RRR group (White industries 6R system). Using this group, he evacuates the system, adds some DYE and recharges with R-134a. He turns on the car engine and the A/C system during at least 30 minutes, and performs a new leak search using an UV lamp and ad hoc eyeglasses.

The same operating mode will be applied to a camping car belonging to another customer (use of CO<sub>2</sub> to put the system under pressure, and release of the system content to the atmosphere).

To complete the operation, he adds a label on the engine chassis indicating the name of the garage, the date, the refrigerant type, and the charge.

At the end, he recommends me to use the A/C several weeks and to come back to check the leaks using DYE.

**Operation cost:** 68.64 \$

**Garage number.** 29 **Date:** 03/08/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

Three technicians work in this garage.

The operator in charge of the car checks HP and LP pressures, and the temperature in the cabin.

He connects the automated RRR group to HP and LP SVs.

He does not recover the refrigerant. He adds DYE, tops up the refrigerant charge and performs a leak search with an electronic leak detector.

No leak is found.

He gives two options:

Either the system is left as is (recharge only 80 \$)

Or he performs refrigerant recovery, evacuates the system, and then recharge, explaining that this will remove moisture in the circuit (140 \$).

I agree for the sole refrigerant recharge.

After the process, I have recovered 623 g.

The operator has also recommended coming back in a few weeks to check the leaks using an UV lamp.

**Operation cost:** 89.60 \$

**Garage number.** 30 **Date:** 03/08/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

There are about 4 employees in the garage.

The operator checks the compressor clutch, the HP and LP pressures, and the air temperature in the cabin.

He connects the automated RRR group to the HP and LP SVs. He recovers the refrigerant, evacuates the system, and recharges the refrigerant. He also adds DYE.

Then using an electronic leak detector he performs a leak search during less than 10 minutes. No leak is detected. He recommends stopping by in a few days to check leaks with the DYE.

**Operation cost:** 52.33 \$



**Garage number.** 31 **Date:** 03/08/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

This garage includes three technicians.

The operation mode is as follows:

- Checking of air temperature
- Gas analysis by connecting an analyzer to the circuit LP SV
- Connection of an automated RRR group to the HP and LP SVs. Control of HP and LP pressures (the A/C system is OFF)

He performs the recovery, then evacuates the system, and recharges. He adds oil and DYE using the RRR group.

The leak search is performed using UV lamp and he wears eyeglasses. The leak search duration is performed during about 10 minutes. No leak is found.

He recommends stopping by in one or two weeks to perform a new leak search.

**Operation cost:** 87.41 \$

**Garage number.** 32 **Date:** 03/08/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

There are three technicians in this garage.

The operator offers me refrigerant recharge and leak search using DYE.

He connects the automated RRR group to HP and LP SVs and checks the HP and LP (A/C system ON, then OFF).

He empties the circuit releasing all to the atmosphere. Then he evacuates the system. He adds DYE and then recharges without looking at the manufacturer label indicating the nominal charge.

He says that he recharged 2 lbs of refrigerant.

He does not perform leak search. He recommends me to come back in a week if the A/C system does not operate adequately. He also mentions that it is usual to recharge refrigerant every year.

**Operation cost:** 95.00 \$

**Garage number:** 33 **Date:** 03/10/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

4 technicians work in this garage.

The operator is equipped with one manifold, one cylinder (30 lbs), and one vacuum pump.

First, he checks HP and LP (A/C ON and OFF).

Then, he releases the remaining content of R-134a to the atmosphere.

He evacuates the system and waits for about 10 minutes in order to check is the pressure raises.

He disconnects valves of HP and HP SVs and realize that they leak (the circuit is still evacuated). So he decides to replace them.

Once he has found new parts, he installs them, prepares a DYE can and recharges directly (without evacuating the system).

He reads the nominal refrigerant charge indicated by the manufacturer.

He recommends me to come back in a week of two to perform a leak search.

**Operation cost:** 140.00 \$

**Garage number:** 34 **Date:** 03/110/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

This medium-size garage employs two technicians and one manager.

The operator checks the HP and LP (A/C system ON, then OFF) using an automated RRR group (ROBINAIR SPX).

He recovers an recycles directly the refrigerant, evacuates the system, adds DYE and recharges the system.

He performs leak firs with an electronic leak detector (during 20 min) then with an UV lamp (during more than 10 min).

He checks leaks at the evaporator by opening the access located on the passenger side. He checks also the condenser fittings, which needs to undo the plastic protection (he is the only one who did that).

He is doubtful on the tightness of the Schraders and so he decides to replace them.

Once again he recovers the refrigerant, he replaces the valves, evacuates the system, and recharges 1.5 lb of refrigerant.

