



JAMA's Voluntary Action Plan to Reduce HFC-134a Emissions

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Japan Automobile Manufacturers Association, Inc.**

Background

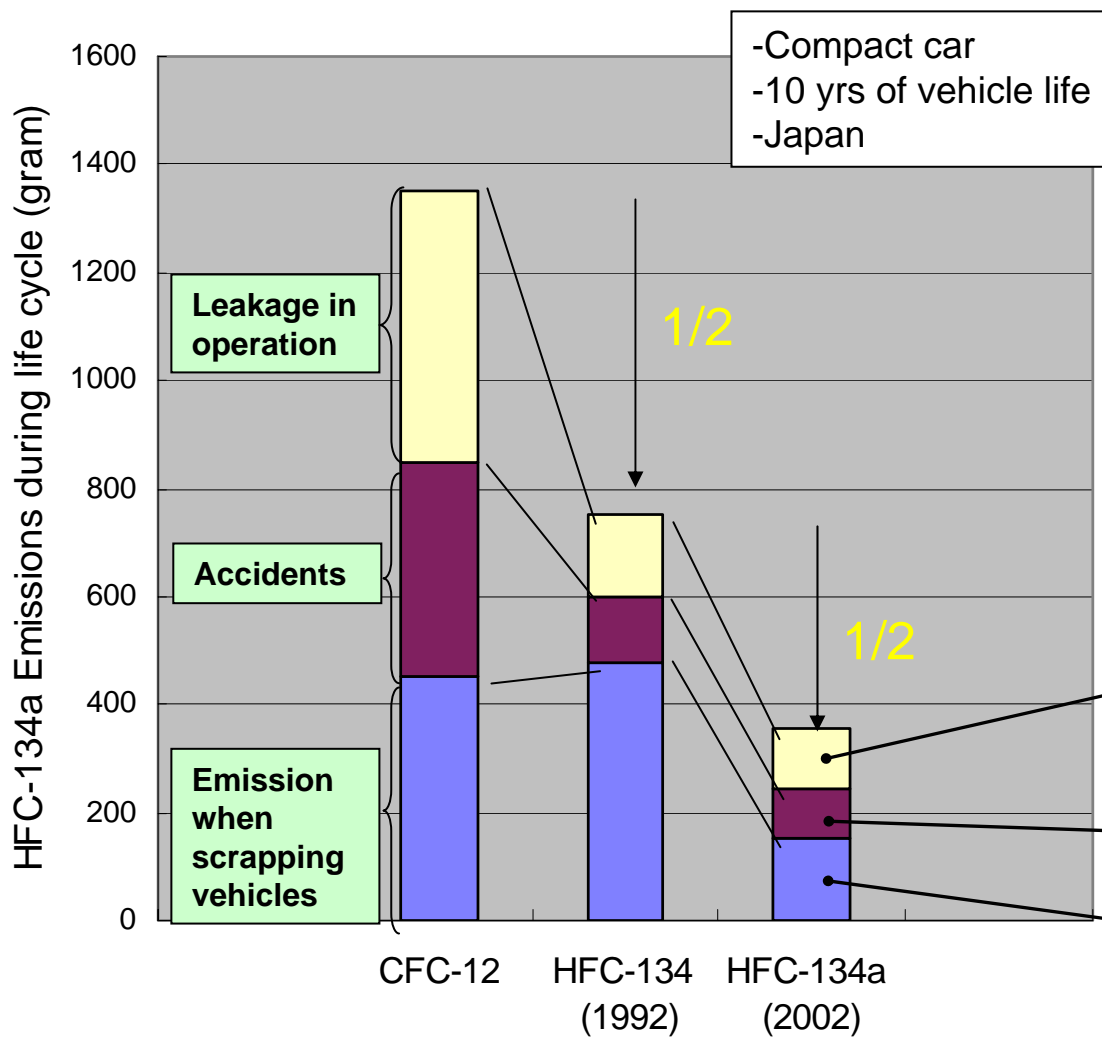
- 1. Fluorinated 3 Gases (HFCs, PFCs and SF₆) were added to the greenhouse gases at COP3 in 1997.**
- 2. The Ministry of Economy, Trade and Industry planned reducing fluorinated 3 gases by a voluntary program within the industry, and requested a decision of an action plan from the main industries which manufacture and use 3 gases.**
- 3. Moreover, it was decided to perform a follow-up in METI's Industrial Structure Council every year.**

JAMA's Voluntary Action Plan

- **Reduction of refrigerant emission from HFC-134a A/C**
 1. **Recommend to use lower refrigerant leakage components;**
 - According to self-assessment of OEM, leak in operation has been reduced from 15gy/yr, and further reduction would be possible in the future.
 2. **Recommend to use small refrigerant charge components;**
 - Target is 20% reduction from 1995 to 2010.
 - The average of charge has been reduced by 16% from 1995 to 2002.
 3. **Recovery and destruct Refrigerant:**
 - Fluorocarbons Recovery and Destruction Law enforced from October, 2002.

- **Research non-HFC-134a car air conditioning system**
 - Share the information of alternative refrigerants
 - Find and solve industry common problems for alternative systems (CO2 and HC)

Reduction of Refrigerant Emission



Leakage in operation:
 CFC-12: 50g/yr
 HFC-134a (1992): 15g/yr
 HFC-134a (2002): 11g/yr

Accidents: JAMA reported in 1999

Emission when scrapping:
 CFC-12 and HFC-134a (1992): No recovery
 HFC-134a (2002): 29% of recovery rate

Initial charge:
 CFC-12: 850g
 HFC-134a (1992): 750g
 HFC-134a (2002): 500g

Servicing refrigerant:
 CFC-12: two times
 HFC-134a: Nothing

**1. Lower refrigerant leakage;
 Design improvement, quality management**

**2. Refrigerant charge reduction;
 Inner volume reduction**

**3. Refrigerant Recovery and Destruction Law;
 Recover and destroy refrigerant at scrapping vehicles**

Recovery rate when scrapping: 0% 0% 29%
 (reported in 2003)

