Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Low-GWP Alternative Refrigerants Evaluation Program (Low-GWP AREP)

TEST REPORT #48

System Drop-in Tests of Refrigerants N-40 and L-20 in a R-404A Ice Machine

Hector Urbieta

Kold-Draft Industries
1525 East Lake Road, Erie,
PA 16511

September 23, 2015

This report has been made available to the public as part of the author company’s participation in the AHRI’s Low-GWP AREP.
1. Introduction:

The ice machine used for this application is the GT564RC with a remote condenser. Ice harvest is about twice per hour and information collected was throughout three cycles. Test facilities are located on site with three test rooms. Refrigerants covered in this report are R-404A, N40, and L20.

2. Details of Test Setup:

   a. Description of System

   The GT564RC ice machine with the remote condenser was the system used to test the refrigerants. The weight of ice per day for this system in 90°F /70°F conditions is 429 pounds and in 70°F /50°F conditions the production is 489 pounds. The test was run under the 90°F /70°F conditions for this system. Energy associated with this machine in the 90°F /70°F condition is at 5.14 kWh per 100 pounds. The refrigerant used for this ice machine is R-404A at a 112 ounce charge. The system uses a Tecumseh compressor (model AKA9455ZXD) with polyolester oil.

   b. Description of Modifications to System

   Initially there was a thought of changing the TXV setting for the different refrigerants. The ice produced was full and consistent in these 2-3 cycles which resulted in no change with the TXV setting for any refrigerant.

   The refrigerant associated with this ice machine is R-404A. The charge for this system is at 112 ounces. Since the system is a remote condenser the charge remained at 112 ounces for N40 and L20. There was no change in refrigerant charge when the refrigerants were removed and replaced with the next refrigerant to test.

   c. Description of Tests Conducted

   Tests were conducted in accordance with AHRI Standard 810 and ASHRAE Standard 29. Before conducting the actual test the ice machine was to run for about 2-3 cycles in order to reach steady state operation and this allowed seeing if any changes needed to be made. Test rooms were brought to 90°F ambient air, the first room for the ice machine and the second room for the remote condenser. The water temperature was set for 70°F and the ice machine was to run for 2-3 cycles to reach steady state. Upon completion the test began initially with R404A, then L20, and finally N40. Each refrigerant was tested and data recorded for three cycles after steady state was reached.

   Instrumentation used was thermocouples (.75% accuracy above 0°C and 1.5% below 0°C), pressure transducers (.25% accuracy), and software to record necessary data throughout the test. The measuring points were low and high side system pressures and evaporator superheat, compressor superheat, and condenser sub cooling. Inlet and outlet temperatures were also recorded for the remote condenser. All ice harvested was weighed
after each cycle along with duration and defrost time for that cycle. The batch weight input into the software allowed for calculation of ice production and energy usage per 100 pounds of ice.

3. Results

a. Data Form

**Low GWP AREP SYSTEM DROP-IN TEST DATA FORM**

<table>
<thead>
<tr>
<th>Manufacturer:</th>
<th>Manufacturer’s Notation:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Information</strong></td>
<td></td>
</tr>
<tr>
<td>Alternative Refrigerant (If not proprietary, composition as Charged, % wt)</td>
<td>N40</td>
</tr>
<tr>
<td>Alternative Lubricant Type and ISO Viscosity</td>
<td>Polyolester (standard)</td>
</tr>
<tr>
<td>Baseline Refrigerant and Lubricant</td>
<td>R404A</td>
</tr>
<tr>
<td>Make and Model of System</td>
<td>GT564RC</td>
</tr>
<tr>
<td>Nominal Capacity and Type of System</td>
<td>500# Ice Machine with Remote Air-Cooled Condenser</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comparison Data</th>
<th>Base.</th>
<th>Alt.</th>
<th>SI Units</th>
<th>Base.</th>
<th>Alt.</th>
<th>IP UNits</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode (Heating/Cooling)</td>
<td>Reciprocat</td>
<td>Reciprocat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Displacement</td>
<td>0.07052</td>
<td>0.07052</td>
<td>m³/3/min</td>
<td>2.49</td>
<td>2.49 ft³/3min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Motor Size</td>
<td>3/4</td>
<td>3/4</td>
<td>hp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Speed</td>
<td>3450</td>
<td>3450</td>
<td>rpm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expansion Device Type</td>
<td>TXV</td>
<td>TXV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubricant Charge</td>
<td>0.482</td>
<td>0.482</td>
<td>kg</td>
<td>1.063</td>
<td>1.063 lb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant Charge</td>
<td>3</td>
<td>3</td>
<td>kg</td>
<td>7</td>
<td>7 lb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant Mass Flow Rate</td>
<td>kg/min</td>
<td>lb/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition, at compr. inlet if applicable</td>
<td>% wt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient Temps.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indoor</td>
<td>db</td>
<td>32.22</td>
<td>32.22</td>
<td>C</td>
<td>90</td>
<td>90</td>
<td>F</td>
</tr>
<tr>
<td>wn</td>
<td>C</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor</td>
<td>db</td>
<td>32.22</td>
<td>32.22</td>
<td>C</td>
<td>90</td>
<td>90</td>
<td>F</td>
</tr>
<tr>
<td>wn</td>
<td>C</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Capacity</td>
<td>W</td>
<td>Btu/hr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensible Capacity</td>
<td>W</td>
<td>Btu/hr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total System Power Input</td>
<td>W</td>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Power Input</td>
<td>W</td>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency Ratio (EER)</td>
<td>W/W</td>
<td>Btu/W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coeff. Of Performance (COP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Other System Changes**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
### System Data