He checks very quickly the tightness of valves. He also checks that the A/C system runs smoothly by controlling pressure and temperature.

He does not make any recommendation.

**Operation cost:** 157.05 \$

**Garage number.** 35 **Date:** 03/11/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

The garage is small and there are two technicians.

The operator checks the gas type by connecting an analyzer to the LP SV of the system. He connects an automated RRR group (ROBINAIR) to HP and LP SVs.

He starts the car engine and the A/C system. He checks the air temperature at the blowing outlets. He also checks service pressures.

He starts the refrigerant recovery, evacuates the system (test under vacuum during about 15 min) and recharges after he has read the manufacturer nominal charge.

Once the system is recharged, he checks again the temperature in the cabin and service pressures.

He adds some more refrigerant.

After some additional checks (pressure/temperature), he performs leak search with an UV lamp and the ad hoc eyeglasses, during about 10 minutes.

No leak is found. Maybe the leak is too small.

He does not recommend coming back for a new leak search.

**Operation cost:** 124.08 \$

**Garage number.** 36 **Date:** 03/12/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

4 people work in this garage.

The technician in charge of the vehicle connects an automated RRR group (ROBINAIR Cool tech 341342 SPX).

He looks neither at the compressor clutch nor does he check the air temperature at the blowing outlets.

He checks very rapidly the pressures; the car engine and the A/C are ON. Then he starts the refrigerant recovery.

The recovery lasts about 10 minutes, and he evacuates the system for 15 min. Evacuation is maintained for about 15 additional minutes to check the leak tightness of the system.

Then he charges oil. The oil is injected by pushing on a button. The level of injected oil is controlled at the oil tank behind the automated group.

He charges the refrigerant in the system. The recharge starts with the car engine OFF, then the car engine and the A/C system are turned ON to finish the recharge. He will charge 2 lbs.

Leak search is performed during about 2 minutes, using an electronic leak detector. He does not check the whole circuit.

He checks the temperature in the cabin and service pressures.

**Operation cost:** 187.38 \$

**Garage number:** 37 **Date:** 03/12/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

Three technicians work in the garage.

The operator in charge of the vehicle checks the air temperature at the blowing outlets, and the compressor clutch.

He connects the automated RRR group and check pressures (A/C system ON, then OFF).

He checks rapidly the system with a lamp.

Diagnosis: the circuit is under pressure, so there is refrigerant in the circuit. It seems that the A/C system has never been serviced.

He recommends refrigerant recharge.

He recovers the refrigerant, evacuates the system, and recharges 1.8 lbs of refrigerant.

No leak search is performed. No DYE is added.

**Operation cost:** 163.25 \$

**Garage number:** 38 **Date:** 03/12/08 **Vehicle:** Mitsubishi Montero

---

**Operation description**

This garage is large with at least 5 technicians.

As soon as the technician takes the vehicle in charge, he connects an automated RRR group (ROBINAIR Cool tech 700) to the system.

He recovers the refrigerant, evacuates the system, and recharges refrigerant.

He performs a leak search with an electronic leak detector.

I have not been able to see much more, since very gently I am requested to leave the working area with regards to liability and insurance.

**Operation cost:** 97.66 \$

**Garage number.** 39 **Date:** 03/13/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

In this garage, I am not allowed to stay in during the operation area because of insurance concern. I can observe from about 10-m distance.

The operating mode of the technician is as follows:

- Check of the temperature of blown air
- Use of an automated RRR group and a manifold for the control of the HP and LP (A/C system ON, then OFF)
- Refrigerant recovery, system evacuation, check of the pressure raise when the system is evacuated (for 15 min), then addition of DYE and refrigerant recharge.
- Leak search with an electronic leak detector.
- No leak search with DYE

No recommendation concerning another visit or to go to another garage in the next weeks to check leaks with DYE.

**Operation cost:** 125.64 \$

**Garage number.** 40 **Date:** 03/13/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

This garage is small with two technicians.

The operator turns the A/C SYSTEM ON. Using a lamp, he checks the circuit, and then he checks the compressor clutch engagement. Then he checks the air temperature at the blowing outlets.

He connects an automated RRR group (SNAP ON Eco 134) via a manifold. He measures service pressures. He adds DYE through the LP SV, using a pump. He performs leak search with an UV lamp and wears ad hoc eyeglasses. He finds traces of UV on the fitting between the two suction lines. He recommends replacing the seal.

The estimates for repairs is 204 \$ all included.

**Operation cost:** NONE

**Garage number.** 41 **Date:** 03/13/08 **Vehicle:** Mitsubishi Montero

---

#### **Operation description**

Two technicians operate in this garage.

The technician in charge of my vehicle checks the compressor clutch and the air temperature at the blowing outlets. Service pressures are not checked.

