SIEMENS

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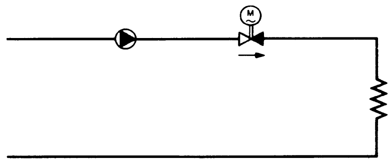
Sizing of valves and hydraulic circuits

Guidelines for hydraulic circuits in heating, ventilating and air-conditioning systems

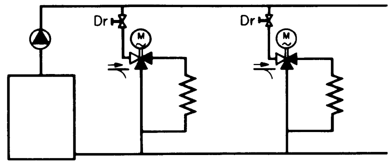
1. Throttling circuit

A regulating valve is to be chosen with a pressure drop Δp_{v100} approximately equal to the pressure loss in the heating loop, including the heating load (determined for nominal flow). If this should lead to the use of an unnecessarily large pump, the following circuit is to be given preference.



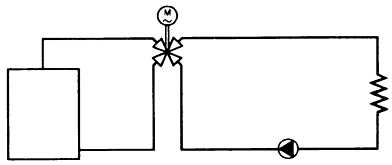
2. Bypass circuit

Tightly closing three-way valves are required as the regulating valves. The pressure drop Δp_{v100} across the valves should range from about the same value to about double the value of the pressure loss across the heating load branch at nominal flow.
The balancing valves Dr are used to adjust the water volumes for the individual heating circuits.



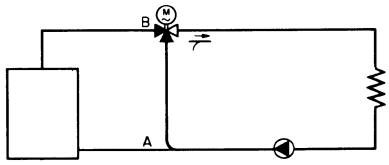
3. Mixing circuit using four-way mixing valves

Normally the nominal size of the mixing valve is equal to the nominal size of the pipe. Care must be taken that the mixing valve is mounted at least at the same height as the boiler flow and that the pressure loss in the boiler loop is kept low.



4. Mixing circuit using three-way mixing valves

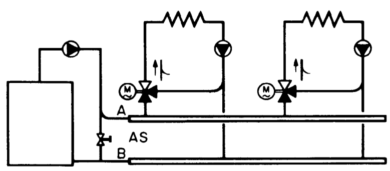
Slipper valves can generally be used. The nominal size is usually chosen equal to the nominal size of the pipe. However, from the point of view of hydraulics, slipper valves one size smaller than the nominal size of the pipe are preferable.
In systems where the pressure difference between A and B exceeds approximately 0,8 mWG, it must be checked that the leakage losses of the slipper valves remain within tolerable limits. If this is not the case, seat valves are to be used or the system must be designed according to circuit 5.



5. Mixing circuit with boiler pump

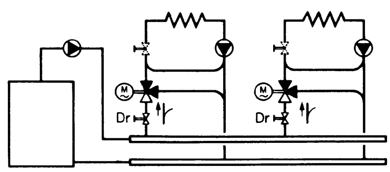
Slipper valves may be used if the static pressure in the system does not exceed the permissible operating pressure of the valves. Their nominal sizes may be equal to, or one dimension smaller than, the nominal size of the pipe. Most important is the correct sizing of the connecting pipe A-B, which ensures that boiler flow remains constant and that the pressure difference between A and B is small for all load conditions. The manual valve AS is open during normal operation. It is closed to maintain emergency operation, only when the boiler pump fails. Its nominal size and also that of the pipe A-B are calculated by using the following rule-of-thumb formula:

NW in mm $\approx 19\sqrt{\text{capacity of the boiler pump in m}^3/\text{h}}$



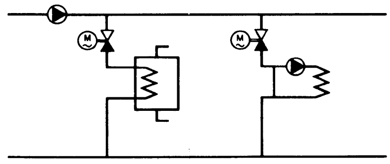
6. Injection circuit

Slipper valves may be used if the static pressure in the system does not exceed the permissible operating pressure of the valves. Their nominal sizes may be equal to, or one dimension smaller than, the nominal size of the pipe. In this system the volume of water at full load must be adjusted with the balancing valve Dr. This ensures that the leakage losses of the slipper valves remain within tolerable limits.
A second balancing valve is often provided in the heating loop (shown in dotted lines). However, it is not absolutely necessary if the pump and the piping network are carefully sized.



