

Thursday, July 19 – Panel Discussion Questions

Thursday Panel Discussion with Vehicle Manufacturers and A/C System Supplier's Perspective in Meeting Future Environmental Needs and Questions from Attendees.

Vehicle Manufacturers:

Wiedemann	Stefan	BMW Group
Wiesmueller	Joachim	BMW Group
Wertenbach	Juergen	Daimler Corp
Monforte	Roberto	Fiat Auto Powertrain Italia
Kikuchi	Koji	Nissan Motor Co Ltd
Rose	Bruno	PSA
Peral	Enrique	Renault
Ikegami	Tohru	Toyota Motor Corp
Hill	Bill	GM

Tier One Suppliers:

Riegel	Harald	Behr GmbH & Co KG
Baker	James	Delphi Corp
Meyer	John	Visteon Climate Control
Ap	N.S.	Valeo

Others:

Wolf	Frank	Obrist Engineering
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SAE-CRP Overview

Questions: Why don't you show results/status? JAMA did. Will CRP evaluate DPH?

Question: What can you tell us about the Solvay find? They are part of CRP-150, but did not present anything at this symposium.

Question: Risk assessment mentioned risks to passenger. What are plans to extend evaluation to factory fill and service scenarios?

VDA

Question: Have German OEMs similar (negative) results for smaller vehicles in case of R744 as refrigerant? When looking at the results of Fiat, Renault, Nissan and Peugeot? (to cooling capacity as performance measurements)

Question: Repeat cost difference comment pertaining to incremental cost for a CO2 v. R134a.

Question: Notice that you didn't mention 152a as candidate for German Automobile Mfrs. Could you explain why?

Question: The fact that design and development work has been ongoing since before 1992 on CO2/R744 systems and quite intensive since 1997/99, but still seeing several problematic and unresolved issues, should that not send a message to any engineer regarding the unsuitability of CO2/R744 for MACs.

Question: Is flammable GAR still unacceptable?

VALEO

Question: How's a/c performance with water-cooled condenser under heavy trailer test such as David Damn?

AP Response: We didn't test under heavy trailer as David Damn. But we already tested in our climatic wind tunnel for 2 hill climbing test conditions on a Mercedes CDI Turbo diesel engine 2.2 Liters common rail injection :

1 - Vehicle speed = 40 km/h, 10% grade at Ta = 30 °C with trailer and second gear box,

2 - Vehicle speed = 90 km/h, 6% grade at Ta = 40 °C without trailer and 3rd gear.

The AC performance of UltimateCooling system (with water-cooled condenser and water cooled charge air cooler) is similar to the conventional system (with air cooled condenser and air cooled charged air cooler).

VISTEON

Question: It was misleading to show R-744 fuel efficiency better than all alternative refrigerants, showing it as R-744 AC off. Please clarify.

Mayer Response: Although AC-off fuel consumption was measured with each system, data were essentially identical and thus only one was shown as the overall AC-off baseline (The figure should probably be labeled simply "AC off").

Question: John Mayer – Why not results for 45 degrees for AC1. Do you consider 0.3 l/km for R744 fuel consumption reduction significant?

Mayer Response: At 45 C the systems had different capacities, so comparing power consumption is meaningless. I assume the second question really asks about (0.3 l) / 100km? If 1 liter of petrol is responsible for about 2500 gr of CO2 emissions, then 0.3 liters will create 750 gr. Which gives an emission reduction of 7.5gr/km. I'll leave it to the car companies to decide on significance.

Question: What is an optimum IHX efficiency for R134a or GAR?

Mayer Response: There is no universal answer. The IHX efficiency affects compressor discharge temperature, refrigerant mass flow rate, distribution in the evaporator core, capacity, and efficiency. If you assume a more effective IHX is more expensive, then finance plays a role as well. So there is no single answer, and just as we have high and low tech evaporators, condensers, and compressors, the market will determine the family of IHXers that make it to commercialization.

BEHR

Question: Subcooling with 1HX is about 3K (comparable with circuit w/o 1HX). What is the improvement due to the 1HX?

Question: Evaporator airflow of 6.5 kg/min cannot really be considered as low or typical for a 25 degree C running condition. Comment.

Question: What is an optimum IHX efficiency for R134a or GAR?

ALL

Questions: What if none of GAR is promising to use CO2 or 2ndary loop of R-152a? What is your backup option?

Ikegami Response: In case of NG for new chemical refrigerant, there is no good refrigerant for global warming up prevention than R134a.

Rose Response: R-744 and R-152a SL are both considered as possible backup solutions. R-744 have been studied for several years but still shows unsolved issues which seem not compatible with the 2011 deadline. R152a SL seems more reliable since technologies are available now. We will work the feasibility of this option within the next months.

