How to select size of products and components.

Thermostatic valves.

Choice of valve size.

Existing one-pipe systems.
All the radiators must be equipped with thermostatic valves to be able to control the room temperature, use the incidental heat gain efficiently and distribute the heat according to requirements. This requires a by-pass at each radiator, and the resistance in the by-pass has to be larger than in the main pipe so that a certain amount of water is let to in the radiator. Good operation is obtained if the thermostatic valve has a low resistance, like valves intended for gravity circulation, and the by-pass is of the same dimension as the main pipe. The by-pass is equipped with a restriction creating the required resistance.

Two-pipe systems.
The valve size is determined on the basis of the required flow and the available differential pressure. Maximum differential pressure is limited to 25 kPa as far as noise is concerned. The available differential pressure for each thermostatic valve is obtained from the pipe calculation.

Flow.
The flow is calculated from the heat requirement in watts, W, and the temperature drop across the radiator in Kelvin, K. The valve size can then either be determined from a selection flow chart or be calculated.
Valve size.
The last valve in the design circuit, (which determines the pump head throughout the entire system) ought to have a resistance of about 5 kPa. The other valves should be sized according to the differential pressure available for them, i.e. the penultimate valve in the design circuit has an available pressure equal to the resistance across the last valve plus the resistance in the pipes between the two valves.

Available Δp for the risers in a two-pipe system.
Fig. 7.2

<table>
<thead>
<tr>
<th>Radiator</th>
<th>l/h</th>
<th>Δp kPa</th>
<th>Pre-set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>140</td>
<td>5</td>
<td>N</td>
</tr>
<tr>
<td>7</td>
<td>140</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>140</td>
<td>72*</td>
<td>3,5</td>
</tr>
<tr>
<td>140</td>
<td>140</td>
<td>80*</td>
<td>3,5</td>
</tr>
</tbody>
</table>

*too high Δp, will create a problem with noise.
Pre-setting.

Adjusting a valve implies a calculation of the difference between the available and the required pressure for the valve. The resistance across the valve should then be increased, through adjustment, so that all the available pressure is utilized. The setting values providing the required resistance can be read from the selection flow charts. The values for each valve should be stated on the drawing so that the setting can be made in connection with the installation.

Choice of control unit.

There are many conditions influencing the function of the thermostatic valve. The control unit has to sense the room temperature to be able to control it. This is not possible if it is covered by a long curtain or a cabinet.

Heat radiation from warmer surfaces, for example heating pipes, a warm floor, electrical devices etc., deceives the sensor into believe that it is warmer than it actually is in the room.

Downdraught and draught from open windows or doors deceives the sensor into believe that it is colder in the room than it actually is.

A control unit with a built-in sensor has difficulties in managing these problems. A control unit with a separate capillary tube connected sensor therefore should be chosen. The sensor can then be placed where it detects the right room temperature.
Control valves.

Primary systems.
Two-way valves and consequently varying flow are recommended for the primary systems.

Available differential pressure.
A resistance of 100-120 kPa is recommended to be available in the design circuit for the control valve.

As regards other control valves in systems without a pressure controlled pump the available differential pressure is obtained from the pipe calculation.

When using pressure controlled pumps with the sensor located farthest away in the system all the control valves should be sized for the lowest available differential pressure of the system. In other words, the differential pressure set on the sensor, 150 kPa, is recommended, minus the resistance in the heat exchanger in question, 20-50 kPa. Check the resistance in the heat exchanger with the supplier!

If the available differential pressure at a valve should increase by 50% or more of the designed differential pressure a differential pressure control is recommended for that particular valve. The designed differential pressure is shared between the control valve and the differential pressure control.

If the pump is equipped with pressure control the valves must be calculated for the lowest available Δp. In this case 150 kPa, 1,5 bar, minus the resistance in the heat exchanger.

Fig. 7:5
Valve size.

Enter information of flow and available differential pressure into the valve selection flow chart and then select the valve size! The dimension of the pipe in which the control valve is to be installed has no influence on the required valve size.

Example, control valve:
\( \Delta t = 50 \, ^\circ \text{C} \),
1) \( P = 1.500 \, \text{kW}; \, Q = 1.500 \times 0.86 / 50 = 25.8 \, \text{m}^3/\text{h} \).
\( \Delta p \) available = 1.5 bar, \( \Delta p \) heat exchanger = 0.3 bar.
2) \( \Delta p = 1.5 \, \text{bar} - 0.3 = 1.2 \, \text{bar} \).