7. Connections to remote supply for calorifiers and other circuits

Tightly closing through-valves are required as regulating valves.
The pressure drop Δp_{v100} across the valve should be about 30...60% of the pressure difference at the remote supply connection.
If the pressure difference varies greatly, the lowest value is to be considered, but ensuring that the valve will close off against the maximum pressure difference. In very extreme cases and for very large systems, a pressure difference control is to be provided.



Nominal sizes and valve terms

Nominal pressure PN (NP)

The nominal pressure PN (NP) is the maximum pressure which a valve is permitted to bear; for media temperature of up to 120°C, it corresponds to the permissible operating temperature. For higher temperatures the progression of the permissible operating pressures are to be observed.

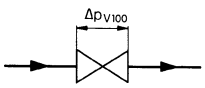
Permissible operating pressure

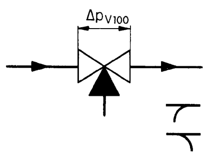
The permissible operating pressure of a valve is graduated according to the temperature of the medium and the material of the valve body. The stages are given in the following table (extract from DIN 2401).

PN (NP)	Material	up to 120°C	over 120°C up to 200°C	over 200°C up to 250°C
2,5	CI-20 CB-38	2,5	2	1,5
6	CI-20 CB-38	6	5	4,5
10	CI-20 CB-38 CS-45	10	8	7
16	CI-20 CB-38 CS-45	16	13	11
	CS-C25	16	14	13
25	CB-38 CS45,5	25	20	18
	CS-C25	25	22	20
40	CS45,5	40	32	28
	CS-C25	40	35	32

Valve nominal value Δp_{v100}

Δp_{v100} is the maximum permissible pressure drop across the fully-opened valve. It is dependent on the design of the valve, taking into account cavitation, erosion and noise. The drawings below indicate where Δp_{v100} occurs.

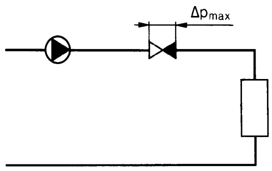




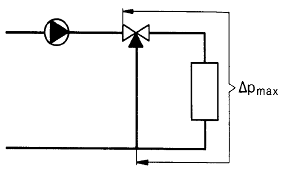
Valve-actuator nominal value Δp_{max}

Δp_{max} is the maximum permissible pressure difference across the valve, at which the respective actuator can still definitely actuate the valve over its entire lift.

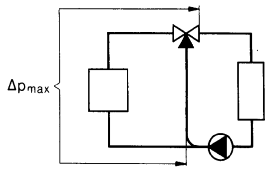
— For through-valves this pressure diffference takes place between the input and output for the prescribed flow direction.



— For three-way valves this pressure difference takes place between the closed port and the two open ports.



Distributor circuit



Mixing circuit

Closing pressure difference Δp_s

Δp_s is the pressure difference at which the actuator or the safety return spring can still keep the valve closed. It is valid only for through-valves, and has importance as the safety value, mainly for systems with high operating pressures (not water systems or district heating).

