Phoenix 2004 Alternative Refrigerant symposium
June 30 –July 1

JAMA's Voluntary Action Plan to Reduce HFC-134a Emissions; Field test and Leak Test Procedure

NISSAN MOTOR CO., LTD — Koshi Kikuchi

TOYOTA MOTOR CORPORATION — Takayoshi Matsuno
JAPAN AUTOMOBILE MANUFACTURERS ASSOCIATION, INC — Tatsuya Ota

DENSO CORPORATION — Toshio Hirata

JAMA's Voluntary Action Plan

- **Reduction of refrigerant emission from HFC-134a A/C**

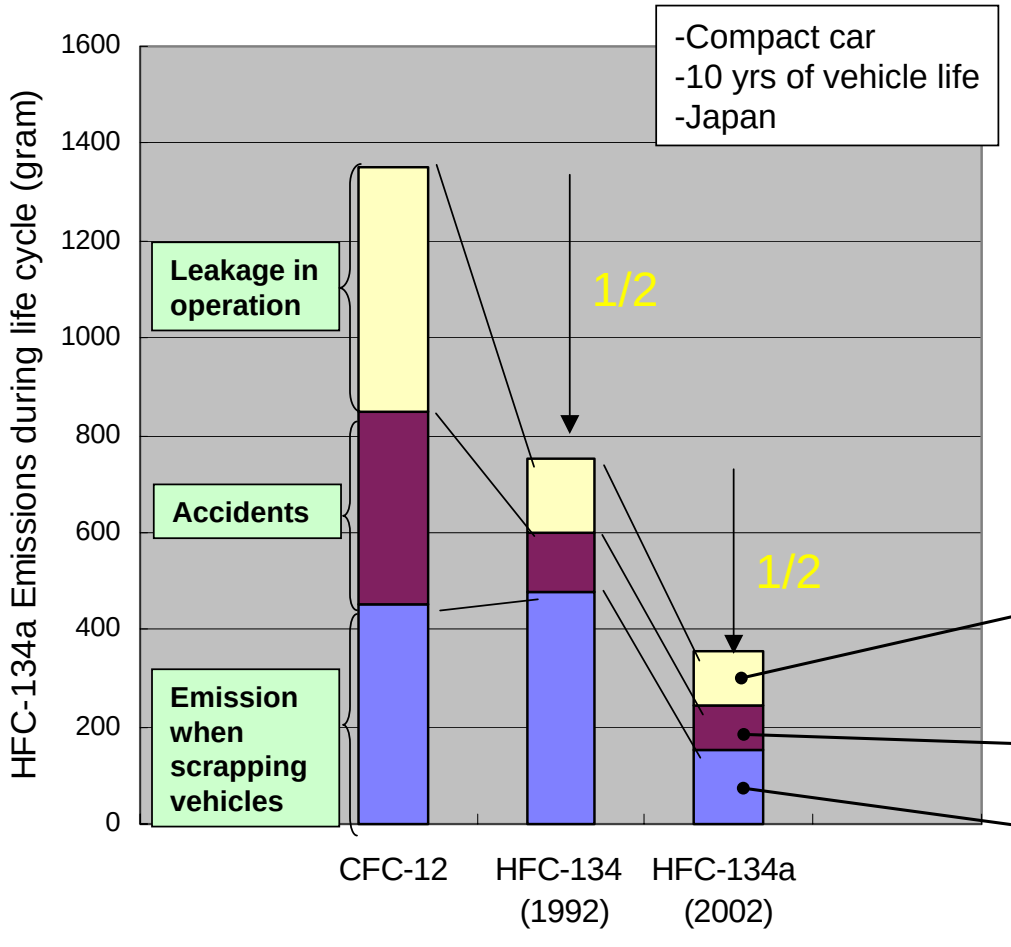
1. **Recommend to use lower refrigerant leakage components;**
   - **According to self-assessment of OEM, leakage in operation has been reduced from 15g/yr, and further reduction would be possible in the future.**
2. **Recommend to use small refrigerant charge components;**
   - **Target is 20% reduction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

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

SAE®

JAMA 社団法人 日本自動車工業会 Japan Automobile Manufacturers Association, Inc.

Reduction of Refrigerant Emission



Leakage in operation:
CFC-12: 50g/yr
HFC-134a (1992): 15g/yr
HFC-134a (2002-2005): 11g/yr

Accidents:JAMA reported in1999

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: 750g
HFC-134a (2002-2005): 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

SAE

JAMA 社団法人 日本自動車工業会 Japan Automobile Manufacturers Association, Inc.

