Comparative study of AC- and HP-systems using the refrigerants R134a and R744

An investigation of R134a- and R744-systems carried out by three car manufacturers

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VDA Alternate Refrigerant Wintermeeting 2002
Comparative study of AC- and HP-systems using the refrigerants R134a and R744

cool down
comparison of R134a and R744
BMW 3 series

<table>
<thead>
<tr>
<th>time [min]</th>
<th>R134a</th>
<th>R744</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>29</td>
<td>17</td>
<td>31</td>
</tr>
<tr>
<td>45</td>
<td>31</td>
<td>58</td>
</tr>
</tbody>
</table>

compartment temperature [°C]

starttemp. head: 75°C
tamb.: 40°C
sunload: 1000 W/m²
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combination of an AC- and HP-system using R744

HP-system instead of a conventional supplementary heater

+ 2 valves
+ water/refrigerant heat exchanger
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heat up
comparison of supplementary heaters at footwellzone

heatpump 7.8 kW
fuel burner 5 kW
electr. boiler 1.4 kW
without sup. heater

temperature wasn’t achieved!
tamb.: -20°C
32km/h / 3.gear
Comparative study of AC- and HP-systems using the refrigerants R134a and R744

comparison of average temperatures at dashboard outlets

Audi A4

R134a

R744
Audi A4 1.9 PD

comparison of average temperatures at headzone

- water
- water & PTC
- HP (water)
Comparative study of AC- and HP-systems using the refrigerants R134a and R744

R. Mager, BMW Group
H. Hammer, Audi AG
J. Wertenbach, DaimlerChrysler

Roadtest 40°C, 1000 W/m², 32 km/h, Gear ‘3’
Comparative study of AC- and HP-systems using the refrigerants R134a and R744

Heat up - comparison production system* vs. R744
HP coolant / air (Full size Diesel Vehicle)

- R134 food-level
- R744 food-level

Reduction 66%

* 5kW fuel burner + 2kW PTC
Roadtest Sweden -27°C, 50 km/h, Gear ‘D’
Comparative study of AC- and HP-systems using the refrigerants R134a and R744

Summary

- the comparative investigation of R744 AC-systems shows:
  - higher performance in cool down mode vs. R134a
  - low compartment temperature and higher dynamic in cool down
  - higher potential for developing components
  - reduction of fuel consumption in AC-mode vs. R134a

- the comparative investigation of R744 HP-systems shows:
  - HP-systems just possible with R744
  - higher performance in heat up mode vs. supplm. heaters
  - reduction of fuel consumption for supplm. heating
  - high compartment temperature and dynamik
  - driving safety at better window lookout

These results of the investigation of R134a-, R744-systems and supplementary heaters are carried out by three car manufacturers!