



## LABORATORY PLANNING GUIDE

# L35 Plumbing Laboratory

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### Covered subjects according to the curriculum

Major topics of learning content:

- thermal expansion of different materials such as PVC, PE, copper and steel
- determination of thermal expansion coefficients and the expansion force
- measurement of pipe elongation
- effect of varying pipe diameter
- expansion compensator
- measurement of the pressure differential on different pipe sections
  - \* influence of various pipe diameters
  - \* influence of different materials and surface roughness
  - \* effect of the flow velocity
  - \* effect of changes in pipe direction
- flow measurement
- function, type of construction and applications of bimetallic dial thermometers
- function, type of construction and applications of liquid expansion thermometers, resistance thermometers and thermocouples
- measuring precision, sensitivity and measuring errors of the different thermometers
- pump characteristics at varying speeds
- determination of pipework characteristics and operating points
- series and parallel operation of circulating pumps
- familiarisation with a central heating system and its components
- hydronic balancing of radiators
- function and operating behaviour of a heating controller
- function and operating behaviour of a four-way mixing valve
- familiarisation of sanitation fittings: two handle mixers and flushing valves
- function of a Venturi nozzle
- cavitation processes at different flow rates and pressures
- function and operation of components of a drinking water installation
  - \* water meter
  - \* pressure reducing valve with and without reversible flow filter
  - \* backflow preventer / system separator
  - \* system of safety devices
  - \* pressure vessel with heater
  - \* circulating pump
  - \* thermal discharge safety device
- introducing contaminants into the system
- limitations of flushing according to technical regulations
- prevention of the return of contaminated water back into the drinking water pipe
- function of various safety devices: pipe separator, backflow preventer, pipe vents
- sewerage systems:
  - \* pressure curve in the downpipe
  - \* bypass
  - \* incorrect flow behaviour with defective aeration of the pipes
  - \* incorrect flow behaviour with incorrect pipe sizing
  - \* flow at pipe offset
  - \* suction effect at junctions
  - \* function of various drainage pipes
- design and function of valves and fittings, piping elements and system components

- planning of piping and system installations according to specification
- reading and understanding engineering drawings and technical documentation
- operational testing of the constructed systems
- familiarisation with various alignment methods: straight edge, dial gauges

### 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
- 15 workstations of 14 different types
- Each experiment base unit is floor standing or on a laboratory table
- 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 10 power sockets distributed according to lab lay-out

Water:

- 11 x cold water
- 4 x hot water
- Drains

Others:

- Compressed air

Laboratory computer network:

- 2 internet connections for staff

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    | Thermal expansion training panel                   | 1 pcs.   |
| Item 2    | Installation technology: losses in different pipes | 1 pcs.   |
| Item 3    | Installation technology: losses in pipe bends      | 1 pcs.   |
| Item 4    | Temperature measurement training panel             | 1 pcs.   |
| Item 5    | Circulating pumps training panel                   | 1 pcs.   |
| Item 6    | Domestic heating circuit training panel            | 1 pcs.   |
| Item 7    | Sanitation fittings training panel                 | 1 pcs.   |
| Item 8    | Cavitation   | 1 pcs.   |
| Item 9    | Drinking water installation demonstrator           | 1 pcs.   |
| Item 10   | Pipe cleaning training panel                       | 1 pcs.   |
| Item 11   | Protection of drinking water training panel        | 1 pcs.   |
| Item 12   | Full-scale sewerage system                         | 1 pcs.   |
| Item 13   | Assembly station: pipes and valves and fittings    | 2 pcs.   |
| Item 13.1 | Assembly and alignment of pumps and drives         | 1 pcs.   |