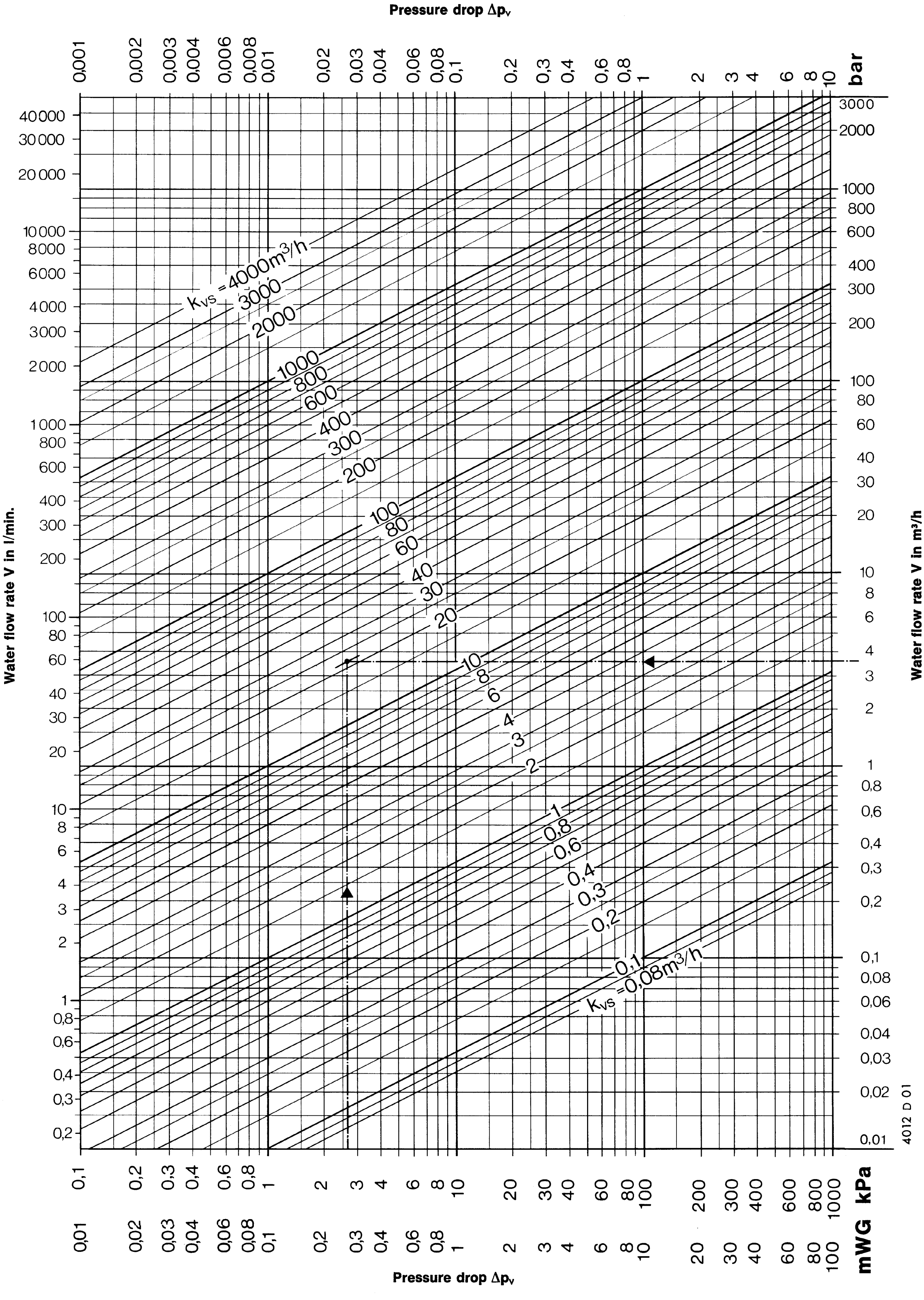
K_{vs}-value (m^3/h)

The K_{vs}-value is the flow nominal value for a definite nominal size of a certain type of valve. It indicates the amount of water (at 5 to 30°C) which flows through the valve (valid also for slipper valves) at nominal lift H_{100} and for a pressure drop of 1 kp/cm^2.

K_v-value (m^3/h)

The K_v-value indicates the amount of water (at 5 to 30°C) which flows through the valve (valid also for slipper valves) at the set lift and for a pressure drop of 1 kp/cm^2.

