



LABORATORY PLANNING GUIDE

L40 v2 Basic Fluid Mechanics Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:

- measurements of the pressure loss in laminar and turbulent flow
- determining the critical Reynolds number
- determining the pipe friction factor
- determining the discharge coefficient of plate weirs
- comparison of measuring weirs (Rehbock, Thomson)
- energy conversion in divergent/convergent pipe flow
- recording the pressure curve and the velocity curve in a Venturi nozzle
- study of the jet forces with different flow rates, flow velocities and deflection angles
- trajectory of the water jet at different outlet velocities
- determination of the contraction coefficient for different contours and diameters
- visualisation of streamlines:
 - * flow around drag bodies
 - * flow through changes in cross-section
 - * influence of sources and sinks
 - * how differently shaped weirs affect the flow
- pressure losses in different pipes, piping elements and fittings
- opening characteristics of angle seat valve and gate valve
- flow measurement with
 - * orifice plate flow meter and measuring nozzle
 - * Venturi nozzle
 - * rotameter
- vertical flow from a tank
- investigation of free and forced vortices
- demonstrate formation and effect of water hammers
- determining the fan efficiency and fan characteristic
- the pressure distribution around a cylinder subject to transverse incident flow
- convective heat transfer of a cylinder in an air-flow tube
- experiments in the field of steady, incompressible flows by means of different measuring:
 - * calculation of the flow rate and the flow velocity
 - * recording the different velocity profiles in both the free jet and the pipe cross-section
- examination of the continuity equation and Bernoulli's principle
- determination of the dynamic pressure
- investigation of the boundary layer on a flat plate
- study of buoyancy on a variety of bodies
- study of the density of liquids
- hydrostatic pressure, Pascal's law
- communicating vessels
- determination of the centre of pressure
- study of surface tensions
- demonstration of capillarity
- Boyle's law
- study of static and dynamic pressure component in flowing fluid
- learning of various methods of pressure measurement

Main concept

The laboratory is designed for accommodation of 24 students + 2 laboratory staff:

- 2 - 4 students form a team and work together at a workstation / training system
- 16 different workstations
- Each experiment base unit is floor standing
- The base units are equipped by different experiment accessories
- 1 workstation is equipped with a PC
- Each workstation is equipped with a manual containing technical information, basic theory, experiment instructions, evaluation help and safety advice.
- Student teams are scheduled to change workstations from lab session to lab session in order to perform the entire range of experiments within the course duration.
- Average time per experiment: 90 to 120 minutes.

2 workstations for laboratory staff (with PC and internet access)

1 printer for common use

1 cupboard for small parts, consumables, tools, paper etc.

1 large shelf for the storage of unused experiment accessories

Initial training provided for laboratory personnel

Trainer: Specialized engineer of G.U.N.T. Gerätebau GmbH, Germany.

To be conducted immediately after installation and commissioning of the equipment.

General topics to be covered for any of the educational systems:

- Basic familiarization with the system.
- Functions and components.
- Overall system configuration aspects.
- Start-up and operational aspects.
- Conduction experiments, including evaluation and calculation.
- Using the system with and without the software (where applicable).
- Trouble shooting and maintenance aspects.
- Hands-on, practical familiarization aspects.
- Seminar participants with the delivered system.
- Details of the manuals.
- Safe operation and preventive maintenance.

Requirements / Utilities

Power supply:

- 230 V / 50 Hz / 1 phase – at least 25 power sockets distributed according to lab lay-out

Water:

- 12 x cold water
- 12 x drain

Laboratory computer network:

- 2 internet connections for staff
- 1 internet connection for students

Location:

- Laboratory space min 120 m²
- This laboratory could be installed on any floor (e.g. ground floor or 1st floor)

Schedule of requirements

Item No.	Description	Quantity
Item 1	Base module for experiments in fluid mechanics	12 pcs.
Item 1.1	Pipe friction for laminar / turbulent flow	2 pcs.
Item 1.2	Plate weirs for HM 150	2 pcs.
Item 1.3	Bernoulli's principle	2 pcs.
Item 1.4	Measurement of jet forces	2 pcs.
Item 1.5	Horizontal flow from a tank	2 pcs.
Item 1.6	Visualisation of streamlines	2 pcs.
Item 1.7	Losses in a pipe system	2 pcs.
Item 1.8	Vertical flow from a tank	2 pcs.
Item 1.9	Methods of flow measurement	2 pcs.
Item 1.10	Vortex formation	2 pcs.
Item 1.11	Hydraulic ram – pumping using water hammer	2 pcs.
Item 1.12	Osborne Reynolds experiment	2 pcs.
Item 1.13	Visualisation of streamlines in an open channel	2 pcs.
Item 1.14	Energy losses in piping elements	2 pcs.
Item 2	Principles of air flow	1 pcs.
Item 2.2	Power meter	1 pcs.
Item 2.3	Electronic total pressure sensor	1 pcs.
Item 2.4	Pressure distribution on a cylinder	1 pcs.
Item 2.5	Friction losses in pipe elements	1 pcs.
Item 2.6	Heat transfer at a cylinder in transverse flow	1 pcs.
Item 3	Air flow experimental plant	1 pcs.
Item 3.1	Venturi tube	1 pcs.
Item 3.2	Measurement of boundary layers	1 pcs.
Item 4	Hydrostatics trainer	1 pcs.
Item 5	Pressure losses in pipes	1 pcs.