Values from diagram:
3) \( k_{vs} = 25 \, \text{m}^3/\text{h}, \, \Delta p_v = 1.1 \, \text{bar} \)

Sizing of the control valves in the adjoining district heating circuit.
Fig. 7:6
Secondary systems.
Two-way valves should also be used in the secondary systems, with a main pump supplying the water out to each mixing loop or shunt.

Available differential pressure.
Two-way valve.
A resistance of 10-15 kPa is recommended to be available for the control valve in the design circuit.

The available differential pressure for other control valves in systems without a pressure controlled pump is obtained from the pipe calculation and as much as possible of the differential pressure should be used.

Available $\Delta p$ with or without pump control at different flow.

With regard to the pressure controlled pump with the sensor at the pump, all the control valves should be sized for the lowest differential pressure they will obtain. The designed differential pressure depends on which type of pressure control that is used:

- a constant differential pressure gives design values according to the pipe calculation
- a proportional control gives that design value which is 50% of the maximum differential pressure
- a pressure control parallel to the pipe resistance gives a design value that is 50% of the maximum differential pressure
- a constant $\Delta p$ at control valve located the farthest away gives design values for all the control valves equal to the lowest set differential pressure
If the available differential pressure at a valve should increase by 50% or more of the designed differential pressure, a differential pressure control is recommended for that particular valve. The designed differential pressure is shared between the control valve and the differential pressure control.

Valve size.
Enter information of flow and available differential pressure into the valve selection flow chart and then select valve size! The dimensions of the pipe in which the control valve is to be installed has no influence on the required valve size.

Sizing of the control valves in the above heating circuit.

Example.
$Q = 3 \text{ m}^3/\text{h}$
$\Delta p_{\text{pump}} = \text{constant}$
$\Delta p_{\text{available}} = \text{from the calculation of the design circuit, including valve 9.}
Here: from the above diagram + $\Delta p$ valve 9.
Excessive $\Delta p$, $\Delta p_{\text{exc.}} = \Delta p_{\text{available}} - \Delta p_{\text{valve}}$
$\Delta p_{\text{pump}} = \Delta p_{\text{system}} + \Delta p$ valve 9.
$\Delta p_{\text{system}} = 60 \text{ kPa}.$
Sizing of control valve 9.
See diagram: 3 $\text{m}^3/\text{h}$, $\Delta p<15 \text{ kPa}$
$k_{\text{vs}} 10$, $\Delta p$ valve 9 $= 9 \text{ kPa}.$
Selecting valve size from diagram:

<table>
<thead>
<tr>
<th>Valve</th>
<th>$\Delta p_{\text{available}}$</th>
<th>$k_{\text{vs}}$</th>
<th>$\Delta p_{\text{valve}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53+9=62</td>
<td>4,0</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>47+9=56</td>
<td>4,0</td>
<td>55</td>
</tr>
<tr>
<td>3</td>
<td>40+9=49</td>
<td>6,3</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>34+9=43</td>
<td>6,3</td>
<td>23</td>
</tr>
<tr>
<td>5</td>
<td>26+9=35</td>
<td>6,3</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>20+9=29</td>
<td>6,3</td>
<td>23</td>
</tr>
<tr>
<td>7</td>
<td>14+9=23</td>
<td>6,3</td>
<td>23</td>
</tr>
<tr>
<td>8</td>
<td>7+9=16</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

Sizing valves from a diagram will not give the same mathematical accuracy as a calculation, but it is good enough when considering the inaccuracy of the underlying calculations.

Fig 7:9
Differential pressure controls.

Only the differential pressure control can eliminate the pressure variations being the result of a varying flow in the systems, and only the differential pressure control can provide the control valves with good working conditions.

The valve size is determined on the basis of the required flow and the available differential pressure. A differential pressure control keeping the pressure constant across a control valve has to be sized along with the control valve.

Primary systems.

Differential pressure controls are used in primary systems to keep the differential pressure constant across a sub-station or a valve in the sub-station.

Available differential pressure.

The available differential pressure for the sub-station, 150 kPa, minus the resistance across the heat exchanger, 30 kPa, is the available differential pressure for both the control valve and the differential pressure control, $\Delta p_{v,2} = 150 - 30 = 120$ kPa.
Valve size.