He offers refrigerant recharge. He connects an automated RRR group (ROBINAIR SPX) to HP and LP SVs. He recycles the refrigerant, evacuates the system, and recharges.

No leak search is performed. No DYE has been used. He does not recommend checking leaks later on.

**Operation cost:** 70.00 \$

**Garage number:** 42    **Date:** 03/13/08    **Vehicle:** Mitsubishi Montero

---

**Operation description**

Although the garage is very small, 4 technicians work there.

The technician in charge of my car checks successively: the temperature of blown air, the compressor clutch, and HP and LP pressures.

He offers refrigerant recharge, and next leak search.

He connects an automated RRR group and notices that the system is under pressure. He performs a leak search using an electronic leak detector. He does not find a leak. So he decides to recover the remaining refrigerant and evacuates the system. He leaves the system evacuated for more than 15 minutes. No pressure raise occurs.

He recharges with refrigerant, according to the nominal manufacturer charge as indicated on the label in the under hood. He had previously added DYE and oil.

Then he performs thoroughly a new leak search using an UV lamp (plus ad hoc eyeglasses) and an electronic leak detector.  
He also checks the evaporator through the visit opening.

During the operation, he notices that the lines are clean compared to the other parts of the engine and tells me that the lines have probably been changed.

**Operation cost:** 106.55 \$

**Garage number:** 43    **Date:** 03/14/08    **Vehicle:** Mitsubishi Montero

---

**Operation description**

The garage is large enough. There are six technicians. Service for A/C service check is 71.61 \$.

When I arrive in the garage, one cap is missing on the LP Schrader.

The operator starts by a check of the system with a lamp.

He connects a gas analyzer to the LP.

The system is under pressure.

He injects DYE with a pump.

He connects an automated RRR group and checks HP and LP.

He tops up the R-134a charge in order to check leaks.

The leak search is done using an UV lamp and ad hoc eyeglasses.

After 10-min search (without check of the compressor, of the evaporator, or condenser fittings), he finds a leak on the most accessible fitting.

The repair estimate is 327.17 \$. I do not agree to make the repair.

He recovers the refrigerant.

When I take the car, the A/C system is at atmospheric pressure. He does not mention the missing cap and this item is not mentioned in the quotation.

**Operation cost:** 91.03 \$

**Operation description**

The garage is small. Three technicians work there.

When I arrive, the system is empty (atmospheric pressure). He connects directly one R-134a cylinder via a manifold. No scale, no automated RRR group or leak detector (either electronic or UV).

He diagnoses that the circuit is empty and needs refrigerant recharge. The quotation is in the range of 100 \$.

He starts the refrigerant recharge, without evacuating the system. He turns ON and OFF the car engine and the A/C system several times. Also, he opens the cylinder, closes it, opens the manifold, and closes it. I have the feeling that he touches all valves without knowing well what he is doing. This behavior lasts about 20 minutes.

Then he disconnects the LP SV and release part of the charge to the atmosphere by pushing on the Schrader (may be he wants to purge air ???).

He recharges. He repeats what he did previously, and again he releases part of the charge to the atmosphere.

All together, this strange operation lasts at least 1h30min. Evidently something worries him. I start to become impatient. He stops operating, tells me that there is a problem without knowing what precisely. His explanations are fuzzy.

At the end, he says that I have not need to use the A/C system at this period of the year. He offers that I stop in another garage of his own, where an automated RRR group is available.

He requests 49.99 \$ for the diagnosis, but what diagnosis ??!, and he adds that if I go to this his other garage the recharge will be free.

In addition, he has lost the cap of the HP SV.

When I get the car back, the circuit is still empty, at the atmospheric pressure, same as when I arrived few hours earlier.

**Operation cost:** 49.99 \$

**Operation description**

There are 4 technicians in this garage.

The A/C system is empty with air inside.

The operator checks the compressor clutch and the temperature of the blown air.

He connects an automated RRR group (Macto Tools) and evacuates the system for 20 minutes. Then he disconnects the group to connect a manifold and one cylinder of brand new refrigerant. He opens valves to charge via the LP SV.

He asks me to start the car engine and to turn the A/C system ON to complete the charge. He looks at service pressures regularly.

I notice regular compressor cycling (ON/OFF regular every 30 seconds approximately).

He charges with refrigerant without knowing how much he is charging.

**Note:**

A garage has already mentioned to me, a few days before, about the compressor cycling. He had recommended replacing the thermostat. Looking at the HP and LP pressures, I wonder if there was not a circuit clogging because of the large number of charges with DYE and oil. So I dismantled the most accessible line (the compressor suction line) to check the circuit. The line was full of DYE and oil. Consequently I cleaned the circuit, which means disassembly of all lines (2 compressor suction lines, 3 liquid lines, the HP liquid receiver, the discharge line). After the system has been evacuated, the compressor cycling is still there. Conclusion, the compressor cycling is really caused by the thermostat default.