<table>
<thead>
<tr>
<th>Degradation Coefficient – Cd</th>
<th>Base.</th>
<th>Alt.</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seasonal Energy Efficiency Ratio - SEER</td>
<td>Base.</td>
<td>Alt.</td>
<td>Ratio</td>
</tr>
<tr>
<td>Heating Seasonal Performance Factor - HSPF</td>
<td>Base.</td>
<td>Alt.</td>
<td>Ratio</td>
</tr>
</tbody>
</table>

**Note:** Cells that should not be filled in are shaded. Please fill in the blank cells, if applicable, with the appropriate information. Note that some information may not be required or even meaningful, depending on the type of equipment tested.

### Low GWP AREP SYSTEM DROP-IN TEST DATA FORM

**Manufacturer:**

**Manufacturer’s Notation:**

#### Basic Information

<table>
<thead>
<tr>
<th>Alternative Refrigerant (If not proprietary, composition as Charged, % wt)</th>
<th>L20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Lubricant Type and ISO Viscosity Polyolester (standard)</td>
<td>Polyolester (standard)</td>
</tr>
<tr>
<td>Baseline Refrigerant and Lubricant R404A</td>
<td>R404A</td>
</tr>
<tr>
<td>Make and Model of System GT564RC</td>
<td>GT564RC</td>
</tr>
<tr>
<td>Nominal Capacity and Type of System 500# Ice Machine with Remote Air-Cooled Condenser</td>
<td></td>
</tr>
</tbody>
</table>

#### Comparison Data

<table>
<thead>
<tr>
<th>Mode (Heating/Cooling)</th>
<th>Base.</th>
<th>Alt.</th>
<th>SL Units</th>
<th>Base.</th>
<th>Alt.</th>
<th>IP UNits</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor Type Reciprocating</td>
<td>Reciprocating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Displacement 0.07052</td>
<td>0.07052</td>
<td>m³/min</td>
<td>2.49</td>
<td>2.49 ft³/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Motor Size 3/4</td>
<td>3/4</td>
<td>hp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Speed 3450</td>
<td>3450</td>
<td>rpm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expansion Device Type TXV</td>
<td>TXV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubricant Charge 0.482</td>
<td>0.482</td>
<td>kg</td>
<td>1.063</td>
<td>1.063 lb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant Charge 3</td>
<td>3</td>
<td>kg</td>
<td>7</td>
<td>7 lb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant Mass Flow Rate</td>
<td>kg/min</td>
<td>lb/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition, at compr. inlet if applicable</td>
<td>% wt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient Temps.</td>
<td>Indoor</td>
<td>db</td>
<td>32.22</td>
<td>32.22</td>
<td>C</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>wb</td>
<td>C</td>
<td>90</td>
<td>90</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outdoor</td>
<td>db</td>
<td>32.22</td>
<td>32.22</td>
<td>C</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>wb</td>
<td>C</td>
<td>90</td>
<td>90</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Capacity</td>
<td>W</td>
<td>Btu/hr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensible Capacity</td>
<td>W</td>
<td>Btu/hr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total System Power Input</td>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compressor Power Input</td>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency Ratio (EER)</td>
<td>W/W</td>
<td>Btu/h</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coeff. Of Performance (COP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Other System Changes
Each refrigerant seemed to yield well amounts of ice in terms of weight and along with the consistency of identical ice across the evaporator plate. Weight ranged from 6.7 to 7.2 pounds per harvest with L20 being at 6.7, R404A at 7.2, and N40 in the middle. Pressures at suction and discharge stayed consistent each point in the cycle (start, end, and defrost) with L20 having the slightly lower pressures at defrost and start at the discharge location. L20 also had slightly lower temperatures at the inlet and outlet of the condenser for start and end times of the cycle.

