Compressor Calorimeter Test of Refrigerant Blend R449A

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Test Setup

Refrigerants

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>GWP (AR4)</th>
<th>Composition (Mass %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R404A</td>
<td>3922</td>
<td>R125/R143a/R134a (44/52/4)</td>
</tr>
<tr>
<td>R449A</td>
<td>1397</td>
<td>R32/R125/R134a,R1234yf (24/25/26/25)</td>
</tr>
</tbody>
</table>

Lubricant

/ BSE32 (Solest 31-HE)
- No Modifications

Other Info

/ Testing Standard: EN13771-1:2003
/ Refrigerant data source: ASEREP v3.5.0
Compressor

Ecoline Series

/ 4GE-23Y-40P

- Semi-hermetic reciprocating compressor
- 380-420V / 3 / 50Hz (1450 RPM)
- 2984CFH @ 50Hz (3604CFH @ 60Hz)
Test Conditions

Operating Range

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>SST</td>
<td>-45°C (-49°F)</td>
<td>0°C (32°F)</td>
</tr>
<tr>
<td>SDT</td>
<td>20°C (68°F)</td>
<td>60°C (140°F)</td>
</tr>
</tbody>
</table>

- RGT: 20°C (68°F)
- Subcooling: 0 K
Results – Capacity Comparison

Compressor Capacity
(R449A/404A)

Saturated Suction Temperature °C (°F)
20°C RGT, 0 K SC

-40 (-40)  -35 (-31)  -30 (-22)  -25 (-13)  -20 (-4)  -15 (5)  -10 (14)  -5 (23)  0 (32)

R404A

Tc=60°C (140°F)  Tc=45°C (113°F)  Tc=40°C (104°F)  Tc=20°C (68°F)
Results – Power Comparison

Power
(R449A/404A)

Saturated Suction Temperature °C (°F)
20°C RGT, 0 K SC

Power (R449A/404A)

R404A

Tc=60°C (140°F)
Tc=45°C (113°F)
Tc=40°C (104°F)
Tc=20°C (68°F)
Results – COP Comparison

COP (R449A/404A)

-40 (-40) -35 (-31) -30 (-22) -25 (-13) -20 (-4) -15 (5) -10 (14) -5 (23) 0 (32)

Saturated Suction Temperature °C (°F)
20°C RGT, 0 K SC

R404A

Tc=60°C (140°F)
Tc=45°C (113°F)
Tc=40°C (104°F)
Tc=20°C (68°F)
Results – Discharge Gas Temperature Data

DGT (R-404A)

- Saturated Suction Temperature °C (°F)
- 20°C RGT, 0 K SC

DGT (R449A)

- Saturated Suction Temperature °C (°F)
- 20°C RGT, 0 K SC
Results – Discharge Gas Temperature Comparison

Discharge Gas Superheat
(R449A/404A)

-40 -35 -30 -25 -20 -15 -10 -5 0
(-40) (-31) (-22) (-13) (-4) (5) (14) (23) (32)
Saturated Suction Temperature °C (°F)
20°C RGT, 0 K SC

R404A

Tc=60°C  (140°F)
Tc=45°C  (113°F)
Tc=40°C  (104°F)
Tc=20°C  ( 68°F)
Summary

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Capacity</th>
<th>Power</th>
<th>COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>R449A</td>
<td>Over Entire Test Range</td>
<td>-19% to +5%</td>
<td>-16% to -10</td>
</tr>
<tr>
<td>Average</td>
<td>-7.4%</td>
<td>-13.4%</td>
<td>+6.8%</td>
</tr>
</tbody>
</table>

/ Capacity

- At the lower SST and SDTs of the tested conditions
  - R449A has lower capacity than R404A
- As SST or SDT decreases
  - R449A has a reduction in capacity as a ratio to R404A
At all test conditions

- R449A used less power than R404A

As SST or SDT decreases

- R449A has a reduction in power as a ratio to R404A
Summary

/ COP

- As the SST and SDT decrease, the reduction of power was greater than the reduction in capacity (as a ratio to R404A)
- COP for R449A is greater than R404A at nearly all tested conditions
- At the lowest tested condition for SST and SDT
  - -35°C (-31°F) / +20°C (68°F)
  - R449A COP was lower than R404A
Summary

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>(\Delta) Discharge Temperature</th>
<th>(\Delta) Discharge Temperature</th>
<th>Discharge Superheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>R449A</td>
<td>Over Entire Test Range: 5 K to 20 K</td>
<td>8(^\circ)F to 37(^\circ)F</td>
<td>+13% to +35%</td>
</tr>
<tr>
<td></td>
<td>Average: 12.8 K</td>
<td>23(^\circ)F</td>
<td>+23%</td>
</tr>
</tbody>
</table>

/ Discharge Gas Temperature / Discharge Gas Superheat

- At all tested conditions
  - R449A greater than R404A
  - approx. 5 K (8\(^\circ\)F) to 20 K (37\(^\circ\)F) higher
  - Discharge Superheat is 13 to 35\% higher for R449A
Thank you

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