LABORATORY PLANNING GUIDE

L22 Assembling and Maintenance Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:

- design and function of valves and fittings, piping elements and system components
- planning of piping and system installations according to specification
- selection of components and drafting of requirement lists
- technically correct preparation and execution of system assembly
- reading and understanding engineering drawings and technical documentation
- operational testing of a constructed systems
- connecting and aligning motor and pump
- alignment of drives, shafts and gears
- familiarisation with various alignment methods: straight edge, dial gauges
- electrical installation of motor and switching elements
- detail installation on a standard centrifugal pump
- familiarisation with maintenance procedures
- planning assembly and maintenance steps
- behaviour during operation and function of
  - * ball valve
  - * butterfly valve
  - * gate valve
  - * wedge gate valve
  - * control valve
  - * safety valve
  - * dirt trap
- determining valve characteristic and the Kvs value of the control valve
- pressure losses at the dirt trap depending on the filter and its load
- determining the pump efficiency
- determining the system characteristics and the operating point of the pump
- checking the required NPSH value of the pump
- experiments with a
  - * lobe pump
  - * multistage centrifugal pump
  - * standard centrifugal pump
- assembly exercises:
  - * spur wheel / worm gear mechanism
  - * piston compressor
  - * spur gear
  - * shut-off valve
  - * wedge gate valve and angle seat valve
  - * centrifugal pump
  - * multi-stage centrifugal pump
  - * screw pump
  - * diaphragm pump
  - * piston pump
  - * in-line centrifugal pump
  - * gear pump
- vibrational spectrum of the running noise of roller bearings
- influence of damage to outer race, inner race or roller body, on the spectrum
- estimating service lives of roller bearings
influence of the lubricant on the vibration spectrum
- detection of faulty roller bearings
- understanding and interpreting frequency spectra
- use of a computerised vibration analyser

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
- 22 workstations with 19 different experiment units
- Large assembling stations on one side of the laboratory and laboratory tables with assembling exercises on the other side
- 5 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 exercise cases, small parts, consumables, tools, paper etc.

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 15 power sockets
- 400 V / 50 Hz / 3 phase – at least 2 power sockets
  Distributed according to lab lay-out.

**Water supply**
- 5 x Cold water and drain

**Compressed air:**
- 1 connection required

**Laboratory computer network:**
- 2 internet connections for staff
- 3 internet connections for students

**Location:**
- Laboratory space min 120 m²
- This laboratory should be installed on the ground floor

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**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>Assembly station: pipes and valves and fittings</td>
<td>3 pcs.</td>
</tr>
<tr>
<td>Item 1.1</td>
<td>Assembly and alignment of pumps and drives</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 2</td>
<td>Pump and valves and fittings test stand</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 3</td>
<td>Universal drive and brake unit</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 4</td>
<td>Supply unit for water pumps</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 4.1</td>
<td>Lobe pump</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 4.2</td>
<td>Centrifugal pump, multistage</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 4.3</td>
<td>Centrifugal pump, standard design</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 5</td>
<td>Assembly spur wheel / worm gear mechanism</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 6</td>
<td>Cutaway model worm gear</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 7</td>
<td>Assembly exercise: piston compressor</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 7.1</td>
<td>Cutaway model piston compressor</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 7.2</td>
<td>Multimedia learning software: piston compressor</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 8</td>
<td>Assembly spur gear</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 9</td>
<td>Assembly exercise: shut-off valve</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 10</td>
<td>Assembly exercise: wedge gate valve and angle seat valve</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 11</td>
<td>Alignment of drives, shafts and gears</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 12</td>
<td>Assembly &amp; maintenance exercise: centrifugal pump</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 13</td>
<td>Assembly &amp; maintenance exercise: multi-stage centrifugal pump</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 14</td>
<td>Assembly &amp; maintenance exercise: screw pump</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 15</td>
<td>Assembly &amp; maintenance exercise: diaphragm pump</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 16</td>
<td>Assembly &amp; maintenance exercise: piston pump</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 17</td>
<td>Assembly &amp; maintenance exercise: in-line centrifugal pump</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 18</td>
<td>Assembly &amp; maintenance exercise: gear pump</td>
<td>1 pcs.</td>
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<tr>
<td>Item 19</td>
<td>Roller bearing faults</td>
<td>2 pcs.</td>
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</table>