Divide $\Delta p_{v2}$ by two and choose a control valve from the valve selection flow chart according to the $\Delta p$ and the flow in question. The remaining $\Delta p$, i.e. 120 kPa minus $\Delta p$, is the available differential pressure for the differential pressure control. Enter the differential pressure and the flow for the differential pressure control into the selection flow chart and then select size!

If the pump is equipped with pressure control, the valves must be calculated for the lowest available $\Delta p$. In this case 150 kPa, 1,5 bar, minus resistance in the heat exchanger. All valves for which the available $\Delta p$ will exceed the design $\Delta p$ with more than 50% require a $\Delta p$ control.

Example, control valve and differential pressure control:

1. $\Delta p$ available = 1,5 bar. $\Delta p$ heat exchanger = 0,3 bar. $\Delta p$ = 1,5 - 0,3 = 1,2 bar.

2. $\Delta p$ available for $\Delta p$ valve = 1,2/2 = 0,6 bar; Values for $\Delta p$ - valve from diagram: $k_{vs} = 40$ m$^3$/h; $\Delta p_{v} = 0,41$ bar.

3. $\Delta p_{v}$ = 0,41 bar.

4. $\Delta p$ available for control valve = 1,2 - 0,41 = 0,79 bar

$k_{vs} = 40$ m$^3$/h; $\Delta p_{v}$ = 0,41 bar;

Pre-set value for the $\Delta p$ control = 0,41 bar;

Fig. 7:12
Setting value.
A differential pressure control keeps the differential pressure constant across a circuit. The setting value for the differential pressure control is equal to the resistance in that particular circuit.

Secondary systems.
In the secondary systems differential pressure controls are used to keep the differential pressure constant across a control valve or a part of the system, for example a riser or a two-pipe radiator circuit containing several thermostatic valves.

Available differential pressure.
In secondary systems, the resistance in the design circuit, of which the differential pressure control is a part, is calculated. It is important when calculating to check the requirements for the differential pressure control in question. Some of these differential pressure controls require a minimum differential pressure to function properly.

The resistance across the differential pressure control in the design circuit is obtained from the selection flow chart. Enter the flow in question into the selection flow chart then select valve size and read the resistance.

For the other circuits the available differential pressure is obtained from the pipe calculation.

Valve size.
Differential pressure control across a control valve.

In the designed circuit first of all check if the differential pressure control requires a minimum differential pressure. Is this the case, select a size of control which requires at least this pressure. Even if the resistance across the smallest valve is not large enough make sure that at least the minimum differential pressure is available. Select accordingly the size of the control valve.

The available pressure in the other circuits is divided by two. The control valve is selected first and the remaining differential pressure is used for selection of the differential pressure controller.
CHAPTER 7 • HOW TO SELECT SIZE OF PRODUCTS AND COMPONENTS.

Available Δp with or without pump control at different flow

Design Δp
Without pump control or with constant Δp
With proportional or parallel pump control

Sizing of the control valves and differential pressure control valves in the above heating circuit.

Example

Q = 3 m²/h

Δp_pump = constant
Δp_available = from the calculation of the design circuit, including valve no 9.

Here: from the above diagram Δp valve 9.

Excessive Δp Δp_exc = Δp_available - Δp_valve

Δp_pump = Δp_system + Δp control and differential pressure valves no 9.

Δp_system = 60 kPa.

Sizing of the control and differential pressure control valves no 9.

See flow chart: 9. 3 m³/h Δp control valve <15 kPa.

Δp valve no 9 k_v = 10, Δp = 9 kPa.

The Δp control valve will be the same size and Δp Δp_valves = 18 kPa.

Δp_pump = 60 + 9 + 9 = 78 kPa.

Choosing valves from a flow chart will not give the mathematical accuracy as a calculation, but it is good enough when considering the inaccuracy of the underlying calculations.

Fig. 7:15

Choosing valves from a flow chart will not give the mathematical accuracy as a calculation, but it is good enough when considering the inaccuracy of the underlying calculations.
Differential pressure control of risers.

With regard to the design circuit, it is first of all a question of checking if the differential pressure control requires a lowest differential pressure. If so, choose a size of control that requires at least this pressure, or make a reservation for the lowest required pressure for the control, even if the resistance across it is not very large.