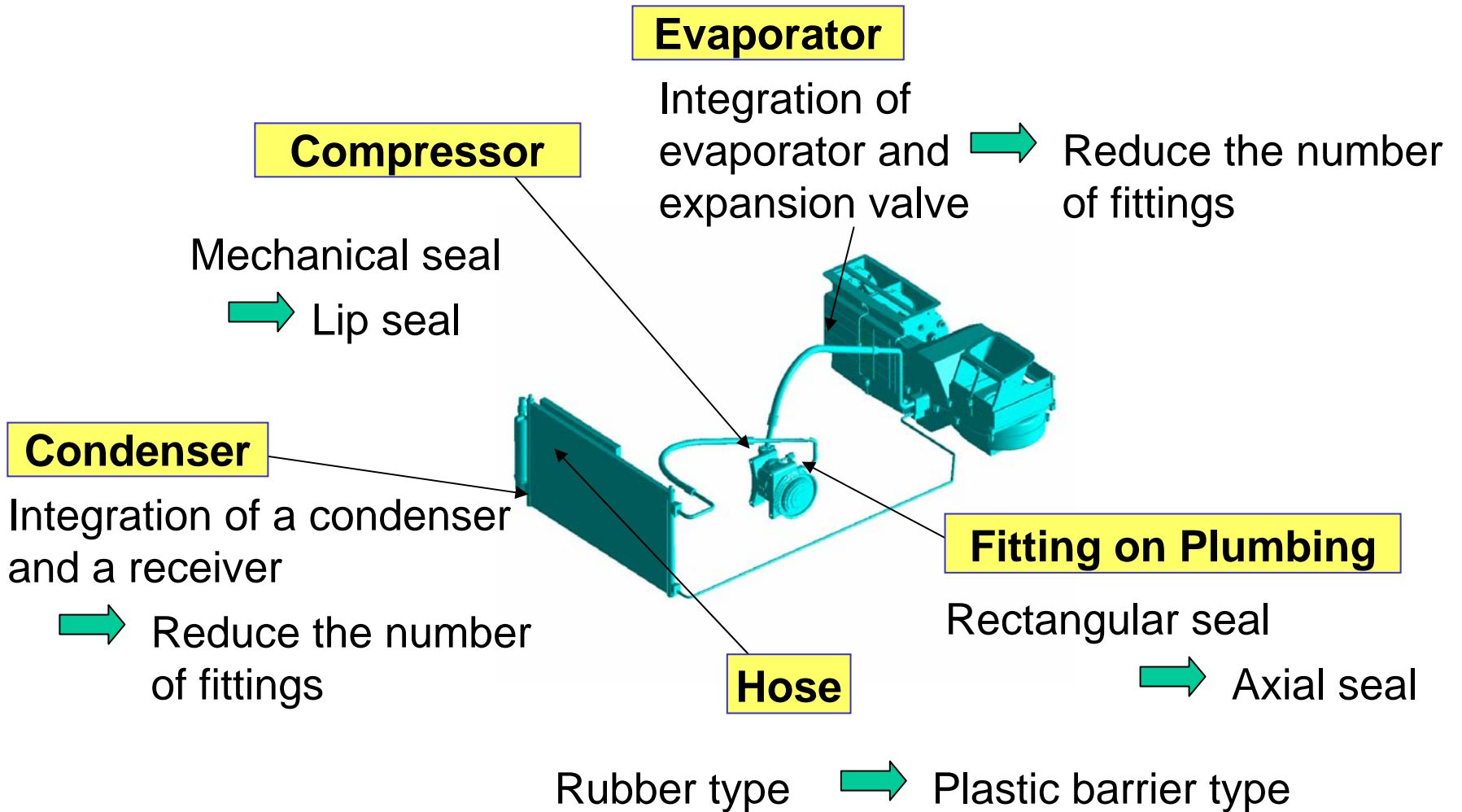
Recovery rate = recovered refrigerant / initial charge

1. Reduction of Refrigerant Leakage in Operation

*Design Improvement

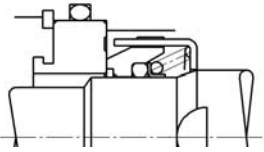
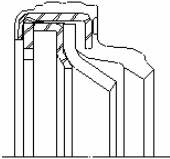
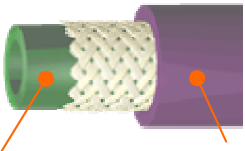
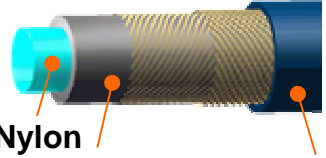
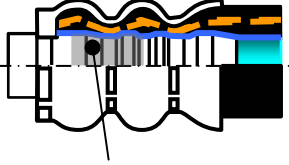
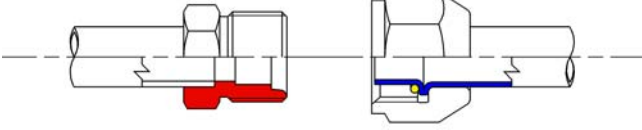
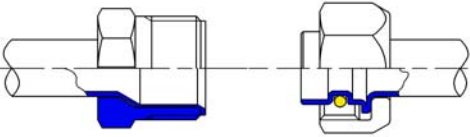
*Assembly Quality Improvement

Design Improvement



Design Improvement

Progression of the components

Year	1980	1990	2000
Compressor (Shaft seal)			
	Mechanical seal		Lip seal
Hose	 <p>NBR CR</p>	 <p>Nylon IIR EPDM</p>	 <p>Rubber Glue</p>
	Rubber type		Plastic barrier type
Fitting			
	Rectangular seal		Axial seal