**Operation cost:** 70.00 \$



**Garage number.** 46 **Date:** 03/15/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

This garage is the smallest one I visited during the campaign.

When I arrive, the system is empty (full of air at atmospheric pressure). Caps on the HP and LP SVs are missing.

The operator checks the temperature of air blown.

He connects rapidly a manifold and one R-134a cylinder and starts the refrigerant charge. He turns the car engine ON, and also the A/C system. He does not open the HP valve of the manifold and so he can only see the LP.

The compressor cycling starts (ON/OFF every 10 seconds). He continues the refrigerant charge looking at the LP.

Several times he turns the engine OFF and then ON. He is perplex, looks at the compressor, and checks the circuit... This lasts for more than 40 minutes.

Finally, he forces the compressor clutch engagement by connecting it directly to the battery. Two minutes of operation and then the big problem. All at once, the compressor rejects refrigerant. The HP safety valve has been opened during few seconds.

The operator who was in the car has been surprised and turned the engine OFF immediately.

His diagnosis is as funny as the situation: he says that there is a leak on the suction line and that there should be a problem with the compressor.

### **Conclusions**

The quotation for replacement of the suction line is 220 \$. He recommends changing the compressor.

I had to pay 45 \$ for the service.

I have recovered 495 g of refrigerant from the system.

The system remained empty, open to air.

**Operation cost:** 45.00 \$

**Garage number.** 47 **Date:** 03/15/08 **Vehicle:** Mitsubishi Montero

---

### **Operation description**

This garage is better organized than others. More than 6 technicians work in it.

The operator connects an automated RRR group (ROBINAIR). He looks at the system pressures and the equipment operates by itself (recovery, evacuation, and recharge).

The operator adds DYE and oil, but he does not perform any leak search. He does not even mention the missing caps on HP and LP SVs.

The bill is 201 \$

**Operation cost:** 201.41 \$

**Garage number.** 48    **Date:** 03/16/08    **Vehicle:** Mitsubishi Montero

---

**Operation description**

Two technicians work in the garage.

The operator in charge of the car checks the compressor clutch. He sees that it does not engage. He recommends to evacuate the system, and to recharge the system with the manufacturer nominal charge that he reads on the under hood. He says that 2 12-oz small cans are necessary for the recharge and that DYE will be added to search leaks.

I have a look around the garage and noticed that there is no automated RRR group.

The quotation is 97.32 \$ including refrigerant recharge and leak search. There is no customer in the garage, but he has no time to take care of the car ...

I validate this garage because the charge is performed using small cans.

**Quotation cost:** 97.32 \$

**No operation**

**Garage number.** 49    **Date:** 03/16/08    **Vehicle:** Mitsubishi Montero

---

**Operation description**

The system is still empty. Similarly to the previous garage, the operator remarks quickly that the clutch does not engage.

During several minutes he is going to try shunting the clutch contact by connecting it directly to the battery.

I do not understand what he is doing. After 20 minutes, he says that the compressor does work and he recommends to change it.

He contacts a supplier and tells me that the price for the compressor is 650 \$.

To this price, it has to be added 60 \$ for the R-134a recharge and 150 \$ for manpower.

Again a no sense diagnosis.

**Operation cost:** 30.00 \$

### **Operation description**

4 technicians work in this garage. The system is still empty.

He turns the car engine ON and also the A/C system. As the previous technicians, he notices that the clutch does not engage. He offers to recharge the system and check leaks.

The operator connects the system to a manifold to the HP and LP.

He looks at pressures. Without much thought, he starts charging the system (no evacuation of the system).

This time, the compressor cycling is less rapid than previously (about every minute).

The operator charges in gas phase without looking at the quantity he is charging. I understand that he does not know anything about pressures.

Several times, he goes inside the car to check if the air blown is cold.

He seeks advice from another technician, who tells him to add oil. He goes to the end of the garage and picks up one 12-oz can.

He connects a clamp in place of the original can (leaks) and S&C a new can. He charges some liquid refrigerant. Without knowing if the can is empty, he disconnects the can, which releases its content to the atmosphere. Moreover, this can does not contain oil.

For the leak search, he uses a usual lamp without any specific equipment to detect DYE (which has not been charged in the system anyway). He finds a leak at the condenser.???

He recommends to replace the condenser for 400 \$ including parts and manpower.

Conclusion: **I paid** 100 \$ for the refrigerant recharge.

I have recovered 772 g.