Concerning the other circuits, the flow and the available differential pressure are entered in the selection flow chart and a suitable valve size is chosen.

Available Δp for the risers with Δp-control valves. Fig. 7:16

### Table: Δp for the risers with Δp-control valves

<table>
<thead>
<tr>
<th>Radiator</th>
<th>l/h</th>
<th>Δp kPa</th>
<th>Pre-set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>140</td>
<td>5</td>
<td>N</td>
</tr>
<tr>
<td>7</td>
<td>140</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>125</td>
<td>140</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>140</td>
<td>140</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

### Table: Δp valve set values

<table>
<thead>
<tr>
<th>l/h</th>
<th>Valve k_v - value</th>
<th>Set values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculation of the pre-set values for the valves in the above system with Δp control valves in the riser. Fig. 7:17
Setting value.
A differential pressure control keeps the differential pressure constant across a circuit. The setting value for the differential pressure control is equal to the resistance in that particular circuit.

\[
\Delta p = k \text{Pa}
\]

\[
\Delta p = \frac{Q}{k}
\]

\[
Q \text{ in each riser } = 980 \text{ l/h}
\]

Available \( \Delta p \) for the \( \Delta p \)-control valves at each riser.

Fig. 7:18

### Sizing of \( \Delta p \)-valves in the riser

<table>
<thead>
<tr>
<th>Valve</th>
<th>( k \text{vs-value} )</th>
<th>( \Delta p \text{ valve} )</th>
<th>( \frac{Q}{k} \text{ l/h} )</th>
<th>( \Delta p \text{ valve} )</th>
<th>( \Delta p \text{ available} )</th>
<th>( \Delta p \text{ riser} )</th>
<th>( k \text{vs} \times \Delta p \text{ vp} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4,0</td>
<td>6,3</td>
<td>22</td>
<td>10</td>
<td>12</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>4,0</td>
<td>6,3</td>
<td>81</td>
<td>10</td>
<td>71</td>
<td>1,6</td>
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<tr>
<td>19</td>
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<td>6,3</td>
<td>85</td>
<td>10</td>
<td>75</td>
<td>1,6</td>
<td>37</td>
</tr>
<tr>
<td>20</td>
<td>4,0</td>
<td>6,3</td>
<td>89</td>
<td>10</td>
<td>79</td>
<td>1,6</td>
<td>37</td>
</tr>
</tbody>
</table>
Flow limitation.

Flow limitation is required in both primary and secondary systems.

Primary systems.

In a primary system, it is the flow to a whole sub-station or to the applied heat exchangers that should be limited.

The heat supply is controlled by a control valve and if the differential pressure across this valve is kept constant with a differential pressure control the sub-station contains the required components to limit the flow.

Calculate the differential pressure that is necessary across the fully open valve to obtain required flow. Set the differential pressure control so that it will provide the differential pressure and the maximum flow is limited.

Combined flow limiters consisting of a differential pressure control and a setting valve are available. The differential pressure control keeps a constant differential pressure across the integrated pre-set valve. The size of the flow is determined by changing the resistance across the setting valve. When large sizes are required a flow limitation is obtained as a differential pressure control can keep a constant differential pressure across a integrated pre-set valve. The valve size is determined in a selection flow chart on basis of the available differential pressure and the flow.

Example, limiting the flow in a primary circuit.
Control valve \( k_{vs} = 4,0 \)

<table>
<thead>
<tr>
<th>Ex. no</th>
<th>( Q ) m(^3)/h</th>
<th>( \Delta p_{valve} )</th>
<th>( \Delta p_{vp-set} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>6,3</td>
<td>6,3</td>
</tr>
</tbody>
</table>

The \( \Delta p \) necessary for a specific flow through a fully open control valve is equal to the setting \( \Delta p \) for the differential pressure control.

Calculation

\[
\Delta p_{v} = \left( \frac{3}{4} \right)^2; \quad \Delta p_{v} = 0,56 \text{ bar} \Rightarrow 56 \text{ kPa}; \\
\Delta p_{v} = \left( \frac{4}{4} \right)^2; \quad \Delta p_{v} = 1 \text{ bar} \Rightarrow 100 \text{ kPa}; \\
\Delta p_{v} = \left( \frac{1}{4} \right)^2; \quad \Delta p_{v} = 0,0625 \text{ bar} \Rightarrow 6,3 \text{ kPa};
\]

Fig. 7:20

Limiting the flow in a sub - station equiped with \( \Delta p \) control valve

Fig. 7:21
Secondary systems.
In secondary systems the limitation of the flow could come into question to a shunt coupling, a riser or a one-pipe circuit.

