



# Refrigeration and air conditioning technology





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Equipped with smart features, it enables flexible lesson planning for small groups or entire classes:

- integration into the existing network
- screen mirroring of the user interface
- access to measured values via WLAN/LAN

GUNT's web-based platform, access to digital media such as drawings, videos,

E-Learning courses, extensive multimedia teaching material such as

Augmented reality, real GUNT devices virtually connected with animations,



Interactive teaching that makes learning more fun and secures the acquired knowledge in the long term



#### From teaching to learning

with game-based learning to kindle the desire to play and increase motivation to learn.

Our concept of hardware and digital features for gamified learning:

- combination of simulation and realworld conditions
- run competitions with our online accessible media
- solve assessments and tasks online
- videos, animations and augmented reality experiences that enable visual learning and intuitive, playful use of the equipment

## Learn complex topics in a simple and playful way



In refrigeration engineering, the state variables such as pressure, temperature and density are important as is the dependence of these state variables on each other. Using a log p-h diagram, the various state variables can be repre-

sented graphically according to their dependencies. Using the log p-h diagram greatly simplifies thermodynamic calculations and is essential for understanding how refrigerating plants work.







Air conditioning means affecting the condition of the room air in such a way that people feel comfortable and their capacity is not impaired. The condition of the air is characterised by tempera-





ture, pressure and humidity. The basic processes of air conditioning can be represented in the h-x diagram.

## Learning with cognitive assistance systems



Intuitive handling of technology

Intuitive handling of technology leads to a better understanding of the complex theory:

- suitable human-machine interfaces, e.g. PLC with touch screen
- intuitive experimentation
- the simple operation
- the detailed animations and explanations of the main components





The playful interaction with complex systems, components and functions teaches new knowledge and skills in less time.

- learning through experience and observation
- finding information quickly

## Visual learning

Visual representation of complex theory that is otherwise invisible and can only be understood through calculation:

- visible phase transitions
- transparent condensers and evaporators



- increase motivation to learn: Learning can be fun!
- interactivity and direct influence on the training environment
- intuitive approach and trying things out
- acquired knowledge is retained in the long term



## The GUNT Science Media Center

#### Basic knowledge and work materials





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#### Digital worksheets



#### The E-Learning course



SCIENCE

platform:

GUNT Media Center on the Web

Digital data packages

are available on GUNT's own

quick and focused acquisi-

helpful in the development

traditional learning content

supplemented by digital content and methods

tion of information

 selected according to didactic criteria

of digital skills



## Thermodynamics of the refrigeration cycle

#### ET 380 Refrigeration cycle: refrigeration plant and heat pump

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 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.







screen

#### Feeling and learning

Heat and cold are the perceptible result of the device setting, well felt in the case of the iced expansion valve. Experienced changes of state in the refrigeration circuit are internalised.





the piping and in the touch

Evaporator with flowing refrigerant

#### Features

- visible phase transitions in evaporator and condenser
- log p-h diagram in real time
- dynamic display of the refrigerant mass flow

The transfer of all relevant measured values to a PLC enables easy evaluation and the display of the process in the log p-h diagram in real time.

Refrigerant: R513A, GWP: 631, fill quantity: 1,25 kg, CO<sub>2</sub> equivalent: 0.8 t, security: DINEN378: A1



About the

## **GUNT** devices for refrigeration

#### Fundamentals of refrigeration and augmented reality experiences



#### Components of refrigeration





Learning objectives

observe the evaporation

and condensation of the

represent and understand

the refrigeration cycle in

determine the coefficient

coefficient of performance,

of performance such as

refrigeration capacity,

compressor work

the log p-h diagram

energy balances

refrigerant

#### Principles of cold production

#### ET 360 Refrigeration circuit with propane

- of O tonnes



#### ET 432 Piston compressor in refrigeration

The compressor is - along with the condenser, evaporator and expansion valve - one of the four main components of a refrigeration system. Smaller refrigeration systems usually have a piston compressor. The flow rate for such compressors is a measure of the refrigeration capacity of the refrigeration system, so the characteristics of the compressor are important for the performance of the entire system.

## speeds capacity

12



#### Learning objectives

- determine characteristic variables of a piston compressor during experiments
- determination of the volumetric efficiency at different intake pressures, pressure ratios and
- determination of the isothermal compressor
- measurement of the mechanical and electrical power consumption in dependence of the high/ low pressure and pressure ratio
- determination of the mechanical efficiency and the overall efficiency



About the product

## **GUNT** devices for air conditioning



#### Fundamentals of air conditioning

Unlike small systems that use conventional climate controllers, this experimental system is equipped with a modern building management system for control. This corresponds to the state of the art for large air-conditioning systems and is advantageous when presenting complex learning content.

#### **S**i Learning objectives

- practice-oriented principles of air conditioning and ventilation technology
- design and maintenance of an air conditioning and ventilation system
- principles of room air conditioning (h-x diagram)
- explanation of components: filter, air heater, air cooler, humidifier, condensing unit, PLC, flaps, outlets
- function of safety devices
- measurement of pressure curve and pressure losses
- effect of air cooler, air heater and humidifier on the state of the air at the outlet
- investigation of the control behaviour of an automatic air conditioning controller, determination of limiting factors

![](_page_7_Figure_14.jpeg)

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![](_page_7_Picture_17.jpeg)

![](_page_8_Picture_0.jpeg)

## Contact

G.U.N.T. Gerätebau GmbH Hanskampring 15 - 17 22885 Barsbüttel Germany

+4940670854-0 sales@gunt.de www.gunt.de

![](_page_8_Picture_4.jpeg)

GUNT Technology Limited Unit 3 · Glenmore Business Park t: +44(0) 1264 33 93 56 Colebrook Way Andover, SP10 3GL

e: sales@gunt-technology.co.uk www.gunt-technology.co.uk

![](_page_8_Picture_7.jpeg)

Visit our website www.gunt.de