WL 308
Heat transfer in pipe flow

Description

- **model of a tubular heat exchanger**
- **heat exchanger can be operated in parallel flow and counterflow**
- **temperature measuring points on the inner tube wall and in the flow**
- **hot water circuit with temperature controller**

The convective heat transfer during pipe flow is determined by internal flow processes inside the tube and by heat conduction processes in the tube walls. With the WL 308 experimental unit, it is possible to study convective heat transfer on the pipe wall and inside the pipe of a tubular heat exchanger. Both parallel flow and counterflow mode with their different temperature curves are demonstrated in experiments.

The core element of the experimental unit is a double tube, which serves as the heat exchanger. Hot water is pumped through the inner tube. Cold water flows in the outer tube either in parallel flow or counterflow. The hot water emits part of its thermal energy to the cold water.

The non-linear temperature progression along the tubular heat exchanger is demonstrated by measuring the water temperatures in both tubes at the inlet, outlet and half of the transfer section. Measuring the tube wall temperature on the inner tube at half the transfer section allows the investigation of the convective heat transfer at the wall.

The closed hot water circuit contains a tank with electrical heater and a pump. Cold water is supplied and disposed of via the laboratory network. Valves are used to adjust the flow rate of hot and cold water.

The flow rate and all relevant temperatures are recorded and displayed on the experimental unit.

Learning objectives/experiments

- record temperature curves
  - in parallel flow mode
  - in counterflow mode
- convective heat transfer on pipe walls and in the flow
- influence of mass flows on the temperature profile
- determining thermal balances
- determining the overall heat transfer coefficient

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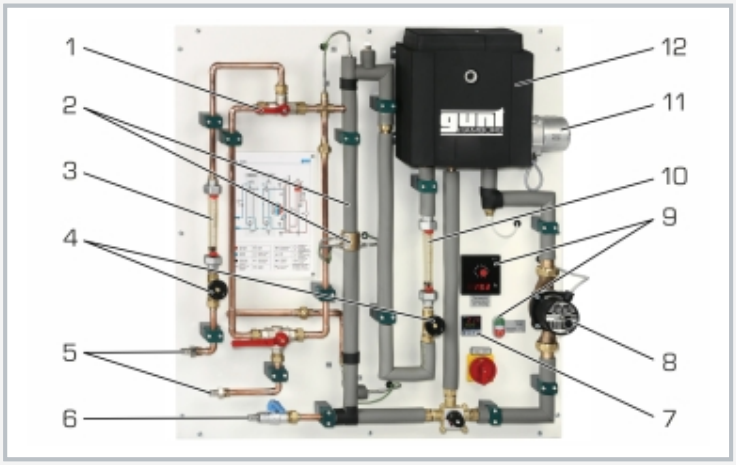
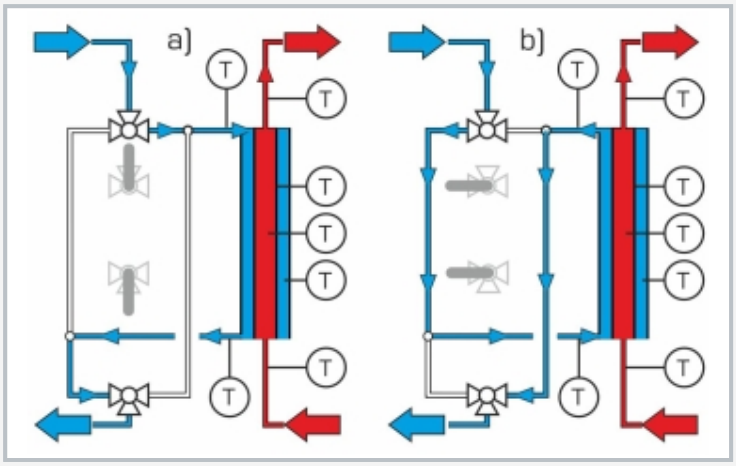
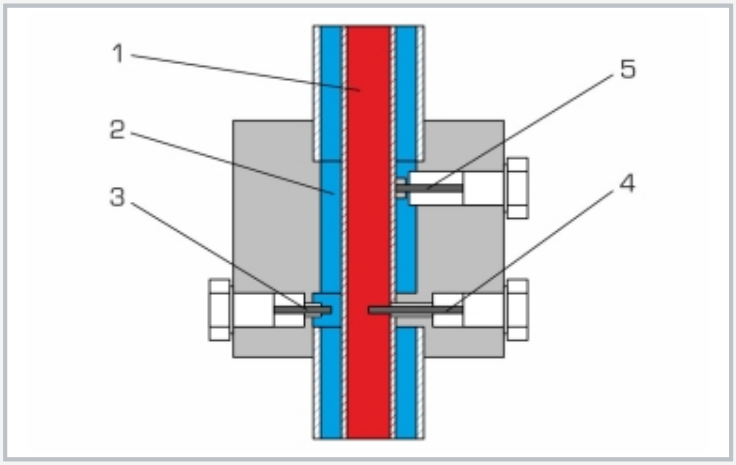


1 3-way plug valve for setting the operating mode, 2 double tube as heat exchanger with temperature sensors, 3 cold water flow meter, 4 valves for adjusting the flow rate, 5 cold water connection and outlet, 6 hot water connection, 7 temperature controller, 8 pump, 9 displays and controls, 10 hot water flow meter, 11 heater, 12 hot water tank



a) counterflow mode, b) parallel flow mode; blue: cold water, red: hot water, T temperature



1 hot water, 2 cold water, 3 cold water temperature measuring point, 4 hot water temperature measuring point, 5 wall temperature of the inner tube measuring point

Specification

[1] convective heat transfer on tube walls and in the flow using the model of a tubular heat exchanger
[2] parallel flow or counterflow operation can be set via 3-way plug valves
[3] closed hot water circuit, insulated, with pump, heater and temperature controller
[4] constant flow rate of hot water via bypass setting
[5] flow rates adjustable via valves
[6] temperature sensors: inlet and outlet temperatures and after half of the transfer section
[7] additional measurement of the tube wall temperature at the inner tube after half of the transfer section
[8] flow meter for hot and cold water in each case

Technical data

Heat exchanger
- tube length: 560mm
- average heat transfer surface: 0,012m^2

Tube inner, copper
- 8x 1mm

Pump
- max. flow rate: 4m^3/h
- max. head: 4m

Heater: 3kW, with overheating protection
Tank: 6,5L

Measuring ranges
- flow rate: 2x 20...250L/h
- temperature: 7x 0...100°C

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase; 230V, 60Hz, 3 phases
UL/CSA optional
LxWxH: 1000x580x1070mm
Weight: approx. 50kg

Required for operation

cold water connection, drain

Scope of delivery

1 experimental unit
1 set of accessories
1 set of instructional material

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Optional accessories

WP 300.09	Laboratory trolley