Verification of Refrigerant leakage

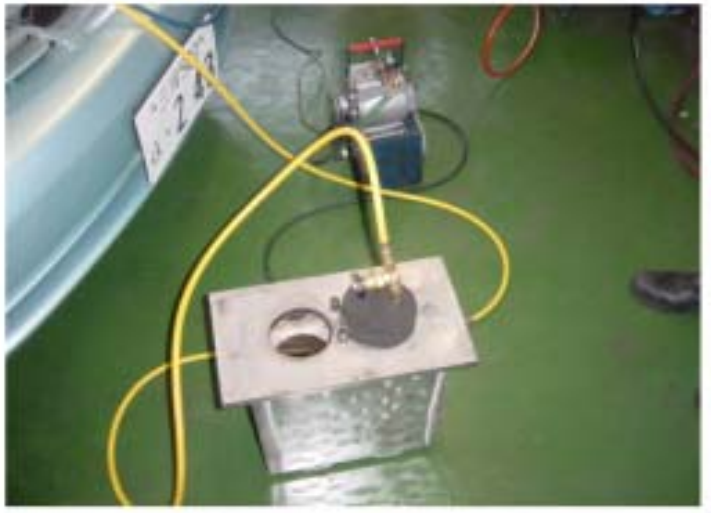
1. Refrigerant emission tracking by Field Survey
2. Proposal of industrial standard for the leakage test

Emission Tracking Activity

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.
	±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.
	±10g (Balance error)	±1.0g (Balance error)
Correction	20g (fixed value)	None

Situation of Refrigerant Recovery using Liquid Nitrogen



Test Vehicles

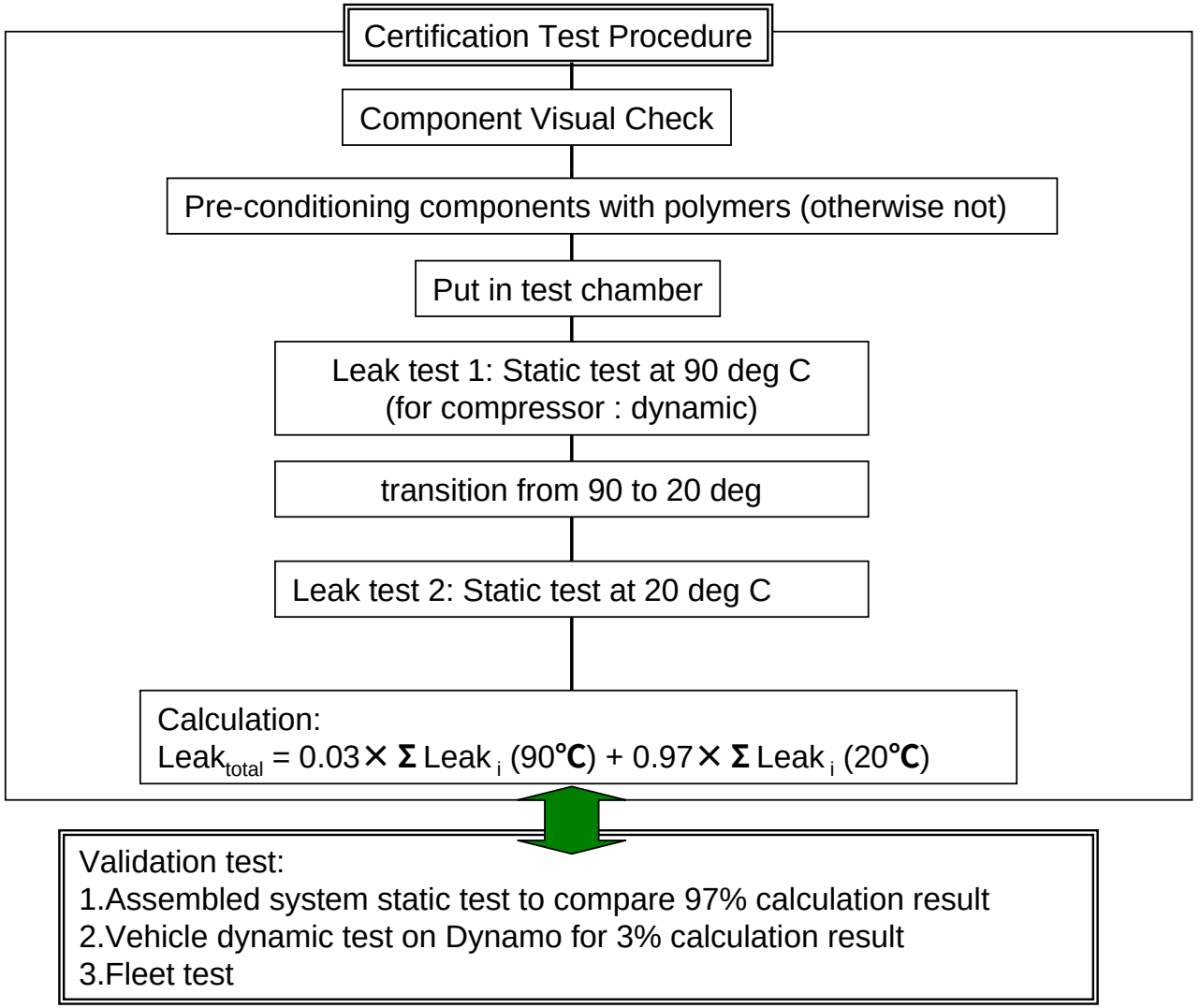
OEM	Vehicle	Type	Beginning of the test			End of the test				
			Date	Charge (g)	Driving distance (km)	Date	Charge	Driving distance	Comp (hr)	Cycling #
Company A	A-1	-	04.04.22	428	5,795					
Company A	A-2	-	04.04.21	329	3,526					
Company A	A-3	-	04.04.21	354	18,140					
Company A	A-4	-	04.04.21	538	22,388					
Company A	A-5	-	04.04.20	515	13,667					
Company B	B-1	-	04.04.19	555	16,180					
Company B	B-1	-	04.04.23	560	34,943					
Company B	B-1	-	04.04.23	575	19,356					
Company B	B-1	-	04.04.08	560	18,607					
Company B	B-1	-	04.04.09	558	9,289					
Company G	G-4	-	Planned to be tested from mid-May.							
Company G	G-5	-								
Sum	131 vehicle (Seven OEMs)									