If there already is a control valve and a differential pressure control in a shunt coupling, use these for the flow limitation too! Calculate the resistance across a fully open control valve at the maximum required flow and set the differential pressure control on this differential pressure!

In other cases there are flow limiters keeping the differential pressure constant across a built-in adjustment valve. They are often sized according to the available differential pressure and the required flow. Setting value is read in the selection flow chart.

Example, limiting the flow in a primary circuit.
Control valve \( k_{vs} 1,6 \)
\( \Delta p \)-valve \( k_{vs} 1,6 \)

<table>
<thead>
<tr>
<th>Ex. no</th>
<th>Q m³/h</th>
<th>( \Delta p_{valve} )</th>
<th>( \Delta p_{vp-set} )</th>
<th>( \Delta p_{contr} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0,4</td>
<td>5,8</td>
<td>5,8</td>
<td>ASV-PV</td>
</tr>
<tr>
<td>2</td>
<td>0,8</td>
<td>25</td>
<td>25</td>
<td>ASV-PV</td>
</tr>
<tr>
<td>3</td>
<td>1,5</td>
<td>90</td>
<td>90</td>
<td>AVP</td>
</tr>
</tbody>
</table>

The \( \Delta p \) necessary for a specific flow through a fully open control valve is equal to the setting \( \Delta p \) for the differential pressure control.

ASV-PV: setting range 5-25 kPa.
AVP: setting range 5-50, 20-100 and 80-160 kPa.

Calculation
1. \( \Delta p_v = \left( \frac{0,4}{1,6} \right)^2 \); \( \Delta p_v = 0,0625 \) bar \( => 6,3 \) kPa;
2. \( \Delta p_v = \left( \frac{0,8}{1,6} \right)^2 \); \( \Delta p_v = 0,25 \) bar \( => 25 \) kPa;
3. \( \Delta p_v = \left( \frac{1,5}{1,6} \right)^2 \); \( \Delta p_v = 0,88 \) bar \( => 88 \) kPa;

Fig. 7:23

Limiting the flow for a control valve in a secondary circuit with \( \Delta p \) control.
Fig. 7:22
Flow limitation in a one-pipe circuit
$\Delta p_{\text{available}} > \Delta p_{\text{1-pipe circuit}} + \Delta p_v$
$\Delta p_v = 25 \text{ kPa}$

Example, ASV-Q

<table>
<thead>
<tr>
<th>ASV-Q</th>
<th>Capacity l/h</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>100-800</td>
<td>1-8</td>
</tr>
<tr>
<td>20</td>
<td>200-1400</td>
<td>2-14</td>
</tr>
<tr>
<td>25</td>
<td>400-1600</td>
<td>4-16</td>
</tr>
<tr>
<td>32</td>
<td>500-2500</td>
<td>5-3</td>
</tr>
</tbody>
</table>

$Q = 1100 \text{ l/h}$
Choose ASV-Q 20
(always choose the smallest possible valve)

Setting value = 11
Control equipment.

Different control equipment is required for different purposes. The control of the flow temperature to radiators requires one type of control, hot water heating requires another, and ventilation devices require a third type. For the last two cases there is also a choice between electronic and self-acting control.

Radiator systems.

The flow temperature in radiator systems is controlled according to the outdoor temperature by a weather compensator.

The electronic central control can be equipped with timers with twenty-four hours or weekly functions. This is however only the case if the heat supply is set back during a period of several days and nights and if the system is not connected to a computer.

A pump stop is an optional function which shuts off the circulation pump when the outdoor temperature is so high that the building requires no heating.

The limitation of the return temperature is usually not required in the two-pipe systems with thermostatic valves.

A computerized supervision and control system is a labour-saving and efficient way of controlling large systems with many sub-stations.

Necessary control equipment for sub-station

Fig. 7.25
Hot water heating.

Water is heated in a heat exchanger or in an accumulator.

The heat supply for the two types of hot water heating can be controlled by a weather compensator with an extra function for this purpose or self-acting controls for the accumulating hot water tanks.

For heat exchangers up to 30 apartments there are self-acting controls with flow compensation available.

