

WL 314

Convective heat transfer in air flow



Description

- convective heat transfer in heat exchangers with different geometries
- additional heat exchanger models available as accessories

Convective heat transfer refers to the transfer of heat between a surface and a fluid. Convective heat transfer processes are associated with fluid flow movements, i.e. convection. In the case of forced convection, a pump or fan directs the fluid to the transfer surfaces, while in the case of free convection, a flow occurs only due to the difference in density of the heated fluid.

WL 314 and its accessories are used to study convective heat transfer at different geometries of the transfer surface. Typical models such as tube bundles, externally heated tubes and internally heated cylinders are considered. In addition, the chimney effect can be demonstrated under free convection in an air duct.

An air duct with fan serves as the measuring section, in which the model of a heat exchanger is inserted quickly and conveniently with the aid of quick-release fasteners.

The air flows past the model, heats up and then exits through an air duct. A streamlined inlet element in the air duct provides a homogeneous flow for conducting the experiment. The volumetric flow rate is set via a throttle valve at the fan outlet. The air duct includes two windows to observe the experiments.

The model of the shell & tube heat exchanger includes two interchangeable tube bundles with different geometries. A heating element, which can be positioned anywhere in the tube bundle, simulates a heated tube. In this way, convective heat transfer can be determined depending on the tube position. Other models are available as accessories.

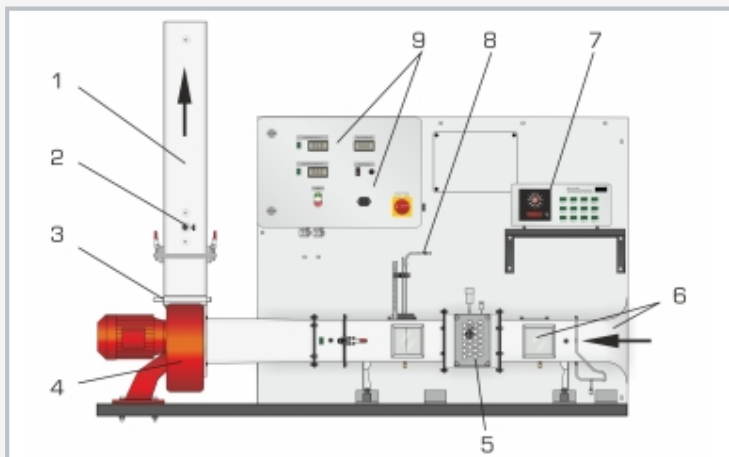
A Pitot tube and a pressure gauge are used to determine the velocity distribution in front of and behind the models. Heating power and volumetric flow rate can be adjusted. The heating power and the temperatures of air and heater are displayed digitally.

Learning objectives/experiments

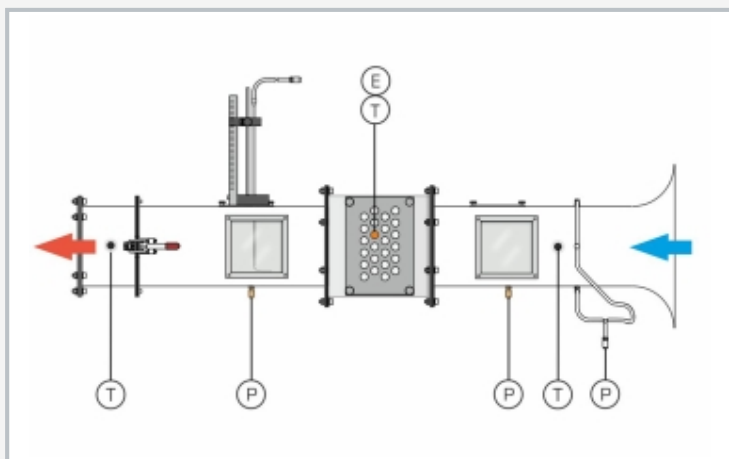
- interplay between Nusselt number, Reynolds number and heat flow
- measurement of pressure distribution in the air duct and development of the velocity profile
- measurement of convective heat transfer in the tube bundle as a function of position
- pressure loss across the tube bundle
- measurement of convective heat transfer with free convection in the air duct (chimney effect)

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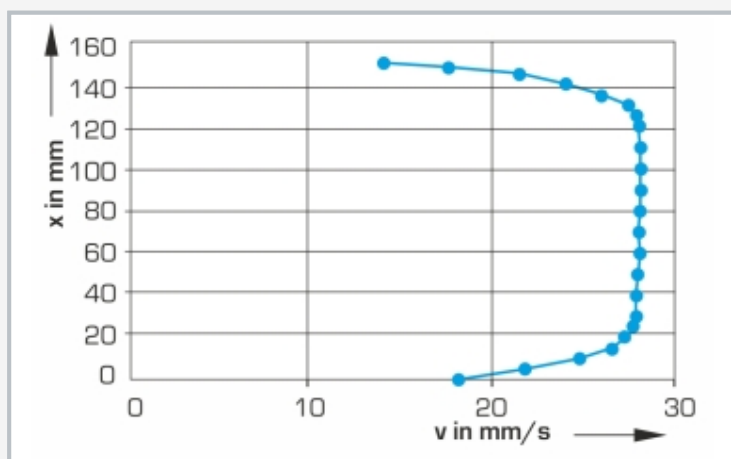
Convective heat transfer in air flow



1 air duct, 2 heating element in the air duct, 3 throttle valve, 4 fan, 5 interchangeable model shell & tube heat exchanger with heating element, 6 air duct with window, 7 measuring amplifier for accessory WL 314.03, 8 movable Pitot tube, 9 displays and controls



Arrangement of the measuring points in the air duct:
T temperature, P pressure, E heating element output



Velocity profile in the air duct
v velocity, x distance

Specification

- [1] convective heat transfer with forced convection
- [2] air duct with streamlined inlet and windows for observation of the experiments
- [3] replaceable tube bundle with two different tube diameters included
- [4] heating element \varnothing 10mm or \varnothing 13mm can be used in the tube bundle at any desired position
- [5] air duct allows experiments on free convection and demonstration of the chimney effect
- [6] heating element \varnothing 10mm can be used in the air duct
- [7] overheat protection for the heating elements
- [8] adjustable air volumetric flow rate
- [9] movable Pitot tube with pressure gauge for determining a velocity profile under forced convection
- [10] display of air temperature, heating temperature and heating power
- [11] other models available as accessories

Technical data

Air duct

- flow cross-section: 150x150mm
- length: 1540mm

Fan

- output: 1,5kW
- max. volumetric flow rate: 2160m³/h

Tube bundle

- 23x tube (\varnothing 10mm)
- 23x tube (\varnothing 13mm)

2 heating elements

- length: 130mm
- output: 220W (\varnothing 10mm)
- output: 250W (\varnothing 13mm)
- overheat protection at 80°C

Measuring ranges

- pressure: \pm 200mbar
- temperature: 2x max. 80°C
- power: 0...400W

230V, 50Hz, 1 phase

230V, 60Hz, 1 phase; 230V, 60Hz, 3 phases

UL/CSA optional

LxWxH: 1930x800x2000mm

Weight: approx. 205kg

Scope of delivery

- 1 trainer
- 1 set of cables
- 1 set of hoses
- 1 pressure meter
- 1 display and control unit
- 1 set of instructional material

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Optional accessories

WL 314.01	Heat transfer in pipes in parallel flow
WL 314.02	Heat transfer in pipes in mixed flow
WL 314.03	Heat transfer in a tube