Assembly Quality Control

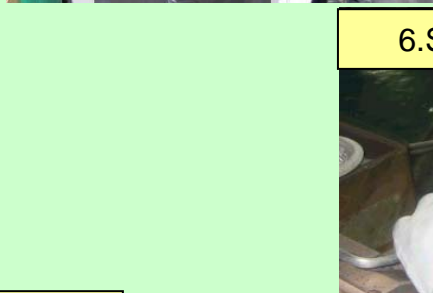
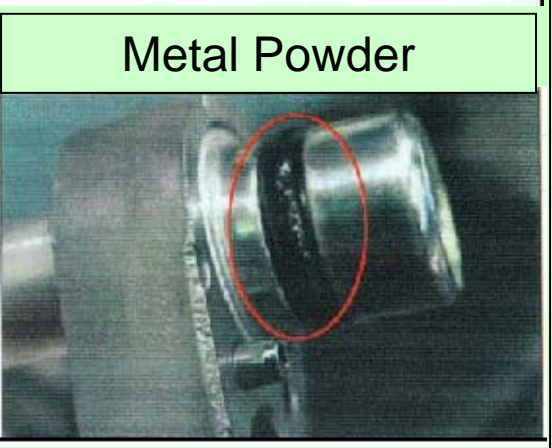
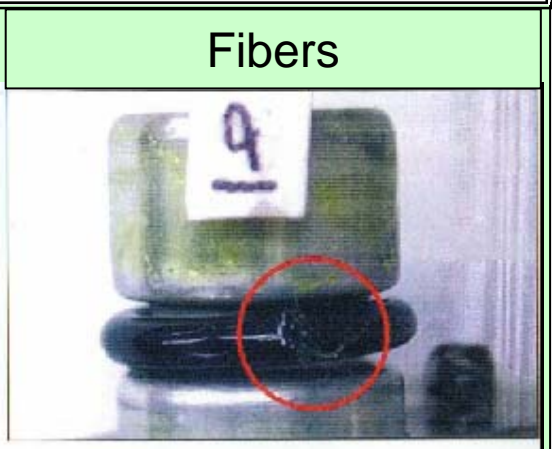
Improvement of Assembly Quality:

- Keep foreign particles off the fittings
- Prevent damage to the O-ring
- Perform component leak test

Inferior Quality Caused by Dust and Practice to Keep off Dust

Pipe Assembly Line

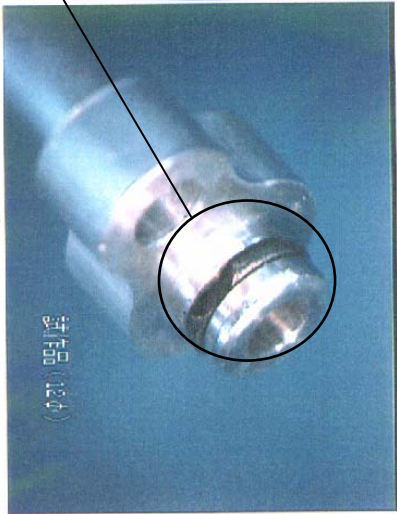
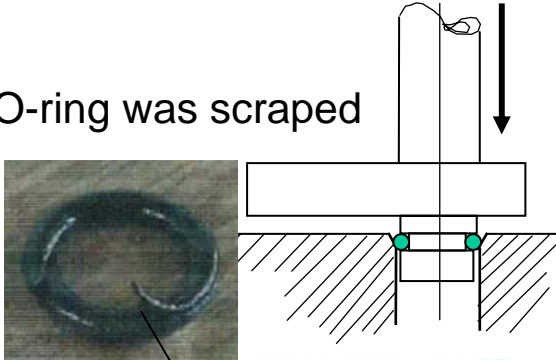
Dust entered into fittings



Evaporator Assembling Line

Insert direction

O-ring was scraped



Evaporator Assembling Line

Oil application station

O-ring assembling station

evaporator

Full automatic assembling:

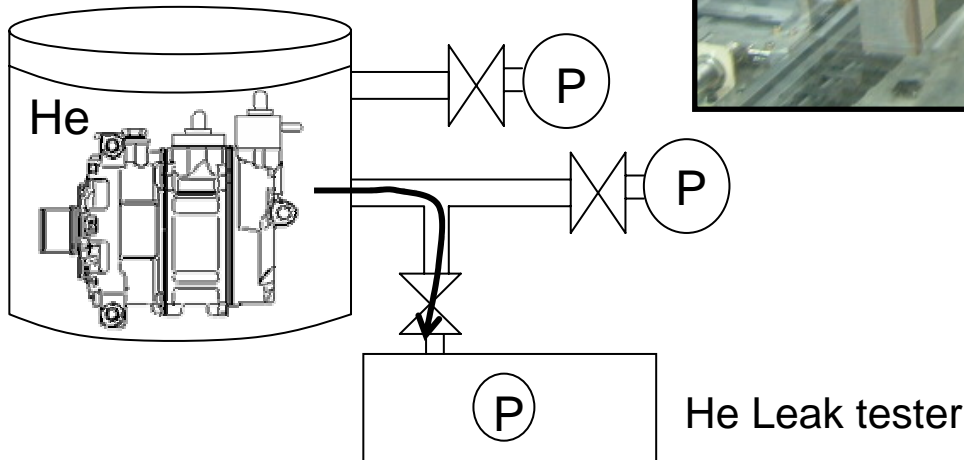
- Automatic oil application
- Automatic O-rings assembling
- Cover assembling machine to prevent dusts

