

ET 411C

Compression refrigeration system



Description

- **compression refrigeration system with transparent evaporator and transparent condenser**
- **compare different expansion elements**
- **effect of under/overfilling of the system with refrigerant**

The setup of ET 411C represents a typical refrigeration circuit consisting of a hermetic compressor, condenser, evaporator and expansion element. Evaporator and condenser are designed as finned tube heat exchangers. The pipes of both heat exchangers are partially transparent to visualise the process of the phase transition during evaporation and condensing. Three capillary tubes of different lengths and a thermostatic expansion valve can be compared as expansion elements.

The trainer is equipped with a receiver for refrigerant. Using the receiver, refrigerant can be added to or removed from the refrigeration circuit. This allows for the effects of overfilling or underfilling of the system to be examined.

The flow rate of the refrigerant is read from a flow meter. Temperature and pressure in the refrigeration circuit and the electrical power consumption of the compressor are recorded by sensors.

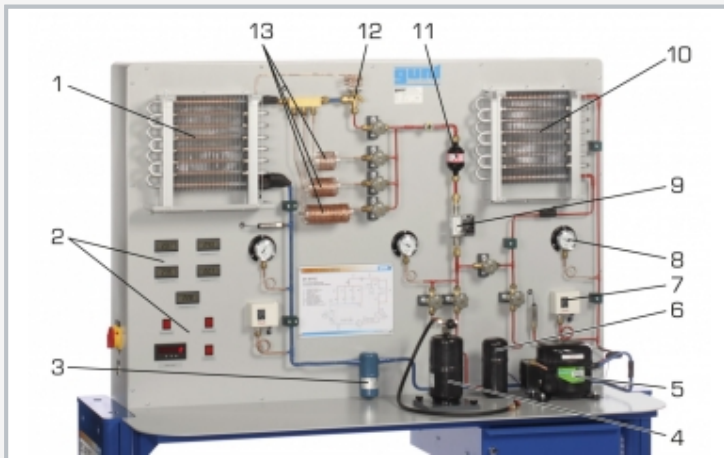
The measured values can be read on digital displays. At the same time, the measured values can also be transmitted directly to a PC via USB. The data acquisition software is included. Parameter changes in the refrigeration circuit can be viewed dynamically in the software's log p-h diagram.

Learning objectives/experiments

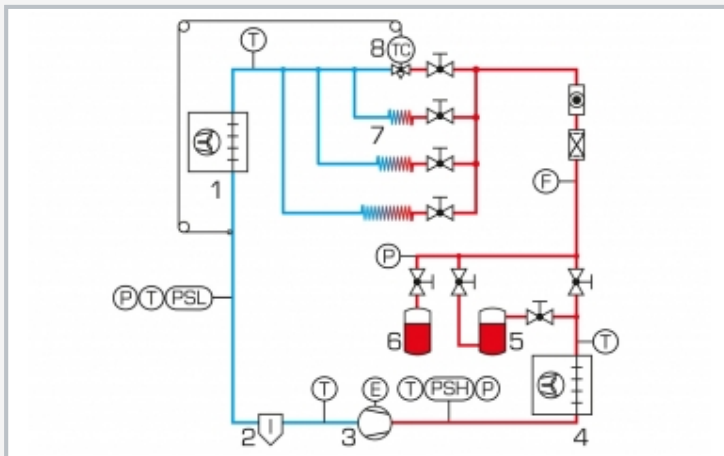
- function and operational behaviour of the refrigeration circuit components
- operation with expansion valve or with capillary tubes of different lengths
- underfilling or overfilling with refrigerant
- thermodynamic cycle in the log p-h diagram
- from the log p-h diagram and in comparison with the measured values
 - ▶ determination of the refrigeration capacity
 - ▶ determination of the coefficient of performance
 - ▶ determination of the efficiency of the compressor

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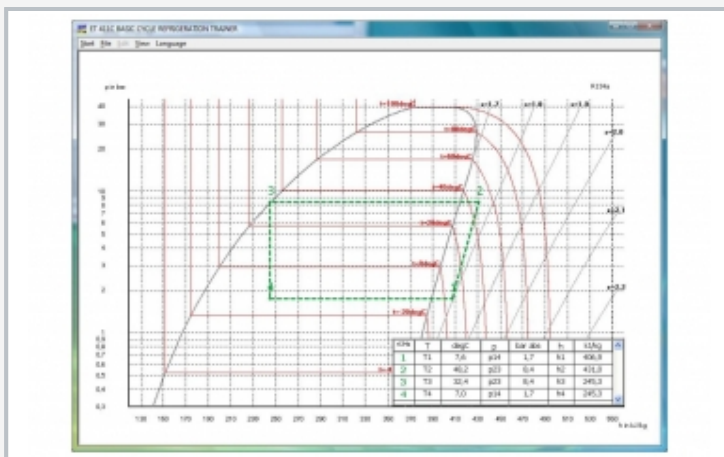
Compression refrigeration system



1 evaporator, 2 displays and controls, 3 suction line receiver, 4 reservoir, 5 compressor, 6 receiver, 7 compressor pressure switch, 8 manometer, 9 refrigerant flow meter, 10 condenser, 11 filter/drier, 12 expansion valve, 13 capillary tube



1 evaporator, 2 suction line receiver, 3 compressor, 4 condenser, 5 receiver, 6 reservoir, 7 capillary tube, 8 expansion valve; T temperature, P pressure, F flow rate, E power consumption, PSH, PSL pressure switch



Software screenshot: log p-h diagram

Specification

- [1] investigation of a refrigeration system with different expansion elements
- [2] refrigeration circuit consisting of a hermetic compressor, condenser, evaporator and expansion element
- [3] transparent finned tube heat exchangers as condenser and evaporator to observe the phase transitions of the refrigerant
- [4] expansion valve and capillary tubes of different lengths as expansion elements
- [5] receiver for underfilling/overfilling the system with refrigerant
- [6] sensors record pressure and temperature
- [7] compressor equipped with two pressure switches
- [8] GUNT software for data acquisition via USB under Windows 7, 8.1, 10
- [9] refrigerant R134a, CFC-free

Technical data

Compressor

- power consumption: 213W at 7,2°/32°C
- refrigeration capacity: 372W at 7,2/32°C

Condenser and evaporator with fan

- max. volumetric air flow rate condenser: 300m³/h
- max. volumetric air flow rate evaporator: 180m³/h

Capillary tubes: 1,5m, 3m, 6m

Receiver for refrigerant: 1,3L

Measuring ranges

- pressure: -1...9bar / -1...24bar
- temperature: 4x -40...150°C, 1x -100...100°C
- flow rate: 2...18m³/h
- power consumption: 0...1000W

230V, 50Hz, 1 phase

230V, 60Hz, 1 phase

120V, 60Hz, 1 phase

UL/CSA optional

LxWxH: 1740x800x1780mm

Weight: approx. 190kg

Required for operation

PC with Windows recommended

Scope of delivery

- 1 trainer
- 1 GUNT software CD + USB cable
- 1 set of instructional material