Question: Can the OEMs give a first impression of the additional costs for a low GWP MAC system (production costs/lifetime costs/service costs) for customers?

Ikegami Response: Part cost up image can be provided, but today we don't have single solution within car industry, we may lose volume effect.

Rose Response: Same cost for MAC components, higher refrigerant cost / same or better fuel efficiency / higher service cost for refrigerant cost and new charging machine amortization.

Question: Is it possible to refill low GWP MAC systems with R134a from a technical standpoint?

Ikegami Response: We will study interchangeability, but it may be difficult. At least we need to change expansion valve setting. For we need check Compressor oil, hose, sealing material as well in our material evaluation.

Rose Response: Every low GWP MAC solution will have specific settings and optimizations that are function of the refrigerant itself (TXV, material compatibility, ...). So in general, it would not be possible to refill with another one. DIYs forbidden ...

Question: Somewhat confusing presentations from ACEA, VDA and Italian/French OEMs with different strategies. Why not have a unified strategy for all of Europe?

Rose Response: The industry is willing to have a unique low GWP refrigerant. But as long as several options are still under investigation, this is not the time for a common decision.

Question: LCCP results show CO2 system is worst overall. Why are we pursuing CO2 systems?

Rose Response: No comment.

Questions: Per Frank Wolf's presentation, the only choice today is CO2, whereas per JAMA evaluation (total leakage & GWP), CO2 is the worst. Also 3 European OEMs proposed to give up CO2. Could he respond? What are EU regulation & time frame for heavy-duty vehicles (trucks, buses, etc.)?

Rose Response: it's up to Frank to answer...

Questions: Based on LCCP data R-134a is more environmental than any GAR or CO2. Will that sway the EU politicians to help the environment? Going back to R-134a?

Rose Response: No comment.

Question: So far all focus regarding modifications necessary for different alternatives have focused on all components, but the compressor. Why not also include compressor, like opening up of discharge restrictions (for pressure pulsation reductions)?

Rose Response: Such optimizations on compressor are also considered but have not been tested in priority due to costs and delays for prototyping.

Question: Assuming no blend is toxicologically free of issues, how much risk are you willing to assume?

Rose Response: Toxicity assessment is still on going. We will never use a substance that present a potential danger for the public. At present time the lower risk seems R-152a w/ SLS.

ACEA

Question: Any objection to the 2ndary loop of R-152a?

Wiesmueller Response: ACEA has no other position to R152a, than to any other alternative. There is no joint position among ACEA-members to the options of choice of refrigerants until now.

Question: Does ACEA also continue the option of R290?

Wiesmueller Response: ACEA-members are not working on it.

Question: Are the new chemical alternatives really covered by the MAC regulation (only f-Gas containing blends covered)?

Wiesmueller Response: As long as the alternatives meet the GWP 150 target: yes

Question: Do you believe that expensive blends are a global solution (possibility of refilling MACs with R134a)?

Wiesmueller Response: no comment

Question: Is one more year enough to resolve all issues associated with R744 system?

Wiesmueller Response: We refer to the ACEA-presentation from Phoenix: the expected feasible timeline was 2012/2018; 2011 is a very aggressive target, which ACEA-members are committed to try to realize.

JAMA

Question: Did you calculate the LCCP at some capacity?

Ikegami Response: LCCP result which was shown in the presentation is not at same cooling capacity. However we checked that even we adjust cooling capacity, conclusion is same within our evaluated models (4.3L Luxury car / 1.5L compact car) and climate conditions (Frankfurt, Athens, Phoenix, Tokyo, etc).

Question: Why is your R744 system performing so badly? (COP, LCCP) When other organizations find much better results?

Ikegami Response: LAR's presentation also shows bad COP and fuel economy, as well. It is known that R744's theoretical efficiency is worse than R134a. In their presentation which mentioned CO2 is superior, R134a's base specification such as compressor type (fix / variable displacement), expansion valve type (fixed or variable), etc were not shown. So the reason is not clear but JAMA think base system (R134a system) is comparison base is not quite optimized.

Question: LCCP results show better values for Fluid H and DP1 but these refrigerants show the lowest capacity and COP? LCCP at same capacity.

Ikegami Response: LCCP is sum of "Direct emission" and "Indirect emission". Fluid-H and DP1's GWPs are much smaller than R134a. It means "Direct emission is much smaller than R134a. Although "Indirect emission" (due to low COP) is slightly worse than R134a, Fluid-H and DP1's "Direct emission" which is much smaller than R134a can compensate its "Indirect emission".