Component leakage Check

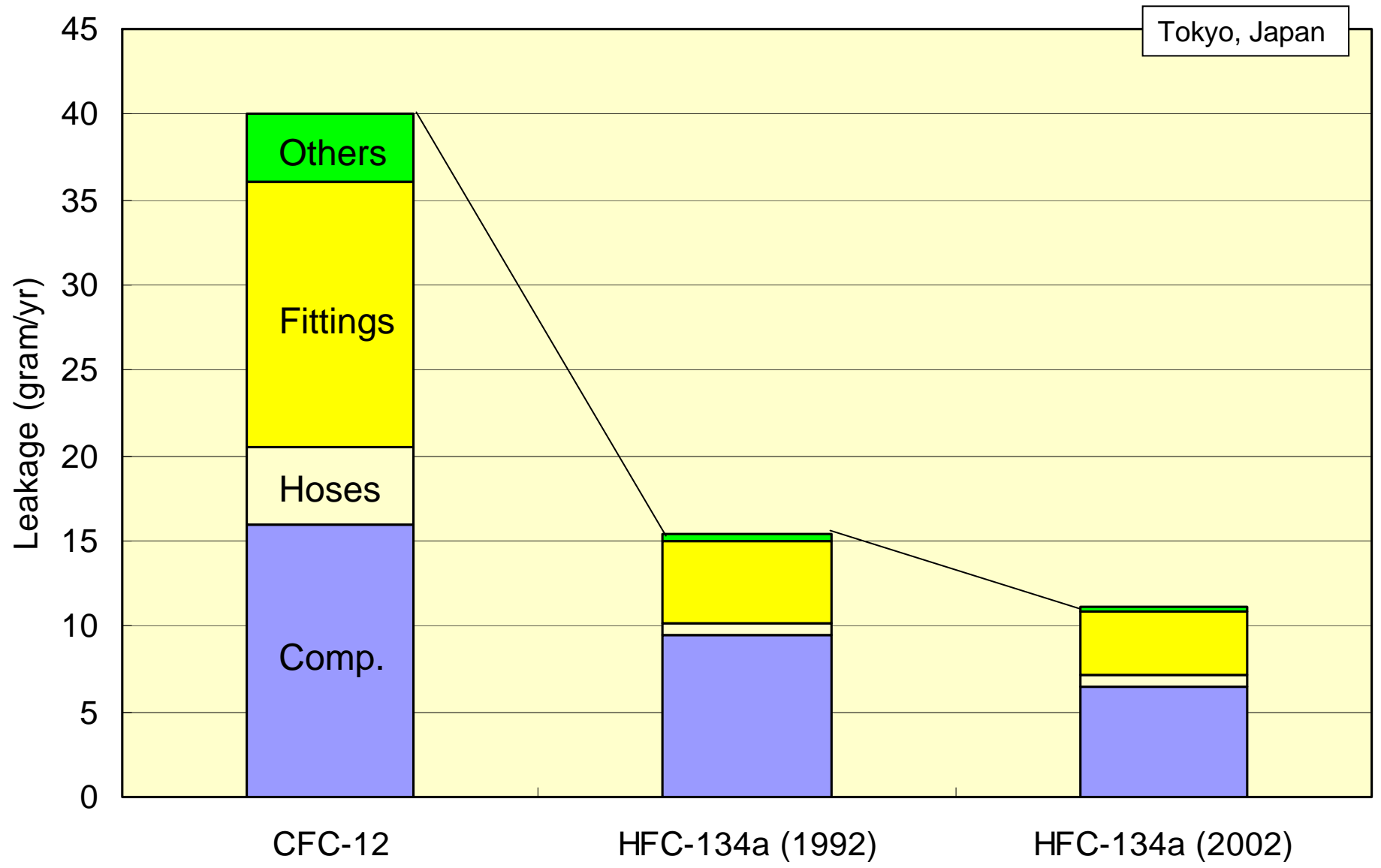
Compressor leak test



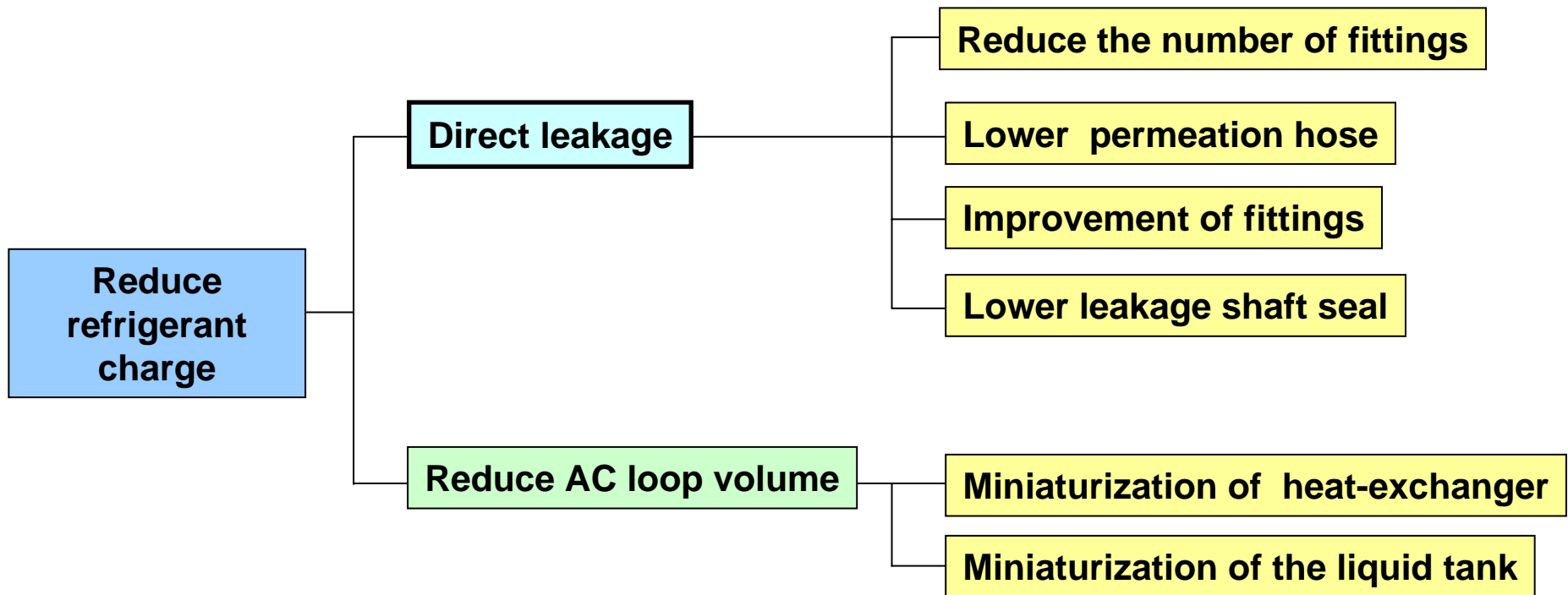
Evaporator leak test



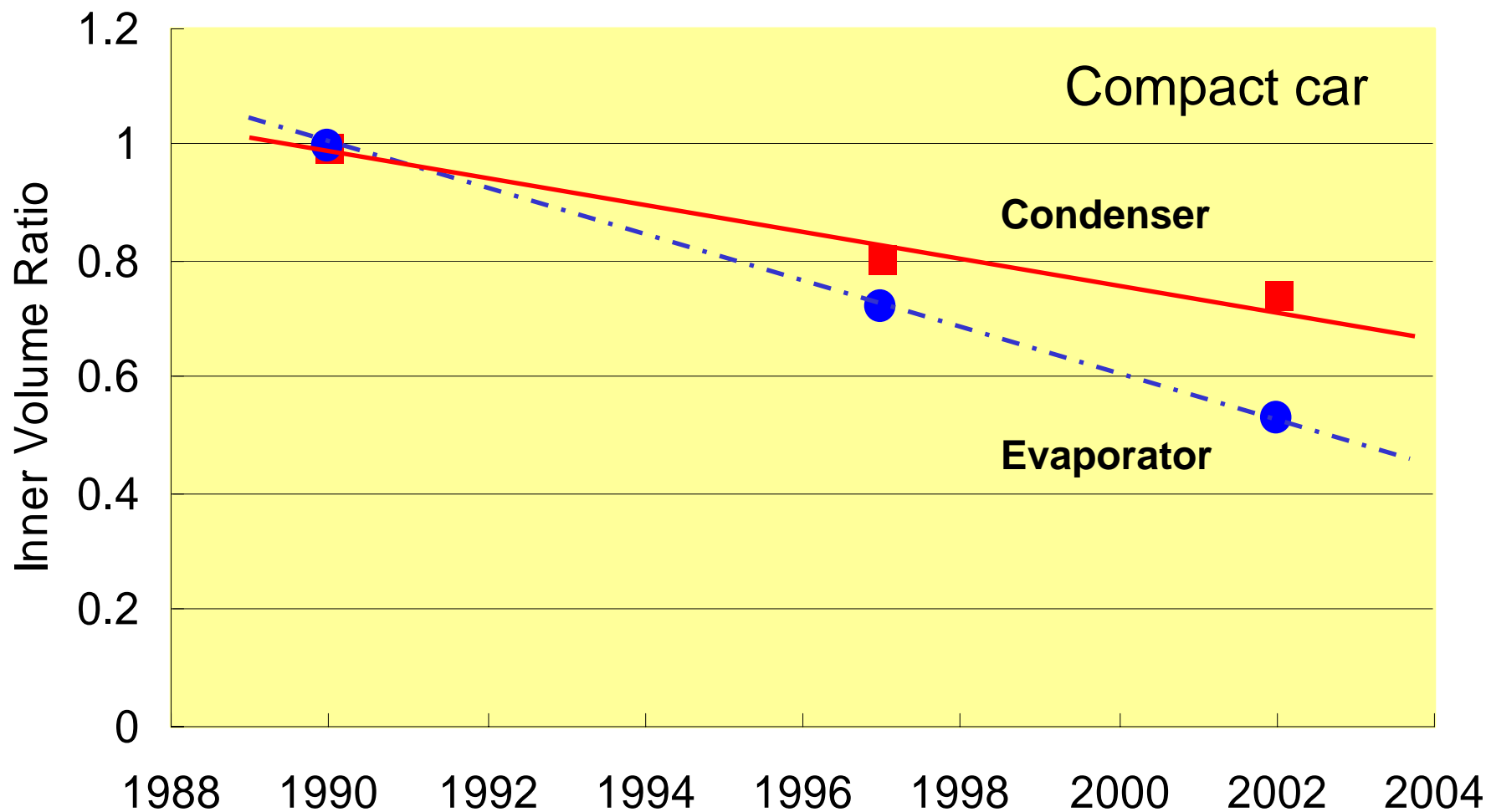
Reduction of Refrigerant Leakage



2.Refrigerant Charge Reduction

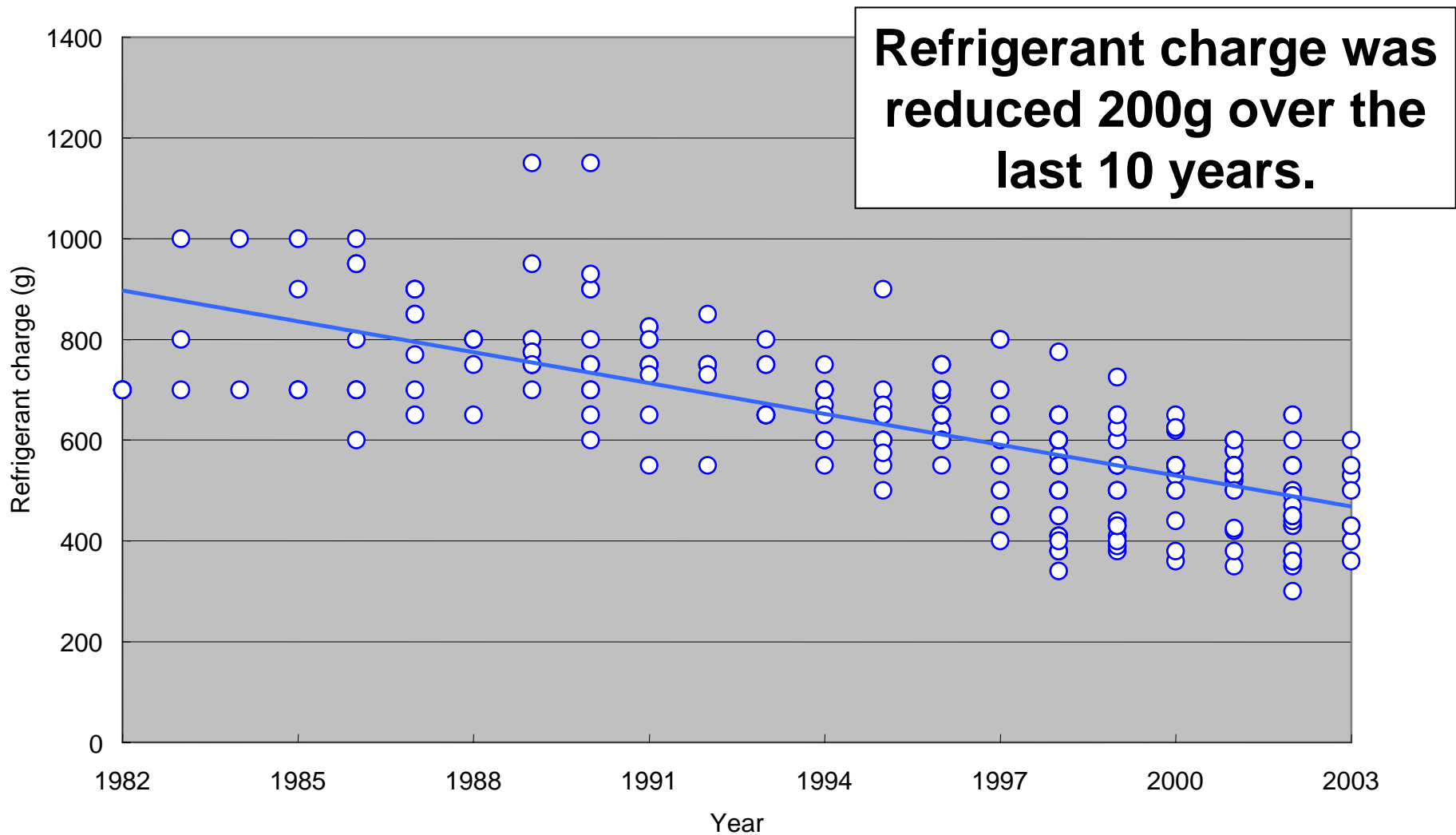


Inner Volume of Heat Exchangers

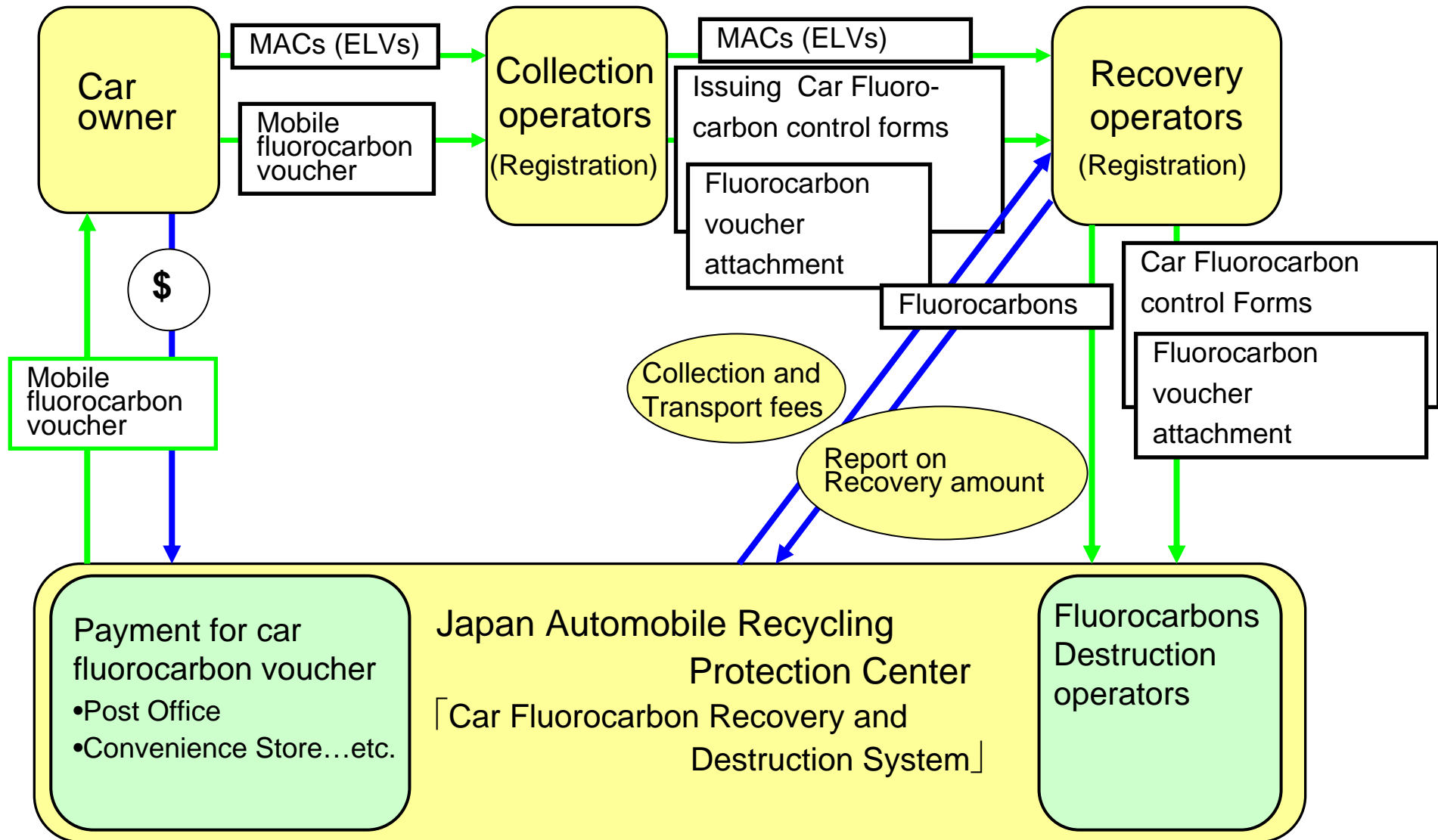


Reduce refrigerant charge

Transition of refrigerant charge in Japanese market



3.Refrigerant Recovery and Destruction system



Achievement by Fluorocarbons Recovery and Destruction Law

(Oct.01.2002 - Mar.31.2003)

		CFC-12	HFC-134a	Total
