

# ET 611

## Air conditioning system with chamber



screen mirroring is possible on up to 10 end devices

### Description

- real air conditioning system with water chiller and climatic chamber for comfort investigations
- integrated router for operation and control via an end device and for screen mirroring on up to 10 end devices: PC, tablet, smartphone

Comfort is of great importance in the air conditioning of rooms and buildings. The comfort depends on the temperature, the relative humidity and the flow velocity of the air. 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.

ET 611 is a full air conditioning system with comprehensive test options. The effect of the air humidity and temperature on the comfort is examined. The system has a climatic chamber designed for test persons to be inside. This allows the trainee to study the effect of different system operating states on his own well-being. The components used, such as radial fan, electric air heater, steam humidifier and water chiller are all used in commercial air conditioning and ventilation technology.

The active components can be run either manually individually or via a central PLC in automatic operation. The PLC controls the temperature and air humidity independent of each other.

Sensors record air humidity, temperature, power, flow rate, and flow velocity. The full air conditioning system consists of two independent system components: main unit and water chiller. The connection is performed via hoses.

The experimental plant is controlled by the PLC via touch screen. By means of an integrated router, the experimental plant 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. Access to stored measured values is possible from end devices via WLAN with integrated router/LAN connection to the customer's own network. Via direct LAN connection the measured values can be transferred to a PC and stored there (e.g. via MS Excel).

### Learning objectives/experiments

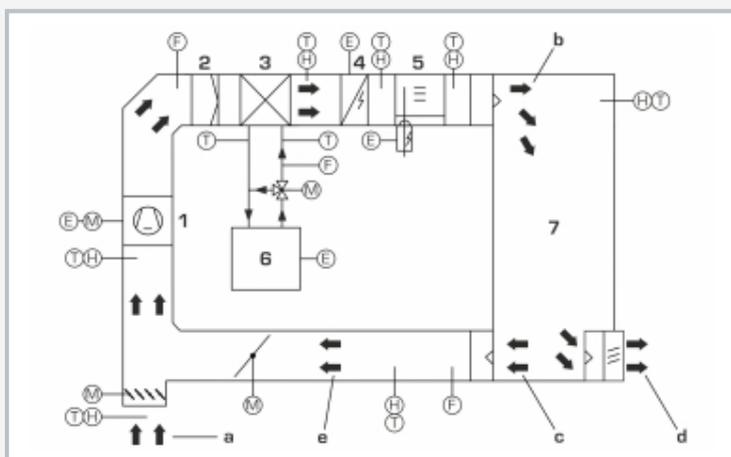
- design, operation and operating behaviour of a real air conditioning system
- recirculating and outer air operation
- changes of state in the h-x diagram for humid air: heating, cooling, humidifying or dehumidifying, mixing
- application of the mixing line
- comfort studies, limit of comfortable humidity
- energy balance in the Sankey diagram
- investigation of the control behaviour of an automatic air conditioning controller, determination of limiting factors

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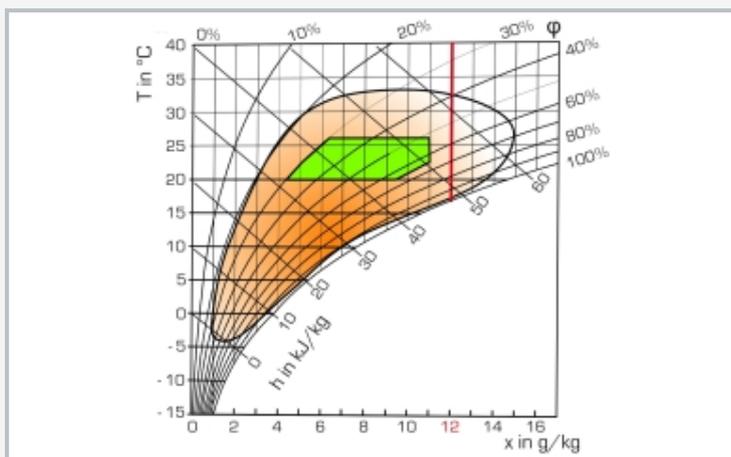
## Air conditioning system with chamber



1 water chiller, 2 flow meter, 3 steam humidifier, 4 climatic chamber, 5 steam distributor (humidifier), 6 air cooler, 7 PLC, 8 outer air inlet with fan; covered: air heater



1 fan, 2 filter, 3 air cooler, 4 air heater, 5 steam humidifier, 6 water chiller, 7 climatic chamber; a outer air, b supply air, c exhaust air, d outgoing air, e recirculating air



h-x diagram with comfort zone (green) and limit of comfortable humidity (red;  $x=12\text{g/kg}$ ); h enthalpy, x absolute air humidity, T temperature,  $\phi$  relative air humidity

### Specification

- [1] air conditioning system with chamber for conditioning and air technology investigations
- [2] chamber suitable for test persons to be inside
- [3] manual and automatic operation
- [4] control of the experimental plant using a PLC, operated by touch screen
- [5] screen mirroring: possible to mirror the user interface on up to 10 end devices
- [6] industrial components: fans, air-cooled water chiller, air cooler, air heater, steam humidifier
- [7] refrigerant: R410A, GWP: 2088
- [8] 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

### Technical data

PLC: Weintek cMT3162X

Radial fan, power consumption: 3,6kW

- max. flow rate:  $53\text{m}^3/\text{min}$
- pressure difference: 2300Pa

Air heater: 6x 250W

Steam humidifier

- steam capacity: 5kg/h
- power consumption: 3,8kW

Water chiller

- power consumption: 3,8kW
- refrigeration capacity: 6,2kW at  $32^\circ\text{C}$ ,  $\Delta T=5\text{K}$
- fan, volumetric air flow rate:  $3500\text{m}^3/\text{h}$

Air cooler, capacity: 6,5kW

Refrigerant

- R410A, GWP: 2088, filling volume: 1,2kg,  $\text{CO}_2$ -equivalent: 2,5t

Measuring ranges

- flow rate: 0...1500L/h (water)
- temperature: 7x 0...50°C (air), 2x 0...50°C (water)
- humidity: 7x 10...90%
- flow velocity: 2x 0...20m/s (air)
- power: 2x 0...6kW, 2x 0...1,5kW

400V, 50Hz, 3 phases

400V, 60Hz, 3 phases; 230V, 60Hz, 3 phases

UL/CSA optional

LxWxH: 2750x1500x1700mm (system)

LxWxH: 1230x1190x2250mm (chamber)

LxWxH: 1279x560x910mm (water chiller)

Total weight: approx. 660kg

### Required for operation

water connection, drain, PC with Windows recommended

### Scope of delivery

- 1 experimental plant, filled with refrigerant
- 1 set of instructional material