Question: Why the LCCP for CO2 is so much more compared to ARCRPII. What were test conditions?

Ikegami Response: We are not sure ARCRP2 result in detail due to confidentiality reason, but our understanding is that conclusion is same as ARCRP2. Test conditions are listed below. (Condition1) Ambient temperature: 35degC, Humidity: 50%, Sunload: 850W/m2, Vehicle speed: 0, 40, 100km/h (Condition2) Ambient temperature: 25degC, Humidity: 50%, Sunload: 500W/m2, Vehicle speed: 0, 40, 100km/h (Condition3) Ambient temperature: 15degC, Humidity: 80%, Sunload: 100W/m2, Vehicle speed: 0, 40, 100km/h

All the tests have done on the vehicle test. From these test result, we applied each cities' driving pattern and climate condition by considering these frequency which are agreed with GM (=same as GM).

Question: Do you think it is possible to improve Fluid H stability with better lubricants? We have seen good data on some POE lubes with Fluid H.

Ikegami Response: In our result, it was NG with both PAG and POE. We can't assert it is not possible to improve, but it should be very difficult. Especially in the after-market, it should be very difficult to guarantee good quality .

Question: Results of testing were done at different capacity for H and R134a. What do you expect if capacity is equal? How will COP be charged? Same? for DP1.

Ikegami Response: It is depends on how adjust performance, but if we adjust the performance with Compressor capacity or Pulley ratio, COP should be R134a>Fluid-H>DP1. This caused by higher pressure drop on GAR especially in high load condition. This should be able to be improved by reducing pressure drop by enlarging the compressor inlet and suction hose/pipe's diameter

Question: Based on thermal stability test with H, will evaluation continue? Why?

Ikegami Response: Evaluation (cooling / compressor load / material) for Fluid-H has already been completed.

Question: All alternative refrigerants are "not negligible" worse than R134a. How can the indirect emissions be better in all climate conditions when calculating LCCP?

Ikegami Response: JAMA didn't mention that new chemical refrigerant's "Indirect emission" is better than R134a. In all these condition, R134a's "Indirect emission" is better than New chemical refrigerants (Fluid-H and DP1). But thanks to low GWPs of New chemical refrigerants (Low GWP=Good for "Direct emission"), LCCP which is sum of "Direct emission" and "Indirect emission" is better than R134a.

Question: Pls. explain why your data seems to contradict those presented by GM (CO2 > R134a)

Ikegami Response: Our understanding is our conclusion is same as GM presentation. CO2 is worse than R134a in general. This tendency becomes to be more obvious in severe climate condition.

Question: JAMA-JAPIA activity for NNR includes all carmakers and suppliers. Why was the same not done for CO2? Can we understand that JAMA-JAPIA directions is NNR? Same? for CRP150.

Ikegami Response: JAMA also evaluated CO2 system, as well. For example, we presented LCCP result together with new chemical refrigerant. However CO2 system's technology is not mature, yet. On the other hand, new chemical refrigerant system technology should be same or similar as current R134a system. JAMA-JAPIA is not focusing on GWP only. We should chose best refrigerant with taking into account life cycle effect to global warming up. In our evaluation, new chemical refrigerant is better solution in terms of both technical maturity and global warming up prevention. However we must consider toxicity. Therefore we don't have the solution, yet.

Question: Has JAMA run 2ndary loop testing on R152a?

Ikegami Response: No. We believe that efficiency must be not so good, because we need another heat exchanger. Also we need much packaging space and much mass (weight), therefore it is not practical. In addition to that, risk to passenger can be reduced by having secondary loop, but the risk on repair or maintenance service can not be reduced. From these reason, it is very difficult to be alternative solution.

Question: Can new chemicals be ready for 2011 if decision is postponed until spring 2008?

Rose Response: Question is for the chemical companies. Current situation seems «Yes».

Questions: Are you completely sure that the GAR will be acceptable in every aspect so that you can recommend to give up R744? What if all GAR turn out to be toxic?

Rose Response: We are not wizards, we are simple engineers and we'd choose the smaller risk.

Question: What is your fall back if chemical refrigerants cannot be qualified?

Rose Response: Question is for the chemical companies. Current situation seems «Yes».

Question: If a self-evaluation on the functions of R744 systems, where do you put yourself between 0 and 100? What are your next steps in order to improve your understanding?

Rose Response: We have been working on CO₂ for several years, in collaborations with nearly all Tier 1 suppliers from the automotive industry. Based on the evaluation of 2007 state-of-the-art components, we consider R-744 as a still non-mature technology.

Question: What is the measurement accuracy of the a/c fuel over consumption?

Rose Response: ± 0.1 l/100 km