# of Refrigerant gas recovered MACs		711,416	244,543	955,959
Recovered gas amount (kg)		282,614	106,606	389,220
Details	Amount of gas delivered to destruction operators (kg)	117,346	46,464	163,810(42%)
	Amount of gas recycled (kg)	90,604	22,685	113,290(29%)
	Amount of gas storage at the end of the year 2003 (kg)	76,109	37,934	114,043 (29%)

- Reported recovered amount is 389ton. Estimated recovery rate is 29% (recovered amount/initial charge=389ton/1358ton)
- Recovery and destruction would be reinforced due to operation of ELV Recycling Law from the next year

Refrigerant Recovery & Destruction 17

Recovered refrigerant is sent to reprocessing facility.



Fluorocarbon maker
(reprocessing operation)



Verification of Refrigerant leakage

1. Proposal of industrial standard for the leakage test
2. Refrigerant Leakage Tracking by Field Survey

Leakage Calculation

Total leakage for complete A/C system would be calculated by adding together static leakage for each components.

$$\begin{aligned} \text{Annual leakage} = & \Sigma L\text{-comp.} + \Sigma L\text{-hoses} + \Sigma L\text{-fittings} \\ & + \Sigma L\text{-Exp. Valve} + \Sigma L\text{-HXs} + \Sigma L\text{-PR S/W} \end{aligned}$$

Test Method: Gas chromatography

Pre-conditioning for components and test conditions: TBD
(need industry agreed proposal)

