

WL 440

Free and forced convection



Learning objectives/experiments

- free and forced convection
- calculation of convective heat transfer at different geometries
 - ▶ flat plate
 - ▶ cylinder
 - ▶ tube bundle
- experimental determination of the Nusselt number
- calculation of typical characteristic variables of heat transfer
 - ▶ Nusselt number
 - ▶ Reynolds number
- investigation of the relationship between flow formation and heat transfer during experiments
- description of transient heating process

Description

- free and forced convection using the example of various heating elements
- functions of the GUNT software: educational software, data acquisition, system operation
- part of the GUNT-Thermoline: Fundamentals of Heat Transfer

Convection is one of the three basic forms of heat transfer. Material-bound heat transport takes place. During convection the fluid is in motion.

The WL 440 offers basic experiments for targeted teaching on the topic of free and forced convection on various heating elements.

At the heart of the experimental unit is a vertical air duct into which various heating elements are inserted.

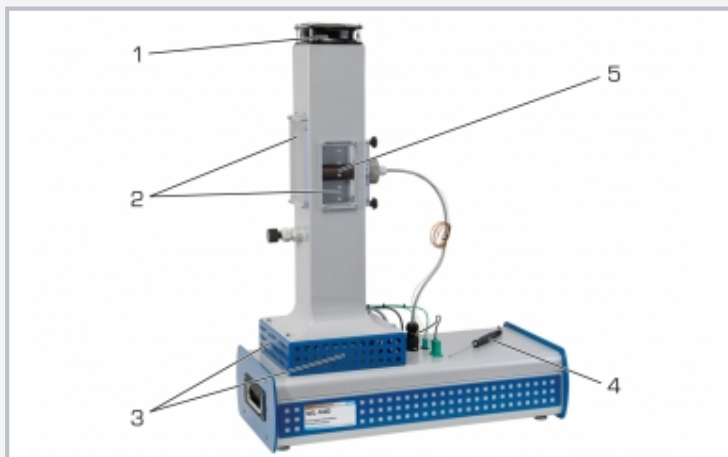
An axial fan is located on top of the air duct. The fan draws in ambient air and guides it through the air duct. The air flows past a heating element and absorbs heat. Four heating elements with different geometries are available to be selected. In order to investigate free convection, two of the four heating elements can be operated outside of the air duct. The heating elements are designed in such a way to release heat only at their surface. The compact design ensures rapid heating and a short time for experiments.

The experimental unit is equipped with temperature sensors at the inlet and outlet of the air duct. The air velocity is measured to determine the air flow rate. Heating power and flow rate are adjusted and displayed via the software.

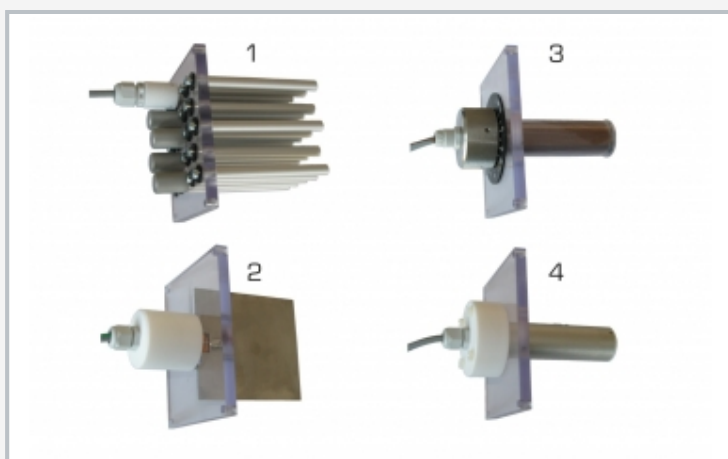
The microprocessor-based instrumentation is well protected in the housing. The GUNT software consists of a software for system operation and for data acquisition and an educational software. With explanatory texts and illustrations the educational software significantly aids the understanding of the theoretical principles. The unit is connected to the PC via USB.

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1 fan, 2 sight window, 3 air inlet, 4 hand-held meter for temperature, 5 heating element



Various interchangeable heating elements: 1 tube bundle, 2 plane plate, 3 cylinder with heating foil to examine the local heat transfer, 4 cylinder with an even temperature at the surface



User interface of the powerful GUNT software

Specification

- [1] investigate heat transfer in the air duct by forced convection
- [2] study of free convection
- [3] air duct with axial fan
- [4] 4 heating elements with different geometries
- [5] continuously adjustable heating power and fan power
- [6] display of temperatures, heating power and air velocity in the software
- [7] microprocessor-based instrumentation
- [8] functions of the GUNT software: educational software, data acquisition, system operation
- [9] GUNT software for data acquisition via USB under Windows 7, 8.1, 10

Technical data

Air duct

- flow cross-section: 120x120mm
- height: approx. 0,6m

Heating elements, temperature limitation: 90°C

- tube bundle
 - ▶ number of tubes: 23
 - ▶ one tube in variable position is heated
 - ▶ heating power: 20W
 - ▶ heat transfer area: 0,001m²
- cylinder with an even temperature at the surface
 - ▶ heating power: 20W
 - ▶ heat transfer area: 0,0112m²
- plate
 - ▶ heating power: 40W
 - ▶ heat transfer area: 2x 0,01m²
- cylinder with heating foil to investigate the local heat transfer
 - ▶ heating power: 40W
 - ▶ heat transfer area: 0,0112m²

Axial fan

- max. flow rate: 500m³/h
- max. pressure difference: approx. 950Pa
- power consumption: 90W

Measuring ranges

- air velocity: 0...10m/s
- temperature: 4x 0...325°C
- heating power: 0...50W

230V, 50Hz, 1 phase

230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase

UL/CSA optional

LxWxH: 670x350x880mm; Weight: approx. 25kg

Required for operation

PC with Windows

Scope of delivery

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

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Optional accessories

020.30009

WP 300.09

Laboratory trolley