

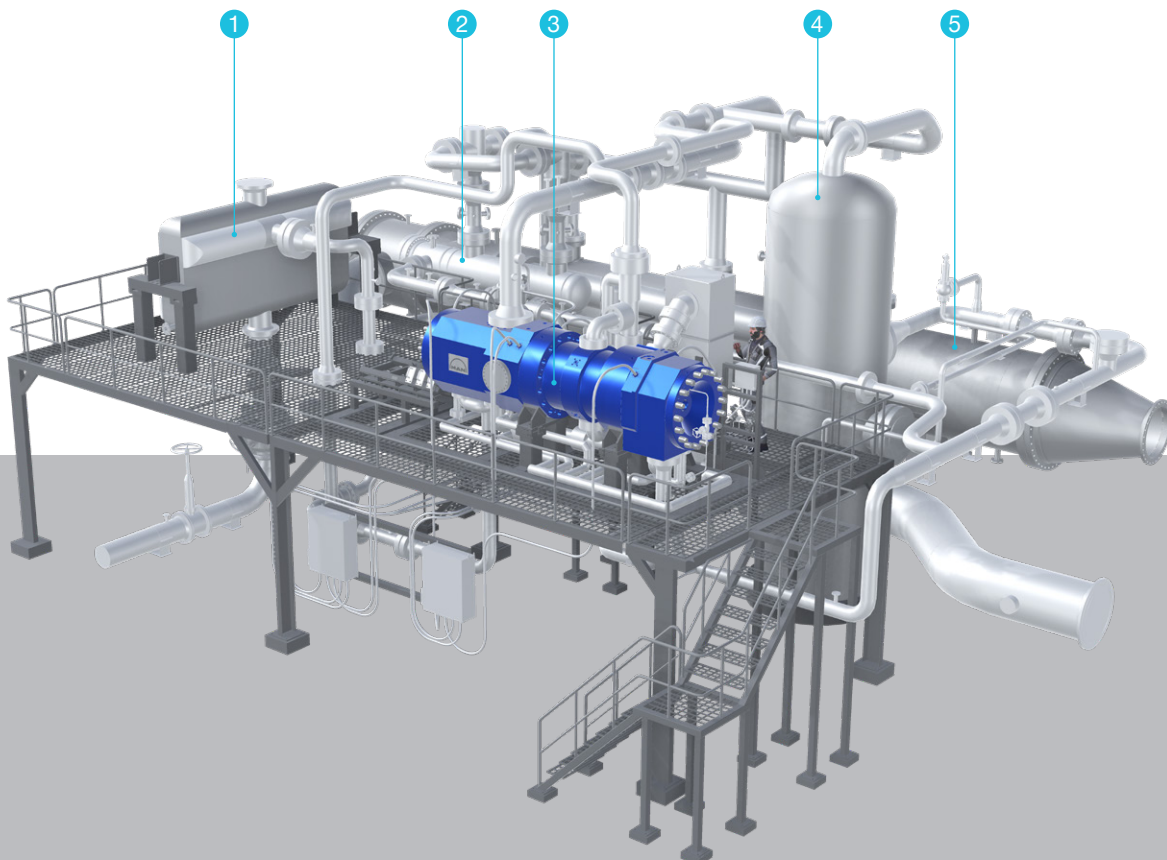
# MAN Heat Pump

The emission-free MAN Heat Pump solution HPU makes efficient use of the special properties that CO<sub>2</sub>, 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.

- 1 **Heat Sink HEX**  
PCHE Type
- 2 **Recuperator**  
S&T, Plate or PCHE Type
- 3 **HOFIM® Compressor and Expander**
- 4 **CO<sub>2</sub> Separator**
- 5 **Evaporator**  
S&T, Plate or PCHE Type

## Benefits at a glance

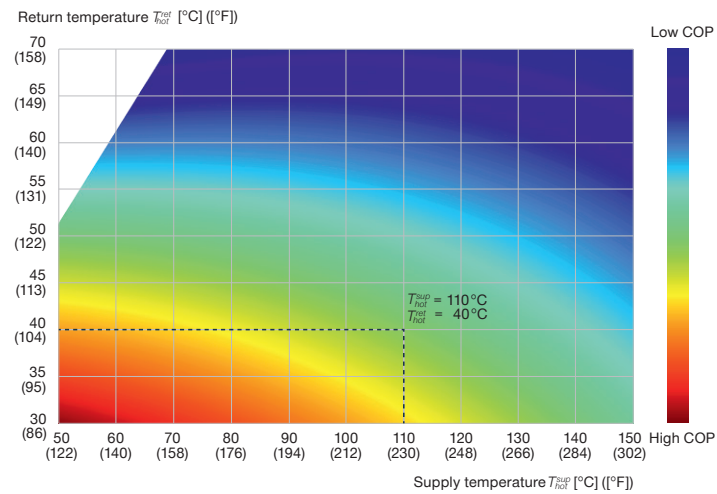
- Large scale supply of heating or cooling
- High supply temperatures
- Environmentally friendly refrigerant
- High power density
- Adaptable to project or site specific requirements
- An all inclusive electric solution for low maintenance and remote operations
- Participation in secondary control power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