Results for the evaporator superheat, compressor superheat, and condenser sub cooling stayed consistent for that particular refrigerant but varied when compared to each other. R404A had consistent evaporator superheat with a slight increasing towards the end. L20 had a higher increasing in the end and N40 had a random spike midway through the cycle at each of the three cycles and was consistent in time with the compressor superheat for that refrigerant. Negative superheat values shown in figures are due to the pressure transducer reacting faster than the thermocouples at the beginning of the harvest stage. When the pressures spike up, the thermocouple is just warming back up.

The reasons for the results in N40 are not known and don’t really match with the ice production it made for its three cycles. The pressure temperature charts of each refrigerant provided by Honeywell were used for the software and look up tables for each refrigerant. N40 even resulted in better energy efficiency than R404A. L20 results did not make it into tier 1 for energy efficiency. Each refrigerant did prove to make good ice but N40 resulted in the better energy efficient refrigerant. Figures and tables with results during the test are shown below.

<table>
<thead>
<tr>
<th>Table: Comparative Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>GT564RC</td>
</tr>
<tr>
<td>90°F/70°F</td>
</tr>
<tr>
<td>Capacity [lb/24h]</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>R404a (baseline)</td>
</tr>
<tr>
<td>L-20</td>
</tr>
<tr>
<td>N-40</td>
</tr>
</tbody>
</table>
Evaporator Superheat Recorded for Three Cycles

Figure 1 R404A Evaporator Superheat
Figure 2 L20 Evaporator Superheat
Evaporator Superheat Recorded for Three Cycles

Figure 3 N40 Evaporator Superheat
Compressor Superheat Recorded for Three Cycles

Figure 4 R404A Compressor Superheat
Figure 5 L20 Compressor Superheat
Figure 6 N40 Compressor Superheat
Figure 7 R404A Condenser Sub Cooling
Figure 8 L20 Condenser Sub Cooling
Figure 9 N40 Condenser Sub Cooling
### Table 1 R404A Pressure Measurements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56</td>
<td>25</td>
<td>144</td>
<td>268</td>
<td>191</td>
<td>238</td>
</tr>
<tr>
<td>2</td>
<td>64</td>
<td>17</td>
<td>133</td>
<td>270</td>
<td>194</td>
<td>262</td>
</tr>
<tr>
<td>3</td>
<td>63</td>
<td>26</td>
<td>140</td>
<td>271</td>
<td>185</td>
<td>256</td>
</tr>
<tr>
<td>4</td>
<td>64</td>
<td>27</td>
<td>134</td>
<td>273</td>
<td>188</td>
<td>256</td>
</tr>
</tbody>
</table>

### Table 2 R404A Ice Cycle Measurements

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Cycle Time</th>
<th>Defrost Time</th>
<th>Ice Batch Weight (lbs)</th>
<th>Lbs/24 Hr</th>
<th>kWh/100lbs</th>
<th>Potable Water (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T#27m16s2ms</td>
<td>T#55s925ms</td>
<td>7.2</td>
<td>380.24</td>
<td>7.03</td>
<td>0.971</td>
</tr>
<tr>
<td>2</td>
<td>T#28m8s563ms</td>
<td>T#56s827ms</td>
<td>7.13</td>
<td>364.83</td>
<td>7.39</td>
<td>0.965</td>
</tr>
<tr>
<td>3</td>
<td>T#27m56s837ms</td>
<td>T#55s924ms</td>
<td>7.13</td>
<td>367.38</td>
<td>7.36</td>
<td>0.967</td>
</tr>
<tr>
<td>4</td>
<td>T#27m43s308ms</td>
<td>T#59s533ms</td>
<td>7.21</td>
<td>374.52</td>
<td>7.21</td>
<td>0.986</td>
</tr>
</tbody>
</table>

### Table 3 R404A Condenser Temp Measurements

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Cond. Inlet Temp (F) Start</th>
<th>Cond. Inlet Temp (F) End</th>
<th>Cond. Outlet Temp (F) Start</th>
<th>Cond. Outlet Temp (F) End</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>115</td>
<td>115</td>
<td>83</td>
<td>76</td>
</tr>
<tr>
<td>2</td>
<td>111</td>
<td>116</td>
<td>84</td>
<td>77</td>
</tr>
<tr>
<td>3</td>
<td>112</td>
<td>117</td>
<td>85</td>
<td>77</td>
</tr>
<tr>
<td>4</td>
<td>113</td>
<td>116</td>
<td>85</td>
<td>75</td>
</tr>
</tbody>
</table>

