District Heating Solutions
Winter Clean Heating Plan for the Northern Region (2017-2021)

- Issued on Dec. 27, 2017
- Jointly issued by 10 ministries and commissions
- The clean heating rate in the northern region will reach 50% in 2019, and 70% by 2021, replacing 150 million tons of loose-burning coal
- For “2 + 26” urban areas, by 2021, realize clean heating and remove all coal boilers below 35 tons in urban areas; in county towns, the clean heating rate reach 80% and remove all coal boilers below 20 tons; In rural areas, the rate of clean heating reaches more than 60%.
The Challenges of Low Ambient Heating With Air Source Heat Pump

Reliability

Low Ambient Heating Capacity

Heating Energy Efficiency
Emerson Low Ambient Temperature ASHP Solutions
EVI Scroll Heating Technology

EVI Compressor

- Create a second suction port in the scroll
- Through the second suction circuit, increase the refrigerant flow and enlarge the enthalpy difference of the main refrigerant circuit
EVI and Liquid Injection System Schematic Diagram
Operating Range Comparison Between EVI and Liquid Injection Compressor

• The minimum evaporating temperature of Copeland Scroll™ ZW series EVI compressor is as low as -35 °C. It can meet the heating requirements at lower ambient temperature. This is helpful for the application of ultra-low temperature air source heat pumps in severe cold areas such as Xinjiang province.

• The wide envelope also ensures the reliability of heat pump systems equipped with EVI compressors in low ambient temperature applications.

<table>
<thead>
<tr>
<th>Heating Capacity</th>
<th>EVI VS Liquid</th>
<th>System Advantages</th>
<th>Project Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑ 8-10%</td>
<td>Number of units DOWN</td>
<td>Electrical heating DOWN</td>
<td>Initial investment ↓</td>
</tr>
</tbody>
</table>

| Heating COP      | ↑ 15-20%       | Running cost DOWN | Payback period ↓ |

![Graph showing heating capacity and COP comparison between EVI and liquid injection systems.](image_url)
Excellent Heating Performance Effectively Shortens Payback Period

The liquid injection system has higher applied cost than EVI system (base).

<table>
<thead>
<tr>
<th>Component</th>
<th>Emerson EVI</th>
<th>Liquid Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce discharge temperature</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Increase heating capacity</td>
<td>Increase</td>
<td>No</td>
</tr>
<tr>
<td>Improve heating efficiency</td>
<td>Improve</td>
<td>Decrease</td>
</tr>
</tbody>
</table>

Heating Source Cost

- Gas Boiler
- ZW EVI
- Other LLI
EVI Advantages in Low Ambient ASHP System

- Greatly improve the reliability of heating in low ambient temperature
  - Expand the operating range of the unit, and it can still provide high-temperature hot water stably at an ambient temperature of -30 °C
- Improve the heating capacity of the unit at low temperature
  - Increased heating capacity by 10-20% at low ambient temperature
- Improve the energy efficiency of system, save running costs, and shorten the payback period
  - Using economizer circulation to improve cooling EER 7 ~ 10%
  - Improve heating COP by 20% at low ambient temperature
Industry Standard Upgrade to Improve Energy Efficiency Guidance

In 3-5 years, HSPF(APF) Will Be The Metrics of Low Ambient Temperature Heat Pump Units. Firstly to Release IPLV(H) Evaluation System, Then to Synchronously Evaluate The Revised High Water Temperature and APF(CSPF&HSPF).

Scenario 1 (revise immediately):
GB xxxx-2021 Energy Efficiency Standard APF, 35/41/50°C water temperature

Scenario 2 (to be revised in 5 years):
GB xxxx-2024 Energy Efficiency Standard APF, 35/41/50°C water temperature

For long-term, should revise to 50°C and corresponding energy efficiency.

GB/T 25127-2010 Product Standard IPLV, 41°C water temperature
GB 37480-2019 Energy Efficiency Standard (based on V. 2010) IPLV, 35/41/55°C temperature

GB/T 25127-2019 Product Standard APF, 35/41/50°C water temperature

IPLVH Level GB37480-2019 Released on Apr 4, 2019 and to be effect on May 1st 2020

<table>
<thead>
<tr>
<th>名义制热量 kW</th>
<th>额定出水温度</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>综合部分负荷性能系数(IPLV (H), W/W)</td>
<td>综合部分负荷性能系数(IPLV (H), W/W)</td>
<td>制热性能系数(COPa, W/W)</td>
</tr>
<tr>
<td>H≤35 (或CC≤50)</td>
<td>35°C</td>
<td>3.40</td>
<td>3.20</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>41°C</td>
<td>3.20</td>
<td>2.80</td>
<td>2.60</td>
</tr>
<tr>
<td></td>
<td>55°C</td>
<td>2.30</td>
<td>1.90</td>
<td>1.70</td>
</tr>
<tr>
<td>H&gt;35 (或CC&gt;50)</td>
<td>35°C</td>
<td>3.40</td>
<td>3.20</td>
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注：a) 主要适用于低湿辐射采暖末端，如地板采暖等；
b) 主要适用于强制对流采暖末端，如风机盘管、强制对流低湿散热器等；
c) 主要适用于自然对流和辐射结合的采暖末端，如风机盘管、低温散热器等。
Emerson Low Ambient Application Product Profile

- Patented EVI technology
- The continuously expanding EVI product line
- Rich EVI application experience

Emerson’s Decades of EVI Design, Manufacturing and System Application Experience Guarantee The Reliable Design and Stable System Operation for Our Customers
Emerson EVI Scroll Heating Technology Summary
Perfect Solution for Heat Pump Heating System

Reliable
- Stable heating capacity under ultra-low ambient enables the application of air-source heat pump units in north regions
- Meet the heating needs of non-central heating area

Energy Saving
- Save operating costs by up to 70%

Environment Friendly
- Replace coal boiler for heating, improve air quality
- From the perspective of primary energy efficiency, CO2 emissions can be reduced
Intellectual Property and Expert Assessment

Tsinghua University, Shanghai Jiaotong University and Harbin Institute of Technology
Have Highly Praised The Systems Using Emerson EVI and Variable Speed Technology
Emerson’s Successful Case

A district heating project in Beijing

R32 heating project in a shopping mall in Yining, Xinjiang

Heat pump heating project of a ski resort in Jilin

R32 project in a scenic spot in Beijing

Heating project in a residential building in Shandong

District heating project of a community in Shandong

A poverty alleviation industrial base in Yining

A district heating project in Tianjin

A heating project in Ningyang, Ningxia