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

Schedule of requirements

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Thermal expansion training panel</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 2</td>
<td>Installation technology: losses in different pipes</td>
<td>1 pcs.</td>
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<tr>
<td>Item 3</td>
<td>Installation technology: losses in pipe bends</td>
<td>1 pcs.</td>
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<tr>
<td>Item 4</td>
<td>Temperature measurement training panel</td>
<td>1 pcs.</td>
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<tr>
<td>Item 5</td>
<td>Circulating pumps training panel</td>
<td>1 pcs.</td>
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<tr>
<td>Item 6</td>
<td>Domestic heating circuit training panel</td>
<td>1 pcs.</td>
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<tr>
<td>Item 7</td>
<td>Sanitation fittings training panel</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 8</td>
<td>Cavitation</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 9</td>
<td>Drinking water installation demonstrator</td>
<td>1 pcs.</td>
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<tr>
<td>Item 10</td>
<td>Pipe cleaning training panel</td>
<td>1 pcs.</td>
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<tr>
<td>Item 11</td>
<td>Protection of drinking water training panel</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 12</td>
<td>Full-scale sewerage system</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 13</td>
<td>Assembly station: pipes and valves and fittings</td>
<td>2 pcs.</td>
</tr>
<tr>
<td>Item 13.1</td>
<td>Assembly and alignment of pumps and drives</td>
<td>1 pcs.</td>
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</tbody>
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