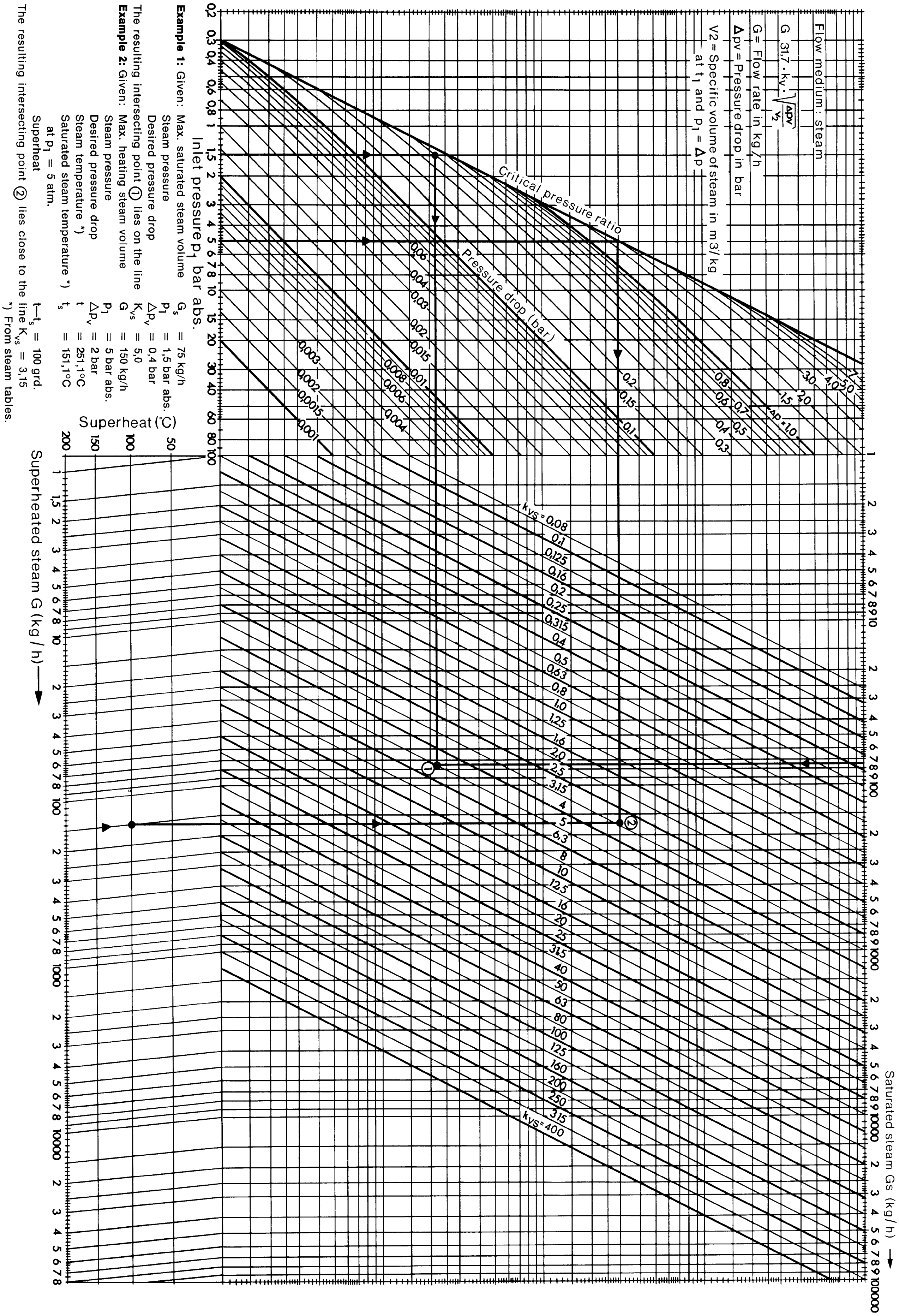
Chart for determining the K_{vs}-value for water



Example shown on chart: V = 3,7 m³/h, Δp_v = 2,6 kPa.
Result: K_{vs} = 23 m³/h

100 kPa = 1 bar = 1000 mbar ≈ 10 mWG = 1 kp/cm²

Chart for determining the K_{vs}-value for steam



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