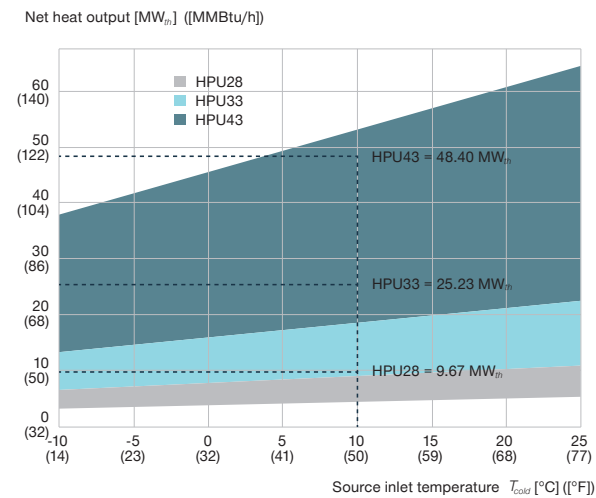
## Nominal Conditions

MAN Heat Pump		HPU28	HPU33	HPU43
Nominal reference conditions: – Heat sink supply / return temp.: 110°C / 40°C (230°F / 104°F) – Heat source temp.: 10°C (50°F)				
<b>Unit</b>				
No. compressors	Pcs.	1	1	1
Variable speed drive (VSD)		Yes	Yes	Yes
Max. thermal turndown	%	50	50	50
Refrigerant charge (CO <sub>2</sub> )	kg (lbs)	9'000 (19'841)	13'750 (30'313)	20'000 (44'092)
Electrical supply voltage <sup>1</sup>	kV	min. 4.16	min. 6	Min. 6
Heating capacity	kW <sub>th</sub> (MMBtu/h)	9'670 (33)	25'230 (86)	48'400 (165)
Cooling capacity	kW <sub>th</sub> (tons)	6'270 (1783)	16'730 (4757)	32'500 (9241)
Motor inlet power <sup>2</sup>	kW <sub>el</sub>	3'400	8'500	15'900
COP (Hot)	-	2.84	2.97	3.04
COP (Cold)	-	1.84	1.97	2.04
COP (total excl. pumps)	-	4.68	4.94	5.08
Dimensions (L/W/H)	m (ft)	12/8/8 (40/26/26)	16/8/8 (52/26/26)	19/10/8 (62/33/26)
Floor load	kN/m <sup>2</sup> (psf)		10 (209)	
Connections at heat sink	-	DN200 (4")	DN300 (12")	DN400 (16")
Connections at heat source	-	DN500 (20")	DN900 (36")	DN1400 (56")
Design pressure	Barg (psig)		180 (2610)	
Design temperature	°C (°F)		200 (392)	
Controller type	-	PLC (Programmable logic controller)		
Communication protocol	-	MODBUS/PROFINET/Ethernet		

<sup>1</sup> Higher voltages are possible <sup>2</sup> Higher motor power is possible (case specific)



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



Net heat output as function of source inlet temperature (Heat sink temp. 110°C / 40°C (230°F / 104°F))

## Advantages of using CO<sub>2</sub> as a refrigerant

- Carbon dioxide is a naturally occurring component which is available in large quantities and is inexpensive compared to synthetic refrigerants
- Carbon dioxide is an environmentally friendly, low GWP, non-toxic and non-explosive medium
- Carbon dioxide 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 CO<sub>2</sub> HP systems provide a high discharge temperature, therefore removing the need for cascade heat pump systems or additional heating devices
- There is no impending legislation phasing out carbon dioxide; hence it can be considered as a safe refrigerant, matching the clients long-term carbon footprint reduction strategies
- Transcritical CO<sub>2</sub> HPU is remarkably suited for significant heat sink temperature differential (between inlet and outlet temperature) above 40K

## Key components



Dismantled HOFIM® Heat Pump core unit

### 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 a 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

### 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 CO<sub>2</sub> in the system

### 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

- CO<sub>2</sub> to air evaporators
- CO<sub>2</sub>-detection system for machinery room and in the water systems
- Heat exchanger online cleaning systems (on water side)
- Additional CO<sub>2</sub> storage vessel for maintenance purposes
- A wide range of after sales support and services is offered

# 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 CO<sub>2</sub> 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.

**MAN Energy Solutions  
Switzerland Ltd.**  
Hardstrasse 319  
8005 Zurich, Switzerland  
P + 41 44 278-2211  
F + 41 44 278-2261  
[info@man-es.com](mailto:info@man-es.com)