ET 380

Refrigeration cycle: refrigeration plant and heat pump

screen mirroring is possible on up to 10 end devices

Description

- **visible phase transitions in evaporator and condenser**
- **log p-h diagram in real time**
- **detailed animations of the main components**
- **Game-Based Learning: learn complex theory easily and playfully**

Make complex changes of state in the otherwise closed piping systems of refrigerating plants visible and tangible. With the aim of creating a memorable concept of the theoretical comparative process through the positions of the components and pipes, this trainer makes an important contribution to the recognition of technical analogies in real plants. In refrigeration plants, the cooling effects are used for cooling. If the heat system is used to produce heat, this is known as a heat pump.

The ET 380 trainer provides an insight into the process of phase change and creates a didactic bridge to the theoretical comparative process, the log p-h diagram.

All relevant measured values are captured by sensors. The simultaneous transmission of the measured values to a PLC enables easy analysis and the representation of the process in the log p-h diagram.

Complex processes, such as changes of state, are visualised by real-time representation of the cycle, e.g. in the log p-h diagram. Intuitive operation of the PLC makes it easy to adjust all elements of the cycle. The effect of the modifications is immediately visible on the touch screen.

The PLC provides accurate data on the condition of the refrigerant, which is used for the accurate calculation of the refrigerant mass flow. The calculation therefore provides a much more accurate result than measurement with conventional methods.

The trainer is controlled by a PLC via touch screen. With an integrated router, the trainer can alternatively be operated and controlled via an end device. The user interface can also be displayed on additional end devices (screen mirroring). Via the PLC, the measured values can be stored internally.

Digital multimedia teaching material is available at the GUNT Media Center. In addition to real-time representation directly on the unit, Game-Based Learning is made possible with these online media, e.g. worksheets, e-learning, videos, etc.

Learning objectives/experiments

- design and function of a compression refrigeration system/heat pump
- load dependency of a refrigerating plant
- represent and understand the refrigeration cycle in the log p-h diagram
- energy balances
- determine the coefficient of performance
- oil transport in the gas phase
- superheating and supercooling
- function of a piston compressor

- GUNT Media Center, develop digital skills
  - ▸ retrieve information from digital networks
  - ▸ use digital learning media, e. g. Web Based Training (WBT)
  - ▸ use visualisation systems

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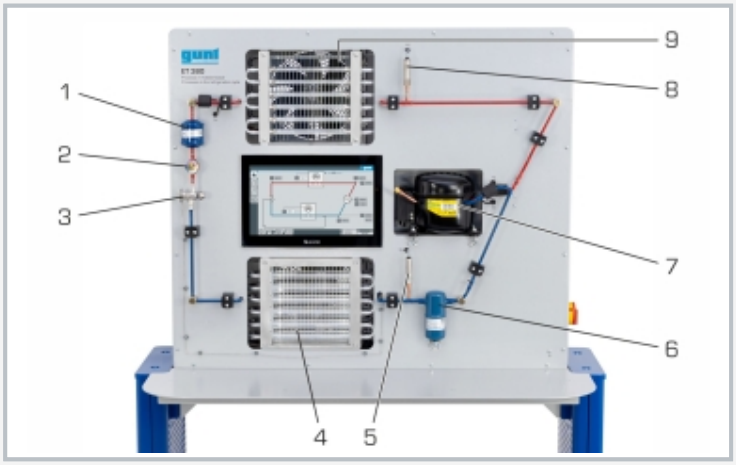
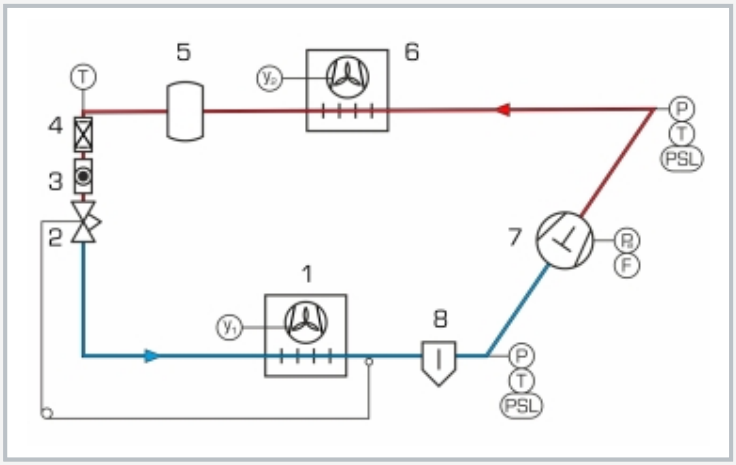
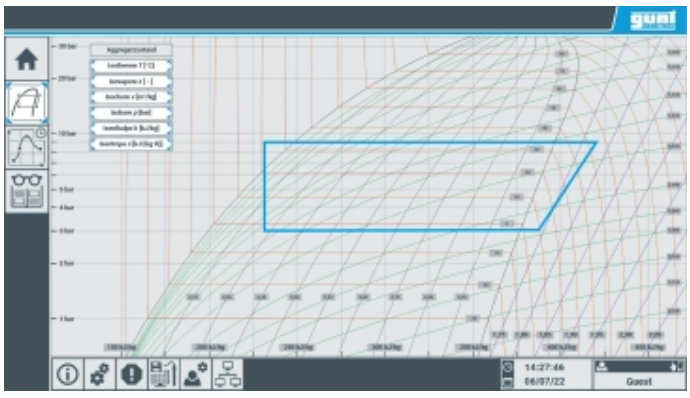


