



LABORATORY PLANNING GUIDE

L45 v2 Fluid Machinery Laboratory

Content

Covered subjects according to the curriculum.....	2
Main concept.....	3
Initial training provided for laboratory personnel	3
Requirements / Utilities	4
Schedule of requirements	4



Covered subjects according to the curriculum

Major topics of learning content:

- investigation of an axial impulse turbine and of a reaction turbine with air flow
 - * determination of power as a function of volumetric flow rate, pressure and speed
 - * recording of torque characteristic
 - * determination of the turbine efficiency
 - * partial pressurisation (nozzle group circuit)
- operating behaviour and characteristic variables of a radial fan and of an axial fan
 - * recording the fan characteristic (differential pressure as a function of the flow rate)
 - * effect of the rotor speed on the pressure
 - * effect of the rotor speed on the flow rate
 - * effect of different rotor shapes on the fan characteristic and efficiency
 - * determination of hydraulic power output and efficiencies
- pressure losses in pipes and pipe elbows
- flow in convergent/divergent nozzles
- supersonic flow in the de Laval nozzle
- determine the speed of sound in air
- compare calculation methods for incompressible and compressible flow
- use complete continuity equation
- determine mass flow using nozzle and volumetric flow rate using orifice
- record calibration curve for orifice
- record fan characteristic curve at different mass flows and speeds
- operating behaviour of centrifugal pumps
 - * single pump operation
 - * series pump operation
 - * parallel pump operation
- principle of operation of a piston pump and of a gear pump
 - * recording of pump characteristics
 - * pressure curves of delivery pressure and cylinder pressure
 - * influence of pulsation damping
 - * p-V diagram
 - * determination of efficiencies
- principle of operation of an axial, a reaction, a Pelton and an action turbine
 - * relationship between torque and speed
 - * efficiency dependent on speed
 - * flow rate dependent on speed
 - * hydraulic power and mechanical power depending on speed
- operating behaviour and characteristic variables of a radial compressor
 - * recording of the compressor curve for both stages
 - * effect of the rotor speed on the pressure
 - * effect of the rotor speed on the flow rate
 - * distribution of stage pressure ratios
 - * effect of compression on the temperature increase
 - * determination of hydraulic power output and efficiencies
- familiarisation with the basic principle of a multi-head diaphragm pump
- familiarisation with the basic principle of a rotary vane pump
- familiarisation with the occurrence of cavitation
- observation of cavitation effect in pumps

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
- 17 different workstations
- All workstations are floor standing or on a laboratory table
- 11 workstations are 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.

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 30 power sockets

Water:

- 2 x cold water
- 2 x drain

Others:

- Compressed air

Laboratory computer network:

- 2 internet connections for staff
- 11 internet connections for students

Location:

- Laboratory space min 72 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	Air-operated impulse turbine	1 pcs.
Item 2	Reaction turbine	1 pcs.
Item 3	Experiments with a radial fan	1 pcs.
Item 4	Experiments with an axial fan	1 pcs.
Item 5	Experiments with a centrifugal pump	1 pcs.
Item 6	Series and parallel connected pumps	1 pcs.
Item 7	Experiments with a piston pump	1 pcs.
Item 8	Experiments with a gear pump	1 pcs.
Item 9	Experiments with an axial turbine	1 pcs.
Item 10	Experiments with a reaction turbine	1 pcs.
Item 11	Experiments with a pelton turbine	1 pcs.
For Item 10, 11, 12	Base unit for turbines	3 pcs.
Item 12	Experiments with an action turbine	1 pcs.
Item 13	Experiments with a radial compressor	1 pcs.
Item 14	Multi-head diaphragm pump	1 pcs.
Item 15	Rotary vane vacuum pump	1 pcs.
Item 16	Cavitation in pumps	1 pcs.
Item 17	Flow of compressible fluids	1 pcs.