Flow compensated thermostatic valve for control of domestic hot water temperature.

Fig. 7:26
Pipes and heat exchangers.

Pipes for heating.

When designing pipe systems an economic water rate has to be maintained. Too low a rate will give large-size pipes, deposits in the pipes, larger heat losses and temperature drops, but of course also a lower flow resistance and thereby lower operating costs for the pump.

An optimization reflecting the costs for pre-insulated pipes gives water rates of approximately 0.6 m/s for the internal diameter of 27 mm to 3.6 m/s for the internal diameter of 1.220 mm.

The corresponding values for insulated standard pipes in the heating system of a building will give about 0.3 m/s for pipes with an internal diameter of 10 mm and 1.5 m/s for an internal diameter of 150 mm.
Pipes for domestic water.

There are three types of pipe material to choose from for the domestic water - galvanized steel, copper and plastic. All of them can as a rule be used for cold water, but copper and plastic are superior. For hot water only copper and special plastic pipes can be used.

Copper pipes are sensitive to high water rates and they are environmentally hazardous, (copper is transported together with the sewage down to the purification plant and will there affect the purification process negatively).

Maximum rates in an easily exchangable pipe:

- cold water 2 m/s
- hot water 1,5 m/s

For plastic pipes there are no limits to the water rate, but pipes intended for domestic hot water must endure the temperature in question for many years – 50 years according to international standards, NKB Product rules, 3, July 1986 and DIN 16892.

Heat exchangers.

Modern heat exchangers, plate and coil units, contain small quantities of water and the flow channels are narrow. By making them short and by laying a large number of them parallel, the flow resistance is kept at a low level in spite of a relatively high water rate.

The high water rate is necessary to prevent deposits from settling on the heat transferring surfaces.

The resistance across the coil unit is in the range of 20-30 kPa and for the plate heat exchanger the resistance is up to 50 kPa. The choice of size is made according to the instructions from the manufacturer. There are domestic water selection flow charts, based on empirical values, giving the total consumption for various number of apartments.
Heat meters.
Heat meters register the delivery to each building/apartment, but they also indicate if anything goes wrong in the system. As there are large variations in the flow, a flow meter must also be able to measure low flows with great accuracy.

The primary network.
Meters on the primary side register the heat consumption, i.e. flow and temperature drops. The meters should be based on ultrasound, and the integration unit should be able to communicate with a central computer. The theoretical maximum flow determines the size of the flow meters. The ultrasonic meter has an advantage of being able to measure the lowest flows very well, independent of size.

Each heat exchanger for heating and for domestic hot water should be equipped with a heat meter.

The secondary network.
On the secondary side, it is sufficient to measure the flow for each apartment. Based on this, make a percentage calculated distribution between the apartments of the total heat supply to the building. Then use a flow meter, mechanical or ultrasonic to register the flow to each apartment.

The variations in flow can be considerable, so it is important to carefully register the low flows here.

Flow meters based upon ultrasound are therefore the most suitable choice, especially when considering the large numbers and the fact that the ultrasonic meters require practically no maintenance.

The choice of the flow meter sizes is made according to the theoretical maximum flow to each apartment.

If the distribution of the heating costs is to be consistent, the hot domestic water to each apartment ought to be registered too, which requires that the riser for hot domestic water be placed centrally, in the stair-well, and that separate pipes are laid from there to each apartment.
Pressure control of pumps.
The pressure control of pumps should be applied on the primary and the secondary sides to reduce the consumption of electricity. The effect on the available pressure will be marginal as the differential pressure control is applied on control valves or parts of the systems.

The primary network.
The required pressure and flow on the primary side is always so high that it requires a pump with a separate motor. The motor is a standard induction motor and a frequency converter is therefore the most suitable choice for control.

Frequency converters are available in the same sizes as the ones being standard for the standard induction motors. There are therefore no problems in selecting the size. Choose a frequency converter corresponding to the size of the motor!

The secondary network.
There are pumps with a wet motor and a built-in pressure control available for the secondary side. These pumps should be used as far as possible and when their capacity isn't sufficient to meet the requirements, dry pumps and frequency converters should be chosen. The largest cut in the operating costs for the pump is obtained when the differential pressure is kept constant at the last riser/valve.

The resistance varies by the square of the flow change and the effect of the pump by the cubic

Fig. 7:30