Proposed Industry Standard Test Method

Shed box

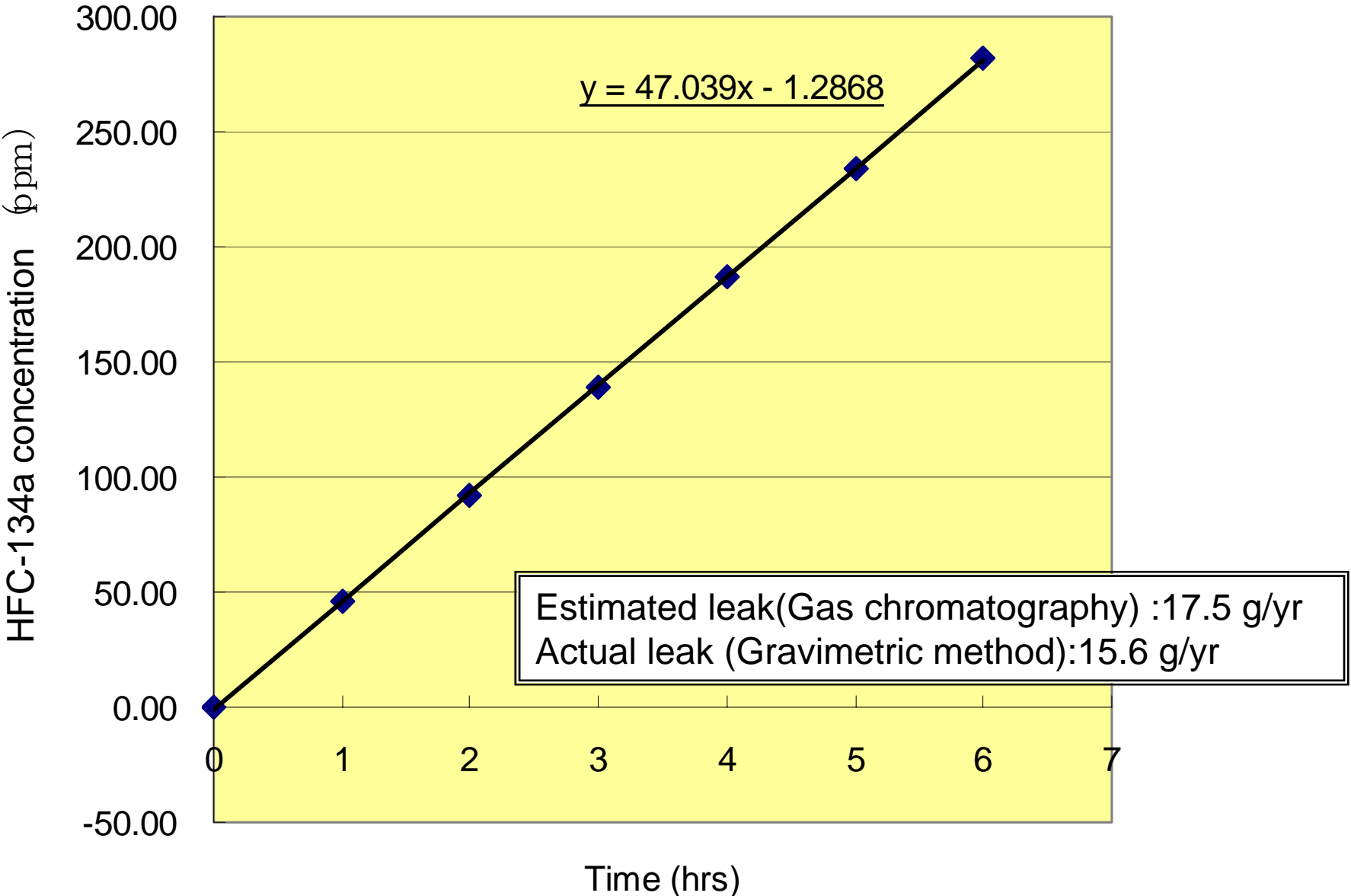
Gas chromatography
+ Data analysis system



- Establish the methodology to measure the accurate refrigerant leakage
- Recommend to use this method as the industrial standard

Example of Test Data

Concentration in shed box (leakage from sample compressor)



Emission Tracking Activity

1. Test Method
2. Monitor schedule

Test Method

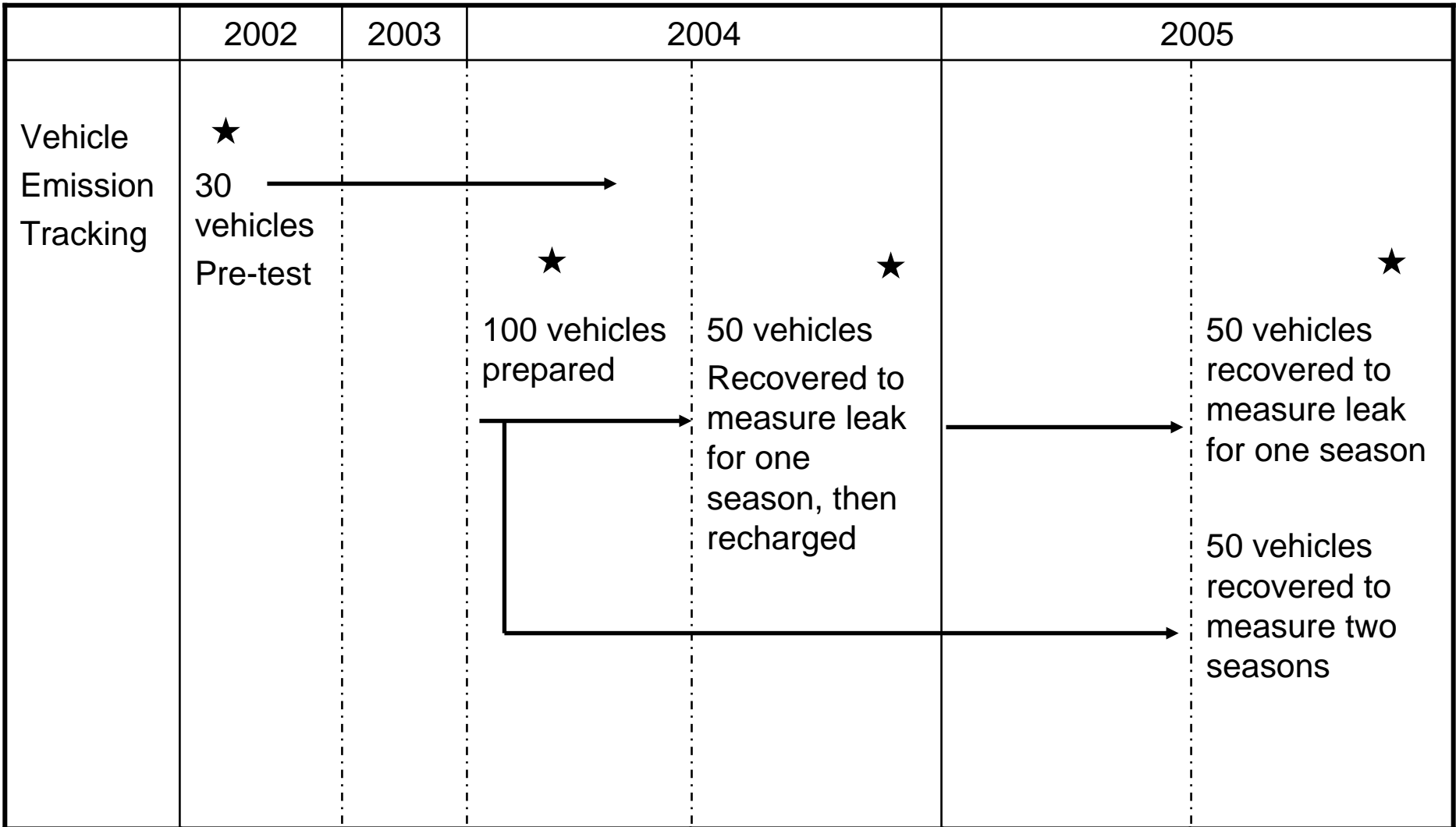
	Previous Method	New Method
Test vehicle	The vehicle in the field is recovered as is (~6 years).	The vehicle is recovered after the elapse of the experimental duration (1~3 years)
Initial value	Per specification	The initial value is controlled.
	$\pm 25-50g$	
Refrigerant recovery value	A commercial refrigerant recovery machine is used. The recovered amount is measured together with the recovery machine.	The refrigerant is recovered using liquid nitrogen.
	$\pm 10g$ (Balance error)	$\pm 1.0g$ (Balance error)
Correction	20g (fixed value)	None

