The emission-free MAN Heat Pump solution HPU makes efficient use of the special properties that CO₂, as a working fluid, has to offer. Operating with an optimized transcritical heat pump cycle, this high temperature industrial heat pump system is able to generate temperatures from 0°C (32°F) up to 150°C (302°F) and up to 50 MW (170.61 MMBtu/h) of thermal heat and 30 MW (8530 tons of refrigeration) of thermal cold with using just one single heat pump unit.

**Benefits at a glance**
- Large scale supply of heating or cooling
- High supply temperatures
- Environmentally friendly refrigerant
- High power density
- Adaptable to project or site specific requirements
- An all inclusive electric solution for low maintenance and remote operations
- Participation in secondary control power market
- Quick start-up, shut down and load change reaction time

**Components**

1. Heat Sink HEX
   PCHE Type
2. Recuperator
   S&T, Plate or PCHE Type
3. HOFIM® Compressor and Expander
4. CO₂ Separator
5. Evaporator
   S&T, Plate or PCHE Type
### Nominal Conditions

**MAN Heat Pump**

<table>
<thead>
<tr>
<th></th>
<th>HPU28</th>
<th>HPU33</th>
<th>HPU43</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal reference conditions:</strong></td>
<td>Heat sink supply / return temp.: 110°C / 40°C (230°F / 104°F)</td>
<td>Heat source temp.: 10°C (50°F)</td>
<td></td>
</tr>
<tr>
<td><strong>Unit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. compressors</td>
<td>Pca,</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Variable speed drive (VSD)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Max. thermal burnout</td>
<td>%</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Refrigerant charge (CO₂)</td>
<td>kg</td>
<td>9'000 (19,941)</td>
<td>13'750 (30,313)</td>
</tr>
<tr>
<td>Electrical supply voltage(^1)</td>
<td>kV</td>
<td>min. 4.16</td>
<td>min. 6</td>
</tr>
<tr>
<td>Heating capacity</td>
<td>kW, (kWth)</td>
<td>9'370 (20,452)</td>
<td>16'730 (37,200)</td>
</tr>
<tr>
<td>Cooling capacity</td>
<td>kWth, (kWth)</td>
<td>8'270 (17,461)</td>
<td>16'730 (37,200)</td>
</tr>
<tr>
<td>Motor inlet power(^2)</td>
<td>kW</td>
<td>3'450</td>
<td>8'500</td>
</tr>
<tr>
<td>COP (Hot)</td>
<td>-</td>
<td>2.84</td>
<td>2.97</td>
</tr>
<tr>
<td>COP (Cold)</td>
<td>-</td>
<td>1.94</td>
<td>1.94</td>
</tr>
<tr>
<td>COP (total excl. pumps)</td>
<td>-</td>
<td>4.68</td>
<td>4.94</td>
</tr>
<tr>
<td>Dimensions (L/W/H)</td>
<td>m (ft)</td>
<td>12/8/8 (40/26/28)</td>
<td>16/8/8 (51/26/28)</td>
</tr>
<tr>
<td>Floor load</td>
<td>kN/m(^2) (psf)</td>
<td>10 (209)</td>
<td>-</td>
</tr>
<tr>
<td>Connections at heat sink</td>
<td>-</td>
<td>DN600 (20&quot;)</td>
<td>DN800 (27&quot;)</td>
</tr>
<tr>
<td>Connections at heat source</td>
<td>-</td>
<td>DN500 (2&quot;)</td>
<td>DN600 (2&quot;)</td>
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<tr>
<td>Design pressure</td>
<td>Bar (psig)</td>
<td>180 (2625)</td>
<td>-</td>
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<tr>
<td>Design temperature</td>
<td>°C (°F)</td>
<td>200 (392)</td>
<td>-</td>
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<tr>
<td>Controller type</td>
<td>-</td>
<td>PLC (Programmable logic controller)</td>
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<tr>
<td>Communication protocol</td>
<td>-</td>
<td>MODBUS/PROFINET/Ethernet</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^1\) Higher voltages are possible  \(^2\) Higher motor power is possible (case specific)

### Key components

**Heat Sink HEX**
- Printed circuit heat exchanger (PCHE) design
- Compact and robust design
- Suitable for efficient gas to liquid heat transfer with narrow approach temperatures

**Evaporator**
- Different types available based on heat source media (Shell & Tube, PCHE, Plate Fin or Falling Film)

**Recuperator**
- Heat exchanger used to optimize the system and reduce system losses
- Different types available based on heat source media (Shell & Tube, PCHE, Plate Fin)

**Separator tank**
- A separator tank is used to control the amount of CO₂ in the system

### HOFIM®
- Integrated machinery concept comprising of a centrifugal compressor, a high speed electric motor and an expander
- Hermetically sealed design preventing gas leakages to the environment
- Modular concept for maximum process design flexibility
- The active magnetic bearing system ensures a broad operating range, the highest reliability and availability as well as a quick start-up and shutdown; without lubrication oil system and complex auxiliaries
- Designed for full remote operation, thanks to the comprehensive electric design
- Optimized installation and commissioning as well as lower maintenance since there is no external cooling medium, no lube oil and sealing gas is no longer required
- The compressor module is fully assembled and tested at the factory in order to ensure a smooth installation and commissioning on site

### Expansion
- Expander stage for recuperation of the usable kinetic energy in the refrigerant
- Expansion valve for the two-phase expansion

### Control system
- Process control system for control and operation of the complete heat pump unit
- Advanced digital services for remote operation, real time monitoring and predictive maintenance available

### Other available options
- CO₂ to air evaporators
- CO₂ detection system for machinery room and in the water systems
- Heat exchanger online cleaning systems (on water side)
- Additional CO₂ storage vessel for maintenance purposes
- A wide range of after sales support and services is offered

### Advantages of using CO₂ as a refrigerant
- CO₂ is a naturally occurring component which is available in large quantities and is inexpensive compared to synthetic refrigerants
- CO₂ is an environmentally friendly, low GWP, non-toxic and non-explosive medium
- CO₂ is a very dense refrigerant with a high volumetric heating capacity; this allows the piping sizes and equipment volume to be much smaller than an equivalent HFC system
- Transcritical CO₂ HP systems provide a high discharge temperature, therefore removing the need for cascade heat pump systems or additional heating devices

### COP operating range as function of heat sink supply and return temperature and a constant source temperature

**COP operating range as function of heat sink supply and return temperature (Heat sink temp. 110°C / 40°C (230°F / 104°F))**

**Net heat output as function of source inlet temperature**

**Return temperature (T ret) [°C] (°F)**

**High COP**

**Low COP**

**Net heat output [kWth] (kWth[k])**
Selected applications

Scalable and modular, MAN Heat Pump HPU is suitable for mid- to large-scale thermal consumers.

**District Heating, municipal, urban and large facilities**

With the MAN HPU, you can decarbonize the complete energy supply for district heating networks, urban quarters, small towns and large facilities like airports, universities or shopping malls.

**Data centers**

Your data center operators can reduce their CO₂ emissions and electricity costs with a direct supply of cooling energy. An additional revenue stream can be created by participating in the power markets and exporting thermal energy, e.g. for district heating.

**Process industries**

MAN HPU provides cost-efficient carbon-neutral heating or cooling for all kinds of industrial processes with intensive heating or cooling demands, especially in the food, beverage and pharmaceutical industries.