



## LABORATORY PLANNING GUIDE

### L34 v3 Ventilation & Air Conditioning Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:

- plan, set-up and test air duct systems
- typical components of ventilation technology
- measure the flow rate and velocity of the air
- measure dynamic and static pressures
- determination of the pressure loss via different components:  
pipe bends, angles, distributors etc.
- recording the different velocity profiles in both the free jet and the pipe cross-section
- examination of the continuity equation and Bernoulli's principle
- investigation of the boundary layer on a flat plate
- recording of system characteristics
- recording of the fan characteristic
- determination of the operating point
- calculate the electric capacity of the fan motor with regard to current and voltage
- calculate the fan efficiency
- temperature control of the air flow in a ventilation system
- fundamentals of the refrigeration cycle
- fundamentals of air conditioning
- components in a refrigeration system/air conditioning system
- system operation
- fault finding
- principle of operation of an evaporator as air cooler
- Heating and cooling in the h-x diagram
- Humidifying and dehumidifying in the h-x diagram
- velocity distribution in the pipe
- velocity distribution behind a cylinder subject to transverse incident flow
- pressure distribution around a cylinder subject to transverse incident flow
- friction losses in pipes, pipe bends and pipe angles
- recording the cooling curve of a copper cylinder subject to incident flow
- determining the heat transfer coefficients from the cooling curve
- air conditioning system and its components
- mixing different air flows
- representation of the circuit in the log p-h diagram
- effect of a cooling load (dry and wet)
- automation in an air conditioning system
- familiarisation with and use of modern air conditioning controllers
- experiments with a cross-flow heat exchanger
  - \* investigation of convection processes
  - \* comparison of heat transfer for different heating elements
  - \* comparison between different heating elements
  - \* demonstration of the relationship between heat transfer, area of heat transfer and flow velocity (Nusselt)

### 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
- 11 workstations of 9 different types
- Each experiment base unit is floor standing or on a laboratory table
- 8 workstation 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.

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 20 power sockets
  - 400 V / 50 Hz / 3 phases – at least 1 power socket
- distributed according to lab lay-out

Water:

- Cold water
- Hot water
- Drain

Laboratory computer network:

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

Location:

- Laboratory space min 120 m<sup>2</sup>
- This laboratory could be installed on any floor (e.g. ground floor or 1<sup>st</sup> floor)

### Schedule of requirements

Item No.	Description	Quantity
Item 1	Air duct systems	1 pcs.
Item 2	Ventilation system	1 pcs.
Item 2.1	Control unit for ventilation system	1 pcs.
Item 3	HSI training system refrigeration and air conditioning technology, base unit	4 pcs.
Item 3.1	Model of a simple air conditioning system	2 pcs.
Item 3.2	Air conditioning model	2 pcs.
Item 4	Principles of air flow	2 pcs.
Item 4.2	Power meter	2 pcs.
Item 4.3	Electronic total pressure sensor	2 pcs.
Item 4.4	Pressure distribution on a cylinder	2 pcs.
Item 4.5	Friction losses in pipe elements	2 pcs.
Item 4.6	Heat transfer at a cylinder in transverse flow	2 pcs.
Item 5	Air conditioning system model	1 pcs.
Item 5.1	Software controller with data acquisition	1 pcs.
Item 5.2	Air conditioning controller	1 pcs.
Item 5.3	I/O connection box	1 pcs.
Item 6	Free and forced convection	1 pcs.
Item 7	Air flow experimental plant	1 pcs.
Item 7.1	Venturi tube	1 pcs.
Item 7.2	Measurement of boundary layers	1 pcs.