Example: Sizing a control valve

**Required**
- 3-port control valve, flanged

**Plant data**
- Pressure class: PN 10
- Plant's rated capacity \( Q_{100} \): 160 kW
- Temperature difference \( \Delta T \): 70/55 = 15 K
- Medium: Water
- Differential pressure across variable flow path \( \Delta p_{\text{max}} \): 8 kPa
- Positioning signal: 3 position, AC 230 V

1. **Determine volumetric flow \( V_{100} \)**

\[
V_{100} = \frac{Q_{100}}{1163.15 - \Delta T}
\]

\[
V_{100} = \frac{160 \text{ kW}}{1163.15 - 15} = 92 \text{ m}^3/\text{h}
\]

2. **Determine differential pressure \( \Delta p_{V100} \)**

Determine the type of hydraulic circuit

<table>
<thead>
<tr>
<th>Differential pressure ( \Delta p_{\text{max}} ) across variable flow path</th>
<th>Mixing circuit without bypass</th>
<th>Mixing circuit with bypass</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta p_{\text{max}} )</td>
<td>With primary pump</td>
<td>Without prim. pump</td>
</tr>
<tr>
<td>Typical range</td>
<td>2...5 kPa</td>
<td>5...15 kPa</td>
</tr>
<tr>
<td>Typical value</td>
<td>3 kPa</td>
<td>8 kPa</td>
</tr>
</tbody>
</table>

\[
\Delta p_{V100} \geq \Delta p_{\text{max}}
\]

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<tr>
<th>Example of hydraulic circuit</th>
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<td>8 kPa</td>
<td></td>
</tr>
</tbody>
</table>

3. **Determine the \( k_r \)-value**

4. **Select nominal flow value \( k_{100} \) and determine resulting differential pressure \( \Delta p_{V100} \)**

\[
k_{100} = \frac{V_{100}}{8 \text{ m}^3/\text{h}} = 32.5 \text{ m}^3/\text{h}
\]

\[
k_{r} \geq 0.8 \cdot k_{100} \rightarrow k_{r} \geq 0.8 \cdot 32.5 \text{ m}^3/\text{h} = 26 \text{ m}^3/\text{h} \rightarrow k_{r} = 31 \text{ m}^3/\text{h}
\]

\[
\Delta p_{V100} = 100 \left( \frac{V_{100}}{k_{r}} \right)^{2^{\frac{1}{3}}} = 8.8 \text{ kPa}
\]
5 Check valve authority $P_v$ (control stability)

$P_v = \frac{\Delta P_{\text{vis}}}{\Delta P_{\text{vis}} + \Delta P_{\text{max}}} \geq 0.3 \ldots 0.6$

Enter resulting differential pressure $\Delta P_{\text{vis}}$

$\frac{\Delta P_{\text{vis}}}{\Delta P_{\text{vis}} + \Delta P_{\text{max}}} = \frac{8.8 \text{kPa}}{8.8 \text{kPa} + 8 \text{kPa}} = 0.52$

6 Select suitable valve range

- Type of valve: 3-port seat valve
- Connections: Flanged
- Pressure class: PN 10
- Nominal size DN: 50
- Medium: Water
- Medium temperature: 70 °C

Available valve range(s): $k_{cv} = 31 \text{ m}^3/\text{h}$, VXF31...

Type of valve selected: VXF31.50, $k_{cv} = 31 \text{ m}^3/\text{h}$

7 Select the actuator

- Supply voltage: AC 230 V
- Control signal: 3-position
- Actuator positioning time: Available ranges: SQA, SKA
- Spring return facility: No
- Auxiliary functions: Auxiliary switch, potentiometer, position checkback signal

Available types of actuators: SQA, SKA

8 Check the actuator’s working range

- Differential pressure: $\Delta P_{\text{max}} \geq \Delta P_{\text{vis}}$, $H_1$
  - $\Delta P_{\text{max}} \geq 300 \text{kPa}$
  - $\Delta P_{\text{max}} \geq 8.8 \text{kPa}$

- Closing pressure: $\Delta P_{\text{cls}} \geq H_2$
  - Not applicable to 3-port valves

Type of actuator selected: SQX32.00 (without spring return, running time 150 s, no auxiliary functions)

Selection

- Type of valve: VXF31.50, for details, refer to Data Sheet N4320
- Type of actuator: SQX32.00, for details, refer to Data Sheet N4554