### Table 4 L20 Pressure Measurements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33</td>
<td>21</td>
<td>120</td>
<td>240</td>
<td>171</td>
<td>216</td>
</tr>
<tr>
<td>2</td>
<td>53</td>
<td>15</td>
<td>115</td>
<td>246</td>
<td>179</td>
<td>219</td>
</tr>
<tr>
<td>3</td>
<td>53</td>
<td>15</td>
<td>121</td>
<td>247</td>
<td>181</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>54</td>
<td>29</td>
<td>128</td>
<td>247</td>
<td>174</td>
<td>183</td>
</tr>
</tbody>
</table>

### Table 5 L20 Ice Cycle Measurements

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Cycle Time</th>
<th>Defrost Time</th>
<th>Ice Batch Weight (lbs)</th>
<th>Lbs/24 Hr</th>
<th>kWh/100lbs</th>
<th>Potable Water (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T#25m6s779ms</td>
<td>T#1m3s141ms</td>
<td>6.66</td>
<td>381.89</td>
<td>6.71</td>
<td>1.02</td>
</tr>
<tr>
<td>2</td>
<td>T#28m33s817ms</td>
<td>T#1m1s337ms</td>
<td>6.99</td>
<td>352.39</td>
<td>7.46</td>
<td>1.019</td>
</tr>
<tr>
<td>3</td>
<td>T#30m13s817ms</td>
<td>T#1m12s161ms</td>
<td>7.02</td>
<td>334.37</td>
<td>7.98</td>
<td>1.019</td>
</tr>
<tr>
<td>4</td>
<td>T#28m443ms</td>
<td>T#1m3s141ms</td>
<td>6.95</td>
<td>357.33</td>
<td>7.42</td>
<td>1.021</td>
</tr>
<tr>
<td>Cycle</td>
<td>Cond. Inlet Temp (F)</td>
<td>Cond. Outlet Temp (F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------------------</td>
<td>----------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Start</td>
<td>End</td>
<td>Start</td>
<td>End</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>96</td>
<td>103</td>
<td>68</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>94</td>
<td>102</td>
<td>68</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>94</td>
<td>96</td>
<td>70</td>
<td>69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>93</td>
<td>102</td>
<td>70</td>
<td>68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 L20 Condenser Temp Measurements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>62</td>
<td>22</td>
<td>113</td>
<td>254</td>
<td>191</td>
<td>239</td>
</tr>
<tr>
<td>2</td>
<td>52</td>
<td>15</td>
<td>122</td>
<td>253</td>
<td>179</td>
<td>225</td>
</tr>
<tr>
<td>3</td>
<td>56</td>
<td>18</td>
<td>140</td>
<td>253</td>
<td>184</td>
<td>214</td>
</tr>
<tr>
<td>4</td>
<td>62</td>
<td>18</td>
<td>143</td>
<td>256</td>
<td>186</td>
<td>208</td>
</tr>
</tbody>
</table>

Table 7 N40 Pressure Measurements

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Cycle Time</th>
<th>Defrost Time</th>
<th>Ice Batch Weight (lbs)</th>
<th>Lbs/24 Hr</th>
<th>kWh/100lbs</th>
<th>Potable Water (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T#25m22s539ms</td>
<td>T#58s631ms</td>
<td>6.92</td>
<td>392.69</td>
<td>6.94</td>
<td>1.018</td>
</tr>
<tr>
<td>2</td>
<td>T#26m1s384ms</td>
<td>T#1m4s43ms</td>
<td>6.94</td>
<td>384.03</td>
<td>7.01</td>
<td>1.02</td>
</tr>
<tr>
<td>3</td>
<td>T#28m13s79ms</td>
<td>T#1m10s358ms</td>
<td>7.1</td>
<td>362.32</td>
<td>7.39</td>
<td>1.027</td>
</tr>
<tr>
<td>4</td>
<td>T#26m14s12ms</td>
<td>T#1m2s239ms</td>
<td>6.99</td>
<td>383.69</td>
<td>6.99</td>
<td>1.019</td>
</tr>
</tbody>
</table>

Table 8 N40 Ice Cycle Measurements

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Cond. Inlet Temp (F)</th>
<th>Cond. Outlet Temp (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>1</td>
<td>104</td>
<td>112</td>
</tr>
<tr>
<td>2</td>
<td>103</td>
<td>111</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>108</td>
</tr>
<tr>
<td>4</td>
<td>97</td>
<td>111</td>
</tr>
</tbody>
</table>

Table 9 N40 Condenser Temp Measurements