HM 250.04
Continuity equation

Complete experimental setup with the HM 250 base module, screen mirroring is possible on up to 10 end devices

Description

- **investigate flow rates at different cross sectional areas**
- **intuitive experiment execution via touch screen (HMI)**
- **integrated router for operation and control via an end device and for screen mirroring on up to 10 end devices: PC, tablet, smartphone**
- **network capability: access to ongoing experiments from external workstations via the local network**
- **automatic identification of accessories via RFID technology**

In the continuity equation, the relationship between the cross-sectional flow area and the flow velocity is analysed. These physical laws are the foundation of fluid mechanics.

HM 250.04 consists of a transparent pipe section with a change in cross-sectional area. To measure the flow velocities in the two different pipe cross-sections, the pipe section contains two impellers with the same pitch. In the experiment, the impellers are rotated by the flowing water. The change of cross-sectional area in the pipe section leads to a change in the flow velocity. The speed of the impellers is proportional to the flow velocity. The speeds, and thus the flow velocities, are recorded inductively. Since the geometry of the two pipe cross-sections is known, it is possible to establish and check a ratio of the speeds. Variances between theory and practice are discussed and limits to implementation are pointed out.

The impellers cover a large part of the flow area, so that irregularities in the flow are largely compensated. During the experiment, incompressible flow is present due to the use of water as working medium. Therefore changes in density do not have to be considered.
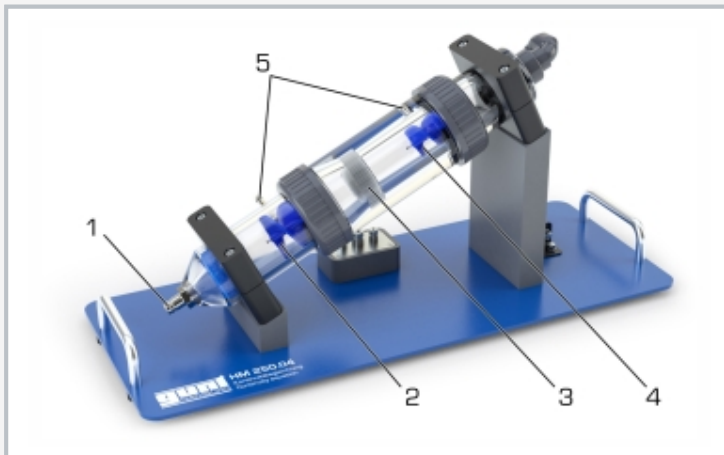
The accessory HM 250.04 is positioned easily and securely on the worktop of the HM 250 base module. Via RFID technology the accessories are automatically identified, the appropriate GUNT software is loaded and an automatic system configuration is performed. The intuitive user interface guides through the experiments and displays the measured values graphically. For tracking and evaluation of the experiments, up to 10 external workstations can be used simultaneously using the local network via LAN connection. The base module supplies the water and is used to adjust the flow rate. Flow rate measurement is also carried out via the base module.

Learning objectives/experiments

- investigation of the continuity equation
- demonstration of conservation of mass
- identification of the influencing variables
  - cross-sectional flow area
  - pitch of the impellers
  - bearing friction
  - uniformity of flow
- GUNT software specifically adapted to the accessories used
  - learning module with theoretical fundamentals
  - device description
  - guided experiment preparation
  - execution of the experiment
  - graphical representation of flow rates at different cross sections
  - data transfer via USB for versatile external use of measured values and screenshots e.g. evaluation in Excel
  - different user levels available

G.U.N.T. Gerätebau GmbH, Hanskampring 15-17, D-22885 Barsbüttel, Telefon (040) 67 08 54-0, Fax (040) 67 08 54-42, Email sales@gunt.de, Web www.gunt.de
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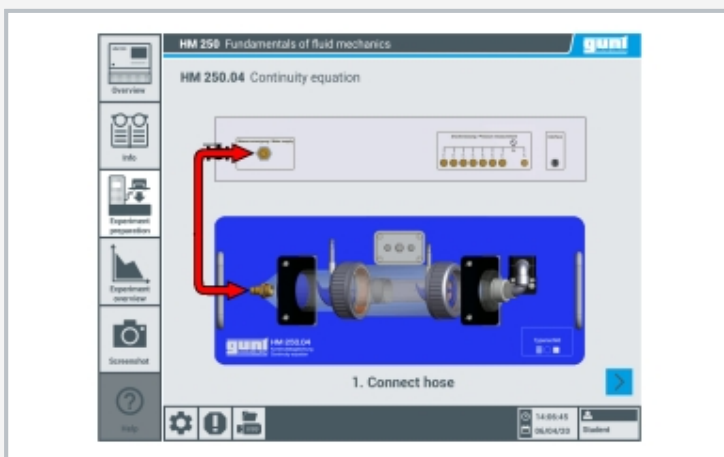
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1 water supply, 2 big impeller, 3 straightener, 4 small impeller, 5 speed sensor

Intuitive user interface on the HM 250 touch screen: graphic display of the measured values, speeds of the two impellers in different cross-sectional flow areas of the pipe section

Touch screen: experiment preparation

Specification

[1] visualisation of the flow velocity
[2] different cross-sectional areas determine the ratio of the flow velocity
[3] two impellers with the same pitch for observation and measurement of the different flow velocities
[4] speed of the impellers measured via inductive speed sensor
[5] flow rate in the pipe section can be adjusted via HM 250 base module
[6] automatic identification of accessories via RFID technology and use of the corresponding GUNT software
[7] experiment execution and display of the measured values via touch screen (HMI)
[8] network capability: access to ongoing experiments and their results from up to 10 external workstations simultaneously via the local network
[9] water supplied via HM 250 base module

Technical data

Pipe section
- inlet: Ø inner 56mm
- outlet: Ø inner 40mm

Inductive speed measurement
- speed sensor
  ‣ switch frequency 5000Hz
  ‣ L 60mm, thread M8
- big impeller
  ‣ built-in magnet pin
  ‣ Ø outer 54mm
  ‣ pitch 60mm
  ‣ number of blades 2
  ‣ cross section 340mm^2
  ‣ flow velocity up to approx. 0,11m/s
- small impeller
  ‣ built-in magnet pin
  ‣ Ø outer 38mm
  ‣ pitch 60mm
  ‣ number of blades 2
  ‣ cross section 200mm^2
  ‣ flow velocity up to approx. 0,22m/s

Measuring ranges
- indicated measuring range speed: 0...999min^{-1}
- indicated measuring range flow rate: 0...15L/min

LxWxH: 650x260x295mm
Weight: approx. 6,5kg

Scope of delivery

1 experimental unit
1 set of instructional material

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Required accessories

HM 250	Fundamentals of fluid mechanics

Optional accessories

HM 250.90	Laboratory shelf

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