Situation of Refrigerant Recovery using Liquid Nitrogen

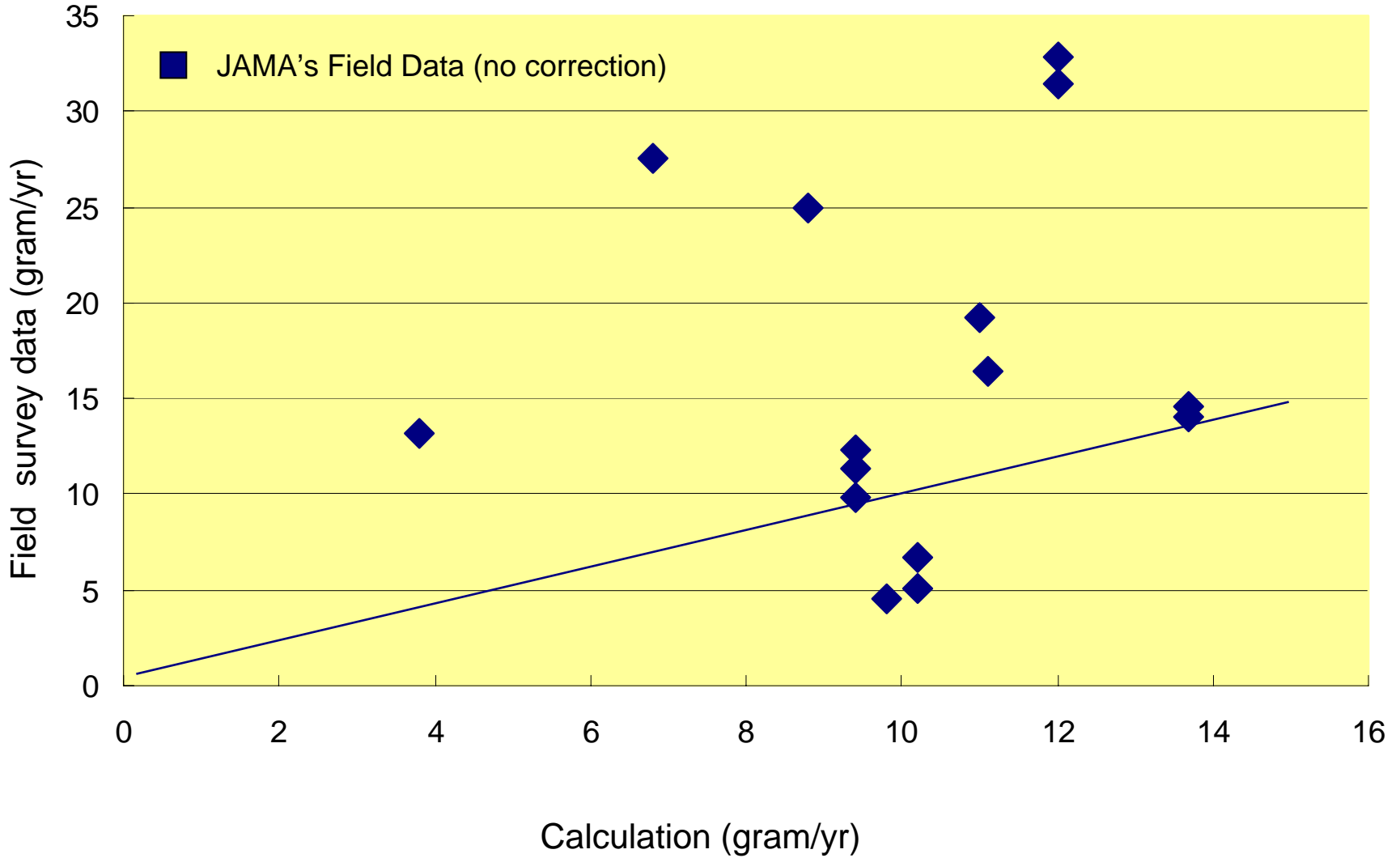
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Monitoring Schedule



JAMA Emission Tracking Activity



Conclusions

- Understand that many of Japanese cars have already carried out the strict management for refrigerant emissions.
- JAMA will establish leak measurement method that can be shared among the industries and proceed verification of the low leak A/C system through vehicle monitoring.

Fluorocarbons Reprocessing Operation