1 filter/dryer, 2 sight glass with moisture indicator, 3 thermostatic expansion valve (TEV), 4 evaporator with ventilator, 5 pressure sensor (low pressure), 6 liquid separator, 7 compressor, 8 pressure sensor (high pressure), 9 condenser with ventilator



1 evaporator with ventilator, 2 thermostatic expansion valve (TEV), 3 sight glass with moisture indicator, 4 filter/dryer, 5 refrigeration receiver, 6 condenser with ventilator, 7 compressor, 8 liquid separator; T temperature, P pressure, F refrigerant mass flow, P_{el} power consumption, PSH, PSL pressure switch, y_1 manipulating variable , y_2 evaporator manipulating variable condenser; blue: low pressure, red: high pressure



log p-h diagram in real time

Specification

[1] make complex changes of state of refrigerating plants/heat pumps visible and tangible
[2] refrigeration circuit: compressor, condenser with ventilator, thermostatic expansion valve, evaporator with ventilator
[3] EC ventilator enables very high load variability
[4] sensors for pressure, temperature, flow rate, power
[5] precise calculation of refrigerant mass flow
[6] 15,6" touch screen with animations showing how the main components work
[7] representation of all measured values in real time over a time axis, such as the log p-h diagram
[8] adjust the scale of the axes and the degree of magnification on the touch screen
[9] control of the experimental plant using a PLC, operated by touch screen
[10] screen mirroring: possible to mirror the user interface on up to 10 end devices
[11] data acquisition via PLC on internal USB memory, access to stored measured values via WLAN/LAN with integrated router/LAN connection to customer's own network or direct LAN connection without customer network
[12] refrigerant R513A, GWP: 631
[13] digital multimedia teaching material online in the GUNT Media Center: E-Learning course, worksheets, videos

Technical data

PLC: Weintek cMT3162X
Compressor
- refrigeration capacity: approx. 372W at 7,2/32°C
- power consumption: approx. 213W at 7,2/32°C
- displaced volume: 5,08cm^3

Ventilator, EC motor: rated speed: 2330min^{-1}
- drive motor power: 83W
- flow rate: 0...1710m^3/h

Refrigerant: R513A, GWP: 631, fill quantity: 1,25kg, CO_2 equivalent: 0.8t, security: DIN EN 378: A1

Measuring ranges
- temperature: -50...180°C
- flow rate: 0...7g/s
- pressure: -0,8...7bar / 0...30bar
- power: 0...750W

230V, 50Hz, 1 phase; 230V, 60Hz, 1 phase
120V, 60Hz, 1 phase; UL/CSA optional
LxWxH: 1328x790x1685mm; Weight: approx. 150kg

Required for operation

ambient temperature: max. 42°C, min. 10°C
PC with Windows recommended

Scope of delivery

trainer, online access to the GUNT Media Center, set of instructional material