Proposal of industrial standard for the leakage test

SAE®

JAMA 社団法人 日本自動車工業会 Japan Automobile Manufacturers Association, Inc.

Flow of ACEA Test Procedure



Required Evidence Data to Validate Test Procedure

1.Accurate leakage data in the real world

2.Influence of parameters such as measuring time and pre-conditioning time which is required for components with polymers, and dynamic leakage on the calculated leakage

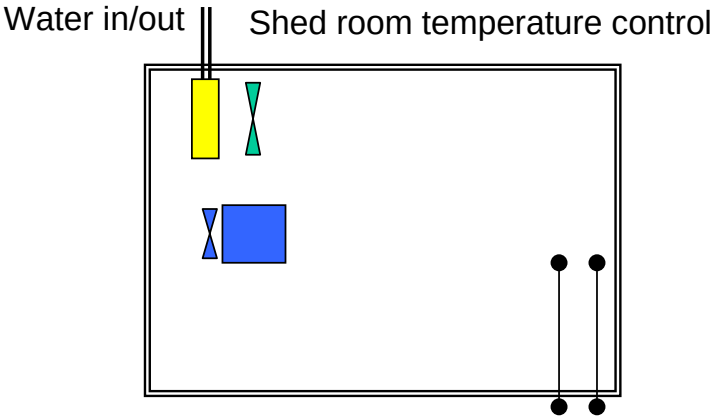
Proposed Industry Standard Test Method

Gas chromatography
+ Data analysis system

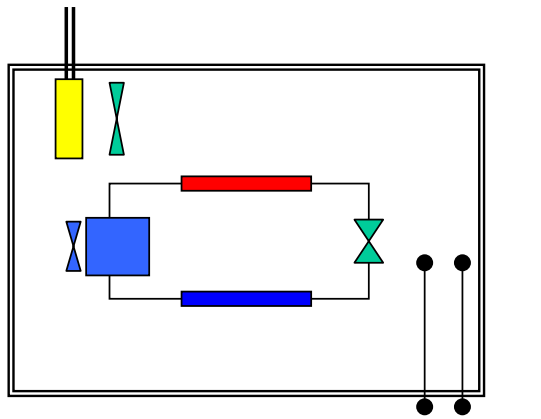
Shed box

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

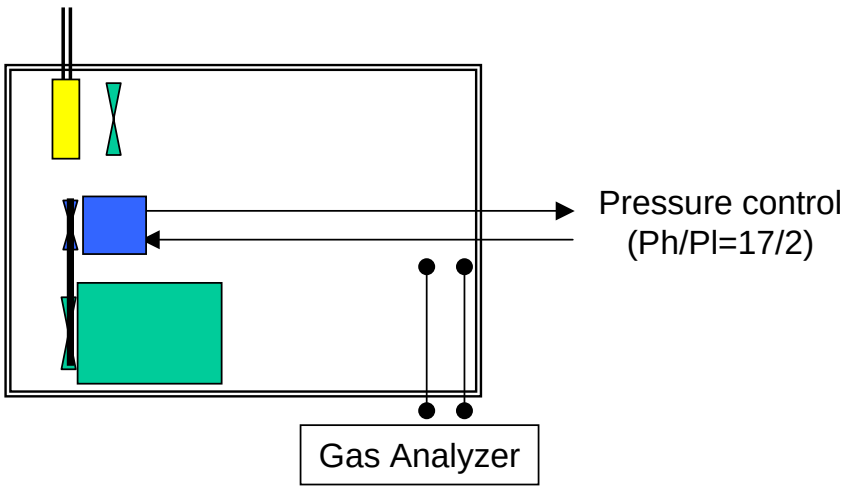
Leak Test Pattern



Static leak test from components



Static leak test from A/C loop



Dynamic leak test from compressor

Validation Test schedule

		～09	10	11	12	1	2	4	5	6	7	8
Component static leak based on proposed procedure	No pre-conditioning	Apparatus set-up					Report					Report
	Pre-conditioning											
	Fleet aging											
Validation test	1.System static											
	2. Dynamo (dynamic leak)		TBD					TBD				
	3. Fleet											

-Validate proposed test procedure
-Seek after simplification of test method (necessity of aging, degree of aging and dynamic leak)